Department
of Energy &
Climate Change

Forward Look: Smart Metering-enabled Innovation in energy management in the non-domestic sector

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URN 15D/002

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Contents

Executive summary

- The UK Government has set up a programme to ensure domestic and small non-domestic customers in Great Britain will be provided with smart meters by the end of 2020. The Department of Energy and Climate Change (DECC) expects non-domestic customers to realize substantial benefits from the use of smart meters. Smart meters will put an end to estimated readings, provide real time consumption information to customers, allow for deployment of time-of-use tariffs, and provide a platform for new energy efficiency products and services to be offered to domestic and non-domestic customers.
- DECC is seeking to develop its evidence base on the potential for smart meter-enabled innovation in energy management products and services which can help to deliver benefits for SMEs[1] in the future. DECC therefore commissioned the Carbon Trust to prepare this technical forward look of anticipated innovation, and product and services development in energy supply and management solutions, enabled by smart/advanced metering in the non-domestic buildings sector, looking broadly at the period up to 2020.
- The Carbon Trust's research has identified five key innovation areas that could be enabled before 2020 by the smart meter roll out for non-domestic customers: 'power of attorney services', automated building performance evaluation, analytics and pattern recognition, device disaggregation and demand-side response, as shown in Figure 1, which are described in section 2 of the report.

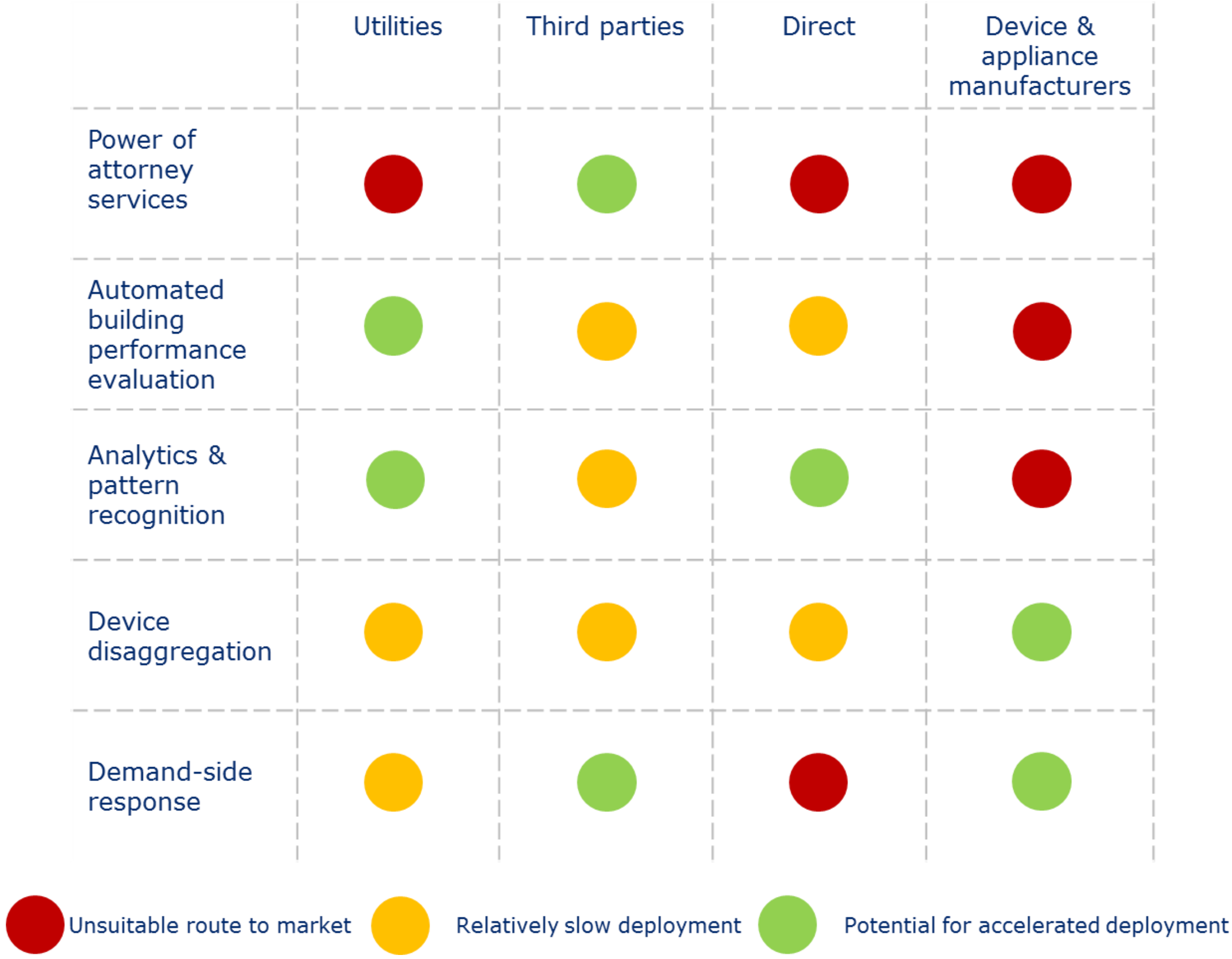
1 Companies with less than 250 employees, a turnover of less than €50m or a balance sheet total of less than €43m

Figure 1: Smart meter enabled innovations for non-domestic customers

Innovation	Summary description	Data requirement
Power of attorney services	A replica of the current service available to domestic customers (via moneysavingexpert.com), where customers can elect to switch automatically when an offer becomes available that meets a pre-set annual saving. Smart meter data would improve the accuracy of the service and also enable further value-added services, e.g. advice about solar panels or insulation.	Half-hourly improves accuracy
Automated building performance evaluation	Comparing actual consumption data from smart meters to theoretical models of energy consumption, based on asset registers, can help to identify energy wastage.	Half-hourly
Analytics & pattern recognition	Software engines that are able to analyse smart meter data and other information on building occupancy, fabric and weather in order to provide customised, actionable energy efficiency advice to non-domestic customers	Half-hourly
Device disaggregation	A range of technologies that allow consumers to understand electricity consumption per device. For example, these technologies could inform customers about under-performing assets	10 seconds
Demand-side response	Smart metering infrastructure enables non-domestic customers to enrol in automated demand-side response programmes, especially if disaggregated devices can be turned off or switched down exploiting their latency.	Half-hourly

- Utilities are the natural route to market for much of the innovation that we have identified in the absence of a competitive energy services market for smaller users, but technology that helps non-domestic customers use less energy does not sit easily with current utility business models, that generate more profit from higher sales. This model could however evolve, as utilities seek to address their challenges around customer trust and engagement. Delivering a useful service could help them win consumers' trust, which in turn could reduce customer churn, lower costs and pay for the cost of providing the service.
- For larger non-domestic customers, third parties have a significant role to play, but the relatively immaterial nature of energy costs for most smaller businesses mean this route to market has to date proved more challenging as new customer relationships need to be formed and it may be hard to develop viable commercial propositions that SMEs are willing to pay for.
- Figure 2 shows the available routes to market for each of the innovative products and services we have identified during our research, combined with "traffic light" assessment of the suitability of each route per service.

Figure 2: Available routes to market for innovative products and services for non-domestic customers[2]



- Figure 3 outlines the possible development pathways for the commercialisation of the technologies our research has identified, together with the barriers and key target sectors. The timing column in Figure 3 relates to our best estimate for the launch and partial uptake of the service amongst non-domestic customers.

[2] 'Direct' here means directly to the customer from the technology owner (e.g. from vendors of analytics and pattern recognition software); 'third party' includes consultants and energy brokers.

