

## **Demand Response White Paper: Integrated Intelligent Lighting Controls**

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Source: National Geographic Stock

Demand Response is a means by which demand on an electrical distribution network can be dynamically managed to meet movements in supply. It has been described as the “Killer App” of the smart grid, in that it uses smart grid technology to provide a service with financial benefits for both end users and electrical network operators.

National Grid is the UK’s System Operator (SO). It is charged with purchasing “Balancing Services” in order to balance demand and supply, and ensure the security and quality of electricity supply across the UK’s Transmission System.

Demand Response is one of many mechanisms National Grid has to manage demand on the transmission network at short notice (less than 4 hours). National Grid uses this service in instances where response to the deficit can be executed within 20 minutes.<sup>1</sup>

### **Demand Response in the UK – Now and Future**

In 2009-10, National Grid procured about 2.6 GW of reserve to balance the network, part of which was demand side resource, at a total annual spend of £91.4m.<sup>2</sup> This was predominantly provided via the utilisation of local generation assets to support electrical demand for short periods.

The UK electrical grid faces a number of imminent challenges to security and supply, such as:

- 30 GW of wind generation is expected to come online between now and 2020, bringing with it greater intermittency of supply<sup>3</sup>
- The majority of UK’s existing nuclear plants are due to be shut down by 2023 and nearly a third of the coal generation fleet will close by the end of 2015 due to the Large Combustion Plant Directive (LCPD)<sup>4</sup>
- An increasing reliance on volatile foreign supplies (the UK became a net gas importer in 2004)<sup>5</sup>
- £200bn of investment is required in the energy network at a time where govt. support for capital expenditure projects is low and market uncertainty is at a generational high<sup>6</sup>

National Grid, DECC & OFGEM have all identified that Demand Response will play a significant role in the changing landscape of the electricity market. A recently published report outlining the National Grids’ view of the UK energy market in 2020 identified the potential for Demand Response across a variety of applications, as shown in Figure 1.

<sup>1</sup> National Grid, A Day in the Life of a Control Engineer, 14 June 2011

<sup>2</sup> National Grid, SHORT TERM OPERATING RESERVE ANNUAL MARKET REPORT 2009/10

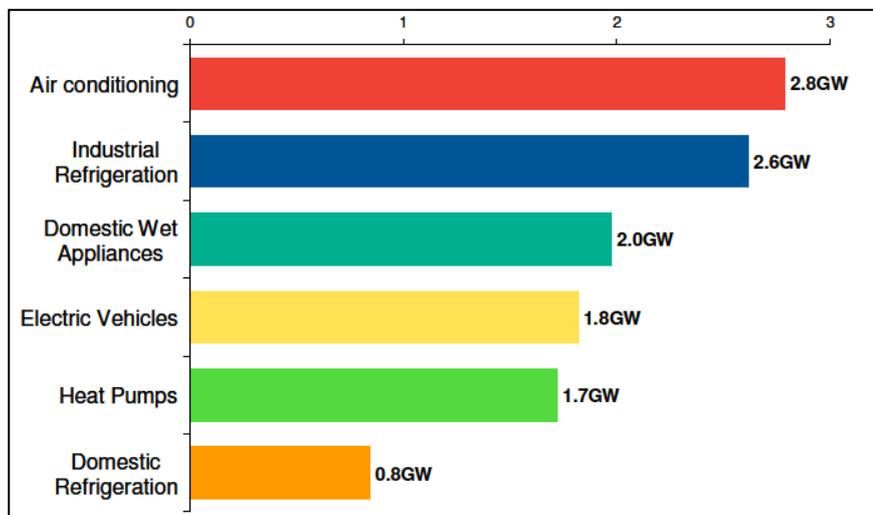
<sup>3</sup> Renewables Advisory Board, 2020 VISION – How the UK can meet its target of 15% renewable energy, June 2008

<sup>4</sup> Centrica, The need for nuclear and new nuclear build

<sup>5</sup> ICIS Heren, UK confirmed as net importer of gas in 2004, DTI reports, 31 March 2005

<sup>6</sup> Guardian, Energy firms must invest £200bn to meet UK targets, says regulator, 9 October 2009

**Figure 1: UK Demand Response Potential**



Source: National Grid, Operating the Electricity Transmission Networks in 2020, June 14, 2011

The potential that intelligently controlled lighting could provide to the Demand Side equation was not listed. Surely lighting controls have a part to play in the UK Demand Response story?

