

Thoughts on a Flexibility Index

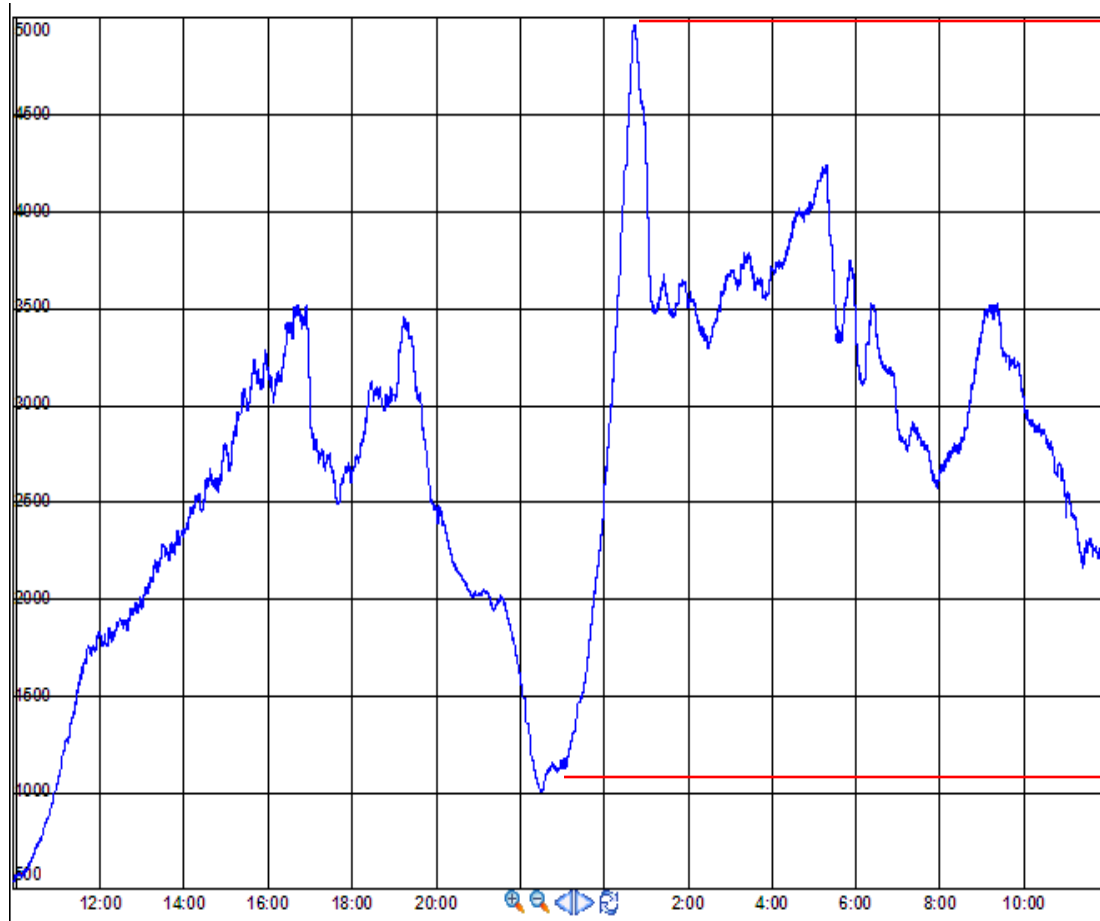
Mark O'Malley

IEA Wind Task on Wind Integration

Quebec City, October 15th 2010

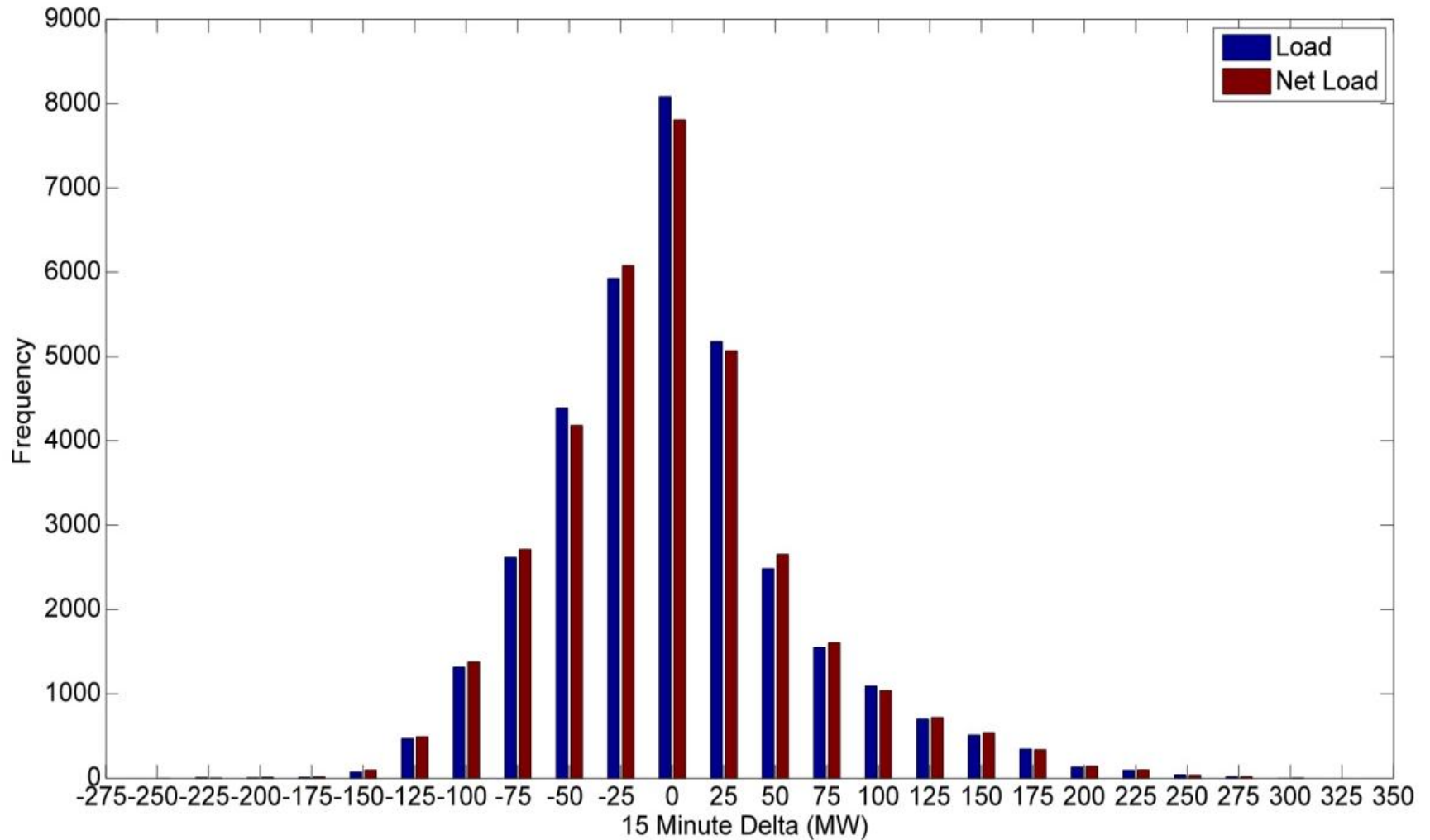


Wind Power Output (MW)

