Performance and Stability Assessment of Future Grid Scenarios for the Australian NEM

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I. AIMS

- To show the importance of aggregated demand response (DR) modelling.
- To study performance and stability of future grid scenarios for the Australian National Electricity Market (NEM) with the increased renewables penetration in 2020.

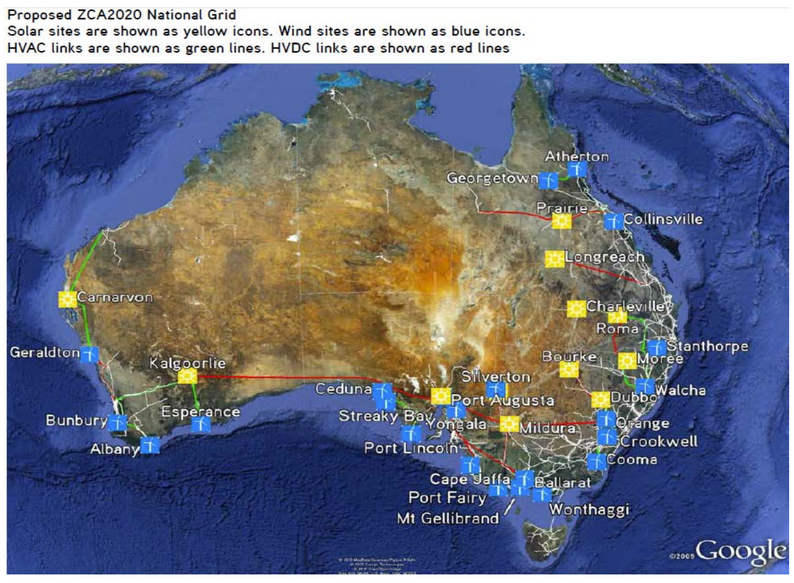
II. INTRODUCTION

Future Grids (FGs)

- Utilize high penetration of diverse renewable energy sources (RESs)
- **Balancing?**
- **Stability?**
- **New Modelling? (e.g. DR)**
- **What the FG will look like?**

Existing FG Feasibility Studies

- Modelling and analysis challenges in FGs **by using a copper plate model** are reported in [1-3].



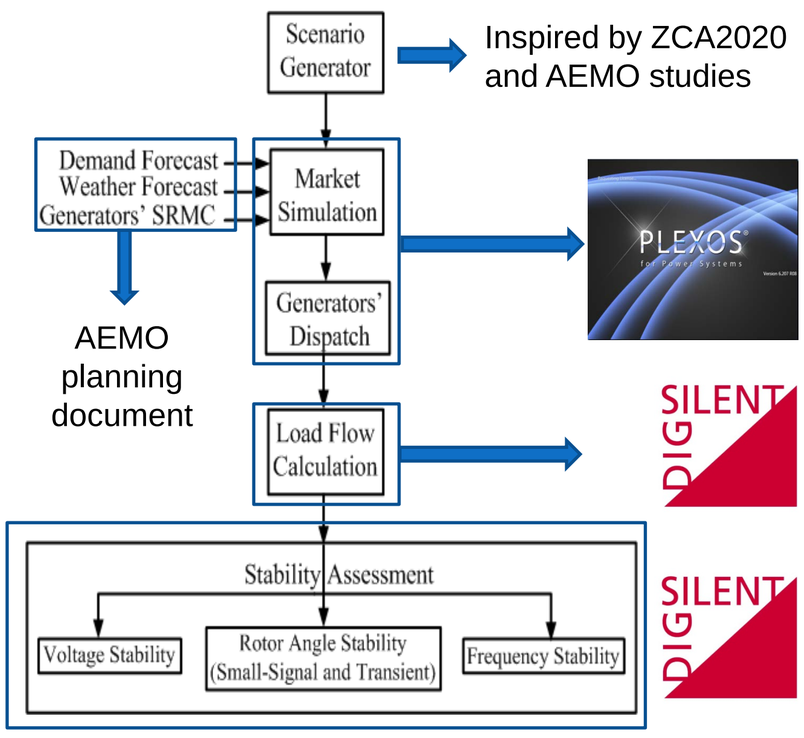
However,

- They have **focused on simple balancing,** and **neglected the network aspects.**
- They have **neglected demand response (DR).**

Simulation Platform

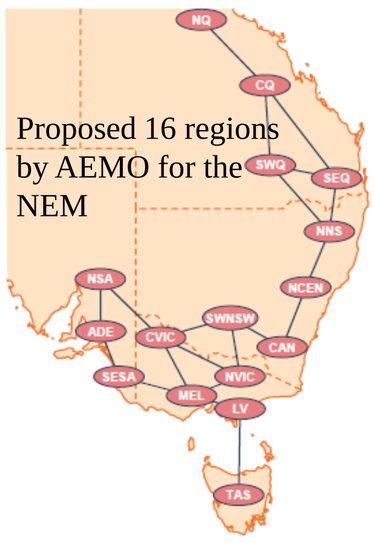
Platform includes [4]:

- Market simulation
- Load flow calculation
- Stability assessment



III. NETWORK TOPOLOGY

- 14-Generator model of the NEM
- Proposed for the small signal stability

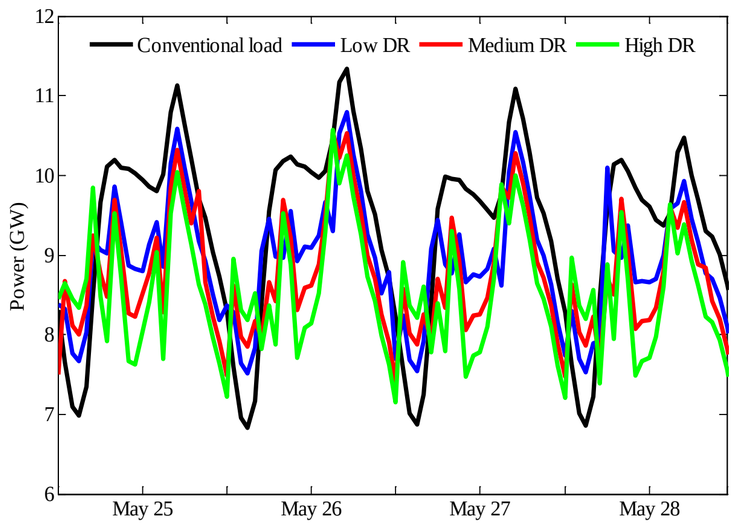


Simplified 14-generator, 50 Hz system.

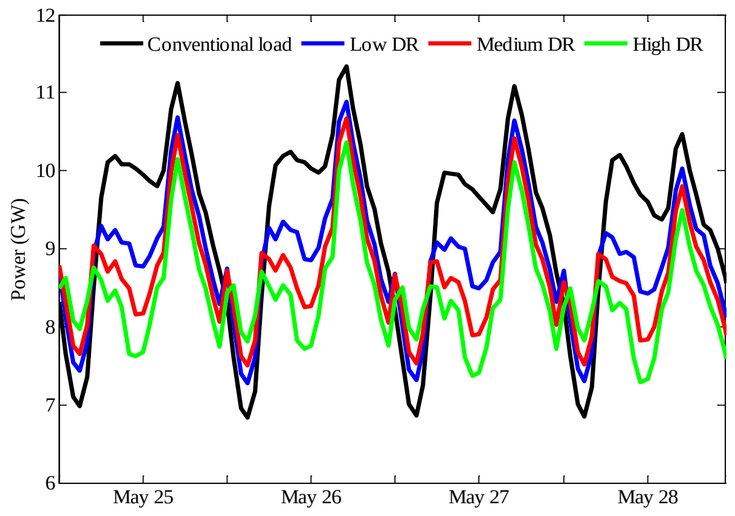
IV. Aggregate DR Modelling

- Conventional load models are invalidated by DR. However, we still want to be able to represent demand in an aggregated manner for the stability analysis.

Price taking assumption:

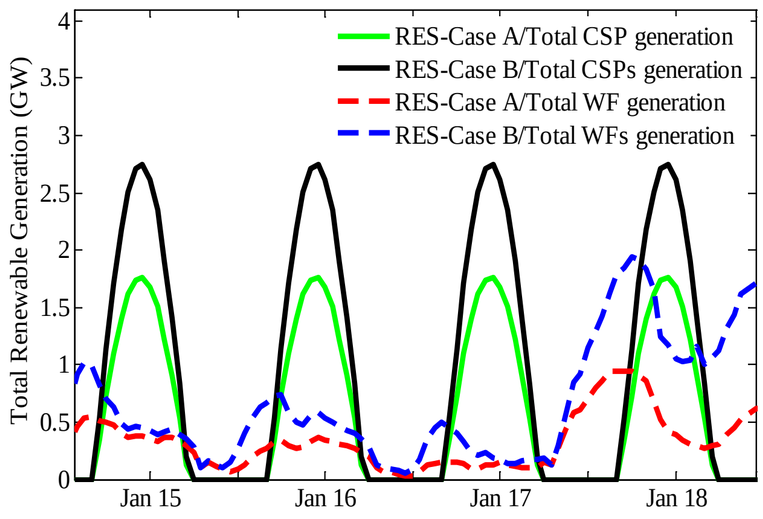


Price anticipating assumption:

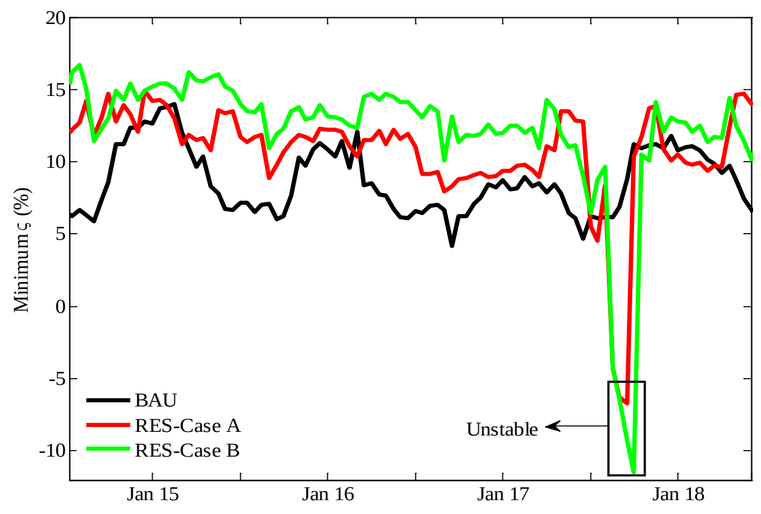


V. SIMULATION RESULTS

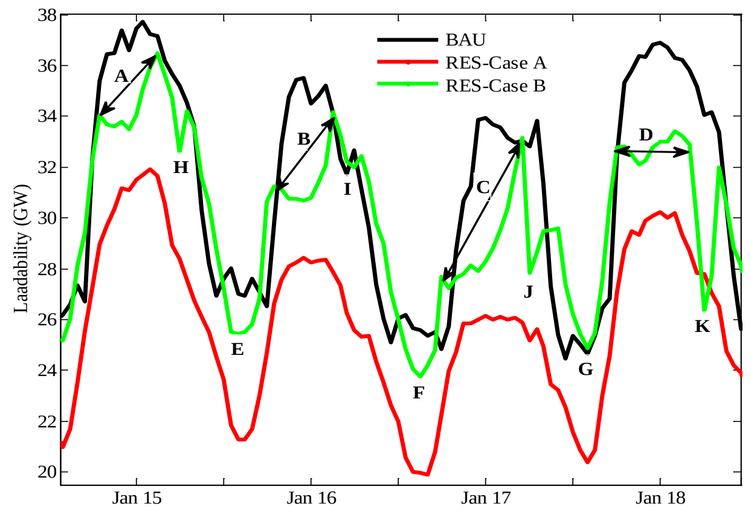
- Scenario 1: BAU
- Scenario 2: RES-Case A
- Scenario 3: RES-Case B
- Balancing results/Table1-No DR



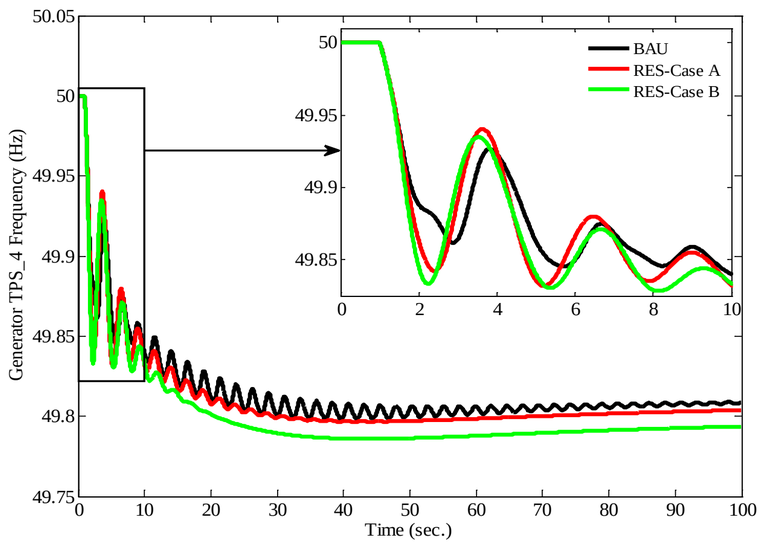
Small signal stability:



Loadability:



Frequency stability:



VI. CONCLUSION

- Stability issues might change for future grids in ways that have not been experienced.
- The importance of DR modelling, and studying the effect of DR on power system performance and stability.

Table 1

	Scenarios		
	BAU	RES-Case A	RES-Case B
Spilled energy (TWh)	0	0	0.1
Spilled hours	0	0	462
Unserved energy (TWh)	0	0	0.001
Unmet hours	0	0	6
Electrical energy from GTs (TWh)	18.73	23.56	31.73

VII. REFERENCES

[1] M. Wright, et al, Australian Sustainable Energy: Zero Carbon Australia Stationary Energy Plan: Melbourne Energy Research Institute, 2010.
[2] B. Elliston , et al, "Simulations of scenarios with 100% renewable electricity in the Australian National Electricity Market," Energy Policy, vol. 45, pp. 606-613, 2012.
[3] AEMO 100 Per Cent Renewables Study – Draft Modelling Outcomes, April 2013.
[4] H. Marzooghi, D. J. Hill, and G. Verbic, "Performance and Stability Assessment of Future Grid Scenarios for the Australian NEM," presented at the Australasian Universities Power Engineering Conference (AUPEC), 2014.