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Research on the Construction Demand of Power Supply and Demand Forecast Platform under the Construction Background of "Three Types and Two Network"

Li-li ZHANG, Wei TANG* and Cheng-long ZHANG

State Grid Energy Research Institute Co., Ltd., Beijing, China

*Corresponding author

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Abstract. Under the new situation, the traditional power supply and demand technology faces a challenge. Under the background of the "three types and two networks" construction, it will be possible to use the Internet of Things technology to obtain more data and information, and to use various algorithms and technologies to accurately predict the power supply and demand situation. This paper systematically analyzes the demand of power supply and demand forecasting platform construction to provide support for power planning and power grid operation.

Introduction

With the deepening of the energy revolution and the digital revolution, the infrastructure of the grid and public services have been upgraded. The basic hub platform of the power grid has become more and more prominent. Under this background, the national power network company has proposed the strategic goal of "three types and two networks", and its core is to build a pan-electric power network based on a strong smart grid. We will build modern enterprises that are hub, platform and shared, and power systems will enter a new stage of intelligent interconnection and real-time human-computer interaction. The state network company will rely on the power grid network, connected with the massive main body, gather massive data, and further improve the quality and efficiency of the power grid.

The forecast of power supply and demand is the basis of researching and formulating power development strategic plan and policy. Scientific, comprehensive and perfect energy and power analysis and prediction technology is of great significance to support power grid companies in power grid planning, production and operation decision-making, and the National Energy bureau in energy planning and power planning. All along, forecasting power supply and demand situation is not only one of the important work of power grid enterprises. In recent years, new energy sources have been connected to the network, and the interaction between the power grid and users has been strengthened. Traditional ways of forecasting power supply and demand are facing challenges. Under the background of the three-type two-network construction, using the characteristics of the Internet of Things, the forecast of power supply and demand will be more accurate.

At present, the literature on power supply and demand mainly focuses on the analysis of power supply and demand, the forecast results of power supply and demand, and the optimization of some aspects of power supply and demand. For example, Literature 1 expounds the relationship between electricity supply and demand and economy. Literature 2, 3,4and 5 mainly analyses and predicts the situation of electricity supply and demand. Literature 6 optimizes the supply and demand algorithm. Literature on systematic research of supply and demand is few, and literature on the construction of supply and demand platform is scarce.

Purpose of Construction

The digital transformation of power grids is under way, and the study and practice of urban energy Internet functions and the role of hubs is at an initial stage. With the construction of three types of two

networks as an opportunity, the platform can accurately determine the development of energy supply and demand, structure, and power supply and demand. It provides support for the planning, production and operation of power grid enterprises, provides support for the construction of a pan-industrial Internet of Things and industrial ecosystems, including new energy sources, and provides better services to users.

Power Supply and Demand Forecasting Platform Construction Content

The pattern of power supply and demand is actually constrained by a variety of factors, such as energy resources, energy policy guidance, and economic development. The influencing factors of energy include the reserves and distribution of resources, etc.. Economic factors mainly include the total economic volume, industrial (industrial) structure, and regional economic development; Social factors mainly include population size, population structure, and population distribution; The main influencing factors in energy policy include energy development and energy use policies. Therefore, power supply and demand analysis needs to analyze the economic situation and energy supply and demand situation first.

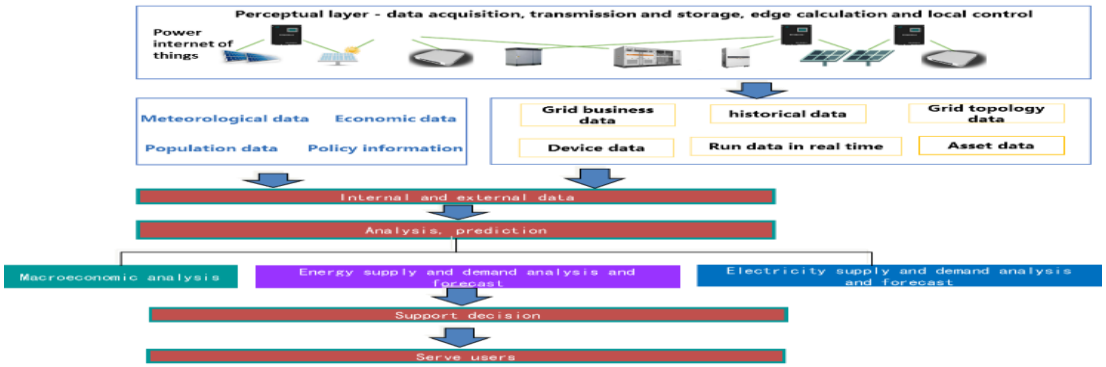

Figure 1. Overall framework of power supply and demand platform.

