Development path of regional integrated energy system

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Abstract. Regional integrated energy system integrates the gas supply system, heating system and power system. In order to build regional integrated energy system, this paper summarizes four kinds of development paths of regional integrated energy system represented by the system side, the supply side, energy network and the user side. This paper can provide a very useful reference for future integrated energy system construction in China.

1. Introduction

Traditional power system, heating system and gas supply system are often lack of coordination with each other. The regional integrated energy system (RIES) can improve energy efficiency through the comprehensive utilization of different energy supply systems [1-3]. RIES has received extensive attention from governments and research institutions [4-5]. An illustration of RIES can be seen in Figure 1.

![Figure 1. Illustration of RIES](image)

As shown in Figure 1, the future RIES is based on the application of the Internet Plus. As it integrates the gas supply system, heating system and power system, it can realize the multi-energy complementarity of electricity, gas and heating systems. RIES is a new form of energy system, and the related technologies and business models are in their initial stage. Thus, the realization of RIES cannot be accomplished overnight. The formation of its technological system and application of various
technologies depend not only on the maturity of the technology itself, but also on the economic and social benefits of the technology application. Taking these factors into account, study on the development paths of RIES will help policy makers make more rational use of policy resources, provide good policy environment for the development of RIES, help relevant research institutions to carry out technology development and scientific research in advance, and guide the capital market to provide adequate financial support for related research and application areas.

Whether it is a single energy interconnection, or a business model, driven by human activity, or the upgrading of energy industry by using the Internet thinking and technology, these are the necessary and sufficient elements of the multi-energy complementary RIES.

This paper is organized as follows. In Section 2, the development path of regional RIES is presented regarding the system side, the supply side, energy network and the user side. Section 3 gives the conclusions.

2. Development path of RIES

RIES consists of the supply side RIES, the energy network, and the user side RIES. Therefore, RIES can be built from four aspects, as shown in Figure 2.

The four aspects are described as follows.

(1) At the supply side, we should accelerate the construction of large-scale energy resource bases such as coal, hydropower, nuclear power and wind power, optimize the energy structure to diminish the harm on environment, build a multi-energy supply system, and promote large-scale consumption of renewable energy [6-7]. China’s energy structure is dominated by coal, while the proportion of clean energy such as wind energy and solar energy is very small, and China faces huge pressure and special difficulty to control GHG emissions. The gradual elimination of coal is an inverted development and transformation. We must take practical steps to reduce coal production capacity, research and develop high efficient, clean coal utilization key technology, and build a sustainable energy system. To build RIES, we need to develop renewable energy vigorously at the supply side, promote the large-scale use of clean energy, achieve rational planning and layout of different types of

Figure 2. Development path of RIES
energy, gradually reduce the proportion of high-carbon power resources such as thermal power, and constantly optimize the energy structure.

(2) At the user side, according to local conditions, we should coordinate the development of CCHP systems and distributed renewable energy. Build an open and shared new form of the energy network, and realize timely and effective access to comprehensively distributed energy [8-10]. Promote the electricity substitution at the user side, and gradually replace the direct use of fossil energy such as coal, oil and natural gas with electricity. We should actively develop and use new energy resources such as solar energy, wind energy and geothermal energy. Also, we should make full use of new energy for heating, and carry out ground source heat pump heating in residential areas.

(3) At the network side, we should speed up the construction of energy infrastructure and applications, build a modern comprehensive energy transportation system with both coal transportation and power transmission. Make full use of UHV transmission and smart grid to strengthen the long-range, high-capacity transmission. Strengthen the construction of the centralized heat supply system to improve the coverage of centralized heating. Optimize the coal transportation mode and strengthen the management of thermal coal transportation. Strengthen the construction of natural gas pipeline network, speed up the transformation of old pipeline network and accelerate the construction of natural gas storage.

(4) At the system side, strengthen the technological innovation work, including energy generation and conversion technologies, energy transmission technologies, equipment plug and play technology, advanced technology of large-capacity energy storage, various types of energy virtualization technology, big data technology and energy management technology [11-13].

Strengthen the construction of energy market and improve the market efficiency and market competitiveness [14]. RIES is a typical open energy system, which must be open, inclusive and pluralistic for energy connection. In RIES, equipment, energy and services can be freely traded, and the market plays an important role in the allocation of resources. The construction of energy market can be strengthened form the following measures.

1) Enable the price mechanism and restore the commodity property of energy so as to promote the transformation of energy, the relationship between energy supply and demand, and the value of the ecological environment.

2) Establish a competitive and orderly modern energy market trading system to support diversified market players and flexible trade among different types of energy.

3) Establish a sound energy subsidy and tax mechanism. The subsidy is reflected in strengthening subsidies for RIES, while gradually eliminating fossil energy subsidies. The tax mechanism such as a carbon tax will decrease total and marginal emissions.

4) Improve the relevant financial system, encourage the securitization of RIES assets, broaden financing channels and support the development of related industries.

3. Conclusion
Although regional integrated energy system is in a period of the rapid development we still have a long way to go. This paper proposes the development paths of regional integrated energy system. Four kinds of development paths are summarized as the system side, the supply side, energy network and the user side, which can provide a useful reference for RIES construction in China.

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