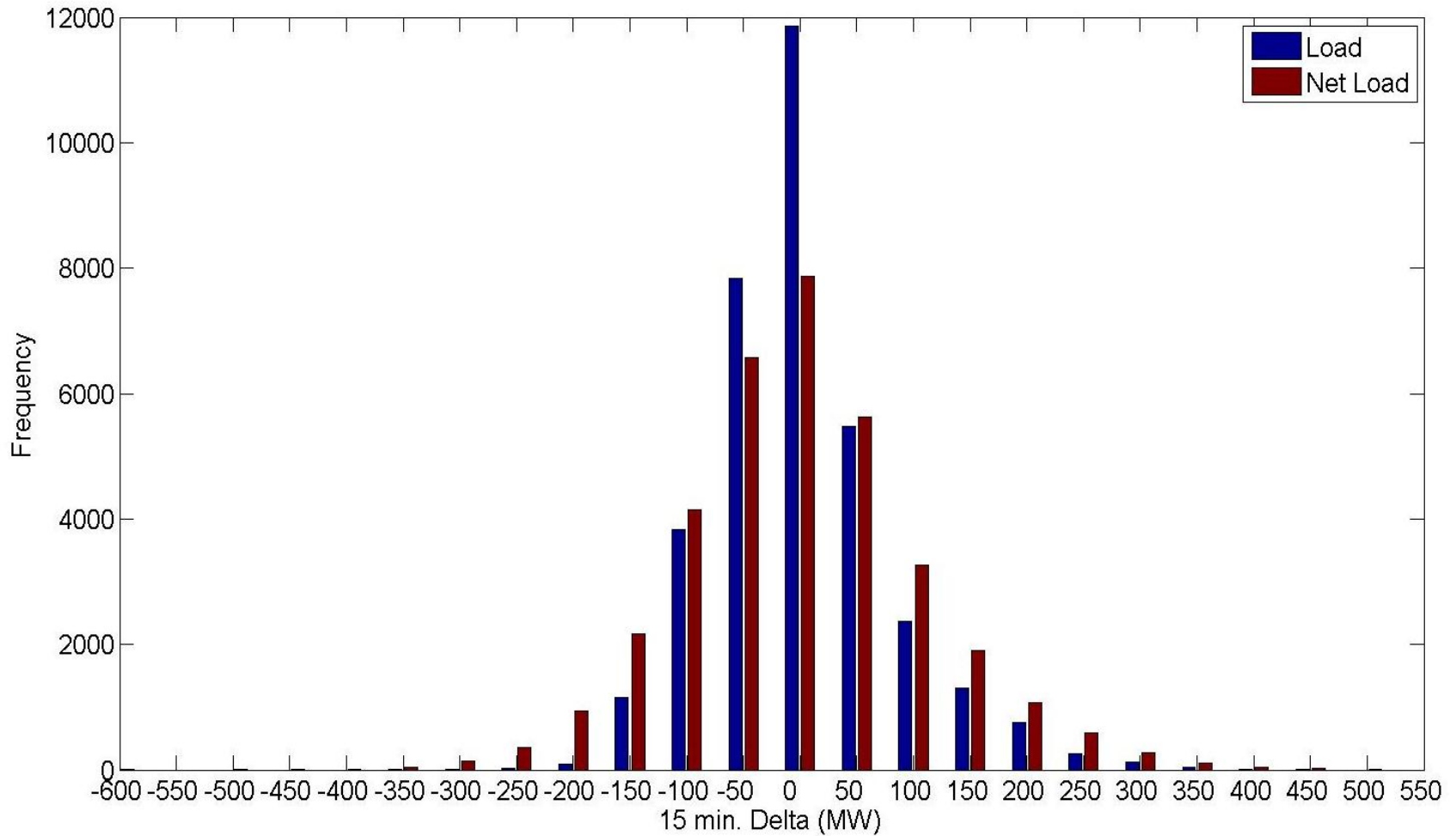


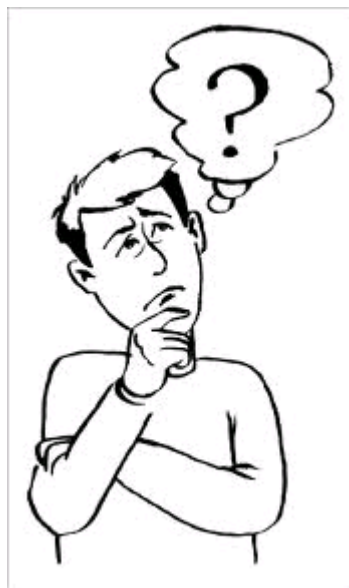
+3,039 MW in
1 hour

Ireland Today

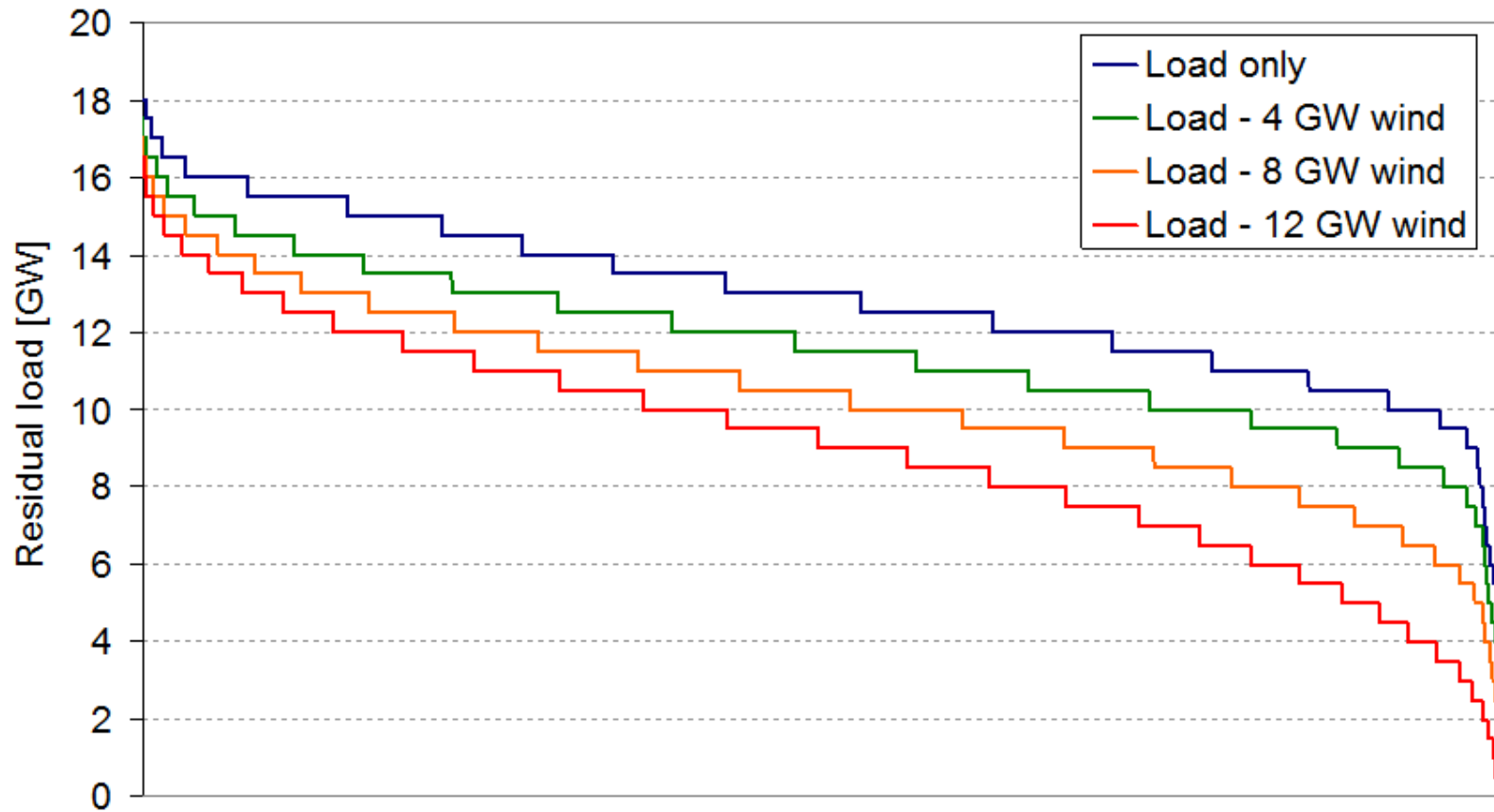


Ireland in 2020

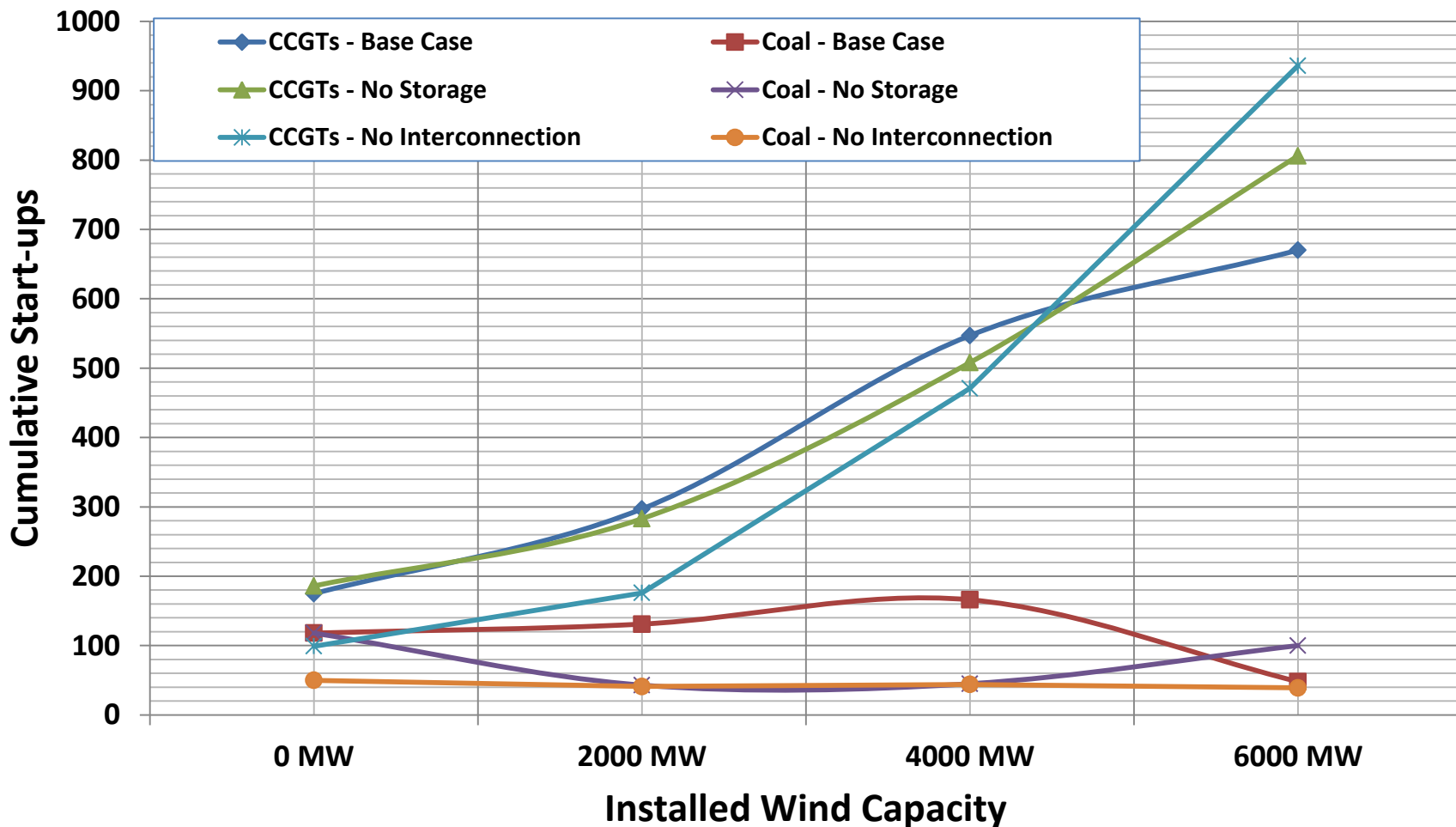




Do we need an index ?



Impact of Wind on Base-load Start-ups