Figure 3: Development pathways for innovative products and services for non-domestic customers

	Development path	Route-to-market	Timing	Supply-side barriers	Demand-side barriers	Target sector
Power of attorney services	Accelerated	Third party	2015-16	• Desire of Personal data store companies to enter non-domestic sector • Good quality pricing engine	• Credibility of broker community with respect to commissions	Small and micro non-domestics
Automated building performance evaluation	Accelerated	Utilities	2015	• Good quality building data • Current utility business model	• Perceived accuracy • Complacency	Larger non-domestics & groups
	Gradual	Third party	2018-19	• Lack of market reach	• Upfront cost for customer	
Analytics & pattern recognition	Accelerated	Utilities	2015-16	• Current utility business model	• Lack of trust in utility • Perceived conflict of interest	All-non domestics
	Accelerated	Direct	2018-20	• Lack of market reach	• Cost of the service	
	Gradual	Third party	2018-20	• Lack of market reach	• Upfront cost for customer	
Device disaggregation	Accelerated	Device & appliance manufacturers	2015-16	• Device and appliance manufacturers prove hard to convince	• Relatively slow uptake of new appliances and devices • Cost of energy hub	All-non domestics
	Gradual		2020 onwards			
Demand-side response	Accelerated	Third party	2015-16	• Lack of market reach	• Inability of customers to defer load • Incentives are too low to encourage participation	Larger non-domestics & groups
	Gradual	Utilities	2018-19	• Lack of incentive for retail utilities		

- The main conclusions of the report are summarized below:
  - It is very important that smart meter data is accessible at a low cost for third party or direct providers of innovative products and services. The stakeholders interviewed for this report highlighted the need for smart meter data to be available via Application Programming Interface (API). The Carbon Trust is satisfied that this will be available at a reasonable cost via the central Data Communications Company (DCC) or consumer access devices (CADs), although some uncertainty remains around those customers that are operated outside of the DCC systems. DCC Users will need to have systems that meet robust security and privacy requirements.
  - Innovative products and services could help support energy management by smaller non-domestic customers more effectively than the provision of basic data analysis and charting. Time-poor smaller businesses are less likely to be prepared to analyse or interpret smart meter data or pay for experts to do this for them

(Non-domestic smart meter research report, Ipsos MORI for DECC October 2013). New products and services described in the report could help overcome such barriers.

- Automated building performance evaluation can help eliminate waste. Theoretical energy consumption models can be built for any building using an asset register, fabric information and weather data. These models can be compared against actual consumption information from smart meters to identify wasted energy.
- Customised, actionable advice can engage even the smallest of customers. The analysis of smart meter data with other data items such as building location and weather data can be combined to provide customised, actionable advice to non-domestic energy customers. Whilst the EU-mandated Energy Savings Opportunity Scheme (ESOS) will require all non-SMEs to have a physical energy audit, data analytics could support remote audits at a much lower cost, making them available for SMEs.
- Tell them how much they can save. Innovative products for non-domestic customers, particularly those that provide customised, actionable advice, should tell non-domestic customers how much they could save, or what the payback period would be, if they follow a specific piece of advice.
- Device disaggregation and the Internet of Things. Technologies that fingerprint and measure the energy consumption at a device level can provide a further layer of insight and advice for non-domestic energy customers. Eventually, Internet of Things enabled appliances and devices could facilitate optimising the energy performance of a building.
- Based on the interviews conducted, we are more sceptical of the economics for non-domestic customers enrolling in virtual power plant demand response programmes prior to 2020. This is due in part to nature of electricity demand in the UK, compared to other countries where these services are currently being provided, and in part due to the relatively low penetration of intermittent renewables in the UK. Where these services do emerge they are likely to start at the distribution network level in networks with a higher proportion of onshore wind or solar PV, or via third parties that manage to attract a significant number of non-domestic customers with profile class 3 and 4 meters[3]. We have two key recommendations that could help to unlock this innovation potential, which are outlined at the end of the report.
- Whilst utilities are the natural route-to-market for smart meter enabled innovation, there is a conflict of interest with their existing business models, as they currently utilities generate higher profits from higher sales. However, some of the utilities the Carbon Trust spoke to for this report are looking at the use of innovative technology to increase customer engagement and reduce churn and therefore costs. Whether and when this shift in business model is likely to happen is still far from certain.

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[3] Sites covered by SMIP don't correspond directly to the definition of SMEs: the analysis in this report focuses primarily on expected products, services and market developments relevant to the approximately two million sites with profile class 3 and 4 electricity meters and gas sites consuming less than 732MWh per annum.

- Most, but not all, innovation is likely to benefit larger energy consumers first. However, these services and technologies could trickle down once they will become more firmly established within this market. The more that smart meter data can enable the provision of practical, targeted and actionable recommendations to small businesses, the more likely small businesses will be to act, both in terms of day to day management and of investments, supported and encouraged by wider mechanisms.

Introduction

1. The UK Government has set up a programme to ensure domestic and small non-domestic customers in Great Britain will be provided with smart meters by the end of 2020, putting requirements on electricity and gas suppliers to deliver this. The programme aims to replace 53 million meters with smart electricity and gas meters in all domestic properties, and smart or advanced meters in smaller non-domestic sites, impacting approximately 30 million premises.
2. The needs of SMEs[4] (including micro-businesses) have tended not to be high on the priority list of other smart metering roll out programmes. SMEs fall between large, often multi-site customers who are often actively engaged in energy management, and the mass market of residential consumers. As a result, they do not always figure highly in the minds of technology developers, utilities and energy management service providers. However they occupy a significant number of sites to be covered by the GB roll-out and are expected to realize energy saving benefits. DECC is seeking to develop its evidence base on the potential for smart meter-enabled innovation in energy management products and services which can help to deliver benefits for SMEs in the future.
3. In preparation for the main roll-out phase, DECC therefore commissioned the Carbon Trust to prepare this technical forward look of anticipated innovation and product and services development in energy supply and management solutions enabled by smart/advanced metering in the non-domestic buildings sector, looking broadly at the period up to 2020.
4. The analysis in this report primarily focuses on expected products, services and market developments relevant to approximately two million sites with profile class 3 and 4 electricity meters and gas sites consuming less than 732MWh per annum[5]. Although no official data currently exist, the Carbon Trust estimates that roughly 50% of these sites are SMEs and 50% are part of larger multi-site organisations.

Scope of work

5. The key objectives of this study are to:
   - Provide a comprehensive overview of future energy management products and services that could be enabled by the smart meter roll out, as well as the expected customer benefits.
   - Provide a general understanding of the main areas of innovation that are expected to be driven by the smart meter roll-out, and the required interaction between original equipment manufacturers (OEMs), Building Energy Management Systems (BEMS) companies and utilities which can help ensure an integrated supply chain.

[4] Companies with less than 250 employees, a turnover of less than €50m or a balance sheet total of less than €43m.

[5] The definition adopted in smart metering legislation.

- Identify key policy drivers and barriers to achieve the expected innovation in products and services.
- Map the non-domestic needs and expected benefits depending on their energy expenditure and energy management capabilities, in order to identify the possible ways in which smart meters and BEMS could interact to deliver these benefits.
- Identify the likely demand-side response applications, and evaluate the extent to which they will be possible, considering that c. 23% and c. 40%[6] of electricity and gas meters respectively are expected to be "advanced[7]", which may limit their capabilities compared to smart meters.

Methodology

6. Our approach to this study consisted of four stages:
   - Desk research. We have accessed information available in publicly available research reports that provide not only a view on the products and services today but also on the future services that will emerge. This has helped to:
     - Identify a comprehensive range of experts and stakeholders on the subject of smart meters and related products and services.
     - Develop a starting point for the types of products and services that are currently available, but more importantly are expected over the coming years.
   - Semi-structured depth interviews. The Carbon Trust interviewed 22 key people in companies and organisations active in the smart meter and related services space to source information. These interviews covered a wide range of stakeholders including, energy management consultants and brokers, technology owners, utilities, the GB regulator and facilities management providers. Semi-structured depth interviews use a light-touch research framework, allowing both the interviewer and the interviewee to explore areas that are developed during the interview via probing in further details of the answers given during the interview.
   - An industry workshop brought together parties across the smart meter and energy supply chain to debate the topic. This helped test some of the initial outputs from the project. In particular, the workshop developed a clear line of sight from innovator to customer, the dependencies and necessary linkages that would enable the products and services to be made available to the non-domestic market.
   - Synthesis of findings from the various data gathering exercises – this report plus dissemination of findings to DECC and stakeholders.

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[6] Smart meter roll-out for the domestic and small and medium non-domestic sectors (GB): Impact Assessment.