Macroeconomic Analysis

Macroeconomic model through analyzing mainly from the Angle of GDP first, with the macroeconomic growth theory and econometrics modeling theory as a guide. China's macro economy is in the medium to longer term supply oriented, in the short term demand oriented, economic model is based on the supply of all the year round. Considering the domestic social and economic development and the world economic situation changes, in based on the simultaneous equations model, using linear regression and nonlinear regression, time series analysis method, the main macroeconomic variables to construct model; Through the use of scenario analysis method for prediction.

In the short term, the trend of investment, consumption and export (commonly known as the "troika") is an important indicator to judge economic growth, and the troika is the main component of the accounting of gross domestic product (GDP) expenditure method, which is the logical basis for its analysis and prediction of GDP.

For economic analysis, the platform needs to realize the following functions:

Analysis of the change trend of relevant historical data and prediction of the future change trend. The analysis of the growth rate and proportion change of each indicator, the comparative analysis of the same indicator year by year, different industries and different regions, and the comparative analysis of different indicators in the same category, and the friendly display through tables, graphs and other ways. To each kind of economic index carries on the short term, the long - term forecast, and analyzes the forecast result trend and so on the basis of the forecast result.

Analysis and Forecast of Energy Supply and Demand

Considering the main factors that affect the demand, such as economic added value, output of key products, population, urbanization, energy price, energy technology, etc., this paper applies regression, time series, unit consumption of output value (product), econometric model to calculate the national and regional, industry and variety of terminal energy demand.

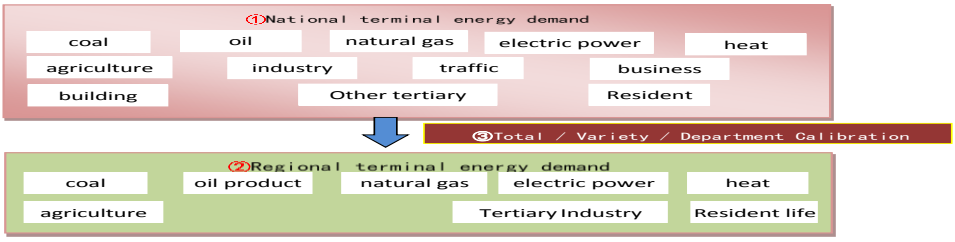

Figure 2. Module calculation ideas.

For energy analysis, the platform needs to realize the following functions.

To query, process and analyze energy data in the form of maps, tables, graphs and energy flow charts. Basic data include total energy consumption, variety consumption, energy production and reserves at the international, national and regional levels. The energy flow diagram can reflect the supply and use relationship of each energy variety from primary energy production to terminal energy consumption and reveal the energy utilization efficiency of each link.

The analysis of energy data includes the proportion of power generation in primary energy consumption, the proportion of electric energy in terminal energy consumption, energy consumption intensity and per capita energy consumption.

Analysis and Forecast of Power Supply and Demand

Power demand analysis and prediction can include electricity consumption prediction, power load prediction, load characteristic analysis and so on. The analysis dimension can be divided into three dimensions: monthly, annual and medium - and long-term.

The forecast of electricity consumption includes seasonal adjustment method, single consumption method, per capita electricity consumption method, department analysis method, input-output model, monthly decomposition method of annual electricity consumption, regional decomposition model, trend extrapolation method, industry decomposition model and combination forecast method.

Power load forecasting includes the maximum load utilization hours method and the monthly decomposition model of annual maximum load.

Load characteristic research includes load characteristic analysis, load characteristic prediction, air conditioning load analysis model, etc.

To analyze and forecast the power supply capacity of the whole country and various regions, including the change trend of the total installed capacity, structure, power generation equipment utilization hours and other indicators; According to the total installed capacity of last year, the new installed capacity of this year, the retired installed capacity of this year and other predicted future installed capacity, the power supply capacity of the whole country and various regions is analyzed and forecast; Comprehensive resource strategic planning: the side of power supply and power demand side resources (such as energy-saving lamps, energy-saving motor, energy saving transformer, ice storage and other energy saving equipment) unified optimization, from a strategic height, through economic, legal and administrative means, such as optimizing use of supply side and demand side resources, to meet the future economic development under the premise of demand for electricity, the whole planning of social total minimum, the biggest benefit.

