

Dynamic Demand in Refrigeration

There are many electrical appliances, such as refrigerators, whose energy supply is not time critical: they need energy to operate, but as long as limits are met, do not care precisely when that energy is delivered. Other time-flexible appliances include air conditioners, water heaters and pumps. These appliances are ideally suited to Dynamic Demand, which automatically modifies their electricity demand, in response to the continuous, second-by-second changes in generated supply.

The response from RLtec's dynamic demand technologies is instantaneous – generally less than two seconds – and is significantly faster than generator set response. The technology is also bi-directional and can both increase or decrease consumption.

If many millions of appliances were fitted with RLtec's patented technology it would provide a form of distributed battery, or virtual power station, in which electricity can be stored and retrieved in order to aid the balance of supply and demand on the grid. Early research¹ shows that these appliances, taken together, have the potential for a large dynamic demand. Fitted with the dynamic demand technology the units in this virtual power station would create an automatic balancing service, reducing demand when there is a supply shortage and vice versa. Acting together, appliances fitted with the technology can react extremely quickly and can, in principle, reduce demand more rapidly than a traditional spinning reserve generator could increase its supply.

This has the potential to reduce imbalances in the electricity grid and provide a more carbon-efficient solution than traditional spinning reserve. They can also create the additional stability that may be required when a large amount of renewable energy with variable output is connected.

The following demonstrates how Dynamic Demand would work in refrigeration, as the most common example of time-flexible energy consumption.

Refrigeration

A typical domestic fridge motor takes 100W when running. During normal fridge operation, the motor's electricity consumption follows an on/off pattern as temperature oscillates between five and eight degrees centigrade. A typical fridge spends 25 per cent of the time cooling, when the motor is on, and 75 per cent warming up when the motor is off. The temperature, or 'coolth', of the fridge represents energy storage. By modifying the timing of the motor in response to grid frequency (changes in the balance between supply and demand), it is possible to provide a response to changing supply from generating plant, without loss of performance by the fridge itself.

¹ Research carried out by the Centre for Renewable Energy Systems Technology (CREST) at Loughborough University and others, and reported in a recent IEEE paper, Stabilisation of Grid frequency Through Dynamic Demand Control, by Joe A Short, David G Infield, and Leon L Freris, published in IEEE Transactions on Power Systems, Vol 22, no3, August 2007.

Refrigeration is an attractive candidate for Dynamic Demand, as overall cost and carbon savings will be significant. It is responsible for a significant amount of electricity consumption: supermarkets alone spend approximately 50 per cent of their electricity consumption on keeping products cold. The attraction of refrigeration for Dynamic Demand also lies in the fact that fridges are connected to the grid 24/7.

Dynamic Demand in refrigeration has the potential to reduce reserve electricity generation as follows:

- More than three million domestic fridges are sold each year in the UK, representing more than 35 megawatts of response. In other words, if fitted with Dynamic Demand technology they would reduce the amount of reserve electricity generation by 35 megawatts.
- Thirty million domestic fridges represent 350 megawatts of response, which is the equivalent of an entire power plant running inefficiently solely to provide reserve supply. Dynamic Demand would make this plant obsolete.
- The refrigeration units in a supermarket chain, represents a response of 7.5 megawatts. Eliminating this generating capacity from the grid would reduce CO₂ emissions by 15,000 tons a year.

To use Dynamic Demand, white goods manufacturers implement a Dynamic Demand control unit containing RLtec's technology in new refrigerators with electronic control although the technology can also be fitted into appliances without electronic control units. The cost of implementation is low, depending on the existing electronics in the fridge, which makes it a cost-effective option for saving domestic carbon emissions.