Troy, N., Denny, E. and O'Malley, M.J. "Base load cycling on a system with significant wind penetration", *IEEE Trans. Power Syst.*, Vol. 25, pp. 1088 - 1097, 2010.

Is it possible to develop a robust index ?

Flexibility Paradigm

Sources

- DSM
- Electricity Storage
- VG
- Interconnection
- Conventional Generation

Physical

Facilitators

- Transmission Networks
- Fuel Storage

Sinks

- Load
- Solar
- Wind etc..

Planning

Institutional

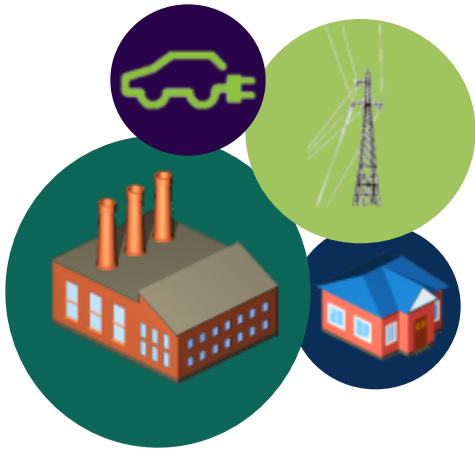
- Forecasting
- Market Resolution
- Gate Closure
- Balancing Area Size
- Grid Codes
- Unit Commitment

Operations

Economic

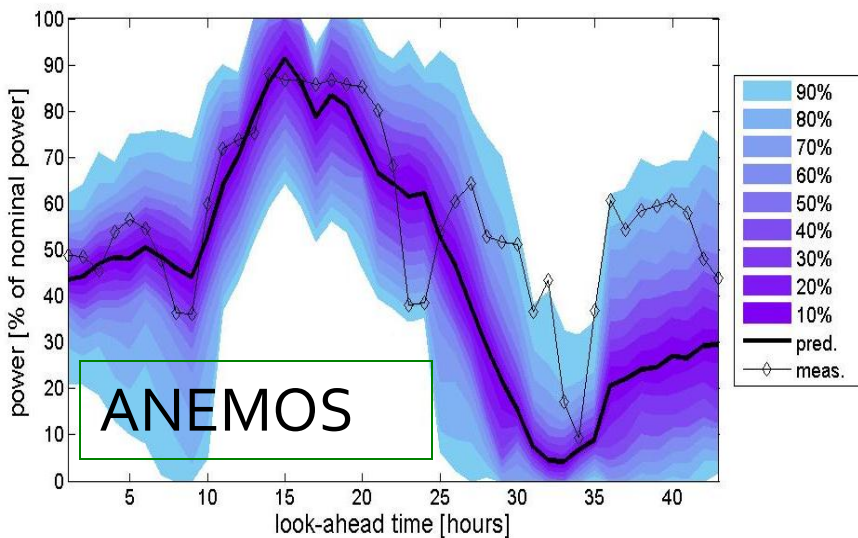
- Ancillary Services Markets
- Cycling Costs

