

INTRODUCTION

- Increasing renewable penetration impacts on system flexibility
- Demand response (DR) can enhance system flexibility by providing various system services such as frequency regulation, contingency reserves and reduction of net load variability

Objective(s):

- Investigate modes of DR participation in system operation
- Identify challenges for DR utilisation
- Propose solutions to overcome DR utilisation challenges

METHODOLOGY

- Detailed thermodynamic models for flexible loads developed
- Load models integrated into system models (single bus and network models of Irish system)

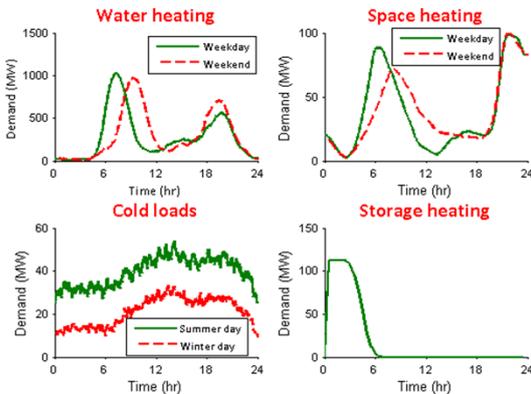


Fig. 1 Load curves for electricity end uses

RESULTS

Provision of system reserves

- DR can provide effective frequency regulation owing to fast response times
- DR variability affects its ability to improve the system dynamic performance as shown for six different system configurations (Fig. 2)

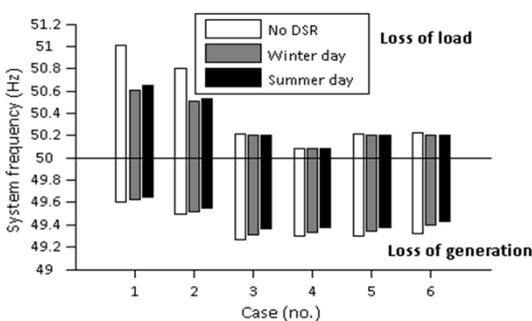


Fig. 2 Impact of DR variability on reserve provision by cold loads

Reduction of net load variability

- Flexible load can be shaped using both a centralised and a decentralised approach
- Utilising DR to reduce net load variability can lessen conventional plant ramping and start-up/shut down requirements
- Flexible load shifting over a number of days can result in utilisation of higher amounts of renewable energy

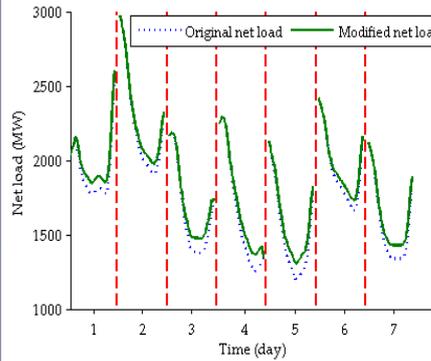


Fig. 3 Net load variability reduction using storage heaters

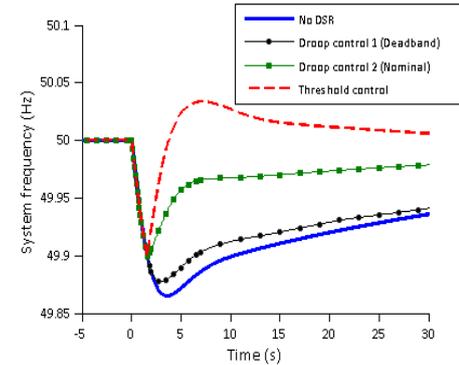


Fig. 4 DR over responsiveness

DR challenges

- Decentralised triggering and recovery strategies can lead to system over-responsiveness due to DR variability
- Active power DR responses may also lead to reactive power imbalances
- Appliance turn off for DR provision leads to load coincidence (Fig. 5)

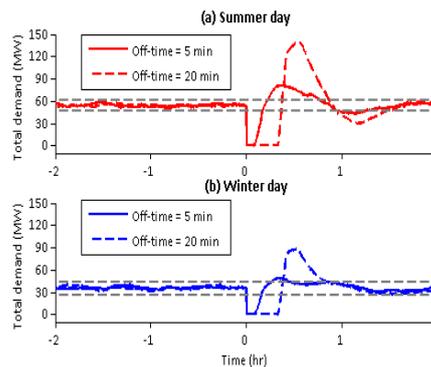


Fig. 5 Load coincidence following a DR event

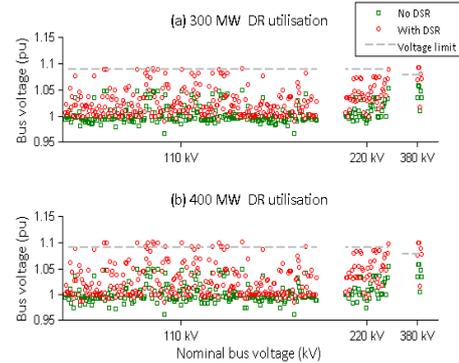


Fig. 6 Effect of DR on system voltages

CONCLUSIONS

- DR can provide system services to facilitate renewables integration
- Demand resource variation and subsequent load co-incidence must be recognised in its utilisation
- Utilisation of DR presents challenges such as reactive power imbalance and over responsiveness which must be addressed

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