Research on the Application of Computer Big Data Technology and Information Systems in the Sustainability of Energy Industry

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Abstract. In order to investigate the impact of different policy options on the energy industry, starting from factors such as energy, economy, environment, policy, and society, based on big data theory, a simulation model of the energy industry development system under the perspective of a low-carbon economy is constructed. The study found that data transformation is an important path to solve the development dilemma of traditional energy companies. It takes the four aspects of data application architecture construction, data technology architecture construction, mobilization and claudication as the basic framework and development ideas, and proficiently uses the "Internet +" thinking to promote Transformation and upgrading of traditional energy companies. The foundation of big data in the energy industry lies in the formation of a cloud management system, which will not only greatly improve the operational efficiency of each management link in production and sales, but also give birth to the establishment of a vertical e-commerce platform based on an organizational structure of "front store and back factory", Continuously optimize customer experience, and explore sustainable development paths for new business growth points.

Keywords: Computer; big data technology; energy enterprise; sustainable development.

1. Introduction

Since 2011, the game between traditional energy and new energy in the new economic cycle has attracted increasing attention from society, policy and academia. On the one hand, the traditional fossil energy industry has entered a cyclical trough due to the overcapacity of enterprises and the downturn in performance. While corporate investment is slowing down, the pressure for “social performance”-oriented transformation triggered by energy security issues is multiplying [1]. This is not conducive to the transformation of the traditional fossil energy industry to a new energy architecture, and it is also not conducive to improving energy efficiency. This has become a traditional fossil. Structural problems of the industrial system of the energy industry. On the other hand, new energy industries and technologies have developed rapidly under the strong support of national policies. In 2010, China's non-fossil energy utilization reached 320 million tons of standard coal, accounting for 9.6% of total energy consumption, and this proportion was in 2015 Has reached more than 14%. Traditional energy is an energy classification relative to new energy and unconventional energy. Generally, under the current scientific and technological level, people have been widely used and technologically mature, such as coal, oil, natural gas, hydropower, etc. In particular, bio-fossil fuel energy is classified as traditional energy, also known as conventional energy. Traditional energy companies are economic entities that are mainly engaged in traditional energy production, processing, and sales. In China, they mainly include oil, natural gas, coal, and power companies. Among them, petroleum companies are industrial companies that mainly engage in the exploration, development, storage and transportation, refining, and sales of petroleum, natural gas and other bio-fossil fuels, and produce and process non-renewable energy. As the pillar industry of China's economic development, traditional energy companies have promoted the rapid development of the social economy on the one hand, and on the other hand they have also brought huge resources and energy consumption. Developing a green economy, transforming the business philosophy of traditional energy companies, realizing the green transformation of business models, and promoting the industrial upgrading of

traditional energy companies such as petroleum are of great significance to the development of the company itself, national economic construction and economic security.

2. Sustainable development of energy companies under big data

2.1. Model construction

The model is composed of five dimensions: driving force, pressure, status, influence, and response, and integrates social, resource and other elements together, which can clearly reflect the impact of social economic development and resource utilization on the environment. According to the goal of low-carbon economic development, this paper takes the basic conditions of energy, economy and environment as the system boundary, and based on the DPSIR analysis method, the overall system is subdivided into economic subsystems, energy subsystems, environmental subsystems, and social subsystems [2]. And the five subsystems of the policy subsystem. Among them, the driving force indicators are mainly the impact of the development of economic and social subsystems on the environment and energy consumption, while the pressure indicators are the use of energy and resources. The development of the energy industry is mainly based on energy demand, energy consumption structure, and environmental the changes in the "status and impact" indicators such as the situation are detected, and the policy subsystem is the response indicator, which examines the effects of policy changes through changes in driving forces and pressure factors. According to the relationship between various variables, the system structure diagram of the energy industry development system is shown in Figure 1 (the picture is quoted from Status, Trend and Potential Generation of Renewable Energy from Waste for Sustainable Development in Africa: An Overview).