Markets

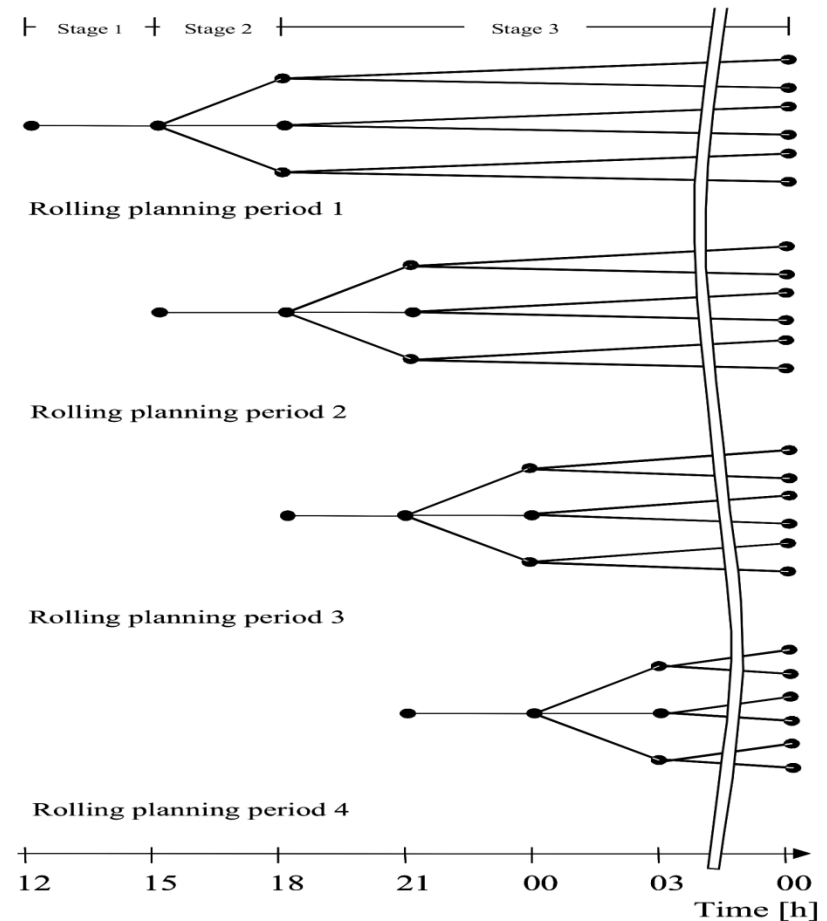




Wilmar: Stochastic Unit Commitment

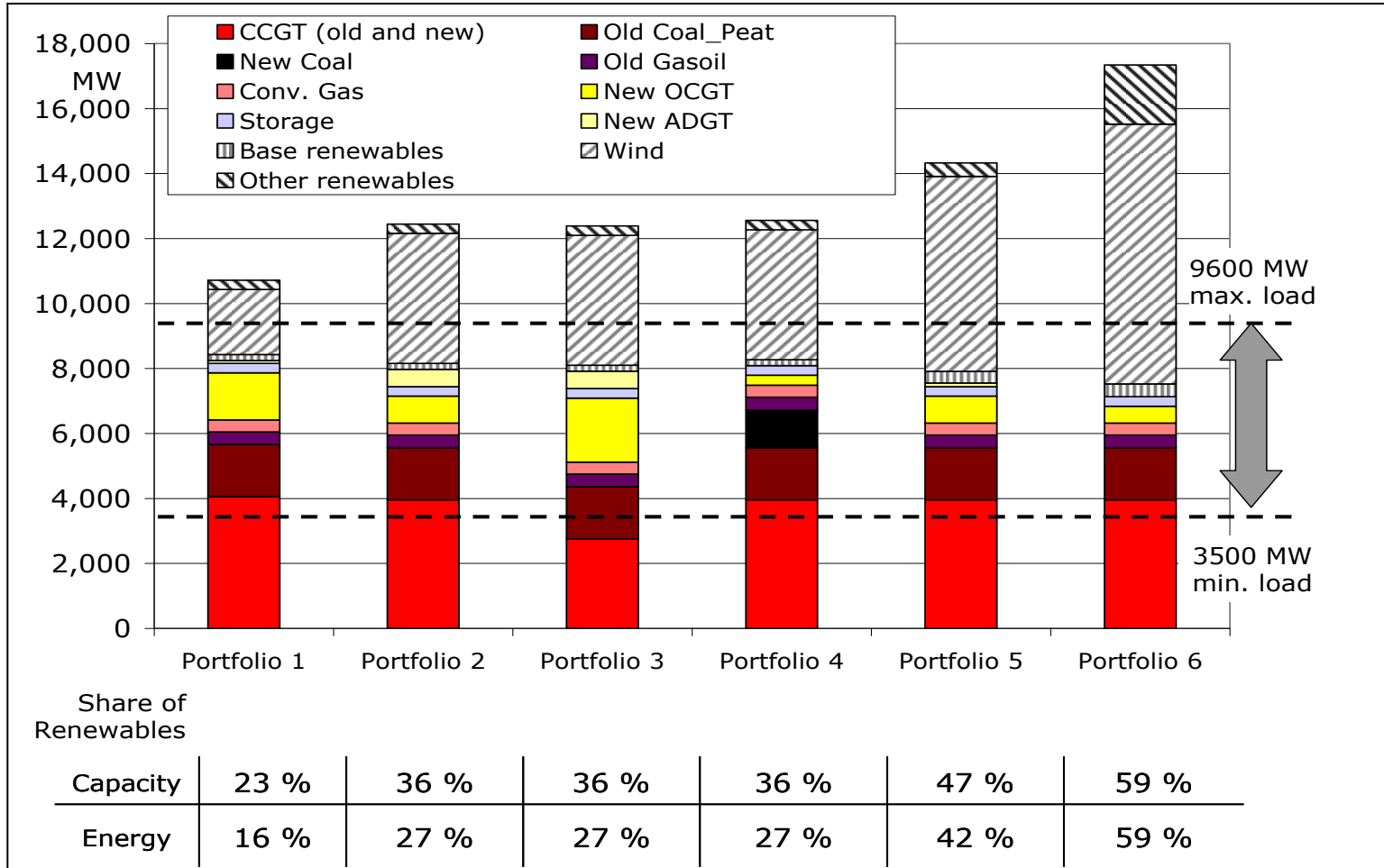


Meibom, P., Barth, R., Hasche, B., Brand, H., Weber, C. and O'Malley, M.J., "Stochastic optimisation model to study the operational impacts of high wind penetrations in Ireland", *IEEE Trans. Power Systems*, in press, 2010.