### **UK Potential for Lighting DRM in Industrial & Commercial Applications**

Demand Response has been successfully implemented in the United States for over 10 years. In California alone, the market for Demand Response via basic bi-level lighting control has been estimated at 289 MW.<sup>7</sup>

In the UK, lighting accounts for about one-fifth of the annual electrical consumption. Electricity consumption of lighting in the UK is split between the commercial (70%), residential (26%) and street lighting (4%) sectors, according to the estimates of the Department for Environment, Food and Rural Affairs (DEFRA).<sup>8</sup>

If those figures are transposed across the typical demand profile of the UK across an individual day, commercial lighting load on the UK grid can account for as much as 8.4 GW.<sup>9</sup> Typically 20-35% of lighting load in a commercial environment may be categorised as non-essential. Therefore, non-essential lighting alone can account for as much as 1.6 GW of demand on the grid. Assuming 10% market participation of this non-essential lighting load, there can easily be upwards of 160 MW of lighting electrical demand that could be readily managed for intermittent periods in the UK.

### **Integrated Intelligent Lighting Controls & Demand Response**

Demand Response requires two key ingredients to be effectively utilised: smart metering and smart controls. A plan for the roll out of Smart Metering is already in place, and will commence in earnest in April 2014 for small to medium non-domestic customers.<sup>10</sup> Smarter building controls are the missing link to realising a great deal of the locked up Demand Response potential in UK.

<sup>7</sup> California Energy Commission, Lighting California's Future: Cost-Effective Demand Response, March 2011

<sup>8</sup> Parliamentary Office of Science and Technology, Postnote, Lighting Technology, Number 351, Jan 2010

<sup>9</sup> Business Green, Wind power better managed as National Grid upgrades forecasting, 25 May 2010

<sup>10</sup> Department of Energy and Climate Change, Smart Metering Implementation Programme, March 2011

A great deal of existing installed lighting control is via manual switching. However, the combination of legislation, such as Part L Building Regulations, increasing electricity price, greater awareness of the benefits of energy management, ISO 14001 and now ISO 50001, have all contributed to creating an environment where much of the “low hanging fruit”, in the form of fitting upgrades, timers & IR switches retrofitting has taken place or is scheduled. The next step is intelligent lighting controls to maximise efficiency.

The mature US Demand Response market has shown lighting control as a DR strategy to be reliable. Using integrated intelligent lighting controls brings additional benefits:

- Greater level of control achievable compared to manual switching
- Makes DR available in virtually every building application
- Greater ease of control
- Easy to predict the results compared to other DR strategies
- Load reductions are highly repeatable
- Amount of lighting load can be reduced rather than completely eliminated, thereby preserving productivity<sup>11</sup>

Non-generation based Demand Response is still in its infancy in the UK. As such, larger energy consuming buildings will be the first to be integrated into a programme, as they offer the greatest financial rewards. It is also more likely that these buildings have a comprehensive Building Management System in place.

Integrated Intelligent Lighting Control Systems provide the ability to interface with these existing Building Management Systems—providing a single platform through which to execute Demand Response strategies across multiple technologies, such as lighting and comfort air conditioning in an office application. Indeed, lighting based Demand Response strategies can complement HVAC strategies—as internal lighting gains make up about 30% of total internal heat gains experienced in a typical office environment.<sup>12</sup> Reducing the internal heat gains from lighting will in turn require less cooling to be delivered to maintain comfort levels during a Demand Response event.

While the financial benefits of DR are proportional to the quantity of electrical load that can be managed, DR participation and Energy Efficient Lighting are not mutually exclusive. In fact an optimally energy efficient lighting installation with enhanced controls makes Demand Response all the more possible.

Integrated Intelligent Lighting Controls creates the opportunity for dimming-based Demand Response strategies—especially where control at ballast level is available. Research carried out by the National Research Council Canada – Institute for Research in Construction have found that in non-daylit commercial applications, 80% of desk based workers accepted short-term reductions in their lighting levels by approximately 20-30%—when the reduction was carried out gradually (2% per minute) with no adverse effect activity.<sup>13</sup> Demand Response is a further mechanism by which Integrated Intelligent Lighting Controls can deliver financial benefits for customers—strengthening the business case for their installation over and above the utility bill savings made.

<sup>11</sup> Peak Load Management Alliance, Making Lighting Responsive to Demand Response, Peter Morante, 29 April 2005

<sup>12</sup> CIBSE Guide A: Environmental design, Table 6.1, Benchmark values for internal heat gains for offices

<sup>13</sup> National Research Council Canada, Institute for Research in Construction, The Potential for Demand-Responsive Lighting in Non-daylit Offices, Guy R. Newsham and Sandra Mancini, October 2006



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