[7] Advanced metering allows a supplier or other party to take remote readings and provide a customer with access to data, broken down into multiple time periods, based on those readings

Smart metering and the non-domestic energy market

For the purposes of this report, the following definitions of 'advanced meter' and 'smart meter' are used:

- An advanced (AMR) meter typically provides one-way, rather than two-way, information flow
- A smart meter provides two-way information flow and typically has capacity to send data to a local area network

In developing the definition of 'smart', the government has so far published two versions of the Smart Metering Equipment Technical Specifications for gas and electricity meters and IHDs (SMETS1 and SMETS2 - though only SMETS1 is currently designated into force). These define a wide range of minimum equipment functionality, including communication links to a user interface which displays clear information to the users, the capability to switch payment mode, and support communications based on Open Standards.

7. The smart metering roll-out for the non-domestic sector focuses on smaller sites (electricity profile classes 3 - 4 and gas loads of less than 732MWh per annum). These fall between domestic sites and those covered by the previous mandate for the roll-out of advanced metering to larger electricity (profile classes 5-8) and gas customers (more than 732MWh per annum)[8] which was due for completion in April 2014.
8. Occupiers of these sites face challenges distinct from those faced by either residential or larger commercial and industrial energy users:
    - Smaller businesses are often time-poor, meaning that any spare resources available are likely to be directed towards activities with the highest marginal returns, frequently those that grow the businesses.
    - This, coupled with the relative immateriality of energy costs, means that addressing energy inefficiency is unlikely to be a high priority for many small businesses.
    - There is generally a lack of expertise within smaller businesses to address energy management of buildings, resulting in both a lack of awareness of problems and of possible alternatives.
    - Since smaller businesses comprise a range of different sectors and use a diverse range of buildings and energy-using equipment, it is often difficult to suggest effective interventions without detailed audits.
    - Even when a smaller business becomes positively engaged with energy management, it may be difficult for them to make the necessary interventions given constraints from existing contracts including timing of contracts renewal with energy suppliers.

[8] See Appendix 1 for more detail on load profile classes

Energy management for SMEs

9. The Government's Consumer Engagement Strategy documents[9] set out DECC's existing expectations and assumptions in terms of how non-domestic customers will obtain access to data and information from their smart meters. DECC state that they expect an expanding energy efficiency services market to play an important role. They also recognise that many non-domestic customers already enjoy energy management services - provided by both third parties and utilities - that leverage either smart or advanced meter data. They point out that services such as automated Monitoring and Targeting (aM&T) are widely available and utilised by larger consumers (where energy costs are more material to the bottom line).

10. DECC expects that the smart meter roll out will enable smaller non-domestic customers to access such services. They state that these are likely to be different to the ones used by larger customers, although they also anticipate that suppliers will generally choose to offer either an IHD or web-based feedback. DECC expects existing energy advisors and brokers to enter the market for smaller customers and compete against energy suppliers. It also notes that "ensuring effective competition is likely to be key to realising customer benefits in this sector".

11. DECC's Consumer Engagement Strategy also points out that the use of the DCC is non-mandatory for energy suppliers in the non-domestic sector and the ability of third parties to access granular consumption data may be more difficult for smart meters that have been opted out of the DCC or where an advanced meter is provided.

12. The Carbon Trust conducted a smart metering field trial with 582 SMEs between 2004 and 2006 which provided evidence on SMEs' use of such energy efficiency services. The trial aimed to demonstrate the benefits of advanced metering for SMEs and to understand the business case for widespread adoption of advanced metering by SMEs. The study demonstrated that SMEs with advanced meters and receiving different forms of feedback (emails, phone calls and site visits) could identify, on average, 12% carbon savings; SMEs implemented a 5% carbon saving during the trial. The SMEs involved in the trial achieved an average saving of £1,000 per annum on their energy bills and a reduction of 8.5tCO_2 per site.

13. In order to replicate the typical recruitment techniques that might be used in a commercial advanced meter roll-out, recruitment into the trial was managed by seven sub-contracted organisations that already operated in the UK metering sector. This meant that the SMEs recruited had a larger consumption per site than the UK average. Indeed, average consumption per site in the trial was around 300M Wh/annum (UK average 22M Wh/annum) for electricity and 900MWh/annum (UK average 400MWh/annum). Figure 4 shows the population of the field trial.

[9] http://webarchive.nationalarchives.gov.uk/20121217152440/http:/decc.gov.uk/assets/decc/11/consultation/smart-metering-imp-prog/4897-consumer-engagement-strategy-con-doc.pdf

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/43042/7224-gov-resp-sm-consumer-engagement.pdf

Figure 4: Annual consumption and emission levels for the sites in the Carbon Trust field trial

	Electricity (Code 5 sites)	Electricity (core SME sites)	Gas	Water
Sites	44	518	108	101
Total consumption	70 GWh	160 GWh	97 GWh	355,000 m^3
Average consumption	1,600 MWh	310 MWh	900 MWh	3,500 m^3
Total emissions	30,100 tCO_2	68,800 tCO_2	18,430 tCO_2	138 tCO_2
Average emissions	684 tCO_2	133 tCO_2	171 tCO_2	1.4 tCO_2

Source: Carbon Trust

14. Although the sites in the trial came from a wide range of industry sectors, their involvement was somewhat self-selecting due to the recruitment process. Consequently the set of trial sites was skewed towards the larger end of the overall SME population. However, when the trial savings were studied in relation to company size, there was found to be no significant difference in average percentage savings. This suggests that the difference in consumption levels at the trial sites and the overall UK average are not significant in terms of the key trial findings.

15. DECC has also published[10] qualitative research with single site SMEs which was carried out in 2013 by Ipsos MORI. This concluded that further action may be needed for the potential benefits of smart metering to SMEs to be fully realised, both in relation to communication and awareness-raising, and the development and provision of appropriate products and services to SME customers. DECC commissioned this report to gather new evidence, and in particular to better understand what products and services will be coming onto the market, from which to inform its strategy. It is also worth noting at this point that wider barriers to energy efficiency (such as split incentives between landlords and tenants) may impact on future developments; however these are outside the detailed scope of this report.

Smart meter roll out status, system design and data access

16. The smart meter roll out for domestic customers and non-domestic customers has already begun. By September 2014, 543,900 smart meters were operating in homes, and 515,300 smart and advanced meters were operating at non-domestic sites.[11] Currently, meter manufacturers are designing meters according to the SMETS2 specification and will soon begin testing their meters, according to our interviews. Most utilities have either deployed or have conducted field trials of smart meters (although not using the SMETS2 specification) to help consumers realise early benefits, to understand customer behaviour, to test the installation process, the reliability of communications solutions and other issues. The

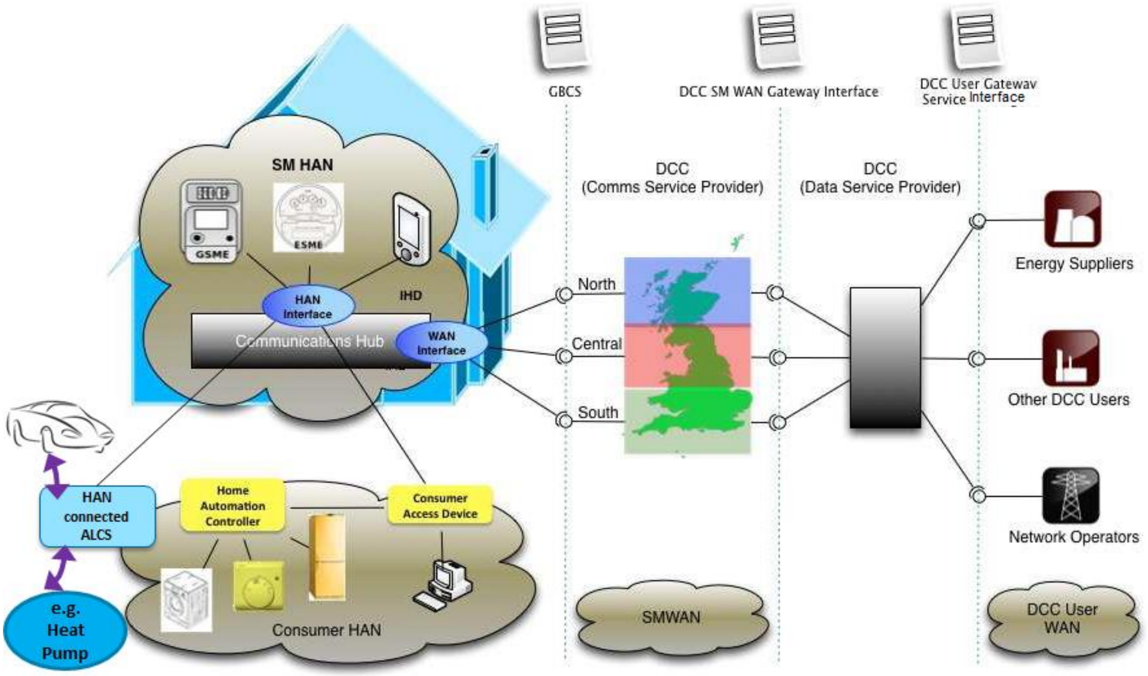
[10] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/251678/attitudes_smart_meters_non_domestic_sme_market_report.pdf