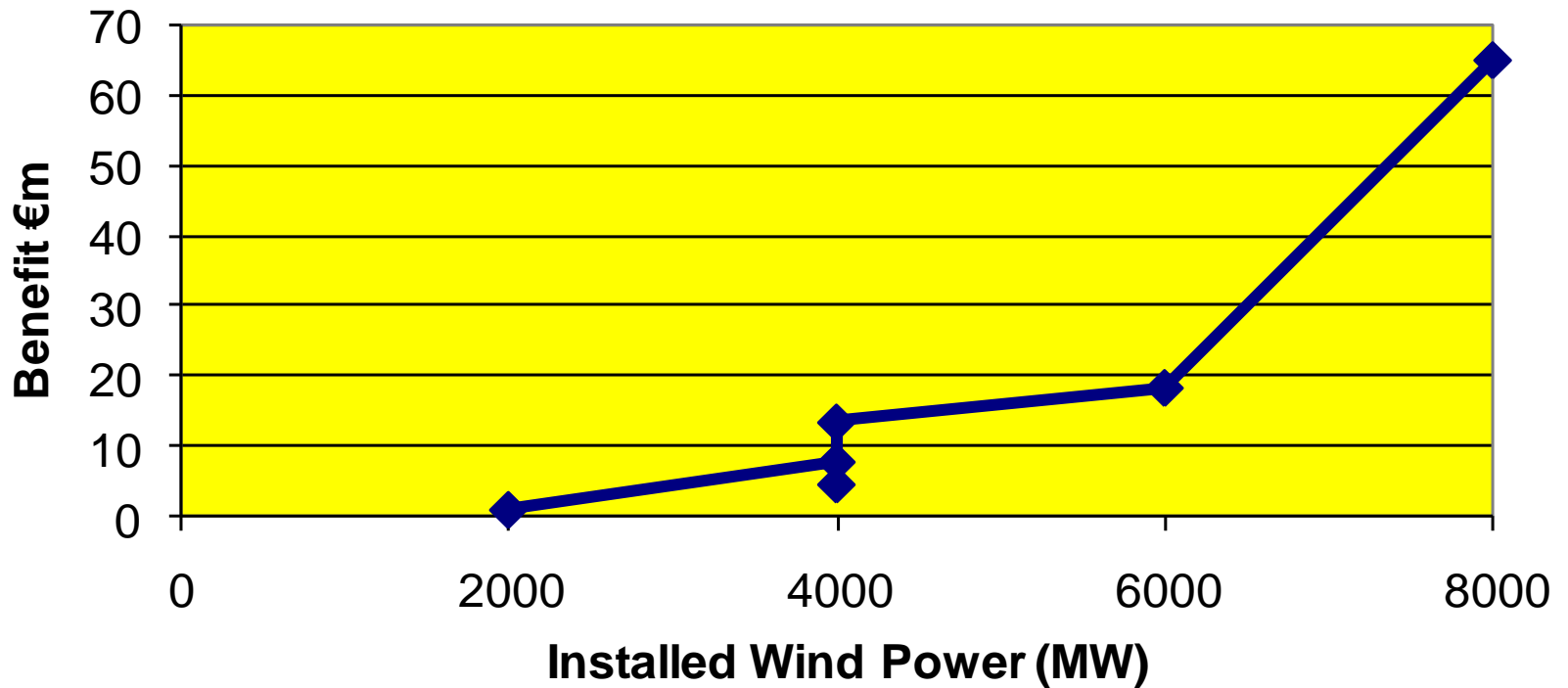




AIGS: Portfolios



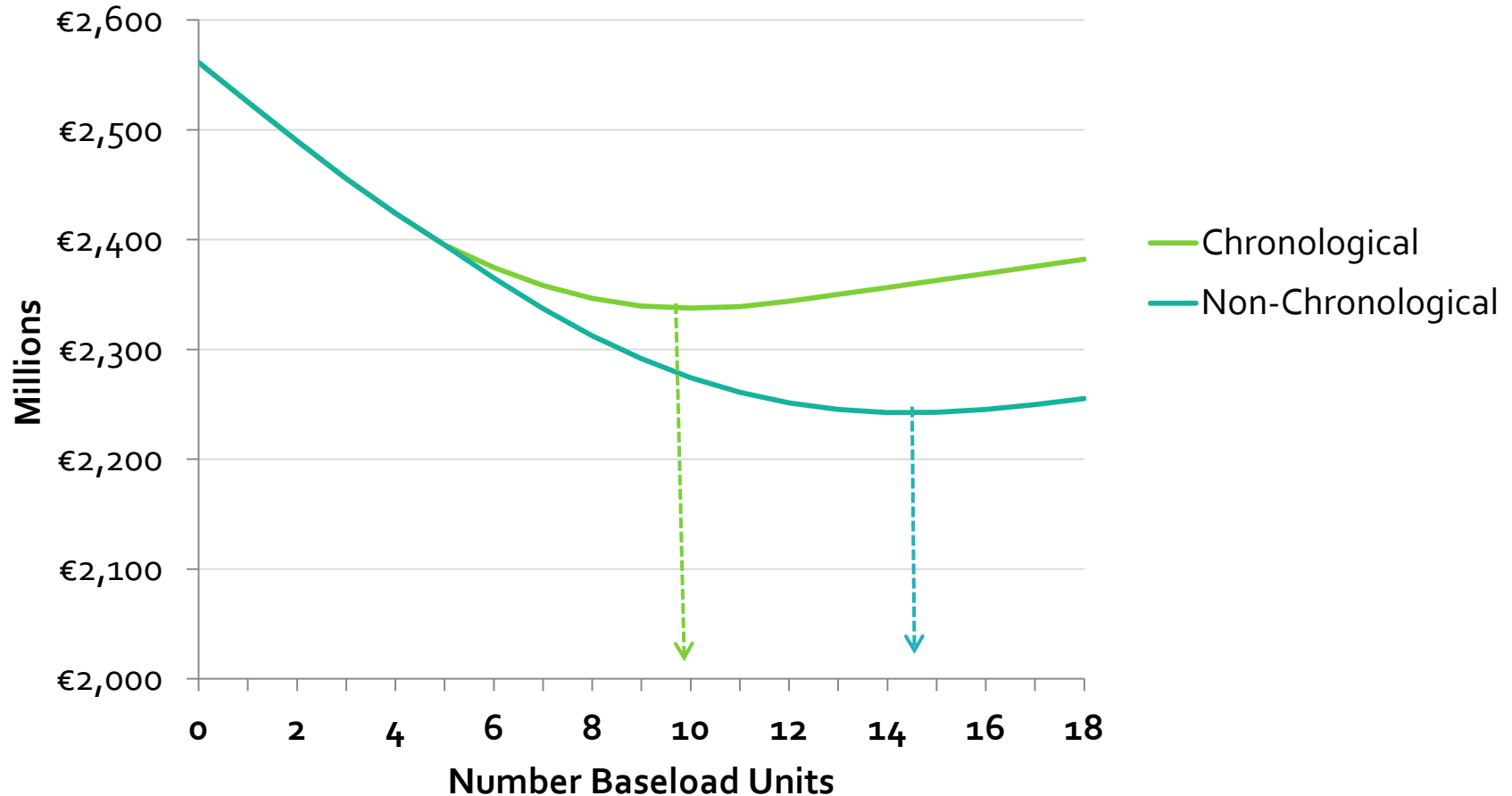
Benefit of Perfect Forecasting over Stochastic Model



How do you make it
computationally useful?

