MECH5275 Renewable Energy: Major Project 2019

Project objective

The objective of this project is to produce a concept design for a set of renewable energy systems to supply the entire electricity market of an Australian region. You may choose any region that participates in the National Electricity Market (NEM), that is either Queensland, New South Wales (which includes the ACT), Victoria, South Australia or Tasmania. If applicable, you may also use waste heat for cogeneration or trigeneration. You may use any renewable energy technologies that are currently considered to be viable.

Groups

The project is to be done in groups of 4. You need to organize yourselves into groups during the first week.

Project Report

Your report should be *no more than 30 pages* using single spaced 12 point font. Extra material can be placed in appendices. The report should include the following sections.

Introduction

Briefly describe the motivations and objectives of the report. You should also describe your region and outline its power demands and available renewable energy resources in this section.

Technology Review

Consider generation and storage technologies that could possibly be used for your power supply systems. Discuss the pros and cons of each option within the context of your particular region. Decide which you will and won't use and highlight any complementary combinations clearly justifying your decisions. Here you should consider (at least) the following:

- Economics: Capital and ongoing costs, land usage, levelized cost of energy.
- Resource availability: Solar flux, cloudiness, wind power availability, geothermal potential, biofuel production, etc.
- Conversion efficiency between the renewable energy resource and electrical energy.
- Environmental impact, social and political factors and lifecycle greenhouse gas emissions.
- Reliability, ongoing maintenance and design lifetime.

Use a tradeoff table to quantify the relative strengths and weaknesses and guide your design choices.

Design and Modelling

Describe your power supply systems. This should include:

- A map showing the locations of each generation and storage plant as well as grid connections and other relevant sites.
- A schematic of each plant showing all of the major components and the interconnections between them along with a description of how the system works. Detailed system design where applicable.
- Demonstrate that your system is able to meet the electricity demands of the region including base, intermediate and peaking loads throughout the year. To do this you should generate a computer model of all systems in the region using `Matlab`, `Simulink`, `Excel` or any other package of your choice. The model will include components that are similar to the models you produced for the technical assignments.
- Using your model combined with realistic data for demand and any other stochastic variables such as wind speed or cloudiness, demonstrate how power demands are met during each half hour interval over the course of a year.
- Estimate the cost of electricity produced by your power plant.
- Outline the likely impacts that your plant will have on the environment. Include a basic life cycle greenhouse gas analysis.

Conclusions

References

Assessment

Progress 5%

There will be four progress milestones worth 1.25% each. The purpose of these is to encourage your group to begin working on the project early. Marks will be awarded on a pass or fail basis – this means full marks if your group has made a reasonable attempt to address the milestone and filled out the logbook and zero marks otherwise. No partial marks will be awarded. These should be submitted via email to the Major Project Contact.

Presentation 20%

Presentations will be 12 minutes with 2 minutes of question time. Each student in a group must speak. Your group represents a startup company pitching your renewable energy solution to an audience of venture capitalists, their technical advisors and government officials who you are trying to convince to invest in your project. Focus on the exciting and innovative features of your design to impress the venture capitalists and also throw in some technical details to convince their advisors that you will be able to back up your claims.

Final report 75%

The final report is to be submitted electronically as a `pdf` file via Turnitin.

Lateness penalty

Milestones and the report will incur a 20% penalty per 24 hours or part thereof.

Logbook

Your group needs to keep a logbook which lists each occasion that you worked on the project including which team members were present. These occasions will include tutorial sessions as well as other times you meet. You should also note any individual work done. Your group must hand in your logbook with each milestone. The purpose of this logbook is to motivate all students to contribute to the group. In some exceptional cases it may be used to adjust individual student's contributions although we hope that will not be required.

Milestones

At each milestone you must submit your logbook as well as the following.

1. Week 2 – Friday 5pm (16/08) – Form your group, think of a catchy name for your startup company and select your region: Submit a list of group members, the name of your group, the name of your region and the reason you chose it.
2. Week 5 – Friday 5pm (06/09) – Gathering data: Submit a summary of the power demands for your region, address daily variations over the course of a year and half hourly variations across the day. Obtain the data you will require in order to accurately model the renewable energy technologies being considered, this means wind speed, solar irradiance, river flow, etc. as applicable. You are aiming to model energy production and demand at every half hour interval over a year.
3. Week 7 – Friday 5pm (20/09) – Tech. Review: Submit a draft of this section of your report.
4. Week 10 – Friday 5pm (18/10) – Final draft: Submit a draft including all sections of your report.

Important dates

- Milestone dates shown above.
- Presentations: Week 13 – Monday and Tuesday (04/11 and 05/11).
- Major Project Report: Week 13 – Friday 5pm (08/11).

Notes

At least one hour of tutorial time will be set aside each week for the major project. This is the time to ask questions and obtain guidance on the direction of your project.

Major Project contact

Dr. Vanja Zecevic
`vanja.zecevic@sydney.edu.au`
Room `S355 J07`