[11] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/387724/Smart_Meters_Quarterly_Statistics_Report_Q3_2014.pdf

contract for the Data & Communications Company (DCC) was awarded in September 2013 and is due to start system testing later this year.

17. Great Britain's smart metering system design is shown in Figure 5. The Smart Energy Code, which will govern how organisations are able to access smart meter data, is largely in place. Whilst non-domestic energy suppliers are not required to use the DCC in all situations it is likely that DCC will be used for the majority of such suppliers and other users to access smart meter data remotely. Third parties, which could provide innovative products and services to non-domestic customers leveraging smart meter data, could access the data as "Other DCC Users" governed by the Smart Energy Code as shown in Figure 5.

Figure 5: Overview of end-to-end smart meter system



Source: DECC

18. To access DCC services, organisations can either become as DCC User or enter into a commercial contract with a DCC user and obtain consent from the energy consumer. Costs to access data are considered below, but there will be some initial investments for DCC users to make. To safely and securely interact with DCC systems, users of DCC data must build systems (or contract with managed services companies) that are capable of interfacing with DCC and they must undergo User Entry Process Testing of these systems. In addition they must meet applicable security requirements (subject to a security audit); and they must have appropriate privacy arrangements (subject to Privacy audit). DCC Users must also have a robust process for gaining consumer consent and verifying that the person giving consent is the energy consumer.

19. DECC has been working with stakeholders to ensure that both security and privacy requirements are robust, but that they also do not represent a significant barrier for smaller organisations wishing to offer services based on DCC data.

20. Providers of smart meter-enabled innovative products and services would be able to access tariff information, 13 months of half-hourly consumption data for gas and electricity and 3 months' worth of half-hourly electricity export data via the DCC, if they have the customer's permission. Under the DCC data retrieval service, the DCC routes data from the meter to the

DCC User. It is anticipated that this will take around 30 seconds to complete, depending on message type.

21. The cost to access data via the DCC has yet to be confirmed, but the DCC has published its "Indicative Budget" for the years 2014/15, 2015/16 and 2016/7. By 2016/17, the DCC anticipates delivering a full smart meter communications service to Service Users, so this represents the best estimate of the DCC budget and the cost implications for Service Users. As shown in Figure 6, the DCC breaks down its budget into three sections:

- Fixed Revenue, paid for by energy retailers and distribution network operators;
- Explicit Charges, including data requests from Service Users, testing and training charges; and
- Elective Charges, including services that relate solely to the supply of energy and services pursuant to bilateral agreements.

22. The DCC currently estimates the variable cost of services requests will be very low (0.2% of the Indicative Budget) and is currently considering how best to allocate these charges. This should encourage companies wishing to offer services using DCC data to sign up to become Other DCC Users and potentially operate as intermediaries via a commercial arrangement with other companies.

Figure 6: DCC Indicative Budget for 2014/15, 15/16 and 16/17

Acronym	Name	2014/15 (£m)	2015/16 (£m)	2016/17 (£m)
EFR_t	Estimated Fixed Revenue	43.8	103.1	117.8
$EECR_t$	Estimated Explicit Charges Revenue	-	0.0	0.2
$EESR_t$	Estimated Elective Services Revenue	-	-	-
EAR_t	Estimated Allowed Revenue	43.8	103.1	118.0

Source: DCC

23. As shown in Figure 7, authorised users with consumer consent will also be able to access smart energy data via Consumer Access Devices (CADs) which include gateways, smart energy hubs, smart appliances, IHDs and laptop dongles that have a ZigBee SEP1.2 interface. Importantly, more granular <10 second electricity data is available via CADs that can help enable services such as such as device disaggregation, the ability to identify individual devices amongst aggregated energy data.

Figure 7: Available access routes to customer energy data

Route to Data	Data available	HAN/WAN	Frequency of updates
Energy Bill/ from supplier	Billing data and daily data for up to 24 months on request. Data held in electronic format via midata scheme.	WAN	Depends on billing frequency/ frequency of midata requests.
Via the DCC data retrieval service	Tariff information; 13 months of half hourly consumption data for electricity and gas; 3 months of half-hourly export data	WAN	Party retrieving the information will need to use a DCC service each time they retrieve data.
IHD	A minimum information set for display only.	HAN	10 seconds (30 mins for gas)
Via Consumer Access Devices	Nearly all consumption and tariff information.	HAN	10 seconds (30 mins for gas)

Source: DECC

Market impacts of smart metering

24. The liberalisation of the SME energy market nearly twenty years ago delivered significant competition and a raft of new entrants who developed significant market shares by offering price savings for customers. More recently, the acquisition of smaller suppliers by larger ones and a shift towards fixed-price, fixed-term contracts for SMEs has led to lower switching levels and high barriers to entry. Smart metering should reduce barriers to entry for new suppliers and make switching easier. The impacts covered here include both expected impacts in the energy supply chain, including how the smart meter roll out for non-domestic customers could improve competition; and expected changes in terms of tariffs and customer supply offers.

Smart meters will enable new entrants into the non-domestic sector

25. The introduction of smart meters may further commoditise the utility sector and lower the barrier to market entry. Currently, utilities use their energy trading functions to manage the risks associated with unpredictable energy requirements from their customers, which result from inadequate information on consumption patterns. Better insights into energy demand will reduce the need for energy trading expertise and the risk associated with getting it wrong. Whilst it is clear to see that many organisations could enter the domestic energy market on this basis, for example telecoms companies, Pay-TV providers and supermarkets, the case for the non-domestic sector is less compelling. Nevertheless, smart meters open the market further for new entrants.

Switching speed and reliability will be improved

26. Improvements in the speed and reliability of the switching process enabled by smart metering (together with a centralised DCC and Ofgem proposals for a new centralised registration system) should encourage non-domestic customers to engage with the competitive market, especially those that have had poor previous experiences.

Smart meters will unlock the market for brokers and switching sites

27. Although successful switching sites exist for the non-domestic sector, there are additional obstacles in this sector to developing high quality pricing engines. Unlike the domestic market, suppliers are not required to publish their tariffs for non-domestic customers, and as the size of the customer grows, prices become more complex and reflective of the wholesale energy market.

28. Smart meter data should allow for both a growth in the number of switching sites available to customers and an improvement of the service offered. Switching sites could become energy marketplaces where energy suppliers bid for customers through a detailed understanding of their consumption data. Analytics could provide a significant level of automation in the selection of a supplier and more certainty for suppliers on the type of business that they are winning. Traditional brokers could also license the data to improve the personalised services they offer. The expected areas of innovation are described in more detail in the next section.

Multi-rate tariffs will unwind cross-subsidies between users with high and low peak usage

29. Smart meters enable multi-rate tariffs to be provided without replacing the meter. Energy suppliers will be able to move customers (with their consent and support) to half-hourly settlement once they have a smart or advanced meter that can record half-hourly consumption and be remotely read, and there are customers who could immediately benefit from moving to existing two-rate and three-rate tariffs. Two-rate tariffs can deliver cost savings in a variety of sectors including leisure, hotels, some retail outlets, restaurants and pubs. An energy broker we interviewed indicated that many non-domestic businesses could save 5% on their electricity bill by moving to a two-rate tariff and the roll out of smart meters would make this much easier than today where meters need to be changed.

