DESIGN OF A PRACTICAL RENEWABLE ENERGY SYSTEM

1 Purpose

The objectives of this assignment are to

- apply the knowledge of renewable energy sources to design a relevant and sustainable electric power system;
- consider different aspects of renewable energy system development practically such as components, standards, project cost and enviromental impact;
- analyze different options critically to make recommendations, and;
- develop professional writing skills using IEEE format and style.

2 Introduction

In this subject, you have been introduced to different energy sources and associated energy and power conversions. The tutorial questions have helped you analyze and design some simple systems using the renewable energy sources. For this individual assignment, you will apply the knowledge of renewable energy sources to work on a design project. The key question for this assignment is "*How do I design a renewable energy system to support the electricity generation for this place?*" This project involves the selection of renewable energy source(s) and location of interest, define the specifications, consider industry/government policies and standards, estimate the project cost and evaluate the design through calculations and simulations. Through this exercise, you will approach renewable energy systems with a more practical and realistic approach.

3 Tasks

Your assignment should include the following tasks:

3.1 Identify a place and renewable energy source(s)

This task can be approached from two different perspectives:

1. Location first. You may have a place in mind already and wanted to explore which renewable energy source might be more sustainable and suitable option for the place. In this case write an investigation mini-report with sufficient proof (i.e. viability from scientific, environmental, economical, etc. viewpoints) to support your judgement about the chosen renewable energy source(s) for the place.
2. Renewable energy source first. You may have interest in a particular renewable energy source. In this case, you need to write an investigation mini-report with sufficient proof (i.e. viability from scientific, environmental, economical, etc. viewpoints) to support your judgement about the chosen place for a particular renewable energy source.

You can choose either one to begin your assignment.

3.2 Determine system specifications

Once the place and the energy source(s) are chosen, the next step is to write down a list of system specifications. Size of the power system is one of the first parameters to consider. The system size is very different between powering a house and powering a village. In addition, is the electricity generation solely supplied by the renewable energy source(s) or complementing the AC grid? You need to work out how much electric power the customers will need to work out the system size, i.e. an energy demand analysis. Other key system parameters to consider are availability of the renewable energy source(s) throughout the hours, days, months and years, patterns of electricity usage in additional to average/peak consumption, predicted lifetime of the renewable energy systems before next upgrade or rebuild, needs for energy storage, etc.

3.3 Design system topology

After setting the system specifications, it is time to explore and compare different system topological options. The system topology provides the framework and indicate the building blocks of the electric power system. Take the wind power system for example. Things for system topology to consider are horizontal/vertical-axis, on-shore/off-shore systems, DC grid/AC grid, distance from generation to consumption, different types and architecture of energy storage system fif needed, etc. The aim of this part is to come up with a reasonable system topology not only to meet the system specifications technically but also to take into consideration the environment sustainability, general system cost, energy policies, international/industry safety standards (e.g. IEEE Standard 1547 on distributed resources interconnection, etc. More standards can be downloaded from IEEEXplore or via UTS Library), etc.

3.4 Design system components

After the building blocks of the system are identified, the next step is to explore what hardware components are available and suitable for the system design. Take the PV power system without energy storage as an example. The system components are PV panels, PV inverters, supporting structures, protection circuits, cabling, meters, etc.

In this design step, you need to perform a project cost analysis on a spreadsheet which includes the equipment and installation costs. The information can usually be found from online hardware stores and industry/government renewable energy project reports, and some engineering project design and management books from the library.

3.5 Evaluate system performance

Throughout the tasks from Secs. 3.1 to 3.4, in addition to your textual explanation and descriptions, you need to run a spreadsheet to keep a record of different analyses such as the energy demand analysis and project cost analysis and design options.

The design tasks from Secs. 3.1 to 3.4 are of iterative nature. For example you are working on the project cost in Sec. 3.4 and finding that a particular component is very expensive. You wonder if other system topology may avoid such component. You may alter the system topology and perform the system components design again. The other approach is to keep at least two system topologies which are both viable in Sec. 3.3 and work on the system components design to determine which system topology is finally adopted.

There are two software packages that might be useful for your project – HOMER and System Advisor Model (SAM). SAM is free of charge. There are plenty of support and documentation for both software packages. Note that using the HOMER or SAM software is entirely your decision based on your availability to pick up a new software and

complete the assignment on time. It will not affect your grades if you don't use the software but simply present a spreadsheet to show your design in additional to the textual and graphical explanation and description.

3.6 Conclude design and feedback

This part are bascially to explain and conclude the design and to discuss the experience learned from this project. You are welcome to provide further feedback to improve the project.

4 Assessments

The total marks for this assignment are 30 out of 100 of the subject marks. This assignment is individually assessed. The assignment will be assessed based on the quality and presentation of your work from Sec. 3.1 to 3.6, and the approach you manage the work flow of this assignment. An interim assessment session is scheduled in Week 7 when you will receive feedback from the tutor or the subject coordinator. It is expected that the student would have completed at least Sec. 3.1 to 3.3 by the time the interim assessment is taken place. The interim assessment is worth 5 marks of the total 30 assignment marks. More details will be released in regards to the format of assessment. Nevertheless, the student should be ready to show the working document and spreadsheet/program to the assessor during the interim assessment session. Details of final submission are shown in the next section.

5 Details of submission

- Format your paper according to the IEEE power and energy society standard. The templates can be downloaded at https://www.ieee-pes.org/templates-and-sample-of-pes-technical-papers.
- The IEEE digital library (IEEEXplore) has rich sources of useful information on R&D and standards on renewable energy systems. You can access all documents on IEEEXplore through UTS library using your UTS login. You can access the information also outside the campus via UTS library. Type "IEEEXplore" in the search bar and follow the instructions to access the IEEE digital library.
- You should use figures, tables, calculations, simulations, etc. to organize and present the information clearly.
- The page length of your assignment should not be more than 30 pages including figures, tables, references and appendix.
- **Submit** your **assignment paper** in **PDF and IEEE format only** and via UTSOnline. There are many free and reliable PDF drivers from http://download.cnet.com/windows/ which converts your documents to PDF. For example, PDF reDirect V2, Solid PDF creator, Foxit reader, etc.
- **Email** your excel spreadsheet or data file if using SAM or HOMER to Hamzeh Aljarajreh at Hamzeh.F.Aljarajreh@student.uts.edu.au.
- Submission link will be available on UTSOnline under the folder \Individual Assignment.
- Plagiarism is a serious matter and TURNITIN will be used. People who copy from each other or from the Internet may lose all the marks and/or fail the subject.
- Deadline of submission is 6 October 2019 (Sunday) at 11:59pm. Late submission will incur marks reduction of 20% per day after the deadline according to the standard late penalty policy.