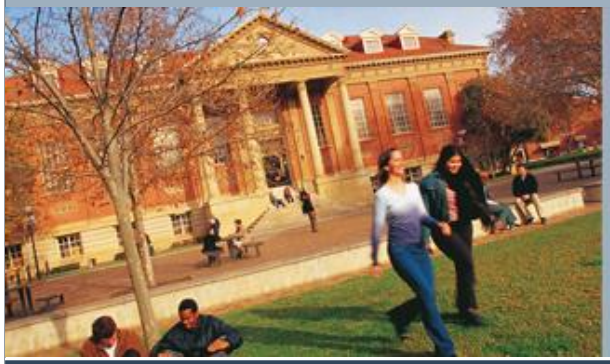
SCHOOL OF
ELECTRICAL AND
ELECTRONIC ENGINEERING

THE UNIVERSITY of ADELAIDE

Energy Storage Requirements for the SA Grid



Ryan Standing

Daniel Bondarenko

Overview

- Project Aim
- Background and Motivation
- Project Summary
  - What needs to be achieved to meet the project aim.
  - Future Applications
- Project Management
  - Work Breakdown and Gantt chart
  - Other planning aspects
- Q&A

Project Aim

The objective of this project is to develop tools to assess the energy storage requirements to ensure reliable supply with high levels of intermittent generation.

- Software Package
- Analysis and Research
- Further Functionality and Research

Background and Motivation

- Changing generation environment
  - More renewables
  - Increasing amount of intermittent generation
- Relevance
  - Australian energy crisis
