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Project 140:
Energy Storage Requirements for the SA Grid

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Summary

1. Project Context and Objectives
2. Method
    a. Data collection and database
    b. Optimisation Techniques
    c. Case Study
3. Results for SA and Case Study
4. Conclusion

Context

- High proportion of renewable energy in SA; exceeding 50%
- Raises issue of intermittency
- Contributed to blackout, load shedding and high prices
- Energy storage is able to reduce this

Objectives

- Collect data and deliver a database as a platform for further research into electricity generation in Australia.
- Perform a case study on energy storage and the SA grid using the research platform.

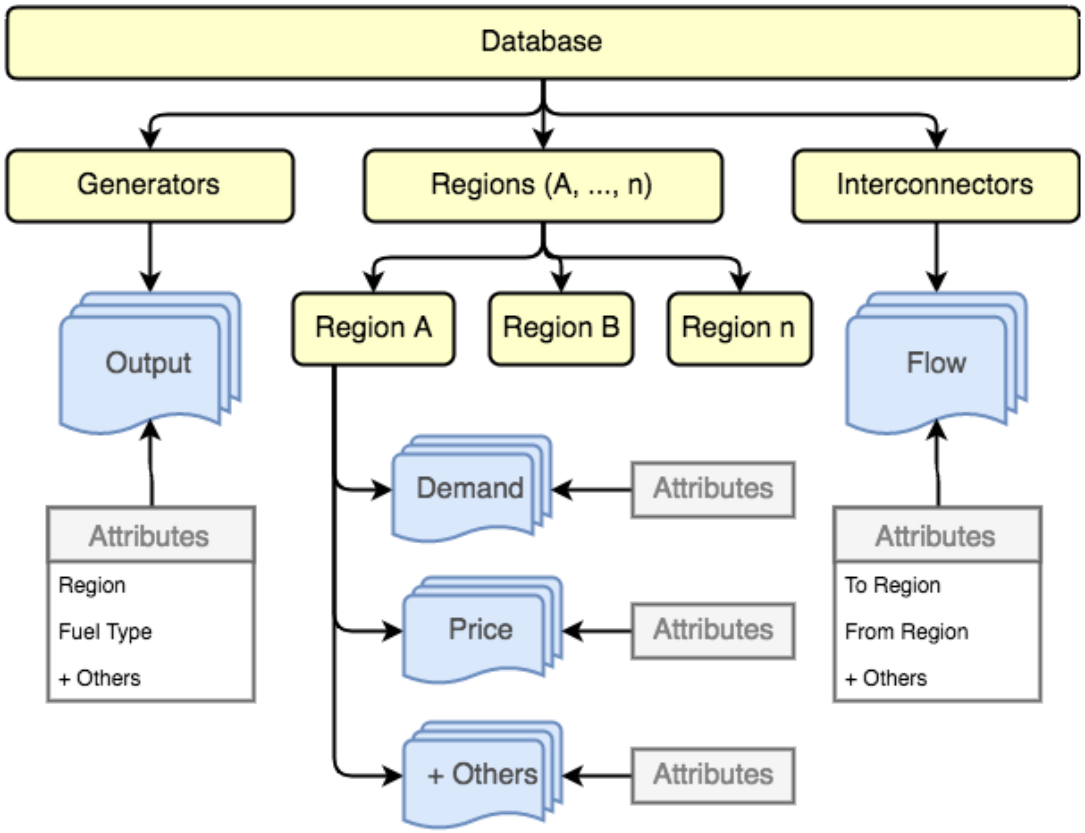
Method

- Collected data
- Created data structure and imported data
- Created Hornsdale dataset for analysis
- Investigated using battery storage (Tesla battery) to reduce variance of Hornsdale output
- Explored battery size required to reach certain variance
- Expanded results for all of SA

Data

- Database of data collected from AEMO data dashboard.
- AEMO data is not structured usefully.
- Data consolidated and structured into database.
- Foundation for our project and future research.