Lower risk premiums will feed through to lower prices and offers can be tailored for customers

30. Energy prices for non-domestic customers are based on the expected consumption that they will have over the period of the contract. This expectation is based on previous consumption data, which with current technology (in many cases, one firm read per year) is normally incomplete. As utilities are often buying energy in advance against the expected consumption of a customer they will use a “risk premium” to mitigate against the possibility that the customer’s consumption turns out to be more or less than their expectation. Smart meter data should drive more accurate consumption predictions and therefore, deliver operational efficiencies for utilities and lower prices for customers.

31. Smart meter data will also allow customers to provide a profile that suppliers can bid for, either directly or via a broker. Smart meter data will provide a measure of control for customers in how they seek out business from energy suppliers and invaluable information for suppliers looking to price contracts. The availability of tariff information from the meter, via the DCC, will also help to drive competition for the non-domestic sector.

Avoided customer acquisition costs could pay for "free" energy efficiency services from utilities

32. Most utilities see the smart meter enabled value added services that they could offer to non-domestic customers as an invaluable retention tool. Customer acquisition costs in the non-domestic sector are as high as most non-domestic customers are on fixed-term contracts. Utilities that we interviewed said that the cost of a lead (i.e. a potential customer that is not in contract, or in the renewal window) is more than £100 to buy or generate. The cost of delivering innovative services that help customers reduce their consumption could be paid for through lower acquisition costs as a result of lower churn.

33. Although this does not address the credibility of the utility sector in supporting energy efficiency, or the natural conflict of interest that this represents under current business models, it does offer the possibility for customers to be provided with value-added services for free, or more accurately included in their energy supply contract. The improvement in energy supply and the lower tariffs that could be enabled by smart meters discussed earlier in this chapter could help utilities to develop better trust with customers to support this integrated model.

Areas of smart meter-enabled innovation

34. This section describes the areas of innovation which the research identified as potentially unfolding during the period of the study, up to 2020. These go beyond the basic energy management products and services described in section 2.

35. The innovation routes to market and development timings for the five key areas ('power of attorney services', automated building performance evaluation, analytics and pattern recognition, device disaggregation and demand-side response) are analysed in more detail in the following section.

Power of attorney services

36. Cheap Energy Club is an existing 'power of attorney' service for domestic customers provided by Martin Lewis's moneysavingexpert.com, which emails subscribers the option to switch automatically once a cheaper deal becomes available according to a saving threshold pre-set by the customer. The service differs from a switching site in the following ways:
    - The system stores the personal data entered by the customer. This means that data like current supplier, previous consumption, MPAN, etc, only has to be entered once. The data is stored in a 'Personal Data Store' (PDS), to which the customer can provide access to third parties for certain data items.
    - Cheap Energy Club does not pay commission to suppliers and is trusted by customers to offer them the best deal.

37. Cheap Energy Club has a million registered users and over a third of those have switched. At the peak, when many suppliers were increasing their prices, over 10% switched in one month. The average minimum saving set by Cheap Energy Club users is £75, and when a deal comes available that saves them this amount over a year they receive an email that includes a switch button. Cheap Energy Club uses moneysupermarket.com's pricing engine.

38. The service is successful because:
    - It gives the customer the right amount of information to make a decision, without them having to do a lot of research or fill out lengthy forms; and
    - Customers trust moneysavingexpert.com to give them impartial advice. The site generates revenue through advertising but this is clearly marked and does not impact editorial or advice.

39. The introduction of smart meters could help to improve the service through access to historical consumption data via the DCC that will allow its analytic engine to give more accurate advice to customers, eliminate the possibility of customers entering inaccurate information at the set-up phase, and allow the system to keep data current.

40. Personal data stores could provide one means of delivering such a service. These are cloud-hosted services where data can be deposited and used under strict control and management of the individual, and shared with organisations under certain circumstances to benefit the individual. Personal data storage companies which have the consumer's consent will be able to access that consumer's energy data from their smart meters and forward it to that consumer's Personal Data Store. Retrieval may be either via the DCC or (using a Consumer Access Device connected by the consumer in their home) via the internet.

41. The prospect of such services – described as 'power of attorney services' in this report – for non-domestic customers is a very real one, although challenges with generating access to a high quality pricing engine remain (see previous section on switching sites). Power of attorney services probably represent an innovation opportunity for small rather than more complex accounts due to the bespoke pricing that larger accounts enjoy.

42. Smart meter data, combined with other information and an analytic engine could also be used by third parties to provide other advice to non-domestic customers apart from switching advice. Using basic information about the building – location, position, age, fabric, Display Energy Certificate information – and combining it with rich consumption data an analytic engine could provide advice to customers about the cost-benefit analysis of energy-related items such as insulation, solar, heat pumps without needing to expose the data to the customer. The innovation involved is described in more detail under the headings below.

Existing types of energy feedback

43. Although IHDs are not mandated as part of the smart meter roll out for non-domestic customers, utilities are required to give access to smart meter data via the internet and the utilities interviewed for this report have plans to provide data via portals that can be used on PCs, tablets and smart phones. Such software can be used, in combination with degree-day data, to help customers understand how they are performing compared to previous periods and versus targets they may have set. They could also be used to help provide customers with alerts if they are approaching pre-set consumption limits and/or historic records. The provision of data may not, however, significantly improve engagement by itself, particularly for smaller customers where energy does not represent a significant share of total costs, as discussed in DECC's 2013 qualitative research.

44. The benchmarking of energy costs across comparable categories of customers is a proven method for encouraging customers to take action on energy efficiency. Benchmarking energy usage is an existing activity in both non-domestic and residential sectors, although the process is more challenging for the non-homogenous, non-domestic sector. Contextual information, for example about the building and how it is used, is required to make the benchmark meaningful and actionable. This could include a consumption per square meter approach and most likely a sectoral approach where, for example, restaurants compare energy consumption per cover. Whilst utilities would be able to offer benchmarking services to their clients – indeed E.ON offers this to UK residential customers utilising OPower technology – third parties may be in a better position to offer these services due to the non-homogenous nature of utility customer bases. Industry associations could provide routes to market for third party suppliers.

45. The "gamification" of energy efficiency is a concept gaining traction in residential energy markets, particularly in North America. Customers can compete against each other, and those that manage to reduce their consumption can earn rewards that can be redeemed for a discount on different products and services. Under the North American model these products and services are paid for via avoided costs for the utility including both avoided generation, transmission and distribution. Whilst the model for funding such a scheme in a liberalised market would be more challenging, and small businesses may not behave in the same way as residential customers, it could be possible to fund such as scheme via a business rate rebate or similar mechanism. The exact funding model should be explored as the technology and business model matures.

Automated building performance evaluation

46. Whilst the steps required to deliver effective benchmarking services that engage non-domestic customers and drive behaviour change at scale needs further exploration, an

alternative approach involves detailed analysis of the energy performance of individual buildings over time, using time series data.

47. Such a service would provide non-domestic customers with an analysis of their historically optimum, weather adjusted energy consumption compared to that of today and could provide ideas and advice on what is causing any differential. This advice is discussed in more detail in the next section, but even without advice, time series data allows engaged non-domestic energy customers to take action to correct anomalous consumption.

48. Importantly, analysing a building's energy performance against itself negates the challenge of the environment around the building, which may have a significant impact on its energy performance. For example, two hotels, one urban and one rural near to a lake, with a similar building fabric and number of rooms may have a large difference in heating requirements in winter and any benchmarking programme would struggle to account for this.

49. New energy performance analysis services, like Carbon Buzz[12], demonstrate that the actual in-use energy consumption of commercial buildings is normally between 1.5 and 2.5 times the amount predicted at the design stage. Smart meter and AMI data can help non-domestic customers identify some aspects of poor performance in actual consumption compared to theoretical performance, thereby reducing wastage.