  - Coal generation closing down
  - Current government policy

Project Summary- Overview

- Data Sources
- Software Package
- Data Analysis and Research
- Sample Results
- Future applications

Project Summary – Data Sources

- Australian Energy Market Operator (AEMO)

- Bureau of Meteorology (BOM)

Project Summary - AEMO

AEMO provides data on registered generators that operate in the National Energy Market. Data includes:

- Generator type, size and fuel source
- Generation data every 5 minutes
- Price data every 5 minutes
- Demand data every 5 minutes
- Interconnector flows every 5 minutes
- Rooftop Solar PV generation predictions.

Project Summary – Software Package

The Software developed for this project will:

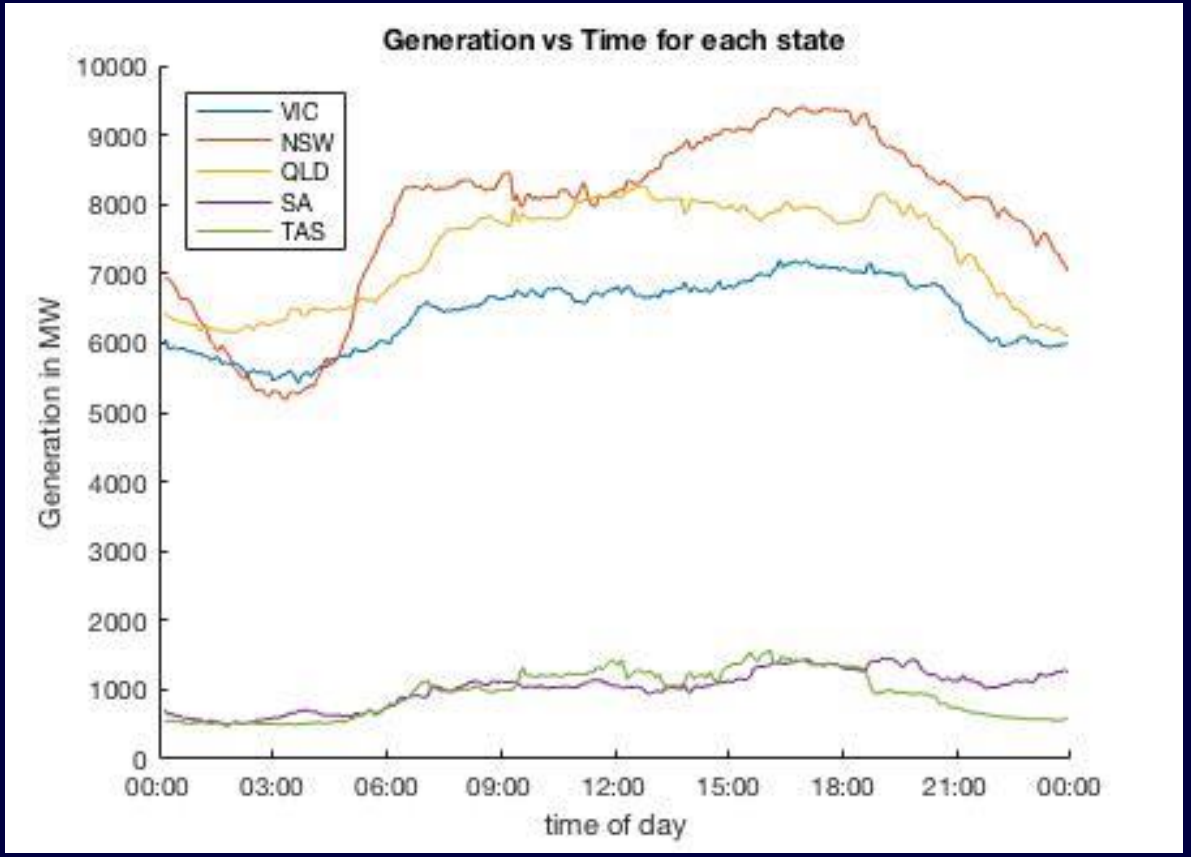
- Collect, collate and store data
- Manipulate the data into user defined subsets
- Utilise plotting tools for analysis purposes

