

Wind Energy Development and Application Prospects of Non-Grid-Connected Wind Power

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Abstract--Renewable energy is the driving element of world economic development. The faster development of wind power has been making more contribution for the development of renewable energy. "Non-grid-connected wind power" is a new concept in the renewable energy field. Non-grid-connected wind power systems directly link wind energy into other various high-energy consumption industries, which have attracted lots of attentions and interests. Theoretical researches and applications of large-scale non-grid-connected wind power, will open up the new areas of world wind power diversified applications, and reveal the start of large-scale wind power diversified applications for human. With the more and more industrial applications of non-grid wind power, it will make a growing contribution to push forward the diversified applications process of world wind power.

Keywords--Renewable energy; non-grid-connected wind power; Denmark

I. INTRODUCTION

Renewable energy is the driving element of world economic development. Wind energy industry is growing very rapidly, faster than any other industry in the world. In 2008, the growth rate of world wind energy industry is close to 30%, the contribution rate of which in the total renewable energy is up to 45%. Non-grid wind power is a new concept in the renewable energy field, which directly apply wind power into a series of high-energy consumption industries without power grid. Non-grid wind power systems indicate a great development opportunities not only in the developed countries but also in the developing countries. Non-grid wind power systems will provide more opportunities for the developing countries especially the poor people who have no access to electricity.

II. OVERVIEW OF WORLD WIND ENERGY DEVELOPMENT

Renewable energy is the driving element of world economic development, and it is in the growing trend. At present, renewable energy as a new energy supply system has successfully captured a large market share of energy, with an increasingly strong market position. In all renewable energy sources, wind energy reveals the fastest-growing, faster than any other industry in the world, and the annual growth rate is up to 20% -30%. Even in the face of financial crisis leading to many industries recessions, the wind energy industry still keeps a good momentum of sustained growth.

Wind energy is an emerging industry, the initial development scale of which is small. In the past decade, wind

power industry has achieved a remarkable development. At present, the global wind energy market is close to 60 billion U.S. dollars, which provides power for more people. At the same time, wind energy industry creates employment opportunities for people. It has created 440 thousand job positions in the world. Hence, wind energy industry is very important to promote economic development. So far, the world largest capacity of the single wind turbine that has put into operation has reached 6 megawatts. It is believed that the greater single capacity of the technology will appear with the in-depth technological research and development. Now the 10 megawatts single capacity has been developed, and Europe is able to produce 15 megawatts wind power units. In addition to coastal wind power projects, as well as offshore wind power projects are also developed. For example, in Denmark, not only large-scale offshore wind power projects, as well as a wide variety of small wind turbine are also developed. From the global development view of wind energy, it has been growing in China. In renewable energy field, China has also been ahead. China has the world's largest solar photovoltaic industry, which is accounted for 90% of the world capacity.

The new energy is increasingly concerned by the international community, especially the development of wind energy. Many countries have held an important meeting to discuss the topic of how to develop new energy sources, which is a very important topic for the whole community. "Kyoto Protocol" will expire in 2012, therefore, it needs to make a new agreement. In 2009, International Renewable Energy Agency (IREC) was set up in Germany, and the organization's members are from 135 countries. IREC will organize some international conferences, inviting government officials and business people together to discuss the development and challenges of new energy. At the end of 2009, a global climate conference will be held in Denmark, which is the current development opportunity of wind energy. In the development of wind energy, there must be some new ideas. For example, the theory of non-grid wind power proposed by Professor Gu Weidong, from Jiangsu Academy of Macroeconomic Research, China, is a new concept in the renewable energy field. It is believed that its impact is far-reaching. It is found that just a small population could access to electricity in some countries, hence, the non-grid-connected technology could provide more development opportunity for the remote areas.

III. IMPORTANT CONTRIBUTION OF NON-GRID-CONNECTED WIND POWER ON THE WORLD RENEWABLE ENERGY DEVELOPMENT

In wind energy development, we must have innovative idea. Dr. Gu Weidong made a breakthrough contribution in this field, who is the chief scientist of Major State Basic Research Development Program of China (973 Program, "basic research of large-scale non-grid wind power system"), have more than 30 years of in-depth research experience in the non-grid wind power field. Actually, I have been cooperating with him for many years. We have been committed to the development of wind energy, and hope that more people enjoy the benefits of new energy.

