Demand as a Source of Contingency Reserve

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Introduction

Increasing share of renewable energy sources warrants a greater role for demand side participation in providing reserves. In comparison with conventional generation, reserves provided from demand may be faster, cheaper and more reliable. Utilization of demand for this purpose requires careful consideration of its dynamic nature, triggering mechanisms and thresholds, recovery and load diversity.

Objectives

In this work, the following questions are being addressed

- Impact of demand resource variability on system flexibility?
- Infrastructure requirements to enable flexible load response?
- Suitable demand resource trigger points?
- How can flexible demand be restored with minimum disturbance to the system ?
- Will individual appliance deferral impact subsequent energy requirements?
- How will load diversity be affected?

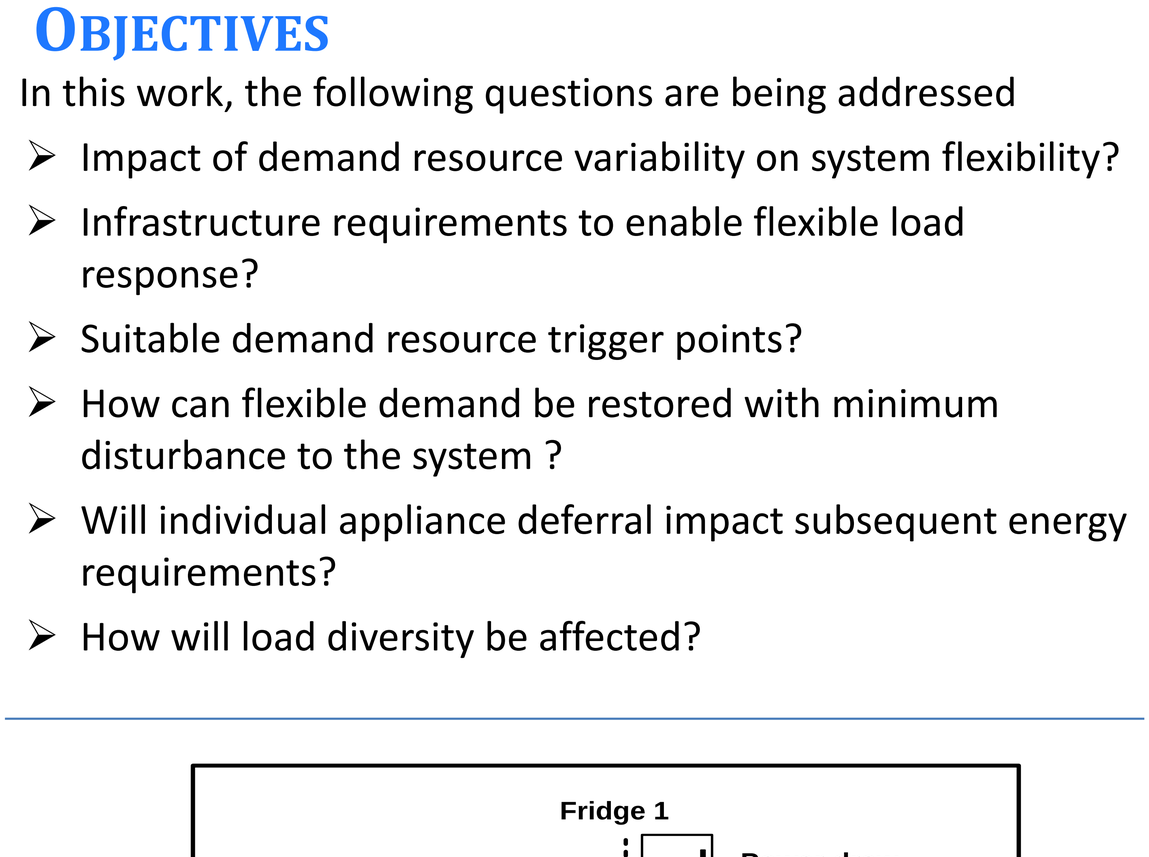

Fig 1. Estimation of demand resource

Methodology

- Detailed thermodynamic models for cold loads developed.
- Load models were integrated into a single bus model of Irish power system.
- Control strategies for demand resource restoration, and impact of energy deferral were studied and quantified.

Results

On 2012 Irish power system, flexible cold loads with 100% penetration and loss of largest infeed is simulated (Fig.2)

Demand for most flexible loads varies as a function of time of day and time year, therefore resource is variable (Fig. 2)

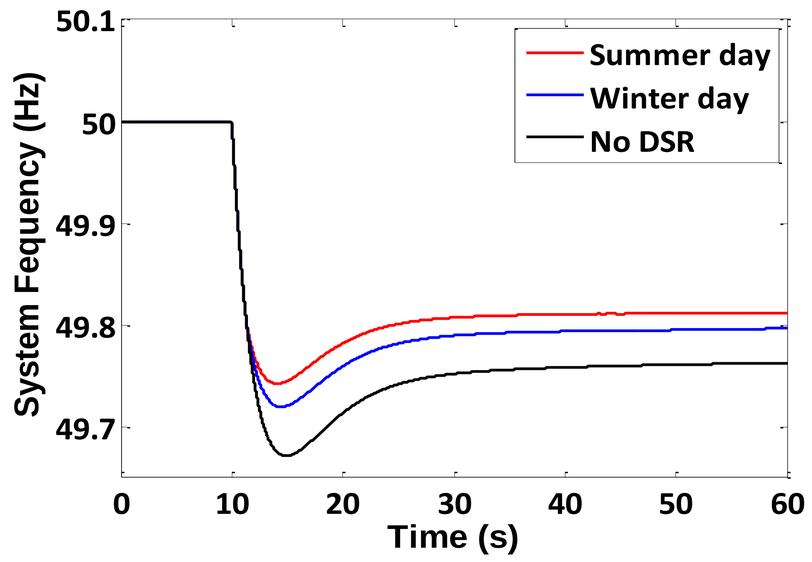

Fig 2. Seasonal variation of demand resource

Differed load recovered in 3 ways:

- simultaneous appliance recovery following a contingency,
- fixed time before appliance can recover
- changing thermostat setpoints in proportion to system frequency (Fig. 3)

Deferring energy leads to appliance coincidence and short term higher power draw requirements from flexible appliances (Fig. 4)

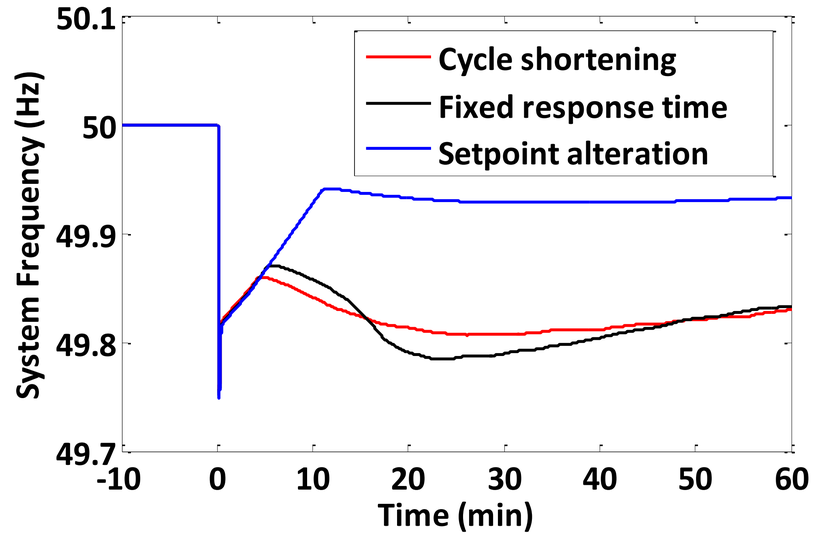

Fig 3. Comparison of load recovery strategies

Conclusions

- Using demand as contingency reserve improves system performance, demand resource varies seasonally.
- Demand resource once utilized requires an energy payback period.

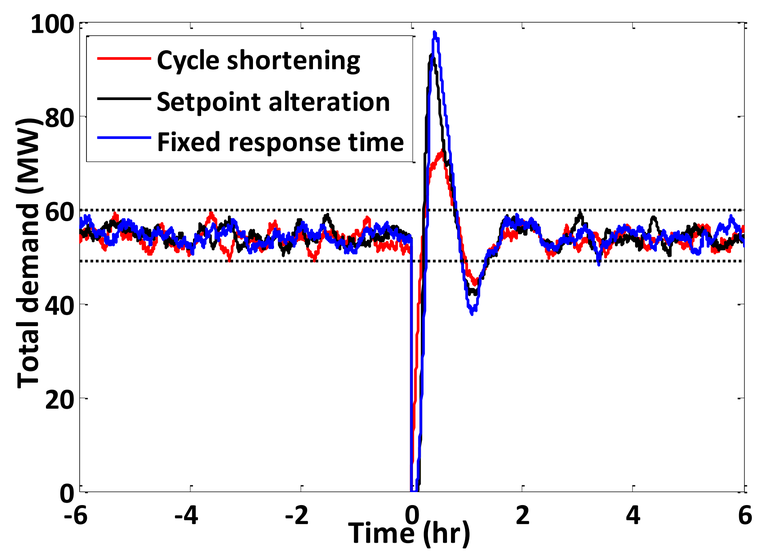

Fig 4. Post contingency load coincidence

- Demand resource trigger frequency settings and recovery strategies vary with the type of resource, nature of service provided and system parameters.

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