**Developing Sustainable Energy——Constructing Wind Power Generation System**

Wind energy is a clean, pollution-free renewable energy source that has long been treasured and used by humans. Since using wind energy to produce electricity is extremely environmentally friendly and has a large wind energy reserve, nations all over the world are placing a growing value on it. The fundamental idea behind wind energy production is to use the wind to propel the windmill blades to spin, then accelerate the generator to produce electricity by speeding up the rotation. Electricity can be produced using windmill technology today at a breeze pace of about three metres per second. For the University of Glasgow, this is not a problem at all. At the University of Glasgow, the wind speed at ground level is approximately 5.6 m/s, and the annual average wind speed at 25 m above the earth is approximately 6.4 m/s (Editor, 2012). The largest onshore wind power station in Europe, the Whitelee Wind Power Station, is located near Glasgow (Khan,2006).

Some of the tall and wide buildings at the University of Glasgow may have advantages when it comes to using turbines. Because the wind speed will increase with the altitude, the solid structure and good infrastructure of the campus buildings increase the possibility of storage of electric energy and heat. Theoretically, some or all of the remaining demand can be met by using the existing turbine form, but the specific installation location and model of the turbine shall prevail. The whole system consists of five components: wind turbine, battery, diesel generator and grid, and converter, as shown in the conceptual diagram.

Figure 1

Wind Power-Diesel Generator-Battery Power Generation System

图示, 示意图

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Note: Adapted from Effects of minute-to-minute variations in wind power on power system functioning by Banakar,2008

How the turbines are installed is a question to be solved. Turbines are generally used relatively infrequently in urban areas due to difficulties such as wind weakening, turbulence, and environmental issues such as noise. However, the use of turbines on the Gera campus has some important advantages: the resulting electricity is used directly locally, with no transmission losses; the form of the building concentrates the airflow, increasing output; teachers and students on the Gera campus can directly participate in the energy use in its buildings and address issues as they are identified.

Figure 2

Turbine installation configuration

图示

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Note: Adapted from The Potential for Urban Turbine use on Multi-Storey Housing in Glasgow by Sharpe,2003

This image is a schematic illustration of the construction of turbines on different buildings. The constructed turbine's calculated swept area is 5.6 metres. Theoretically, this would permit the installation of up to 8 turbines—6 at the parapet level and 2 in the motor room—on the available roof surface. However, prior studies have shown that installing 4 turbines at the parapet level and 1 turbine at the machine house's roof is the most economical course of action.

Figure 3

Comparison of energy demand and turbine capacity

表格

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Note: Adapted from Multistory housing complexes in Glasgow's 1998 Environmentally Friendly Cities have integrated solar thermal upgrades by Sharpe,1998

The city of Gera near the Gera campus also has wind turbines built to generate electricity. According to the energy comparison above, wind turbines can supply more than 25% of the yearly water and heating load in established neighborhoods and about 30% of the winter space heating load. In actuality, the low thermal efficiency of the blocks and an expensive heating system resulted in a low real fuel use. If people switched to wind power, it would be cheaper and people would use it more for a reasonable level of comfort. The contribution that can be made by the wind component will thus increase proportionally. Therefore, the University of Glasgow, which is also deep in the center of Glasgow, will also be able to solve energy problems to a great extent and reduce carbon emissions by building wind turbines.

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