Portfolio optimisation

18



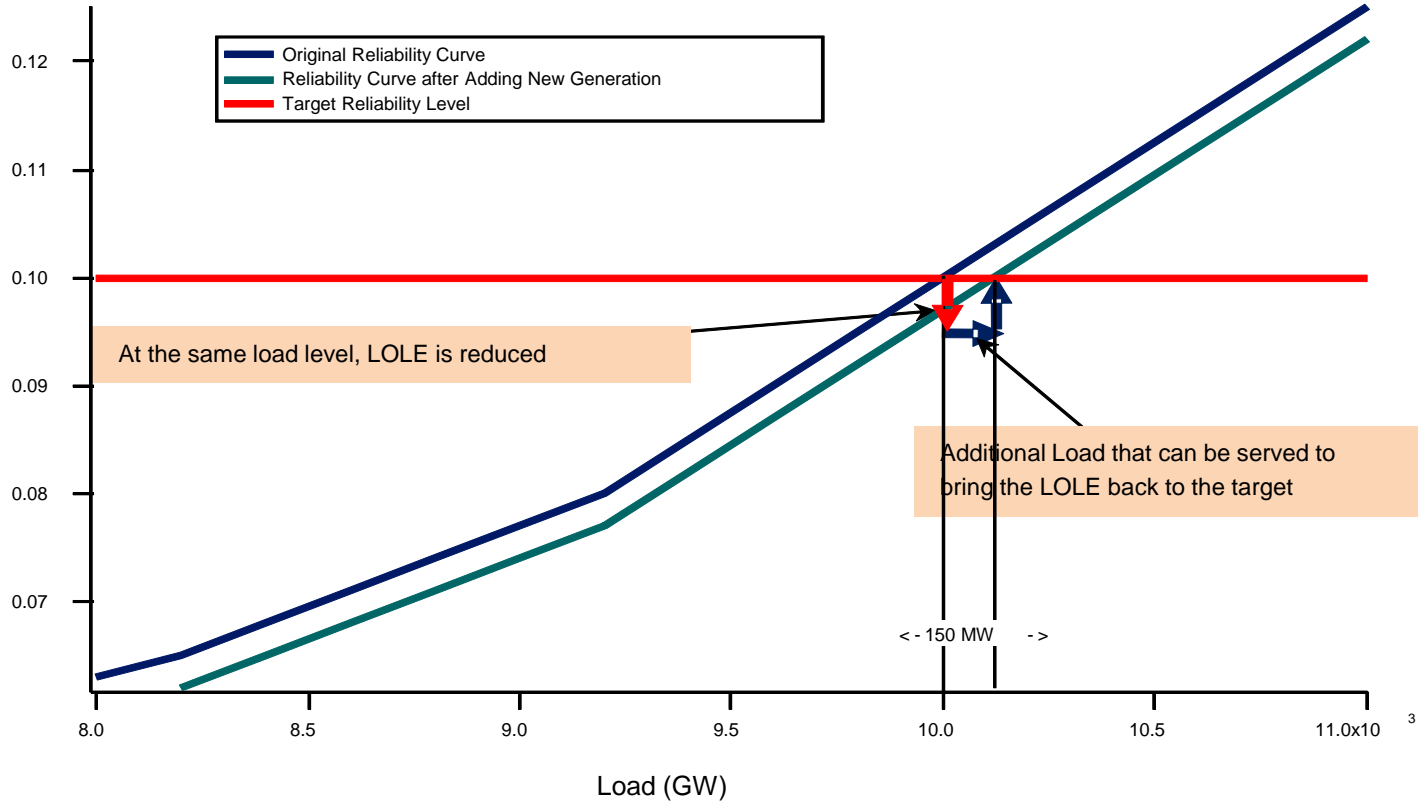
Doherty, R., Outhred, H. and O'Malley, M.J., "Establishing the role that wind generation may have in future generation portfolios", *IEEE Transactions on Power Systems*, Vol. 21, pp. 1415 – 1422, 2006.
Shortt, A. and M. O'Malley, "Impact of Variable Generation in Generation Resource Planning Models", *IEEE PES General Meeting*, Minneapolis, USA, July 2010.

Are there any metrics now ?