50. Non-domestic customers that have an understanding of their portfolio of buildings and the energy consuming assets that they have, would be able to populate a theoretical model of what their energy consumption should be. Theoretical energy consumption models need not be a time-consuming task to populate and could be completed over the telephone with small businesses providing information such as their address, hours and the various energy consuming devices they use into an asset register. The theoretical performance of the building can then be compared to the actual performance in order to identify potential problems. Whilst this approach would initially identify major wastage, the refinement of models over time could identify more subtle issues.

Analytics and pattern recognition

51. Analysis of smart meter or AMI data can provide a wealth of information about the energy performance of a building and reduce the need for expensive and time consuming site audits. Emerging pattern recognition technology can provide deep insight into energy underperformance in buildings and could be used to provide tailored, actionable advice to non-domestic customers without the need for site audits.

52. Pattern recognition technology analyses granular (half-hourly or less) consumption to assess energy underperformance in buildings. For example, pattern recognition can identify when:

- Heating or cooling timings are not aligned with occupancy and plant comes on too soon or switches off too late;
- Boilers, or other heating components such as heat exchangers, are the wrong size for a building;
- Time clocks have not been updated according to the season;
- Outliers in energy performance are obvious – for example a school using more energy during holidays compared to weekends or a pub's gas consumption in comparable temperatures;
- Building energy management systems have been manually overridden and not re-set.

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[12] www.carbonbuzz.org

53. Pattern recognition technology can then be used to provide advice to non-domestic customers on these topics such as:

- Changing heating controls to earlier or later as appropriate for building occupancy;
- Re-specifying capital equipment at an appropriate renewal point; and
- Re-setting timing controls and/or re-setting BEMS controls.

These could be provided via email, SMS or automatic changes to building controls or time clocks.

54. There is potential for analytic engines to provide further actionable advice to non-domestic customers using smart meter data combined with other data and information. As most energy service provision already operates in the background (most customers do not appreciate how a complex system enables their lights to come on when they press the switch) this is intuitively highly appropriate. The additional information and data required could include local weather data, the type of business, hours of business, occupancy data (perhaps generated via electronic entry and exit systems) and information regarding the building fabric.

55. Such innovation is already becoming available. Some software developers' analytic engines integrate Google Maps information and local weather data from the address of a building and combine it with interval energy consumption data to provide insights into both the performance of plant in the building (heating and cooling) and occupancy related energy use remotely. Software developers have sought to validate their solutions by comparing them with site audits and physical sub-metering with some success. Further growth in the sector should also lead to improved validation.

56. Short, simple online energy audits could also add richness to the data and generate further insights for non-domestic customers. Questions such as "do you have single glazing?", "do you have a draught excluder?" and "when was your heating system last serviced?" can all improve and refine the advice given to customers.

57. Such analytical tools can be used to send insights and recommendations to building managers and occupants. This could include information like "high gas and electricity consumption indicates that heating and cooling systems are working simultaneously", "your building's lights are on all night", "changing your air conditioning filters will pay back in approximately eight months" or "you should change your air-conditioning settings to X today due to the weather forecast".

58. This approach could be made more meaningful if energy savings were calculated and sent to the client. Although it may be challenging to make these 100% accurate – energy savings calculations are fraught with difficulties and unknowns – they make the difference to the bottom line clear. Examples could include "switching your lights off at night could save you £500 per year and pay for a sensor control system", "changing your air-conditioning filter will reduce its energy consumption by 5% over the next three years, the cost will be paid for in 8 months, providing you with a £3,000 saving over the three year period" or "changing your air conditioners setting to X today would save you £10, with no impact on your customers' or employees' comfort levels".

59. Providers of customised, actionable energy efficiency advice services described above could also host energy marketplaces and give non-domestic customers access to information about capital items they could consider. For example, should the service recommend a change to an air conditioning filter, the system could also provide information about local suppliers, their prices and whether the customer may qualify for an enhanced capital

allowance via the Energy Technology List. The system could also provide advice on solar feed in tariffs and the cost-benefit of solar for non-domestic sites for example.

60. Larger energy users will be required to complete an on-site audit every four years via the Energy Savings Opportunity Scheme (ESOS), which is being implemented in response to the EU Energy Efficiency Directive. For most SMEs not covered by ESOS, physical energy audits will prove to be too expensive and smart meter data can fill the gap. Smart meter data could also enable on-going advice to be provided to larger non-domestic customers during and in-between their ESOS audits.

Device disaggregation

61. Understanding electricity consumption at the device level can be used to benchmark the performance of different devices against each other or to compare a device's energy consumption against the manufacturer's specification. Using this information one could also closely monitor the impact of any energy efficiency interventions that have been made and mitigate the tendency for behavioural change to be short lived. Device-level data could also be used to inform decisions about asset renewal or configuration.

62. Many large commercial energy customers, such as supermarkets, use sub-metering to understand and manage the performance of large energy consuming devices such as air conditioning units or freezers. Sub-meters currently cost between £75 and £100 per meter and 32-channel GPRS data loggers are also required, which cost around £500. A convenience store could be fitted out for £3,000-£4,000 and the investment should be paid back in 2-3 years with a 5-10% reduction in electricity consumption. However this type of service is typically too expensive for smaller organisations to implement and may not be perceived to be paid for quickly enough via the savings they generate.

63. An alternative to sub-metering is 'at the plug' data capture and control. Smart plugs sit between the plug on the appliance and the socket in the wall and can be used to understand the consumption of specific devices and to turn them on and off. Smart plugs are available in the UK for £25 and are commonly used in US residential demand response programmes for domestic air conditioning units. Smart plugs normally communicate via a Home Area Network (HAN) technology, such as Zigbee, with a hub device that can be remotely managed via a PC, tablet or smart phone. Non-domestic customers could use smart plugs to understand their energy consumption more thoroughly or to enter into demand response programmes by exploiting latency in certain devices such as air conditioning or freezers (see our discussion of demand response in the section "Small businesses may struggle to support load aggregation & virtual power plants").

64. Technology is also available – the use of micro-chips that measure current to a reasonable degree of accuracy (i.e. non-fiscal) – that can be implanted into electrical cables at very low cost, whichcan measure the consumption of devices and appliances without the need for a relatively bulky and expensive plug. The uptake of this type of technology is, however, dependent on wider adoption decisions including device and appliance manufacturers being convinced that it would be of benefit to their businesses.

65. New technologies are being developed and tested that are able to identify and fingerprint different electricity consuming devices using meter data from a single point. One Dutch technology, which currently is available within a non-fiscal sub-meter but could be embedded in a smart meter at a future time, identifies the electrical signature of energy using devices using 10 second consumption data in order to calculate their individual consumption and provide feedback.

66. Software is also being developed that will be able to offer "nudges" to non-domestic customers about their energy consumption using real-time information about electricity

consumption at the device level combined with building fabric information – e.g. from an EPC – and basic information about the organisation e.g. working hours.

67. Examples include being able to inform non-domestic customers that their air conditioning is on at the weekend when they are closed, that one air-conditioning unit is performing poorly compared to the others and is in need of a service, or that specific devices are being left on when there is no-one in the building. The real-time nature of this technology helps to support and embed real behaviour change as advice could be immediately actionable and be used to monitor compliance with agreed energy efficiency policies and commitments.

The 'Internet of Things'

68. Devices with embedded communications that can be controlled remotely or respond to changes in conditions (weather, energy prices, etc.) are now becoming available. For example, Wi-Fi enabled air conditioners are now available in the US market that can automatically enter themselves into utility demand-side response programmes, or could make decisions on their output and energy consumption based on a series of pre-set ranges in conjunction with thermostats and energy price data. Smart meters are often described as the first devices that represent the 'Internet of Things', where devices will be able to communicate with each other to drive efficiency, lifestyle and business benefits. Once devices are connected and can report their energy consumption data, energy efficient consumption becomes more transparent and measures adopted and monitored to make consumption more efficient.