Dr. Gu Weidong proposed the theory of non-grid wind power system, and make non-grid-connected wind power famous in the world. He opened up the diversified applications of wind power, and is a pioneer in this new field. Non-grid-connected wind power is a new concept in renewable energy field. Non-grid wind power system combined wind power with other energy sources to provide power.

Recently, the global guiding ideologies on energy saving and emission reduction are that new energy sources replace traditional energy sources. That is to say, the new energy sources are set in opposition to the traditional energy sources. However, in the foreseeable future, the traditional energy sources will continue to be the basis energy sources for the world. According to his research achievements for 30 years, he put forward that new energy "grafts" on traditional energy to improve the overall efficiency of traditional energy, in order to achieve the clean use of traditional energy especially coal resources, and realize the unity of economic benefits, energy saving and emission reduction.

On the global scale, large-scale non-grid wind power is an important application. The research and development of non-grid-connected wind power reveals the beginning of large-scale wind power diversified applications. The most important influence on the author is the non-grid wind power project in East China Sea led by Dr. Gu Weidong, which is very significant for the development of China's Yangtze River Delta region wind energy, and provides a huge opportunity. I have cited this example in other countries. In 2005, at the "Strategic Forum of Building a Green Energy Capita of China", the author speak: "The theory of non-grid-connected wind power proposed by Mr. Gu is an innovation in the world. It provides very valuable suggestions for the application and spread of wind power, and also provides reference for other countries who want to develop wind energy."

In the near future, non-grid-connected wind power systems will have greater development opportunities not only in developed countries, but also in developing countries. The new system will provide more opportunities for developing countries, especially poor people.

IV. DEVELOPMENT AND APPLICATION OF WIND POWER IN DENMARK

A. Power structure



Figure 1. Location of Denmark

Denmark is a very small country (see Fig. 1) and the population is less. However, the development and utilization of wind energy resources is from 30 years ago in Denmark. The trend of electricity development by the fuel in Denmark is shown in Fig. 2.

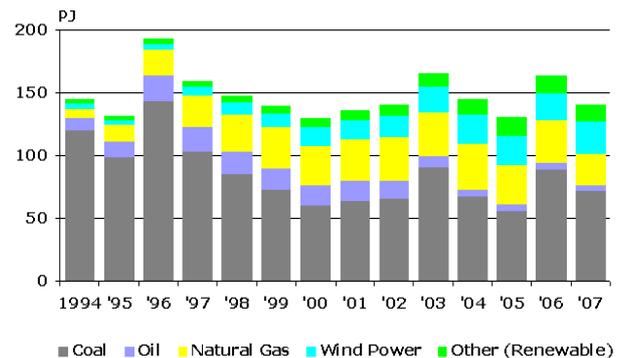


Figure 2. Electricity by the fuel in Denmark

Seen from Fig. 2, the proportion of coal-fired power is continue reduce, and wind power is becoming more and more important, have occupied 20%, which is expected to reach 30% in next two or three years.

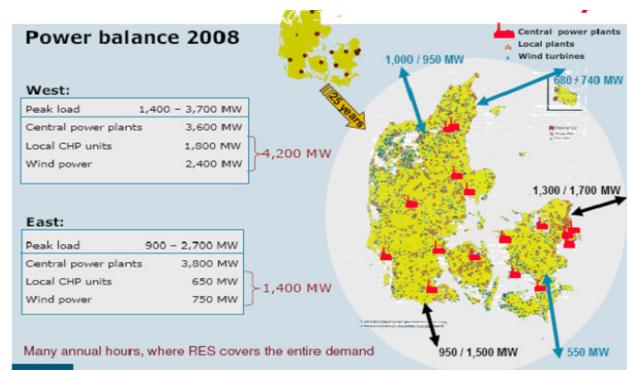


Figure 3. Power balance of Denmark

Figure 3 shows the power balance of Denmark in 2008. The power structure un-bundled is shown in Fig. 4. The production, transmission and distribution of power are managed by different companies.