Data



Variance Minimisation

- 3-day windows of data used as a perfect forecast for future outputs.
- Used variance minimisation of generator output as the target outcome.

Optimisation Techniques

- Constraint-based Algorithms
  - Basic approach to controlling energy storage
  - Uses constraints to manage the storage system

- Genetic Algorithms (GA's)
  - GA's use principles of evolution to explore vast solution spaces
  - Achieve near global optimum results in reasonable timeframes.

Hornsdale Wind Farm

- 305MW wind farm situated 200km north of Adelaide.
- Site of 129MWhr Tesla/Neoen battery installation.
- Case study using 2016 data and GA to determine how energy storage could be used to alter the generator output.

Results

Hornsdale:

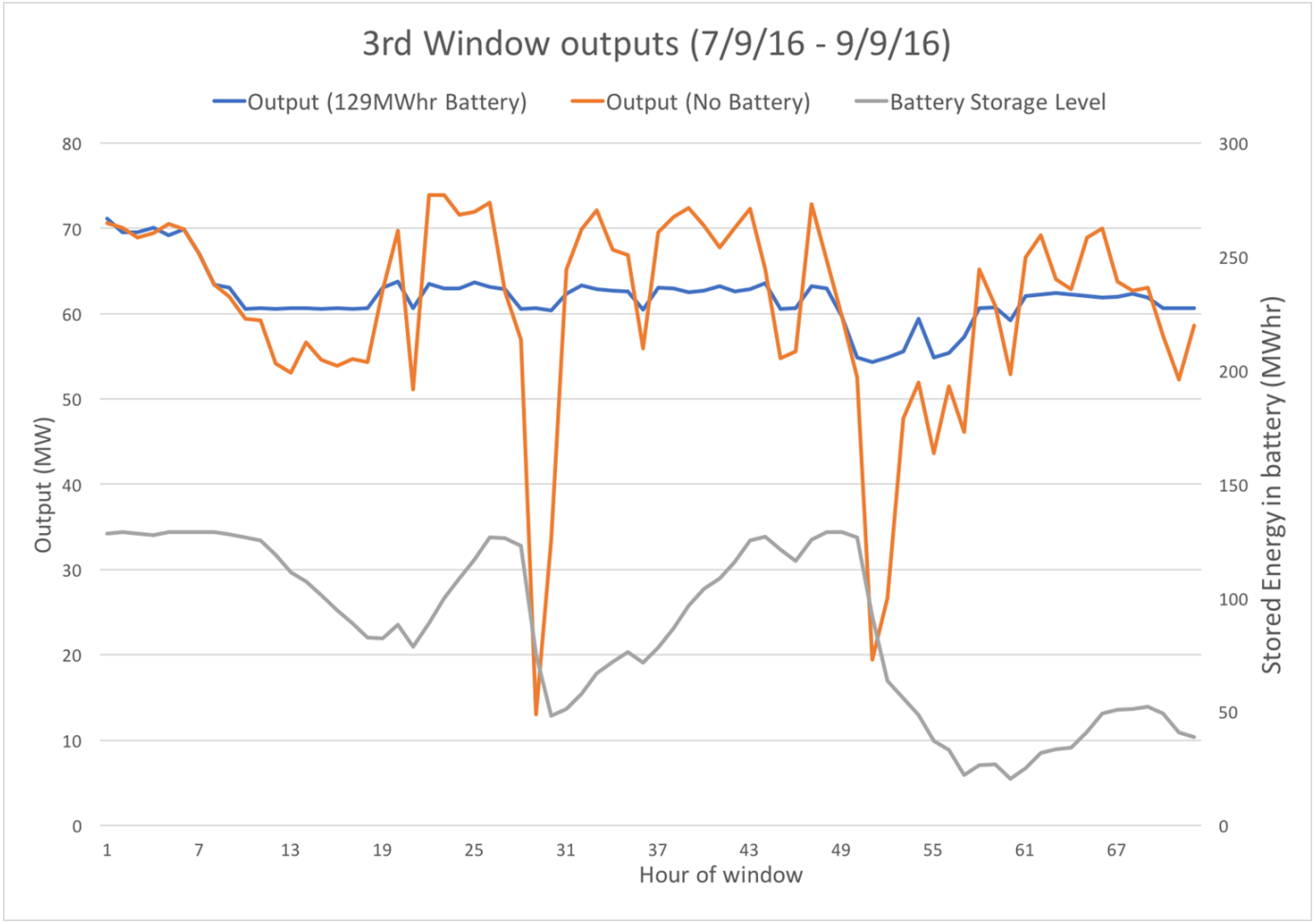
- Variance reduction over whole year of 38.3%
  - GA outperformed naive approach by 10.5%
- 500MWhr capacity required for >60% reduction in variance.

