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Michael Brear, Director
Melbourne Energy Institute

Short term wind forecasting: some physics, some control and some market design implications

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Melbourne Energy Institute

Short term wind forecasting

Some physics, some control and some market design implications

Prof. Michael Brear, Director, MEI

- **Presentation to ESIG Down Under**
- **1st September, 2020**

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Acknowledgements

- Dr. Mostafa Naemi: my (now ex-) student who did the work that I am presenting today, particularly in the following two papers.

Naemi, M. and Brear, M.J., 2020, *A hierarchical, physical and data-driven approach to wind farm modelling*, Renewable Energy, in press
Naemi, M., Davis, D. and Brear, M.J., 2020, *Optimal performance of a wind farm and battery storage in the Australian electricity market*, in preparation

- Dr. Dominic Davis: my post-doc who worked with Mostafa and myself on these problems.

- Meridian Energy Australia (MEA): with whom we are currently collaborating on wind farm forecasting.

- The Australian Renewable Energy Agency (ARENA): for their generous support of MEA and MEI on our current wind forecasting project.

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Summary

- The integration of wind farms into wholesale markets appears to present several, *complementary* and *investible* opportunities.

- For example, our own analysis suggests that the following can be good things to do:

  - **improve wind farm control and enable it to provide FCAS:** improves dispatch regulation and provides system services;
  - **improve short term wind forecasting:** improves dispatch regulation further; and
  - **integrate a (relatively small) battery with the wind farm:** improves dispatch regulation again whilst providing more system services.

- And these are not either/or options, e.g.

  - **improved short term forecasting + battery:** means that less battery (and thus CAPEX) is needed and a greater total NPV can be achieved than by using only a battery;
  - **an integrated battery can realise greater value than a stand-alone battery:** enables greater total NPV via optimal provision of FCAS, energy (largely by less curtailed wind) and dispatch regulation (sometimes choose to incur this penalty in order to go after other revenues).

- This suggests that:

  - established market frameworks still present significant opportunities for wind farm owners *to serve system needs*; and
  - (at least for wind farms) market reform processes should be optimistic as to what new assets might be *investible for owners* and *useful to the system*.

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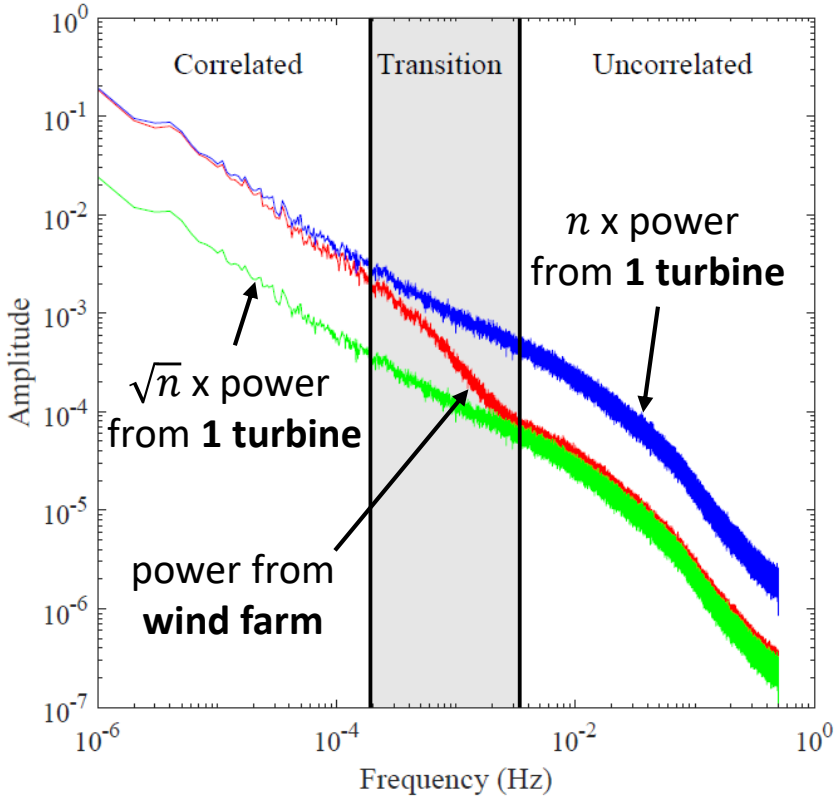
Some physics

