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

Wind energy is a clean and pollution-free renewable energy, which has been valued and utilized by people a long time ago. The use of wind power to generate electricity is very environmentally friendly and has a huge wind energy reserve, so it is increasingly valued by countries all over the world. The basic principle of wind power generation is to use the wind to drive the windmill blades to rotate, then increase the rotation speed through the speed increaser and promote the generator to generate electricity. With current windmill technology, electricity can be generated at a breeze speed of about three meters per second. For the University of Glasgow, this is not a problem at all. The surface wind speed at the University of Glasgow is about 5.6m/s, and the annual average wind speed at 25m above the ground is about 6.4m/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

描述已自动生成

Note: Adapted from Impacts of wind power minute-to-minute variations on power system operation 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

描述已自动生成

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 estimated swept area of the constructed turbine is approximately 5.6m. In theory, this would allow a maximum of 8 turbines to be placed on the available roof area - 6 at the parapet level and 2 in the motor room. However, according to previous studies, the most cost-effective solution is to install 4 turbines at the parapet level and 1 turbine at the roof level of the machine house.

Figure 3

Comparison of energy demand and turbine capacity

表格

描述已自动生成

Note: Adapted from Integrated solar thermal upgrading of multi-storey housing blocks in Glasgow' 1998 Environmentally Friendly Cities by Sharpe,1998

The city of Gera near the Gera campus also has wind turbines built to generate electricity. The energy comparison above shows that wind turbines can provide approximately 30% of the winter space heating load and more than a quarter of the combined annual water and heating load in existing neighborhoods. In fact, existing actual fuel use was low due to the poor thermal performance of the blocks, combined with an expensive heating system. 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.

Reference:

Editor, R. (2012) . Scotland's biggest windfarm grows. to generate enough power for Glasgow.

Whitelee Windfarm. (2022). Retrieved March 21, 2023, from https://www.whiteleewindfarm.co.uk/whitelee-windfarm-about-us.

Banakar, H. , Luo, C. , & Ooi, B. T. . (2008). Impacts of wind power minute-to-minute variations on power system operation. IEEE Transactions on Power Systems, 23(1), 150- 160.

Guo M. (2021). An interconnected power generation system of wind energy, light energy, wave energy and ocean current energy based on a common base. CN112594132A.

Sharpe T. (2003). The Potential for Urban Turbine use on Multi-Storey Housing in Glasgow,1-10

Acosta, J. L., &amp; Djokic, S. Z. (2010). Assessment of renewable wind resources in UK urban areas. Melecon 2010 - 2010 15th IEEE Mediterranean Electrotechnical Conference. doi:10.1109/melcon.2010.5476217

Sharpe TR, Porteous C D A, MacGregor K. (1998). Integrated solar thermal upgrading of multi-storey housing blocks in Glasgow' 1998 Environmentally Friendly Cities. pp. 287 – 290

Früh, W. (2013). Long-term wind resource and uncertainty estimation using wind records from Scotland as example. *Renewable Energy,* *50*, 1014-1026. doi: 10.1016/j.renene.2012.08.047