SA:

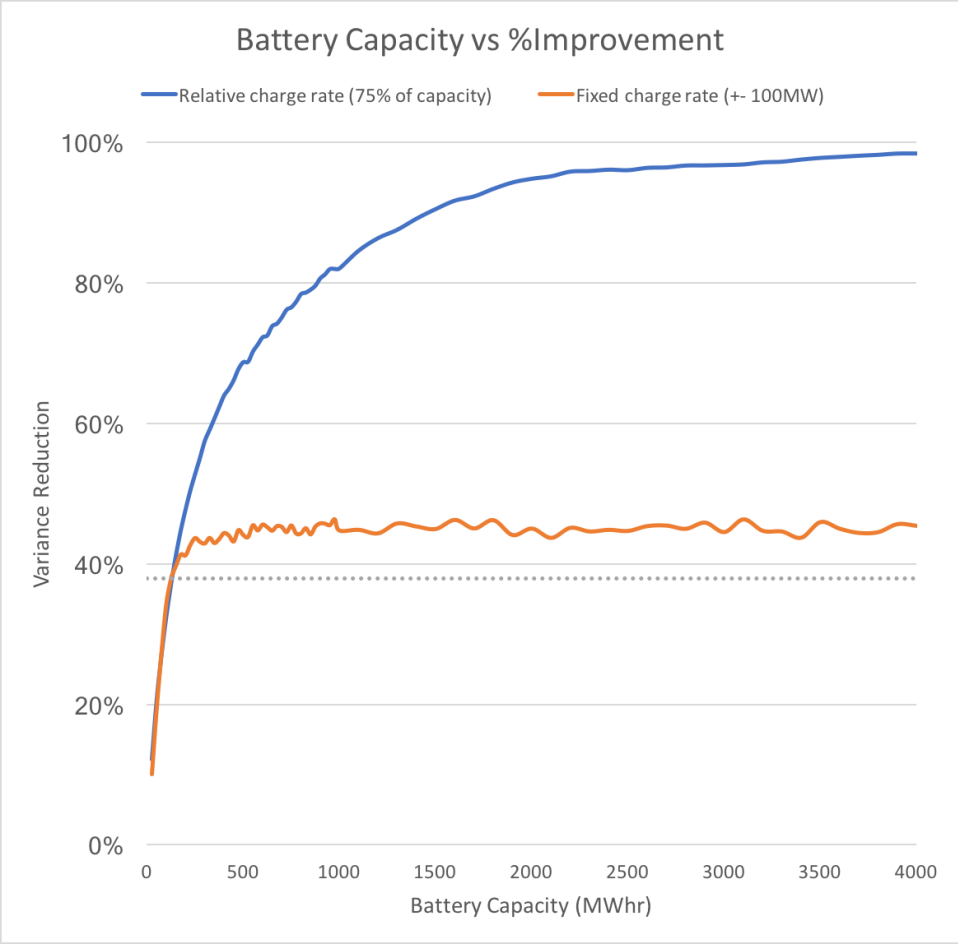
- Variance reduction of 55% requires 2GWhr of energy storage for all generation in SA.