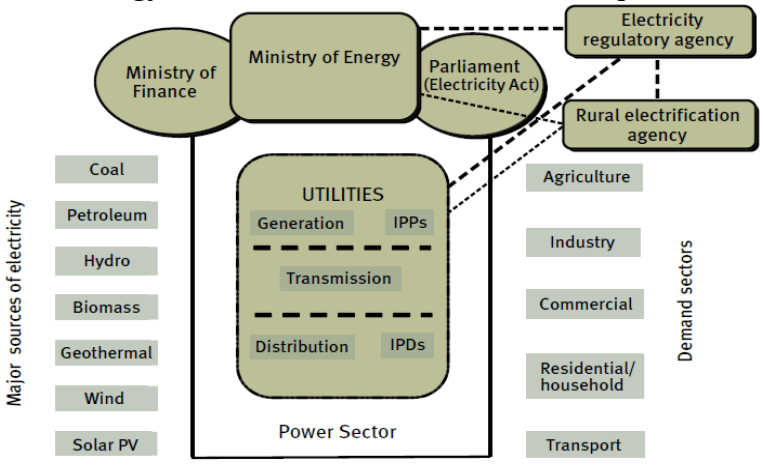


Figure 1. Structure diagram of energy industry development system

The economic subsystem mainly selects the total GDP as the state variable, and uses the output value of the three industries as auxiliary variables to interact with other subsystems to ensure the operation of the system; the energy subsystem is based on the energy we depend on for survival. The main research elements are: coal, oil, natural gas and new energy; the environmental subsystem not only provides a carrier for our daily life, but also has a certain self-purification ability, which is mainly reflected in the emission of CO_2 and industrial waste gas; the main research of the social subsystem The two elements of population and social development, population resources are connected with other subsystems through per capita GDP and per capita energy consumption, thereby participating in the dynamic changes of the system; the policy subsystem, the government should play a vital role in energy policy, Energy planning plays a guiding role in the development of the energy industry and is conducive to improving the government's rational allocation of energy resources [3]. Each subsystem plays different functions and roles in the sustainable energy development system. The structural relationship of the subsystems is obtained through the relationship between the various variables as shown in Figure 2 (picture quoted in A Framework for Defining Sustainable Energy Transitions: Principles, Dynamics, and Implications).

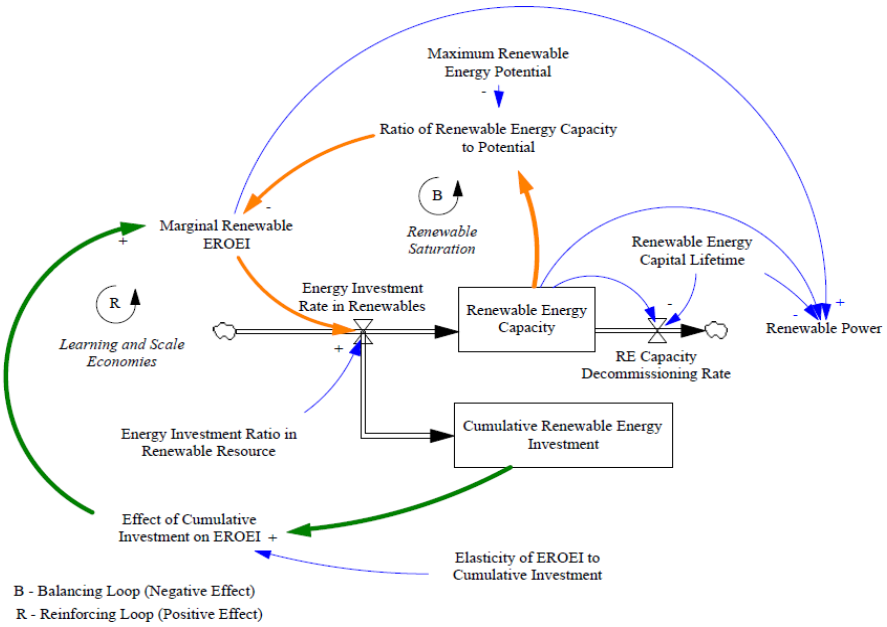


Figure 2. Subsystem structure diagram

2.2. System flow diagram and main equations

All variables in Venism are composed of the following four types: constants, state variables, rate variables, and auxiliary variables. The definition of data includes several methods such as table functions, constants, initial values, and average values [4]. Parameters with large fluctuations are taken as table functions, and parameters with small fluctuations over time are taken as constants or the average of historical data, such as population growth rate, several conversion coefficients, and so on.

