Introduce:

With high carbon emissions, global warming is one of the most pressing issues of our time. An increase in global average temperature will directly lead to extreme weather events (such as floods, droughts, storms, etc.). Carbon emissions can also lead to imbalances in ecosystems, affecting human health. As a leader who pays great attention to environmental issues, the University of Glasgow, how to reduce carbon emissions is an important challenge that the University of Glasgow is now facing. At present, the University of Glasgow has begun to take many active measures to reduce solar emissions. At the same time, many implementation methods are being explored. Reducing carbon emissions and even reaching net-zero emissions is very challenging due to building space and building age restrictions on the main campus of the University of Glasgow. This article investigates the University of Glasgow's efforts to reduce carbon emissions and makes some recommendations. It mainly explores the challenges of reducing carbon emissions on the main campus of the University of Glasgow and proposes some practical solutions. The research focuses on the possibility and necessity of implementing the following methods in the University of Glasgow: (1) Improve Energy Efficiency (2) Promote Renewable Energy (3) Carbon Accounting (4) Green House. It also summarizes the main challenges in the specific implementation of some methods and puts forward an outlook on the energy structure of the Glasgow campus in the future.

Investigation:

Solar energy is a world-recognized high-quality clean energy. Li et al., (2022) clearly pointed out the prospect and development of solar energy in the article. Today's solar systems generate roughly 255 times more electricity than they did in the early 2000s. If you want to reduce the carbon emissions of the University of Glasgow and improve the energy structure of the university campus, solar energy is one of them.

Figure 1

表格

描述已自动生成地图

描述已自动生成*Global Insolation Radiation Map*

*Note.* From the World Bank and the International Finance Corporation

It can be seen from Figure 1 that the solar radiation level on the campus of the University of Glasgow is relatively poor. It is very difficult to install a solar system on the University of Glasgow campus to extract traditional fossil energy. Therefore, the solar system on the campus of the University of Glasgow is feasible as a clean energy alternative to traditional fossil energy. But this is only a partial replacement, not a complete improvement. The article by Ahshan et al. (2019) strongly support this idea. The article presents a possible solution: adding facilities to a small portion of the campus. This can reduce the loss when the photovoltaic grid fails due to weather.

How to do:

There are very limited places where photovoltaic systems can be installed on the campus of the University of Glasgow, and the ideal place is on the roof of each teaching building, so that better solar radiation intensity can be obtained, so that the photovoltaic system can achieve optimal power generation efficiency. The findings of Radosevic et al., (2022) also support this point of view, and it is also proposed that to improve the efficiency of solar energy, the roof photovoltaic panels can be tilted to a certain angle. Gunerhan & Hepbasli, (2007) also researched the inclination angle of solar photovoltaic panels, and the research results are shown in Table 2 below.

Figure 2

*Optimal tilt angle for photovoltaic panels*

图表, 折线图

描述已自动生成

*Note.* From Gunerhan & Hepbasli, 2007

Some solar systems are very simple to install while being undemanding to the terrain and location. Solar energy systems are almost all modular installations. Each photovoltaic panel is a photovoltaic panel that integrates various required devices. When installing, it can be simply spliced directly, plug and play. If you want to install a solar system on the roof of the building, you must also pay attention to the evaluation of various indicators (load bearing, angle, stability, etc.) of the teaching building structure in the campus. To obtain the maximum power generation efficiency, it is necessary to pay attention to the angle of installation when installing solar panels on the roof to maximize the use of solar energy. At the same time, a stable control system is required to ensure that the solar system can produce stable and high-quality electricity.

Advantage:

Usually, small solar systems can be installed in a few days, which is very fast. This is a very important advantage. At the same time, once the solar energy is installed, except for some simple daily maintenance, the life of the solar energy system can generally reach 25 years. Now due to the development of technology and breakthroughs in various fields, the installation cost of solar energy is gradually reduced. The operating cost is also very low, with only some daily maintenance costs such as: inverters, cables, connectors, etc. in the system hardware. However, as time goes by, due to factors such as solar system hardware aging and wear and tear, the power generation efficiency of the solar system will decrease. Therefore, it is necessary to have a clear estimate of efficiency and cost before deciding to install a solar system.

Challenge:

Low-cost maintenance of solar energy is a very important challenge facing the solar industry. Majdi et al., (2021) also clearly pointed out in the article that solar panel maintenance usually adheres to the concept of replacing when it breaks, which will cause a lot of money loss and a lot of electronic waste and carbon emissions.

Figure 3

*Photovoltaic power curves for different sunlight intensities*

图表, 折线图

描述已自动生成

*Note.* Eltawil & Zhao, 2013

Maximum power point tracking (MPPT) is also one of the important challenges. Since the energy conversion rate of photovoltaic panels is very low, and the power of photovoltaic power generation is closely related to the intensity of sunlight radiation. The photovoltaic power curve is also non-linear. Therefore, MPPT is very important for a solar photovoltaic system. It can maximize the power production capacity of photovoltaic panels, ensure that the photovoltaic system operates at maximum capacity, improve the quality of output power, and make the photovoltaic system much more stable. However, changes in the intensity of sunlight and changes in the temperature of the photovoltaic panel will seriously affect the MPPT algorithm to track the maximum power point. Rezk & Eltamaly, (2015) focused on the response and accuracy of various MPPT algorithms under rapidly changing climatic conditions. So how to track the maximum power point more accurately has become another important challenge for photovoltaic power generation.

Li, L., Lin, J., Wu, N., Xie, S., Meng, C., Zheng, Y., Wang, X., &amp; Zhao, Y. (2022). Review and outlook on the International Renewable Energy Development. Energy and Built Environment, 3(2), 139–157. <https://doi.org/10.1016/j.enbenv.2020.12.002>

Ahshan, R., Al-Abri, R., Al-Zakwani, H., &amp; Ambu-saidi, N. (2019). Solar PV system design for a Sports Stadium. 2019 IEEE 10th GCC Conference &amp; Exhibition (GCC). <https://doi.org/10.1109/gcc45510.2019.1570520864>

Radosevic, N., Liu, G.-J., Tapper, N., Zhu, X., &amp; Sun, Q. (C. (2022). Solar Energy Modeling and mapping for the Sustainable Campus at monash university. Frontiers in Sustainable Cities, 3. <https://doi.org/10.3389/frsc.2021.745197>

Gunerhan, H., &amp; Hepbasli, A. (2007). Determination of the optimum tilt angle of solar collectors for building applications. Building and Environment, 42(2), 779–783. <https://doi.org/10.1016/j.buildenv.2005.09.012>

Majdi, A., Alqahtani, M. D., Almakytah, A., &amp; Saleem, M. (2021). Fundamental study related to the development of modular solar panel for improved durability and repairability. IET Renewable Power Generation, 15(7), 1382–1396. <https://doi.org/10.1049/rpg2.12079>

Eltawil, M. A., &amp; Zhao, Z. (2013). MPPT techniques for photovoltaic applications. Renewable and Sustainable Energy Reviews, 25, 793–813. <https://doi.org/10.1016/j.rser.2013.05.022>

Rezk, H., &amp; Eltamaly, A. M. (2015). A comprehensive comparison of different MPPT techniques for photovoltaic systems. Solar Energy, 112, 1–11. <https://doi.org/10.1016/j.solener.2014.11.010>