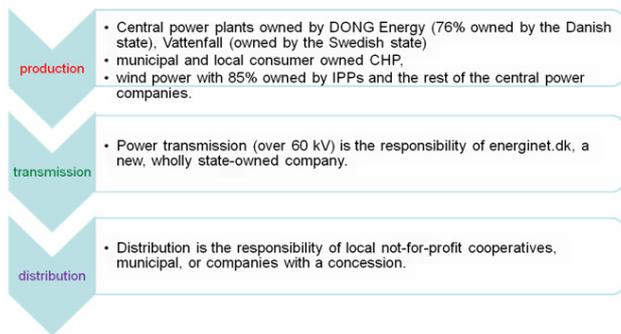


Figure 4. Power structure of Denmark

B. Status of wind power development

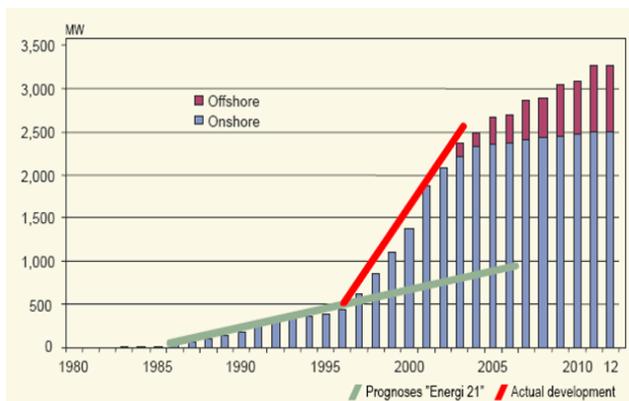


Figure 5. Status of wind power development in Denmark

It can be seen from Figure 5 the wind power is developing rapidly in Denmark. Figure 6 shows the infrastructure of electric power. In the 1980s, there are only 12 combined heat and power plants. But now there are thousands of power stations including wind power companies to supply power.

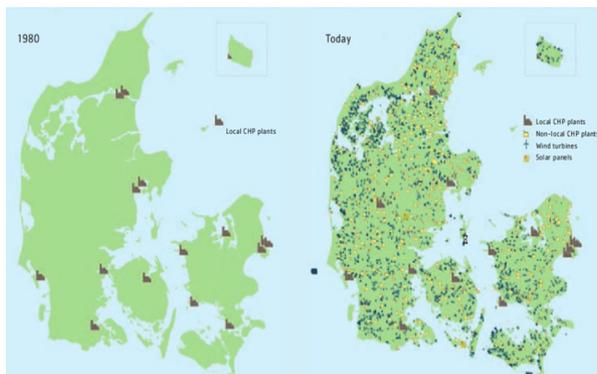


Figure 6. Infrastructure of electric power

C. Storage of wind power

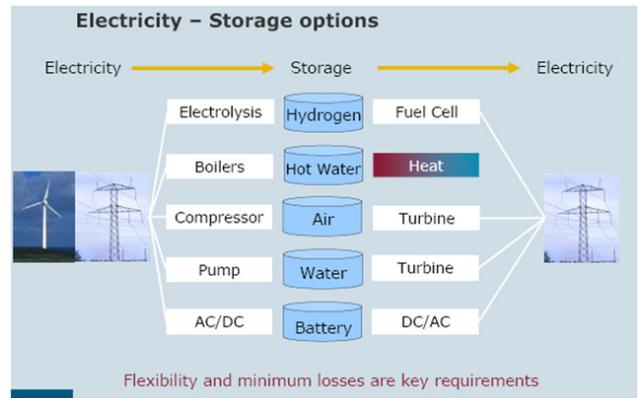


Figure 7. Options of electricity storage

Wind power is very unstable and cannot be controlled. Figure 7 shows the options of electricity storage. We can establish a system which combines wind power with other energy to provide power together by using different electricity storage options.

V. ENDING WORDS

The development of wind power has brought to human new opportunities and challenges. We must to manage the wind power better, in order to achieve better results. The application of non-grid-connected wind power is an important route to promote the harmonious development of economic and environment, and will surely be a future trend.

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