3. Construct an energy analysis model for the energy enterprise ecosystem

According to the energy comprehensive indicator evaluation system for sustainable development of the system suggested by Odum, this article converts the natural resources, human resources, and currency resources possessed by the organization into energy labels, forming an organizational potential energy that uses energy as a measurement unit to analyze the enterprise Ecosystem sustainable development issues (Figure 3 is quoted in THE INTEGRATED GREEN ECONOMY MODELLING FRAMEWORK).

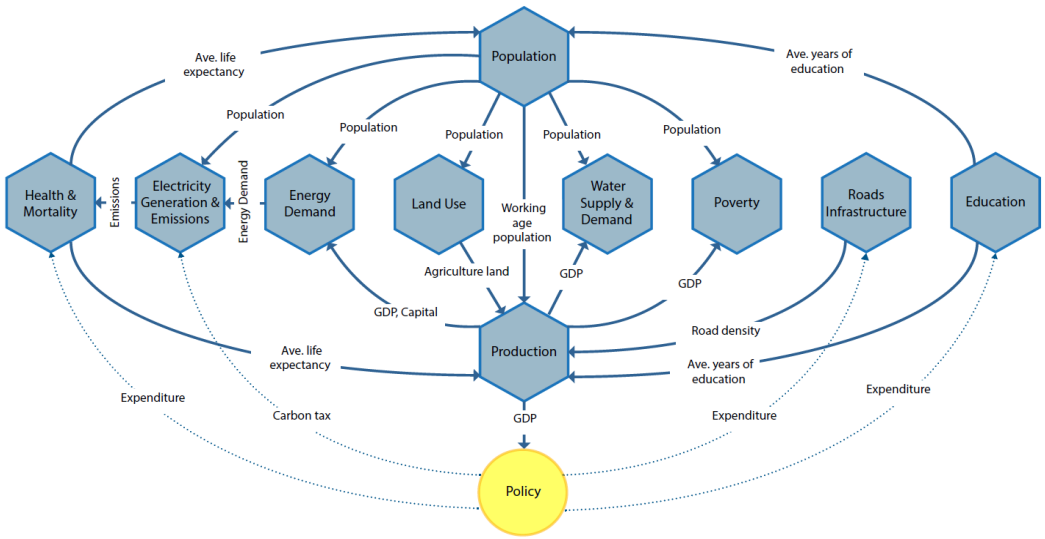


Figure 3. Schematic diagram of energy input and output of enterprise eco-economic system

Note: E_{mH} represents the energy value of human resources invested by the social economy; E_{mC} represents the energy value of monetary resources invested by the society and economy; E_{mR} represents the energy value of renewable resources invested by the natural environment; E_{mN} represents the energy value of non-renewable resources invested by the natural environment; E_{mY} represents the energy of the system output

The sustainable development indicator system based on energy analysis is based on the input, output and feedback energy flow of the system. Referring to the definition in the energy analysis indicator system given by Odum, some commonly used indicators and calculation methods are listed below:

3.1. Energy Investment Rate (EIR)

The ratio of the energy value of social economic input to the energy value of natural environmental input is an index to measure the degree of economic development and the degree of environmental load.

$$EIR = \left(E_{mH} + E_{mC}\right) / \left(E_{mR} + E_{mN}\right) \tag{1}$$

The larger the value, the higher the degree of system economic development; the smaller the value, the lower the level of development and the stronger the dependence on the environment [5]. The energy investment rate can be used to determine the benefits of economic activities under certain conditions, and to measure the load rate of environmental resource conditions on economic activities, which can be used to determine the location of enterprises.