Project Summary – Data Analysis and Research

- Proof of Concept for software tools
- Relevant, real world data analysis for research
- Explore the gaps in intermittent generation within the NEM

Project Summary – Sample Results

- Plots created manually using AEMO data from 14/3/17
- This generation vs time plot is representative of the type of results we will produce with software tools



Project Summary – Future Applications

- Software tools to be modular and scalable
  - Modular: code uses individual functions
  - Scalable: code is able to scale to larger datasets
- Use and expand the software tools to solve more complex issues
  - Dynamic energy storage requirements
- Adapt the software to use non-AEMO data for other areas

Project Management - Overview

- Work Breakdown Structure
- Work allocation
- Gantt Chart
- Risks and challenges
- Resources and budget

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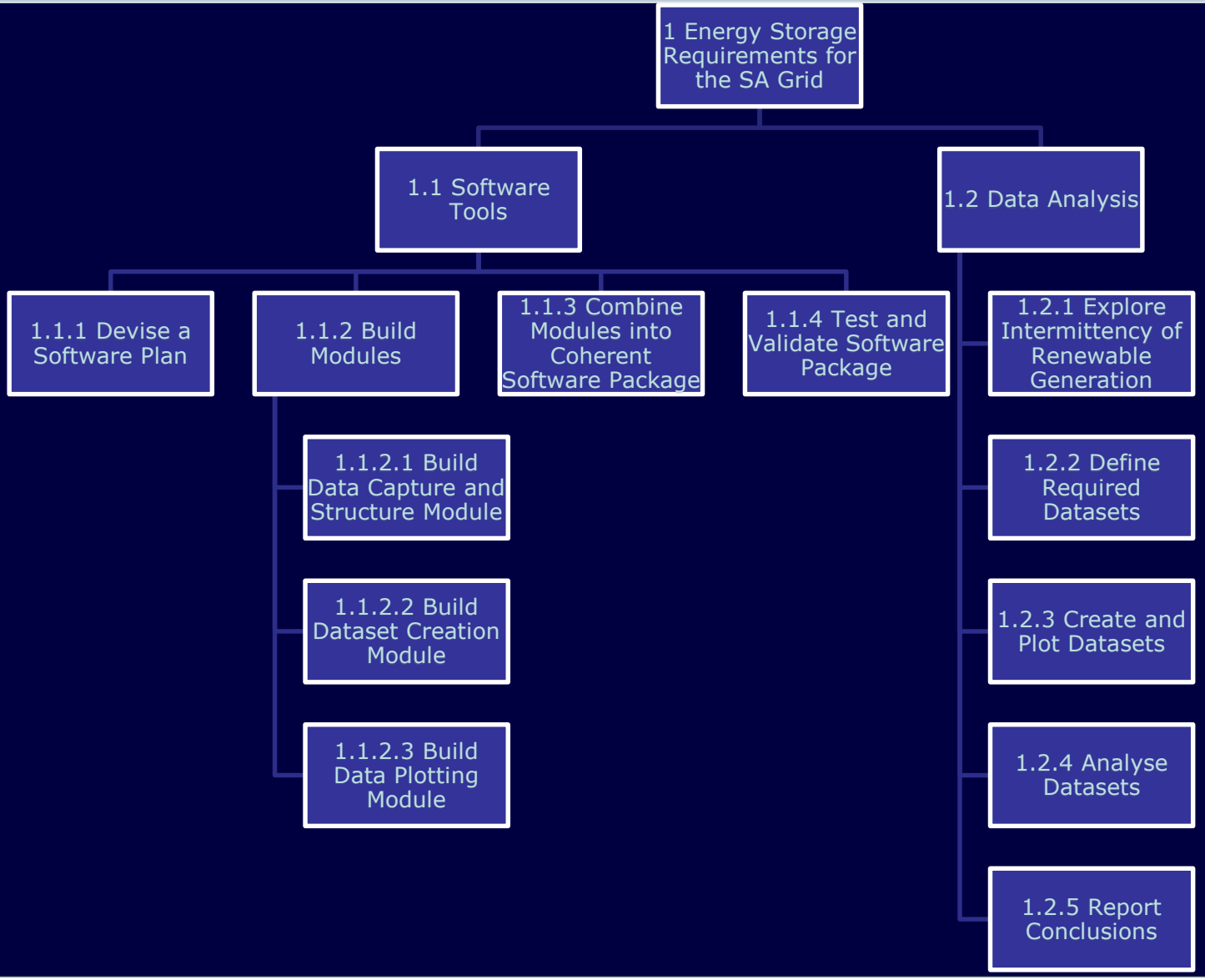
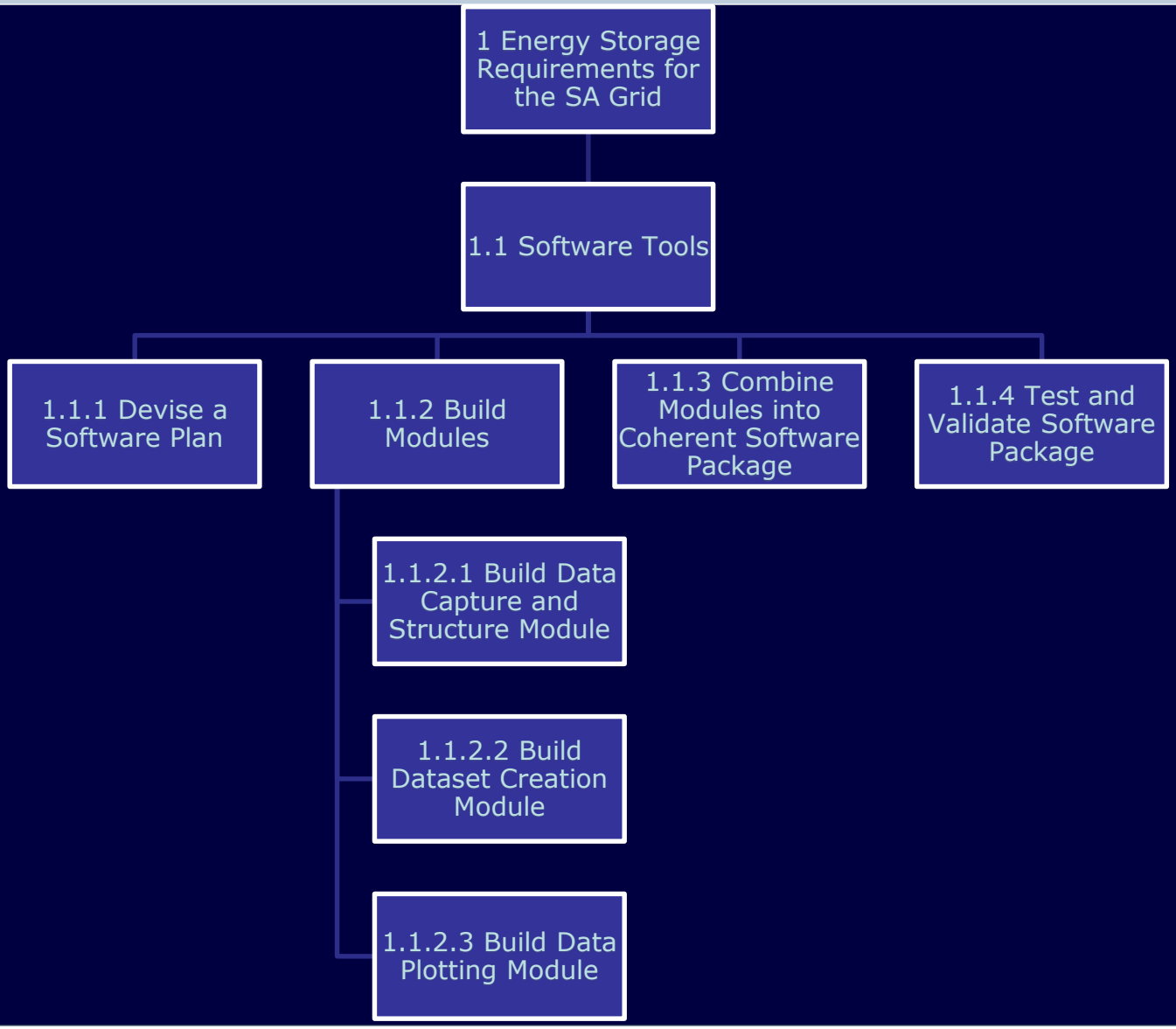
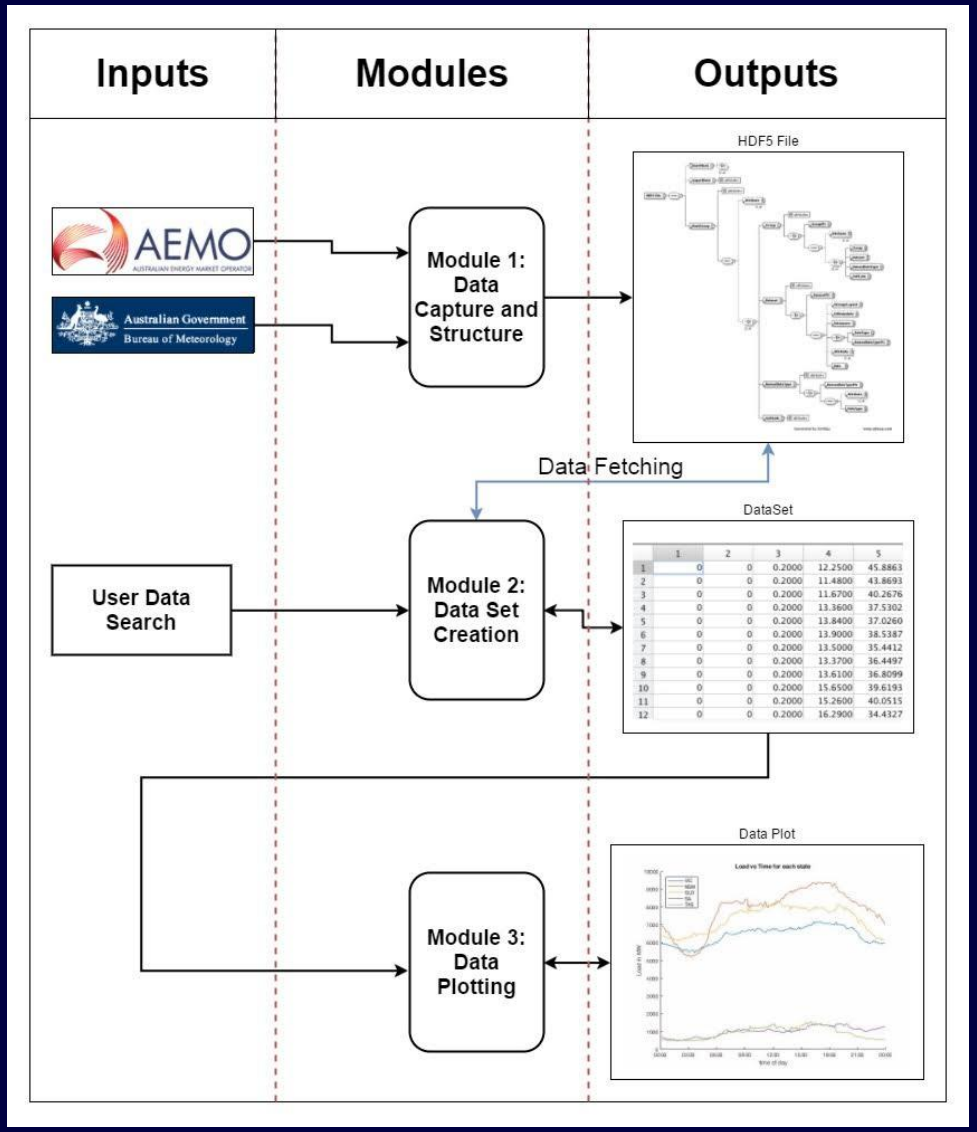
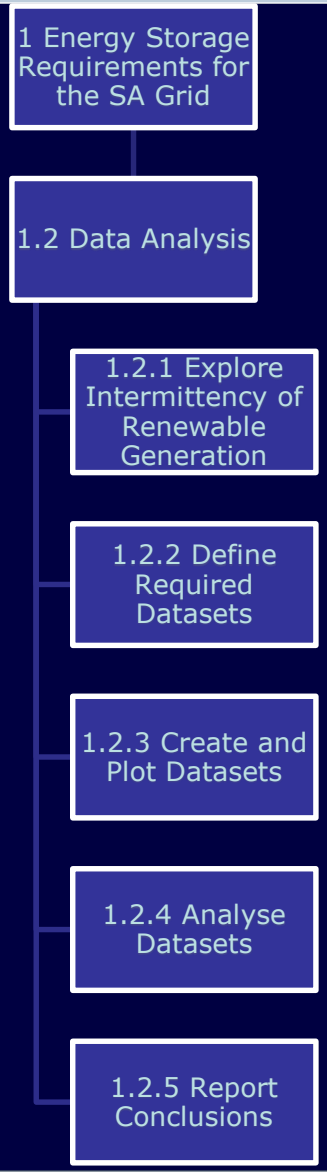