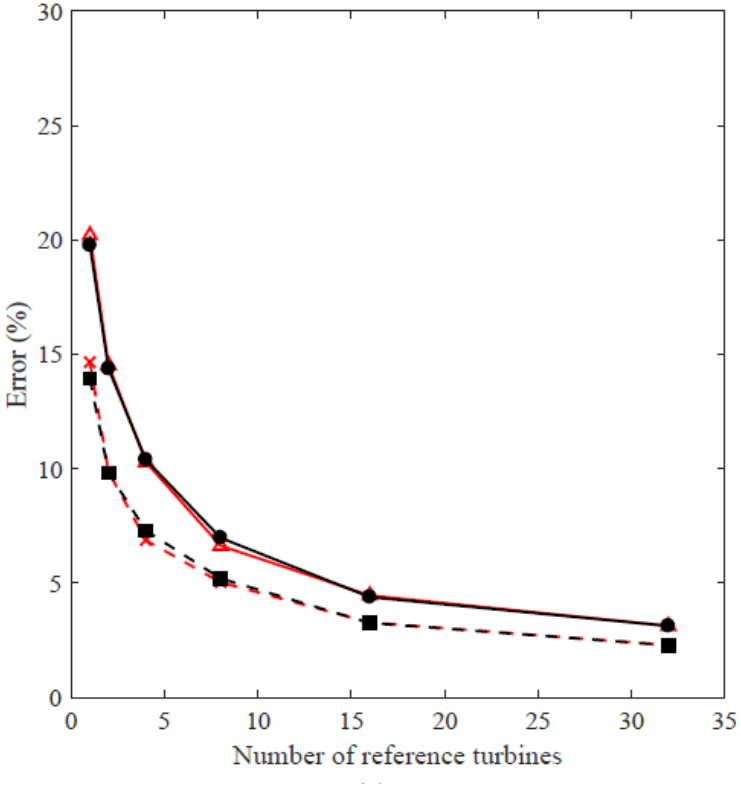
Understanding the wind and the cross-correlation of turbine power generation

Mt Mercer Wind Farm

Annual spectra of power



Model accuracy vs model complexity



- See https://forecasting.powershop.com.au/ for more information.

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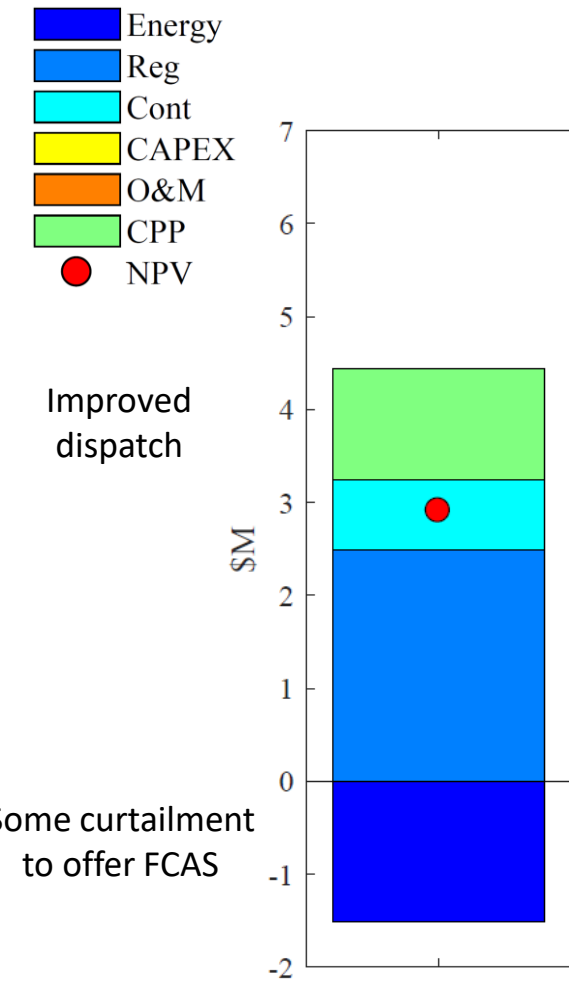
Some control and some market implications