Energy Storage Requirements for the SA Grid

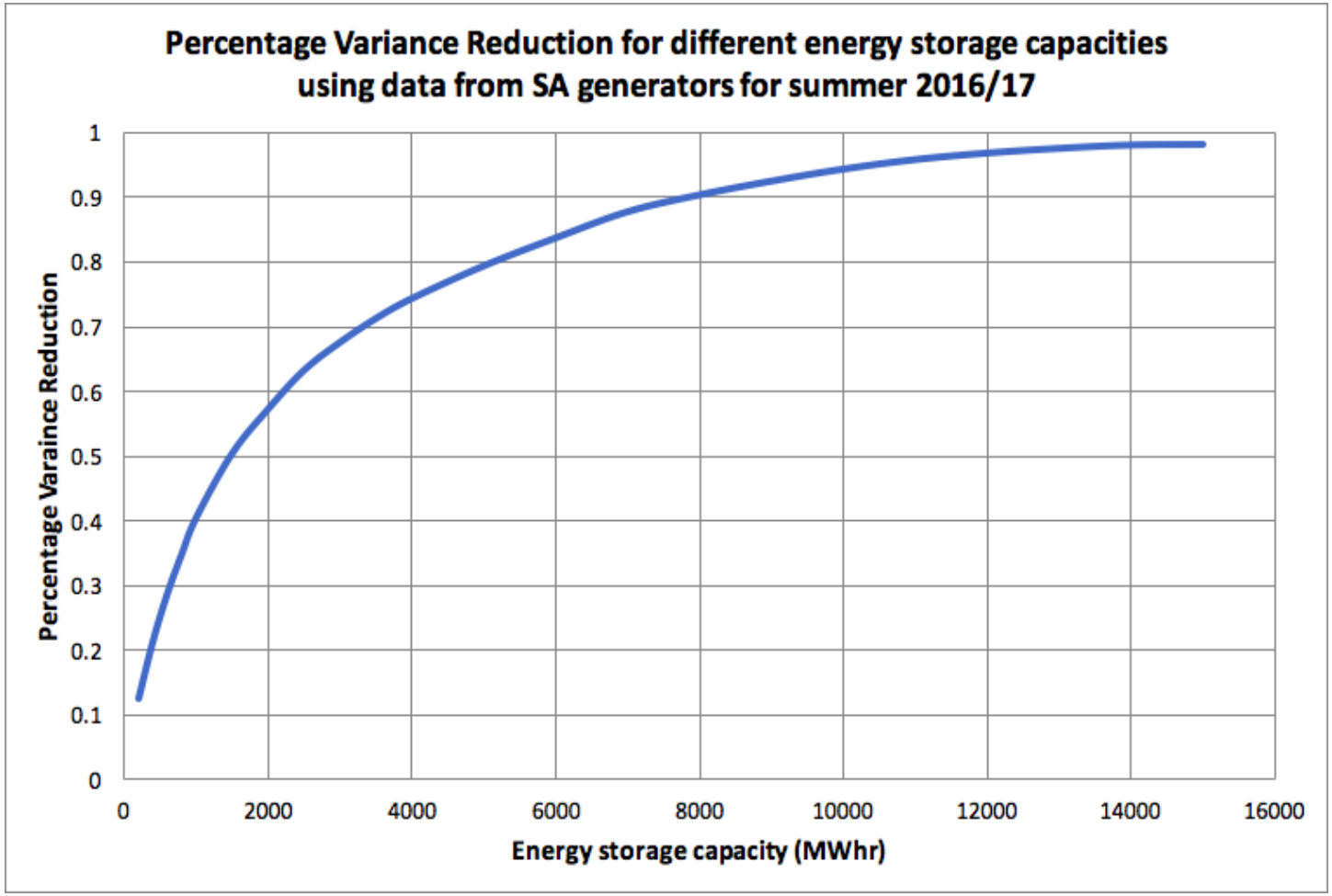
Hornsdale Wind Farm Results



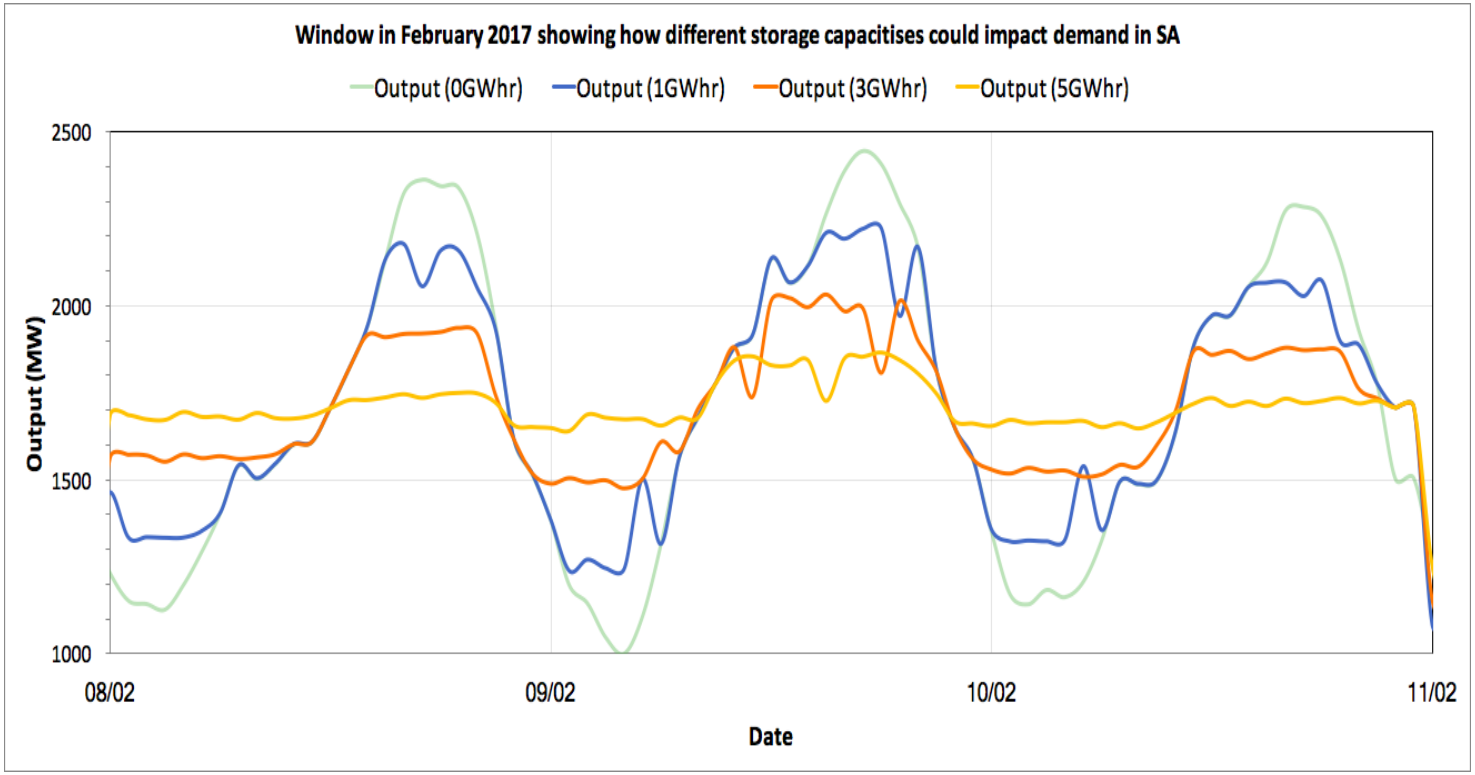
Hornsdale Wind Farm Results



SA Energy Requirements



SA Energy Requirements



Significance

- Energy storage has been shown to reduce intermittency of generator outputs.
- Results show how storage combined with renewables can approximate the behaviour of thermal generators.
- Intelligent management of energy storage system improves performance over naive approaches.

Future Work

- Expand database to include more datasets
- Improve model to account for non-ideal characteristics and more realistic scenarios
- Apply the practices to the NEM as a whole
- Explore using energy storage for profit maximisation
- Compare cost of energy storage with cost of new generators

Thank you.