1 Energy Storage Requirements for the SA Grid
1.1 Software Tools
1.1.1 Devise a Software Plan
1.1.2 Build Modules
1.1.3 Combine Modules into Coherent Software Package
1.1.4 Test and Validate Software Package
1.1.2.1 Build Data Capture and Structure Module
1.1.2.2 Build Dataset Creation Module
1.1.2.3 Build Data Plotting Module


Inputs
Modules
Outputs
AEMO
Australian Government
Bureau of Meteorology
Module 1: Data Capture and Structure
HDF5 File
Data Fetching
DataSet
User Data Search
Module 2: Data Set Creation
Module 3: Data Plotting
Data Plot


1 Energy Storage Requirements for the SA Grid
1.2 Data Analysis
1.2.1 Explore Intermittency of Renewable Generation
1.2.2 Define Required Datasets
1.2.3 Create and Plot Datasets
1.2.4 Analyse Datasets
1.2.5 Report Conclusions

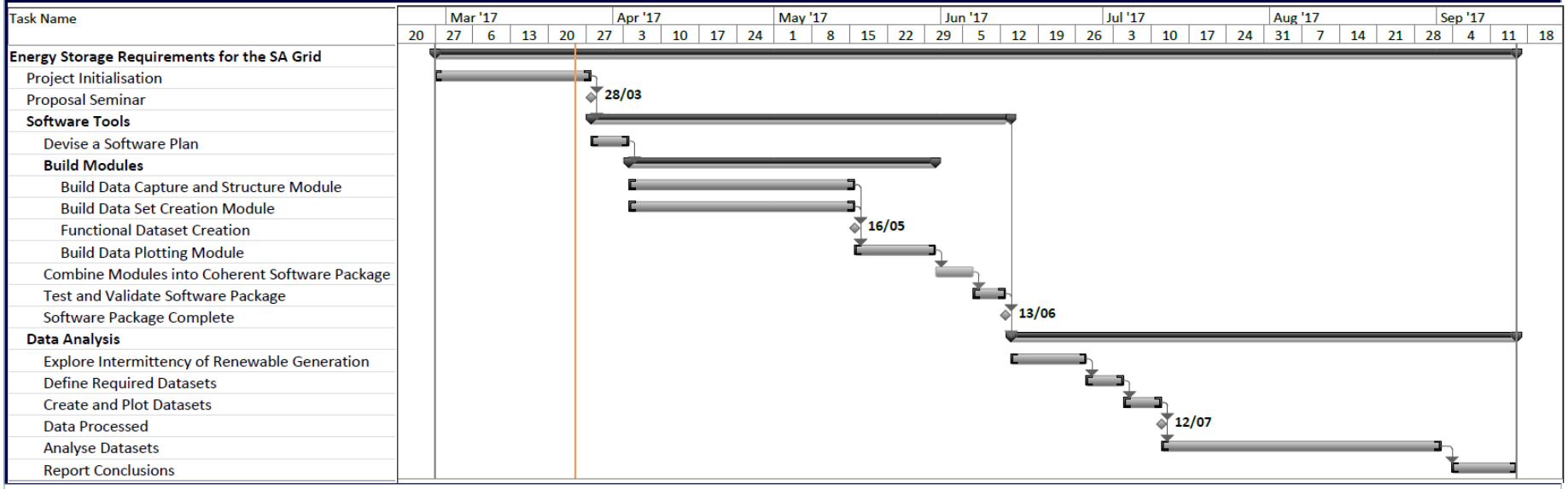
Project Management – Work allocation

- Work allocated as per the table
- Any other work will be done collaboratively

Task	Person responsible
Data Capture and Structure Module planning, coding and testing	Daniel
Dataset Creation Module planning, coding and testing	Ryan
Dataset Plotting Module planning, coding, testing, plotting, analysing and reporting.	A collection of datasets for each member

Project Management – Gantt Chart

- Time allocated: Week 1 of Semester 1 until Week 8 of Semester 2
- Continuous work during this period
- Similar time allocated to software tools and data analysis



Project Management – Risks and Challenges

- Risk of falling behind if group member is unwell
  - Mitigate by making continuous progress
- Inexperience with Python is a challenge

Project Management – Resources and Budget

- Software required is all open-source or freely available
- BOM data may need to be purchased at a cost of $545 for 10 years of data.
  - Some data is freely available, purchasing is a last resort

Conclusion

- Aim to find solutions to intermittency problems of renewable generators
- Use software tools to obtain and manipulate data
- Analyse data to explore energy storage as a solution