New energy plays an increasingly important role in power supply and demand. For the new energy forecast is more complex, it needs to be mentioned again. (1) wind power prediction: traditional wind power prediction is to make weekly prediction of wind power to arrange routine unit maintenance plan, day-ahead prediction of wind power to arrange daily generation plan, and hour-level prediction

of wind power for real-time dispatching. The current wind power prediction method, according to the prediction of physical quantities can be divided into different aimed at wind speed forecasting method and aiming at wind farm output forecast method, according to the input data can be divided into different use and not use digital weather forecast results of two kinds of methods, according to the different forecast model can be divided into continuous method, time series method, intelligent forecasting method, physical model method, synthesis method and so on, according to the forecast can be divided into different time scale long-term forecast, mid-term forecast and short-term prediction and short-term predictions. (2) the forecast of photovoltaic (pv) : now the main forecasting method from the time scale can be divided into short-term prediction (0 to 6 hours), a short-term forecasting (6 hours - 1 day), medium and long term prediction (a few days - 1 year), mainly using statistical methods, including medium long term prediction is based on historical data, find the rule of photovoltaic (pv) using the time series method, multiple regression analysis and artificial neural network method to forecast. (3) the forecast of water and electricity: water and electricity prediction research is more, the traditional method on the time scale can be divided into short-term (6 hours), short-term (has), medium (monthly), etc., because of the water and electricity and water and has strong nonlinear relation between related factors, main current medium long term prediction using neural network and support vector machine (SVM) method and artificial intelligence algorithms.

For power supply and demand analysis and prediction, the platform needs to realize the following functions

(1) Power consumption analysis

Collect monthly and annual data of national and regional electricity consumption by industry and industry, and provide data query, analysis and display functions.

(2) Load characteristic analysis

Based on the 8760 load curve of the power grid, the load characteristic analysis was carried out, including the maximum load/minimum load/load coefficient of day/month/year, typical daily load curve of each season, typical load curve of holidays, cooling and heating electricity consumption, annual load duration, peak load in the morning, afternoon and evening of working days, etc. The analysis results are output in the form of graphs, tables, etc.

(3) Power demand forecast

This module realizes the prediction of power demand, including per capita electricity consumption model, elasticity coefficient model, output value single consumption model, industry decomposition model, department analysis model, LEAP model and regional decomposition model. In addition, there are neural network method, support vector machine method, gray prediction method and so on. The forecast result is the input of load curve forecast.

(4) Load curve prediction

This module realizes the prediction of load curve. In addition to the prediction of load characteristics, it also introduces load characteristics of different industries for detailed characterization. The main methods include industry load curve synthesis method, bidirectional pinch method, base load curve correction method, etc.

Index of Power Supply and Demand

The supply and demand index is the ratio of power supply capacity to power demand.

Power supply capacity is the product of total generating capacity (G) and power transmission capacity coefficient (f). For the same installed capacity, the number of hours (h) of generation utilization varies, so does the generation capacity. The power transmission capacity coefficient indicates whether the power grid has bayons in its transmission and distribution links, and whether the power generated by the power plant can be transmitted and dropped. The output times f reflects the power supply capacity. Considering the influence of hydrological changes on power supply, large water inflow (s) can increase hydropower output in rainy season. Then, the power supply and demand index can be expressed as:

$$I = \frac{f(h \cdot G + a \cdot s)}{c \cdot D + b \cdot T} \tag{1}$$

Where, h is the hours of power generation utilization; A is the influence coefficient of water inflow on increasing hydropower generation; D is the electricity demand (if there is an outgoing channel in this region, the demand includes the local power demand and the minimum outgoing demand), and c is the regulation coefficient of the power supply across the region; T is the temperature; high (low) T can increase the cooling (heating) load; b is the influence coefficient of temperature on electric quantity.

The profit and loss of power supply capacity can be expressed as:

$$D_G = \frac{f(h \cdot G + a \cdot s) - (c \cdot D + b \cdot T)}{h} \tag{2}$$

To facilitate the understanding of the meaning, the calculation formula of power supply and demand index can be modified as:

$$I = 1 + \frac{D_G}{G} \tag{3}$$

The difference between and 1 in the equation is the power profit and loss.

(1) 1.00 ~ 1.05 is the basic balance area of power supply and demand. At this time, the power supply can meet the demand of economic development.

(2) >1.05 refers to the area where the power supply is greater than the demand, at this time, the power supply may be excessive, warning us to pay attention to.

(3) <1.00 refers to the area where the power supply is less than the demand. At this time, the power supply may be insufficient, warning us that we should pay attention to orderly use of electricity, or actively interact with users to implement demand response. In the case of serious mismatch between supply and demand, such as <0.9, it is necessary to actively prepare for the construction of power supply or the construction of trans-regional transmission channels, so as to reduce the impact on economic development.

Suggest

In the process of platform construction, it is necessary to apply big data, cloud computing, Internet of things, mobile Internet, artificial intelligence, block chain, edge computing and other information technologies and intelligent technologies, pool resources from all aspects, and provide sufficient and effective support for planning, construction, production and operation, comprehensive service and other aspects.

Due to the large amount of data involved in the platform, it is necessary to collect and manage all the data uniformly. Therefore, it is necessary to break down the data acquisition barrier of energy terminal in advance. By using the index of power supply and demand and other representative values of analysis and prediction, demand-side management work is done well in advance, so as to finally provide users with more intelligent and humanized universal power services.

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