Demand side response

69. Demand side response (DSR) is an important area of future innovation enabled by smart metering, and forms part of DECC and Ofgem's broader strategy for the energy market. In April 2014 Ofgem launched a project to realise the opportunities of settling domestic and smaller non-domestic electricity customers half-hourly[13]; they have also directed the Balancing and Settlement Code Panel to consult on the implementation date of a modification that would mandate larger non-domestic electricity consumers (those in profile classes 5-8) to be settled using half-hourly consumption data[14]. These developments will open the market for DSR outside of traditional customer segments. Therefore, DSR could play a key role in enabling peak load shifting, improving electricity security of supply, reducing the need for investment in generation plants and network reinforcement, reducing electricity costs, technical losses and risks of faults and blackouts, as well as contributing to existing and new balancing services.

70. The ability of large electrical loads to respond to supply-side shortages is a relatively mature process, but new services are becoming available for smaller customers who can enter into the balancing market using third party providers such as ENERNOC, which supports many demand response programmes in the US by aggregating smaller customers, including commercial buildings, into virtual power plants. Commercial buildings respond, for example, by manually lowering non-essential lighting, adjusting air conditioning or heating, perhaps shutting down some lifts and making other minor adjustments that do not affect the overall performance or comfort of the building. In return, they receive a payment from the demand response programme.

71. Other European countries also operate mature demand response programmes that target electricity consuming devices, such as electric hot water heaters, that can cause demand

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[13] https://www.ofgem.gov.uk/ofgem-publications/87053/electricitysettlementlaunchstatement.pdf

[14] https://www.ofgem.gov.uk/ofgem-publications/85912/directiontobscpanelonmodificationp272.pdf

spikes but which can be normally deferred at times of peak demand. Such 'Ripple Control' systems, used in France and commonly in Eastern Europe, send messages down power lines to switch electric water heaters on or off to manage their load without unduly impacting customer comfort.

72. Typically, demand side response and virtual power plant programmes are most effective in markets where there is a high delta between the average load and the peak load on an electricity system, including countries where there is a very high air conditioning load (the USA, Australia) or a high electric heating or hot water load (France, New Zealand). In the UK, the peak electricity load is on a winter's evening – the 2013 peak of 55,734MW was recorded at 5.30pm on 23rd January. This compares to an average system load of 35,324MW for 2013. This peak load is principally recorded due to the cold, dark weather and the arrival of people home from work. There may be some scope for this whole system load to be partially avoided by a demand response from the commercial building sector, but the case is not as compelling when compared to countries with a higher summer peak load.

73. Of more value may be managing local constraints within the distribution network, particularly in networks where there is a high penetration of onshore wind or solar PV. In this scenario the distribution network operator could offer incentives to non-domestic customers to respond to supply-side shortages, although this response would need to be automated, unlike the current virtual power plant services, and respond according to some pre-set limits (i.e. not all the lifts in a building could be turned off). The complexity and cost of such a system means it is not yet being implemented commercially, although increasing intermittency of generation will change the economics of it over time.

74. Standards, such as OpenADR, have also been developed which aim to facilitate widespread adoption of automated demand response systems which can control smart appliances in the home. The smart metering system will allow consumers to connect Gateway Devices, which will allow such systems to access consumption and tariff information directly from smart meters; a Gateway Device could act as a hub for a Home Energy Management system. Companies in the UK are already designing such hubs which can support multiple communications standards.

Innovation routes to market

Utilities – natural owners of this innovation?

75. In many ways utilities are the natural delivery route for smart meter enabled innovation in energy efficiency for non-domestic customers; however whether this will be successfully adopted is not yet clear. This is a strategic decision for the companies concerned; if and when they do get on board, then the delivery of innovation will be far easier. For many this will require a change of mind set and business model, which, while far from certain, is at least being investigated by some of the utilities interviewed by the Carbon Trust for this report, and could help utilities fix some of their current challenges including the deficit in customer trust and engagement. The first challenge is changing the business model; the second will be convincing customers of the change.

76. Currently, the UK's energy suppliers for non-domestic customers make more profit if they sell more energy. For example, the weather's impact on natural gas demand is recognised in utilities' financial results, with colder weather driving higher demand and higher profits and vice versa. This model needs to change, at least to some degree, if utilities are to be a significant route to market for smart-meter enabled innovation in energy efficiency. This could involve selling the energy commodity at cost, plus an energy efficiency service alongside it with a margin included; or some other change, such as bundling such services into supply contracts. It may be that new entrants into the market with a fresh and compelling proposition force incumbents to follow suit.

77. If utilities do decide to go down such a path, this could help to address their challenges around customer trust and engagement. The customer relationships that utilities have currently are numerous but shallow. This means that they have the market reach to take innovation to market effectively, and the rationale to deepen their customer relationships. For example, by delivering customised, actionable advice on reducing energy consumption, utilities could be able to engage their customers and win trust. This in turn could reduce customer churn, lower costs and pay for the cost of providing the service (e.g. software licenses and hardware they may need to install in the customer's premises).

Third parties could generate more trust but lack the market reach

78. Third parties such as brokers, energy consultants and EPC contractors play a significant role in the overall business energy market, but the perceived immaterial nature of energy costs for smaller businesses mean they have yet to create a significant footprint in this sector. This makes this route to market more challenging as new customer relationships need to be formed and SMEs will need to pay for a service that they may not value.

79. Customer disengagement, a lack of sales and marketing reach and limited returns for smaller customers means third parties will need to provide a very low cost or nearly-free service in order to generate significant SME uptake of innovative energy management services, or rely on significantly higher energy prices to drive demand.

80. For larger non-domestic customers who will tend to have a higher capability and incentive to invest in energy management, third parties have a significant role to play. In this sector the number of customer relationships is lower, and customers are likely to value the independence of a third party relative to their energy supplier where customers see a conflict

of interest. In this sector, it is interesting to note the relative lack of success that utilities have had in developing their energy services businesses compared to third parties. Ensuring that third parties have easy access to data via the DCC will facilitate this market to develop further.

Technology owners can target property portfolio organisations directly

81. Organisations that own large property portfolios (local and national government and commercial building landlords) could buy some of the services described in this report directly from vendors. In the USA, vendors of analytics and pattern recognition software have had some success with targeting federal, state and city governments directly and this could be a route to market for innovators to develop an early revenue stream. In the UK, the public sector's responsibility to take the lead on energy efficiency could help prove and validate more widely the commercial benefit of smart meter enabled innovation for non-domestic customers.

82. We have summarised the key areas of innovation that could be delivered for non-domestic customers by smart meters in Figure 9.

Figure 9: Smart meter enabled innovations for non-domestic customers

Innovation	Summary description	Data requirement
Power of attorney services	A replica of the current service available to domestic customers (via moneysavingexpert.com), where customers can elect to switch automatically when an offer becomes available that meets a pre-set annual saving. Smart meter data would improve the accuracy of the service and also enable further value-added services, e.g. advice about solar panels or insulation.	Half-hourly improves accuracy
Automated building performance evaluation	Comparing actual consumption data from smart meters to theoretical models of energy consumption, based on asset registers, can help to identify energy wastage.	Half-hourly
Analytics & pattern recognition	Software engines that are able to analyse smart meter data and other information on building occupancy, fabric and weather in order to provide customised, actionable energy efficiency advice to non-domestic customers	Half-hourly
Device disaggregation	A range of technologies that allow consumers to understand electricity consumption per device. For example, these technologies could inform customers about under-performing assets	10 seconds
Demand-side response	Smart metering infrastructure enables non-domestic customers to enrol in automated demand-side response programmes, especially if disaggregated devices can be turned off or switched down exploiting their latency.	Half-hourly

