The UK’s new and existing buildings must adjust to a low carbon economy (the Department for Business, Energy and Industrial Strategy). Investing in renewable and energy efficient projects is crucial to help UK to reach net zero emissions by 2050. The development of Regenerative Hydrogen Fuel Cell energy storage systems will have significant economic benefits and will deliver deep cuts in CO2 emissions. 1. This assignment is based on a competition challenging entrant to reduce the greenhouse gas emissions of UK industrial buildings by 50%. 2. The following information is provided in the accompanied brief file: a. Photographs of the Raleigh Technical Design Ltd (RTD) headquarters building, b. The site energy information, which includes brief description of the following: i. Floor areas and electrical consumption, ii. Annual electricity cost, iii. Current working schedules. 3. Energy consumption of the building is monitored and hourly electricity consumption is provided for this study. Based on an electricity price of 15.9 p/kWh, floor area of 371.6 m2 and CO2 conversion factor of 0.2556 kg/kWh of electricity from the UK Grid [1],

Develop an understanding of physical, technological and economic factors that determine the design and use of renewable Hybrid Solar PV/RHFC energy systems. 2. Apply a characterisation method to estimate the site solar resource. 3. Perform an in-depth design and analysis of the renewable Solar PV/RHFC power generation concept to cope with the electricity demand of the industrial building. 4. Demonstrate the ability to present results in a structured written report. 5. Demonstrate the ability to carry out internet searches for up-to-date technical information on renewable Solar PV/RHFC technological solutions and products.

a baseline electricity performance can be drafted as is shown in the table below. Electricity Annual energy use (kWh) 225,343.6 Annual energy cost (inc VAT) £35,829.6 Unit cost (p/kWh) 15.9 kWh/m2 floor area per year 606.41 Carbon dioxide emissions (kg-CO2) 57,597.8 Carbon dioxide per area (kg-CO2/m2 ) 155 A - 4 • You are asked to carry out a feasibility study of possible inclusion of renewable Solar PV/RHFC energy technology into the UK business building electrical load. For this you may use the help of Homer Energy, an interactive software tool, which will allow you to investigate renewable PV/RHFC energy strategies and explore different options in the design process for a proposed building electrical load. Homer Energy, can be downloaded at: https://www.homerenergy.com/(21-day free trial). However, other methods of analysis are equally accepted. 4. For the annual energy consumption of the building and using the hybrid PV/RHFC energy system design, determine: i. The nominal power capacities of the Solar PV array and the fuel cell system that can be incorporated into the building power load, ii. The power input to the electrolyser system and the amount of hydrogen to be stored (in kg). iii. The annual energy production and savings that can be achieved with the hybrid renewable PV and RHFC energy storage system, iv. The annual energy cost with the renewable Solar PV/RHFC energy technology, overall savings in electrical energy and CO2 emissions, v. The hybrid PV/RHFC system efficiency and the payback period of the integrated renewable solar energy/storage system. 5. Comment on viability of using hydrogen as an energy carrier on a global scale/niche application. Notes: In order to meet its challenging greenhouse gas (GHG) emission reduction targets, the UK Government has developed a number of incentive schemes to encourage renewable energy production, including: The smart export guarantee (SEG) to encourage small scale, low carbon electricity generation. SEG comes into force on 1 January 2020, The actual electricity price for the non-domestic sector including climate change Levy (CCL) and VAT is 15.9 p/kWh (DUKES), The actual CO2 emission factor for electricity generated in UK is 0.2556 kg/kWhe (DEFRA). If you require training materials associated with Homer Energy and Helioscope (for PV array integration), you can access some of it here: https://www.youtube.com/watch?v=Po8uOwKMVhk https://www.helioscope.com/ [1] Department for Business, Energy & Industrial Strategy, Greenhouse gas reporting: conversion factors 2019. [Online]. Available: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors