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Our Mission

We are a dynamic, visionary and ambitious company committed to improving the way electricity is supplied and consumed, reducing greenhouse gas emissions and the overall cost of electricity supply.

Introducing Dynamic Demand

Andrew Howe, CEO *RLtec*

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Contents

1. Grid – what is energy balancing and response
2. Benefits of features of dynamic demand load provided response
3. What is and how does dynamic demand work
4. Status in the UK
5. Questions

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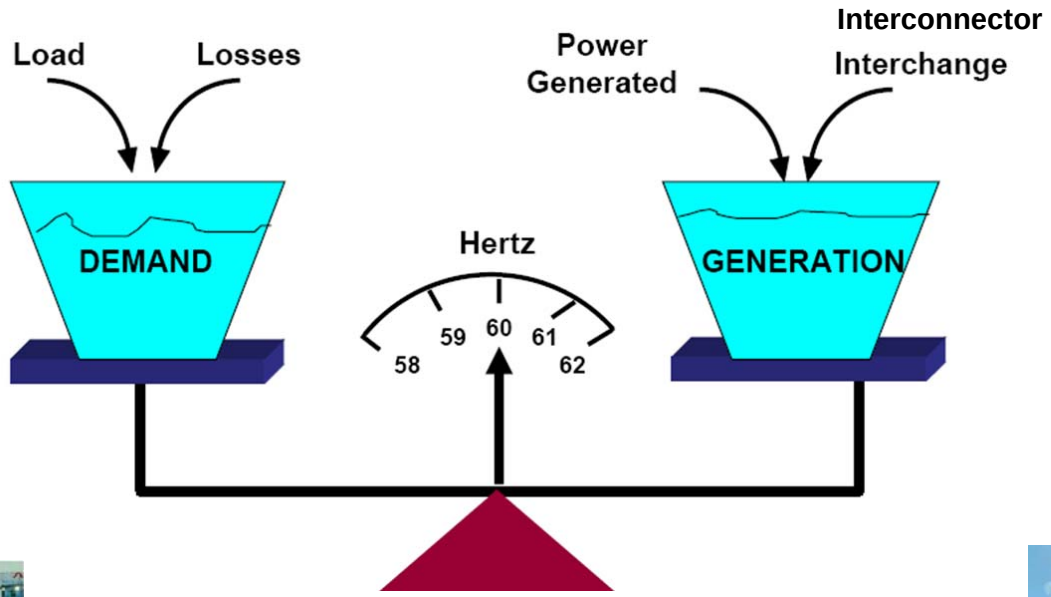
Energy Balancing Service to Electricity Grids

- **Energy *generated* must match *demand***
  - Second to second basis
  - No energy storage on grid



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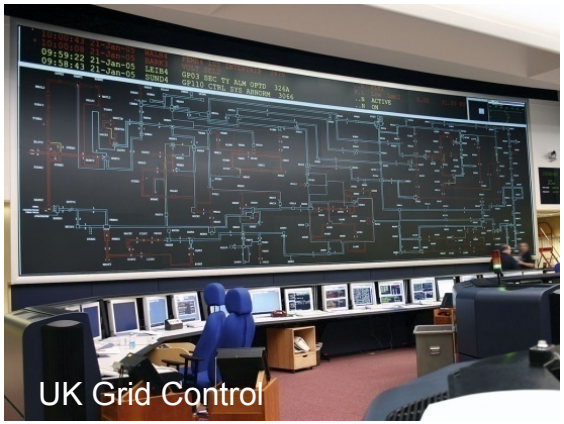
Dynamic Generation = Primary Response

- **Response provides *insurance cover* *e.g. station fails***

- **Power stations provide response**
  - "Throttle control" – second to second output change from station
  - Lower thermal efficiency at reduced output MW capacity
  - UK Government estimate 2m CO_2 tonnes/year wasted in UK

- **More than 70% of UK balancing generation is carbon-emitting**


UK Grid Control

- **Paradigm change**

  Loads can substitute for generation station response

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Dynamic Demand as a Balancing Service

- **Loads could provide a balancing service**
  - Carbonless
  - No running costs, therefore independent of fuel cost
  - Near instant autonomous reaction, fault tolerant
  - No transmission and distribution losses (so ~10% extra)

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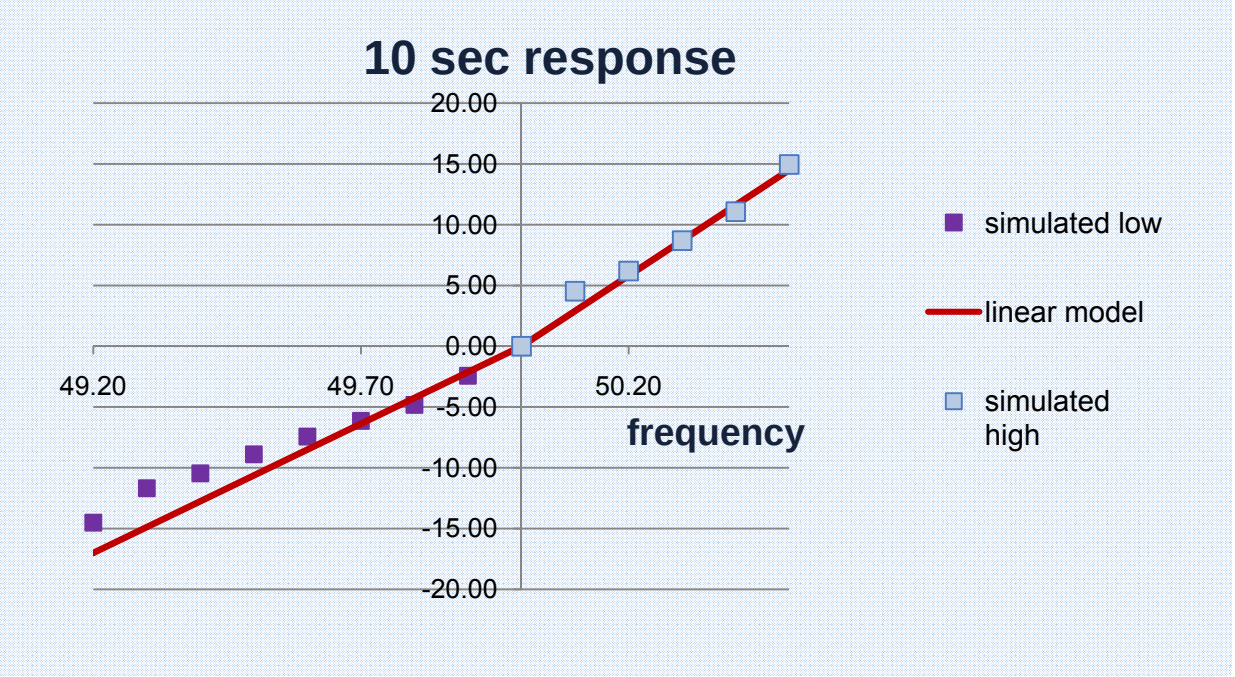
Dynamic Demand Features

- **Load follows frequency**
  - Bi-directional (i.e. both up and down) consumption changes
- **Provides modulating proportional response**
  - Virtual power station substituting for throttle control generation



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RLtec Dynamic Demand Features

- **Operates within pre-existing load control parameters**
  - Makes a recommendation to switch based on grid frequency history
- **Hence no discernable impact on load performance**
  - kWh neutral
  - No impact on load owner (e.g. safe food storage temperature limits)
- **Avoids synchronisation**
  - Maximum randomisation of load population's internal energy states
- **Uses a population without communications**
  - Loads constantly shifting switch points to spread burden evenly

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Grid Service - Response Services Summary

	Generator	Static Demand	Dynamic demand
Increases generation margin	x	x	✓
Zero carbon emissions	x	?	✓
Modulating response	✓	x	✓
Large supply base	x	?	✓
Location independence	x	X	✓
Price stability (fuel cost)	x	✓	✓
Long term pricing	x	✓	✓

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Dynamic Demand Technology - Benefits

- **Security of supply**
  - Autonomous and fault tolerant
  - Frees up generation margin – no de-load
- **Reduces UK's carbon emissions**
  - UK Government estimate 2m tonnes savings
- **Reduces energy costs**
  - Balancing costs reduced, firm future pricing, large volumes
- **Facilitates renewable generation integration**
  - Wind variable output requires more response volume

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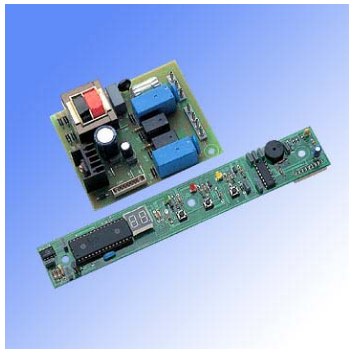
How does it work?



- **Monitors grid condition**
  - Grid frequency measurement, therefore **no communications**
- **Recommendation to load to switch**
  - Stored energy (e.g. temperature) & grid condition criteria
  - NO change to normal operational limits
- **Implementation in loads**
  - Software within existing electronic load controller
  - Alternatively, replacement with intelligent thermostat / motor
- **POPULATION BEHAVIOUR**
  - One device does not offer a service!

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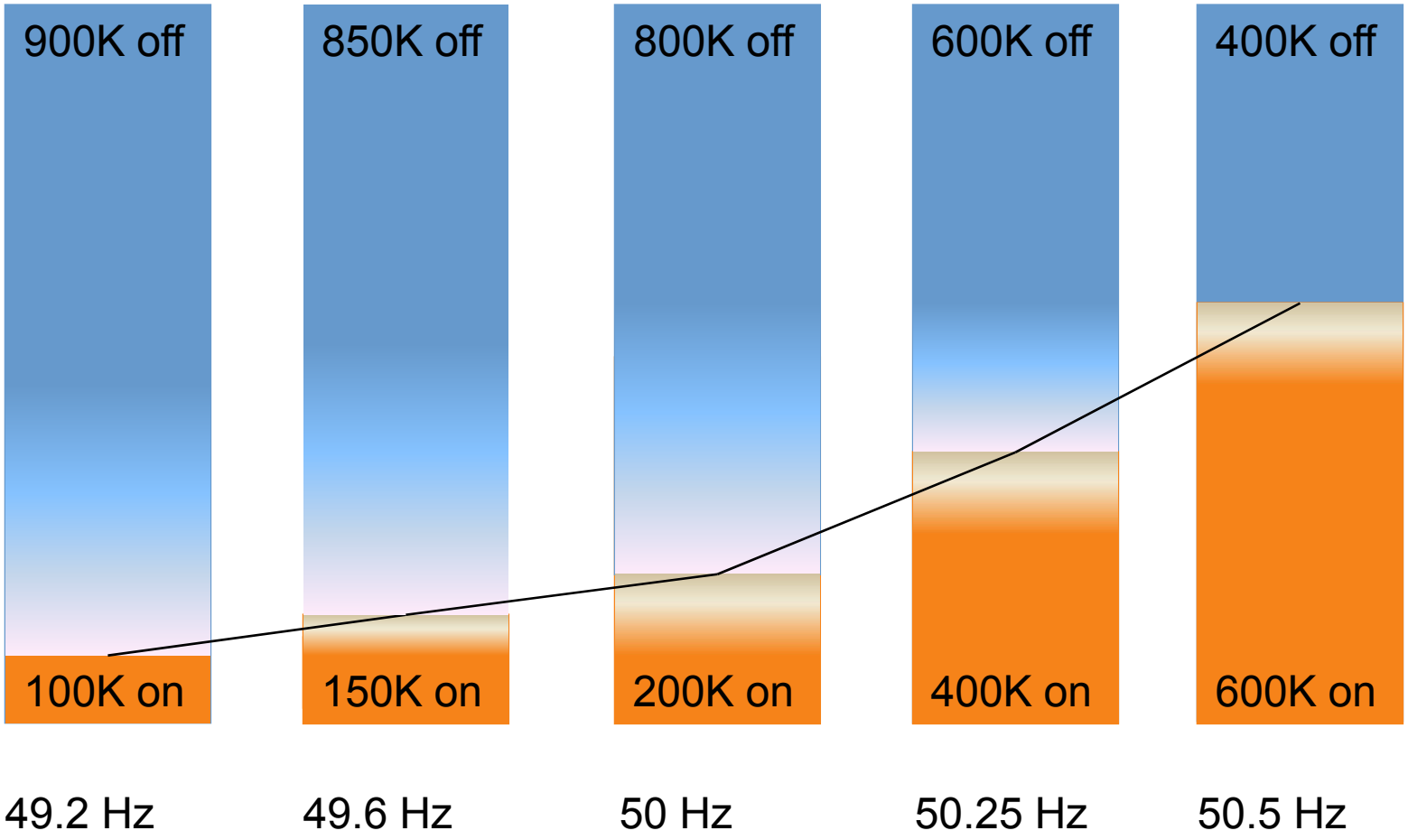
Population Behaviour at Different Grid Frequencies

1m Fridges @ 100W and a 20% duty cycle



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Trial set up

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Trial Results

- **Population 100 A+ fridges**
  - 200 compressors
- **Grid frequency profiles**
  - Supplied by National Grid – based on generator response testing
- **Test equipment**
  - The grid = 16kW frequency inverter, 1mHz resolution
  - Metering = PM3000 power meter

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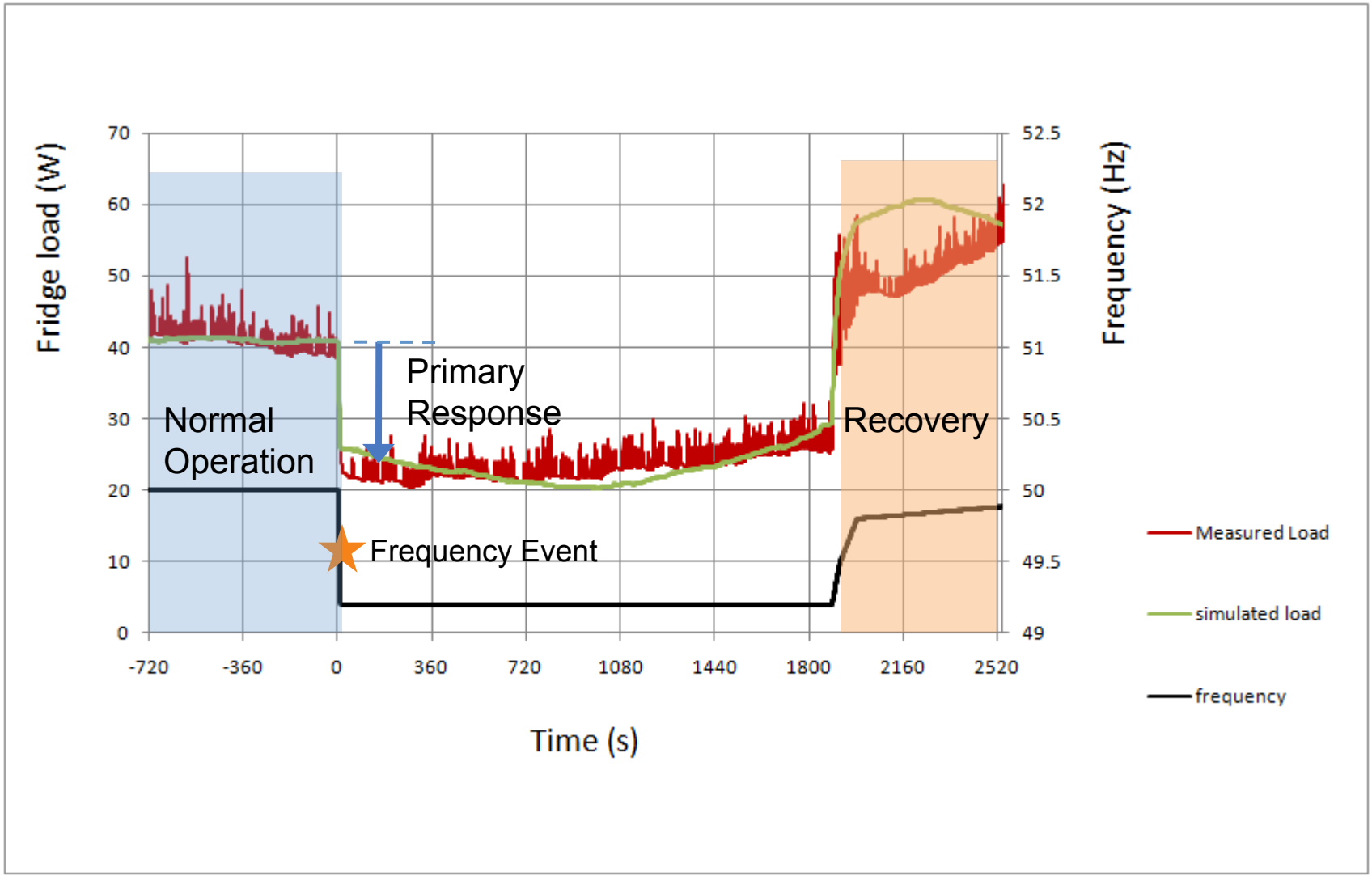
Low Response e.g. Power Station Fails



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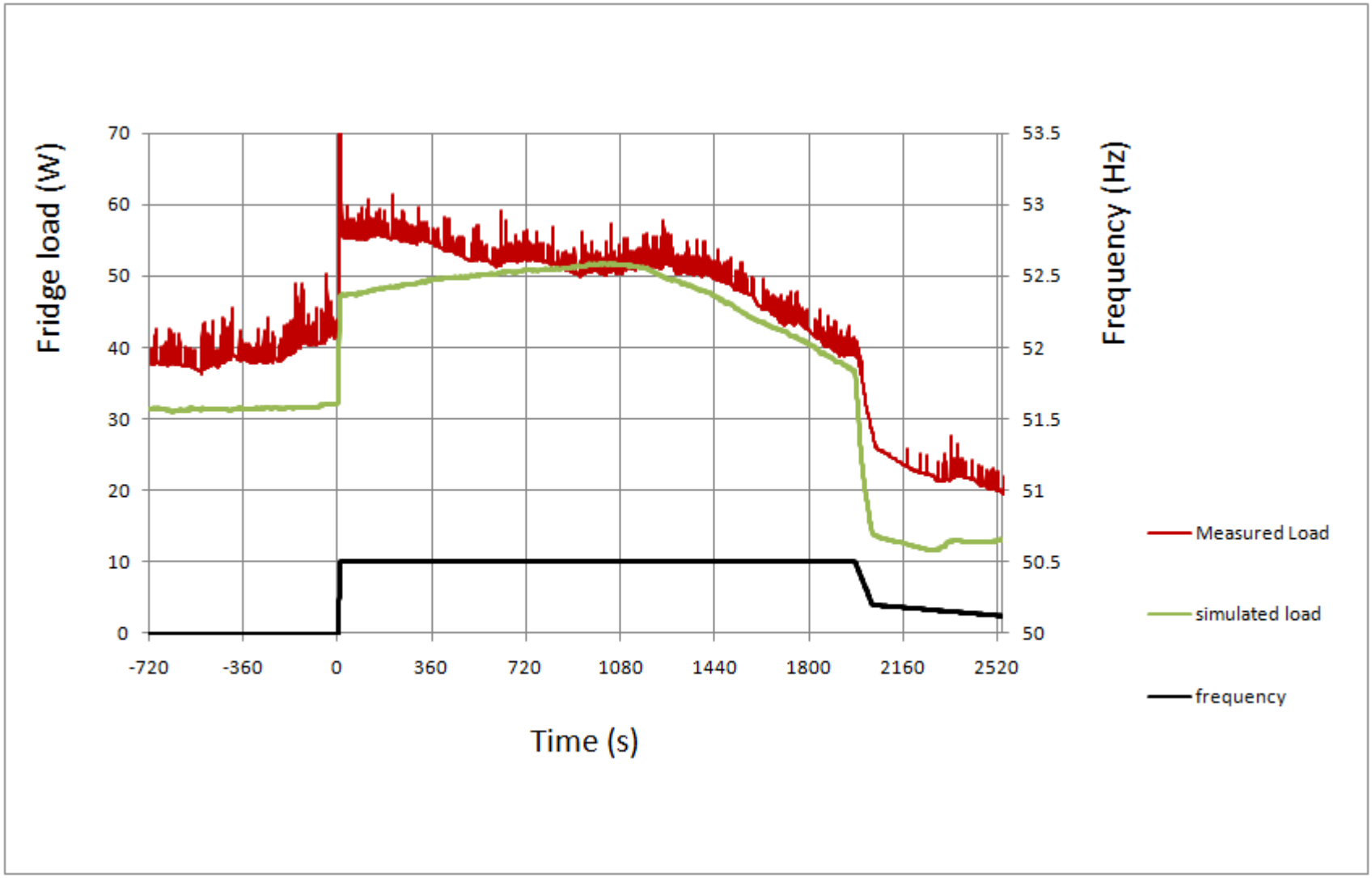
High Response – Excess Generation