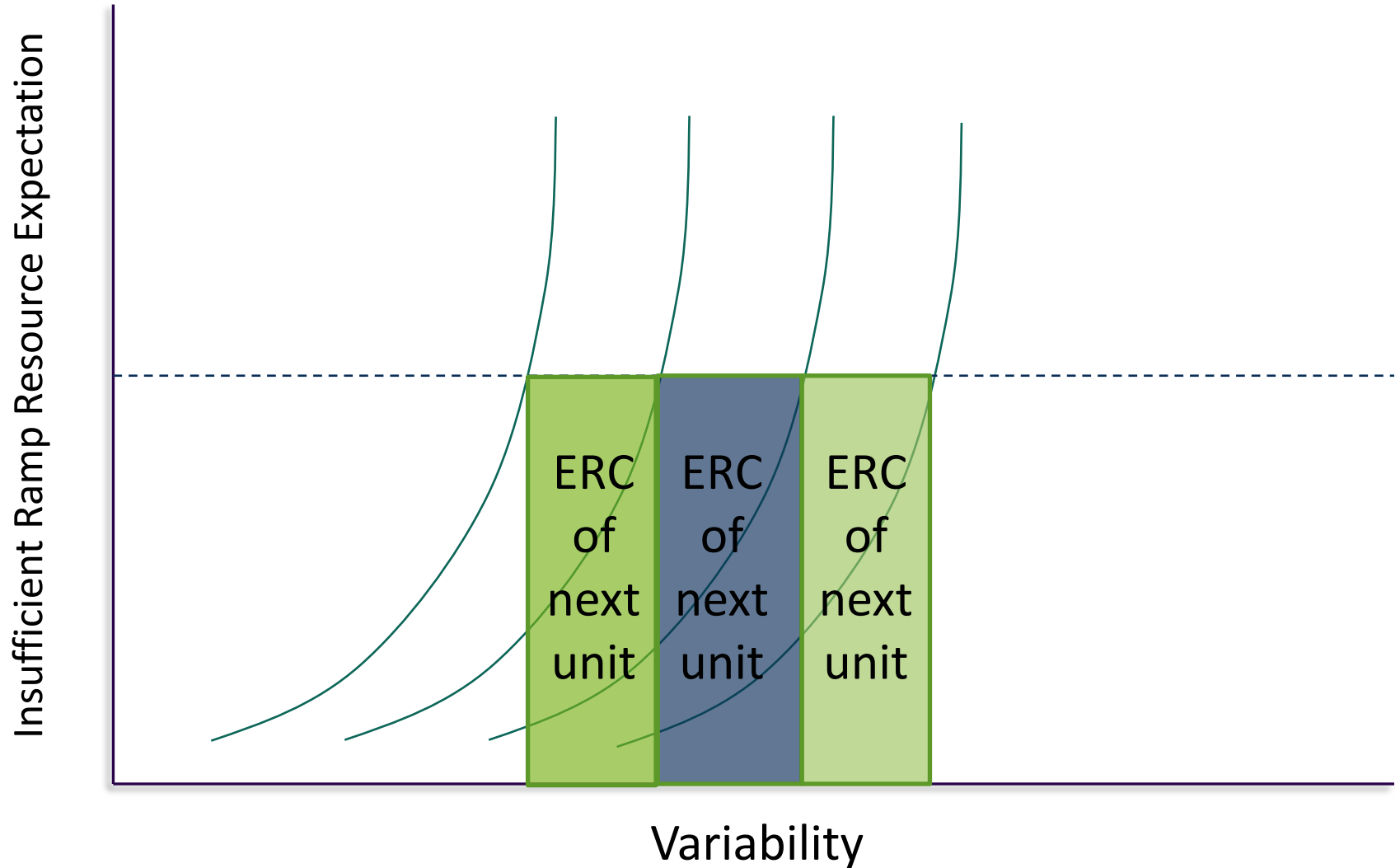
Effective Load Carrying Capability

20

Loss of Load Expectations
days/years

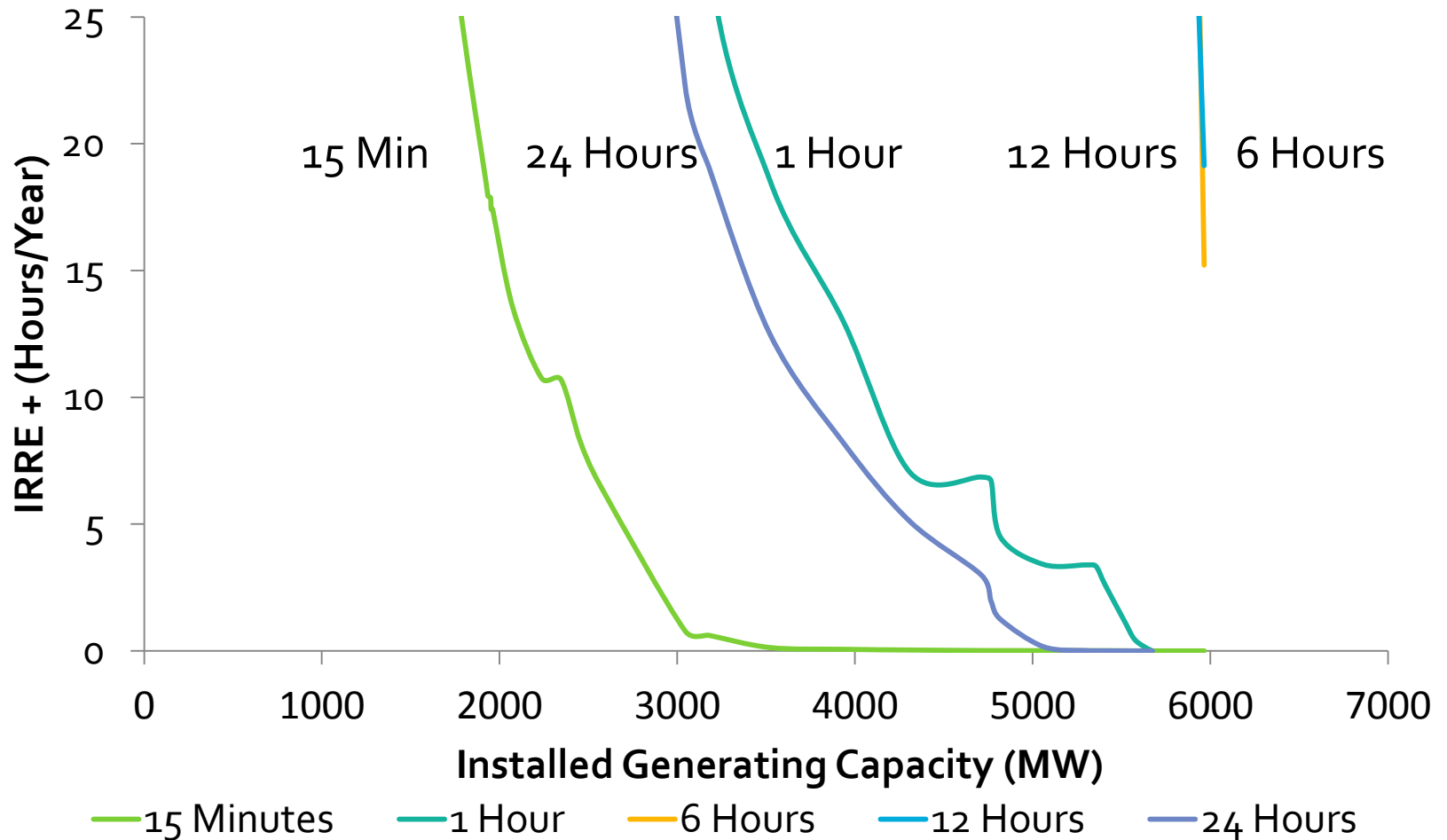


Effective Ramping Capability



A Flexibility metric ?

22



E. Lannoye, M. Milligan, J. Adams, A. Tuohy, H. Chandler, D. Flynn and M. O'Malley, "Integration of Variable Generation: Capacity Value and Evaluation of Flexibility", *IEEE PES General Meeting*, Minneapolis, USA, July 2010.



Is there a killer application ?



happytoast

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