Performance of a controlled wind farm and an integrated battery over 10 years

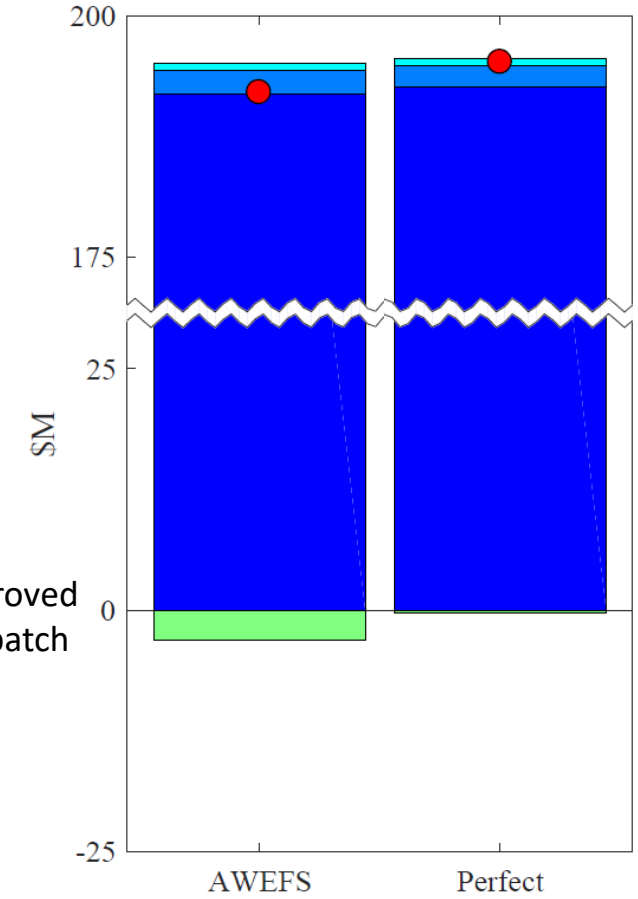
Wind farm w/ control + FCAS



Improved dispatch

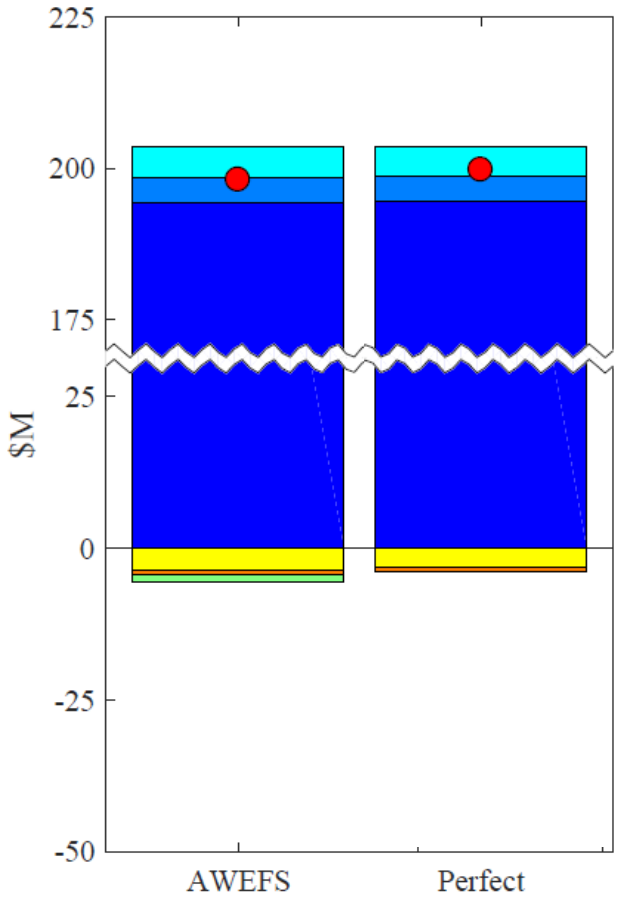
Some curtailment to offer FCAS

Wind farm w/ control + FCAS
+ improved short term forecasting



Improved dispatch

Wind farm w/ control + FCAS
+ improved short term forecasting
+ an optimally sized battery



More system services

Improved dispatch and less curtailment

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