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Next Steps

- **Field trial 3000 fridges**
  - Domestic trial to determine lifetime carbon savings per fridge
  - Leads to carbon based revenues under UK CERT legislation
  - Trial value 130,000 tonnes CERT carbon (>$3.5m)

- **Commercial loads**
  - Order from Sainsbury (top five retailer) for commercial trial in some retail properties
  - Based on modifying building management controller software
  - Loads range 5 to 200kW, across their estate of 500 properties

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Customer Perspective – National Grid

- **Reviewing the "Firm Frequency Response Tender" framework**
  - Currently addresses static load service (FCDM) and dynamic generator services
  - Currently being updated to incorporate dynamic load side services

- **Both nuclear and renewable integration planning started**
  - 1.8GW largest generation station
  - 35GW renewables (mainly wind) capacity by 2020 (Government target)

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UK Government's perspective

- **Consulting on 2020 Renewables Strategy**
  - Expectation of "white paper" next year
- **Impact on balancing**
  - $2.4b market in UK short term balancing

Table 7.12 Short term balancing costs

Scenario	Wind output (% total)	Balancing costs (£/MWh)
Conventional	3.1%	0.7
Lower	27.1%	4.5
Middle	32.7%	5.3
Higher	42.0%	6.5

Source: SKM Report on Growth Scenarios for UK Renewables Generation, published by BERR June 2008

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Benefits to Governments

DEPARTMENT FOR BUSINESS
ENTERPRISE & REGULATORY REFORM

DYNAMIC DEMAND

Government Response to Clause 18 of the Climate Change and Sustainable Energy Act

AUGUST 2007

6. Conclusions and proposals for a way forward.

This report identifies encouraging evidence as to the potential of dynamic demand to increase the efficient operation of generation, reduce the costs of operating the electricity grid and reduce the emissions of greenhouse gasses. The report considers potential barriers to the uptake of the technology and reviews possible support measures. The Secretary of State therefore supports the development of dynamic control technology in principle, subject to conformation of the technology's potential by the comprehensive analysis currently in hand.

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Questions?

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27th May 2008 – 40 year event in UK