3.2. Net Energy Production Rate (EYR)

The ratio of the energy of the total output of the system to the energy of the social economic input is an indicator to measure the contribution of the system output to the economy, that is, a standard to measure the productivity of the system.

$$EYR = E_{mY} / \left(E_{mH} + E_{mC}\right) \tag{2}$$

The higher the value, it indicates that the system has obtained a certain economic energy input, and the higher the energy value of the products produced, the higher the production efficiency of the system [6]. The net energy output rate is particularly important for the evaluation of energy and import and export value. It can be used to illustrate the efficiency of energy production and utilization, and to show the competitiveness of economic activities.

3.3. Environmental Load Rate (ELR)

The ratio of the total energy input of the system's non-renewable resources to the total energy input of the renewable resources is used to evaluate the environmental pressure of the system.

$$ELR = E_{mN} / \left(E_{mR} + E_{mH} + E_{mC}\right) \tag{3}$$

The Energy Sustainability Index (ESI) is defined as the ratio of the system's energy output rate to the environmental load rate. The quantitative standard of ESI is determined through empirical research, namely, ESI<1 is developed organization, and 1<ESI<10 is developing organization. Since then, scholars have constructed the system's sustainable development performance energy index (EISD) and the system's sustainable development performance energy index marginal effect (ESID). The higher the EISD value, the higher the economic benefit per unit of environmental pressure, and the more competitive the system will have on the long-term scale of sustainable development [7]. ESID shows the change trend of system EISD caused by new unit energy input, so as to avoid unnecessary exchange performance value loss and improve the social and economic benefits of unit energy input.

4. Suggestions for sustainable development of energy enterprises

4.1. Establish low-carbon awareness and low-carbon thinking

In the low-carbon transition, enterprises must first establish a high degree of low-carbon development awareness, combine enterprise development with energy conservation and emission reduction, promote new concepts of energy conservation and emission reduction, advocate a new culture of low-carbon consumption, and establish "green services" and "green products." "Awareness, establish a low-carbon thinking scheme for the company; at the overall strategic level, it is necessary to establish a macro strategy and long-term plan for low-carbon development of the company, establish a corresponding energy saving and emission reduction system, and use the system to ensure and supervise the low-carbon environmental protection measures.

4.2. Intensify research and development of low-carbon technologies

The low-carbon, clean, and efficient use of traditional energy sources depends on technological innovation. There are three main ways for traditional energy companies to achieve low-carbon economic transformation: improving energy efficiency; using low-carbon fuels; and carbon segregation. Low-carbon technologies generally include three categories: new energy technologies, energy efficiency improvement technologies, and carbon capture and storage technologies [8]. Chinese traditional energy companies should focus on strengthening the research and development of CO_2 capture, storage and utilization technologies, and develop low-carbon energy technologies in a targeted manner; they should also strengthen the development and utilization of low-carbon and high value-added conversion technologies for oil and gas resources, and vigorously develop multi-connection Production facilities to improve the comprehensive utilization rate of resources and energy.

4.3. Establish a carbon emission trading system and promote institutional innovation

The construction of carbon trading, emission rights trading and other environmental protection energy rights trading markets is also a comprehensive and major mechanism innovation [9]. It is necessary to actively follow the international mainstream trend of "using market mechanisms to promote energy conservation and emission reduction", actively promote the construction of trading platforms, and carry out the construction of carbon markets.

5. Conclusion

The global focus on low-carbon economy has brought new opportunities for the sustainable development of traditional energy companies. Traditional energy companies should seize the opportunity to closely integrate the low-carbon economy with their own development, increase efforts to tackle core low-carbon technologies, improve institutional systems, enhance the strength of low-carbon economic development, and realize the transformation of production and operation modes and the market for products and services. Low-carbon transition.

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