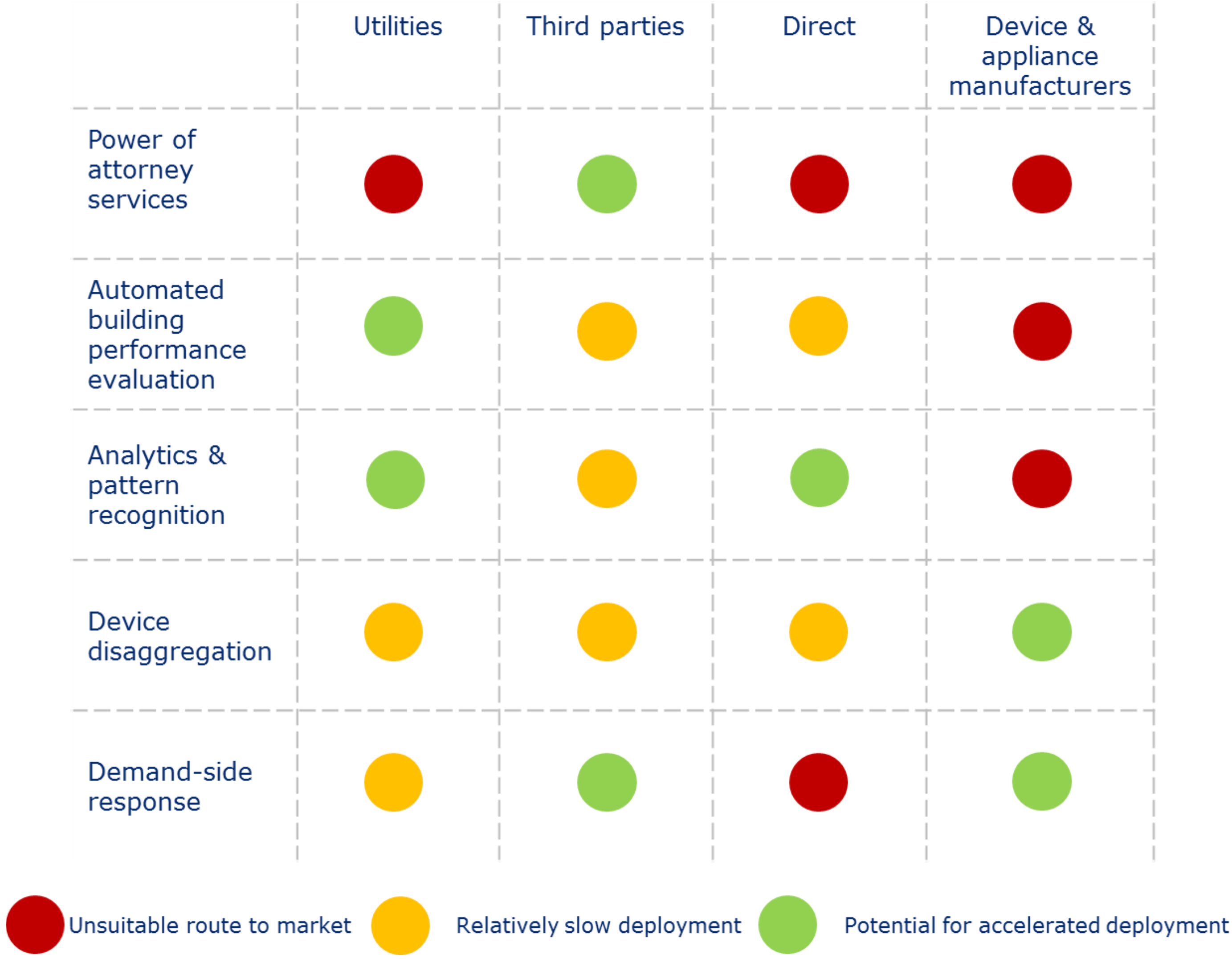
83. Inevitably, all these products and services – with the exception of power of attorney services – will be more attractive for larger energy customers where energy is more material to overall costs. It is unlikely, given the relative immateriality of energy costs compared to other costs, that a high proportion of SMEs will invest in paid-for services or products that would allow them to become more energy efficient. Therefore, innovative products and services would need to be very low cost, for example smart devices which need not cost more than regular devices, or be included in the overall cost of an energy contract. Larger customers

are more likely to make investments to help them minimise their energy costs and may prefer to make these via a third party if they do not trust their energy supplier to give them appropriate advice.

84. Therefore, routes-to-market are critical in assessing how and when innovative products and services may become available and what their uptake might be.

85. Figure 10 shows the available routes to market for each of the key innovative products and services we have identified during our research, combined with a “traffic light” assessment of the suitability and speed of each route per service.

Figure 10: Available routes to market for innovative products and services for non-domestic customers



86. ‘Power of attorney’ services[15] for business could be developed now, especially for small customers that have relatively simple, comparable products for both electricity and gas. The version for domestic customers run by moneysavingexpert.com is successful due to the site’s reputation for impartiality and getting the best deal for the customer. A non-domestic version would need the same impartiality and value, thereby breaking away from the current energy broker model where energy suppliers pay a commission to brokers for new custom

[15] See the recent report by Ctrl-Shift for Ofgem ‘The Changing Consumer Empowerment Landscape’ for a description of this approach.

which can lead to partial outcomes. A revenue model for such a service could include a membership fee, or a fixed switch fee each time a customer is switched to a better deal.

87. Utilities are in the best position to accelerate the deployment of energy efficiency tools such as automated building performance evaluation, analytics and pattern recognition due to their market reach and ability to bundle such services within a retail energy product. Indeed, one utility told us that it was actively engaged with a software developer from the USA to develop a service for non-domestic customers based on data analytics. Whilst third parties may enter the market to deploy such services we would not expect them to be deployed quickly due to their relatively small market reach (compared to utilities) and the need for them to recover the cost of such services from customers.

88. In the domestic sector, E.ON has deployed OPower technology in order to launch its “Saving Energy Toolkit”, which allows customers to compare their energy consumption to similar E.ON customers in their area and to assess their energy consumption using theoretical models. The economic rationale is that the “Saving Energy Toolkit” will improve customer retention and lower total customer acquisition costs, which covers the cost of the software purchase and the lost sales via the energy efficient behaviour it supports in customers. Utilities interviewed during this research indicated that this economic model could be applied to the non-domestic sector. One utility also told us that they knew of an energy supplier in New Zealand that had paid for OPower software by savings achieved from its marketing and advertising budget.

89. Low cost device disaggregation technology is coming to the market. During this research we interviewed two technology developers that were in the process of commercialising both software and hardware for device disaggregation. The first was developing software that could be embedded in a smart meter that could identify the fingerprints of different electricity consuming devices in response to the need for smart meters to provide benefit to non-domestic customers in the Netherlands. This developer had the technology installed in 40 non-domestic sites, which have demonstrated double-digit electricity savings.

90. The other technology developer was a UK company that had developed a low-cost chip that could be installed in a device – or a device cable – that could measure energy consumption and communicate with a home-area-network (HAN). The chip would cost device and appliance manufacturers around £1 per unit.

91. The last-mentioned company was also working on a low-cost switch that could be installed in a power cable that could be used to switch the device on and off. The very low cost nature of this technology means that it could be very attractive for device and appliance manufacturers to install it, or something similar, in their devices. This technology, in turn, would potentially facilitate the development of automated demand-side management programmes run by utilities or third party providers. Current demand-side management programmes use manually driven responses such as adjusting heating and cooling controls or turning off lifts. By automating, for example, air-conditioning controls across thousands of units, a significant DSR contribution could be achieved when there are supply-side constraints either driven by high demand periods or low production from variable renewable generation.

Development pathways

92. Figure 11 outlines the possible development pathways for the commercialisation of the technologies our research has identified, together with the barriers and key target sectors. Whilst it would have been desirable to forecast uptake rates, this has not been possible given the uncertainty associated with each pathway and the different nature of each technology and it’s respective routes to market. The timing column in Figure 6 relates to our

best estimate for the launch and partial uptake of the service amongst non-domestic customers.

Figure 11: Development pathways for innovative products and services for non-domestic customers

	Development path	Route-to-market	Timing	Supply-side barriers	Demand-side barriers	Target sector
Power of attorney services	Accelerated	Third party	2015-16	• Desire of Personal data store companies to enter non-domestic sector • Good quality pricing engine	• Credibility of broker community with respect to commissions	Small and micro non-domestics
Automated building performance evaluation	Accelerated	Utilities	2015	• Good quality building data • Current utility business model	• Perceived accuracy • Complacency	Larger non-domestics & groups
	Gradual	Third party	2018-19	• Lack of market reach	• Upfront cost for customer	
Analytics & pattern recognition	Accelerated	Utilities	2015-16	• Current utility business model	• Lack of trust in utility • Perceived conflict of interest	All-non domestics
	Accelerated	Direct	2018-20	• Lack of market reach	• Cost of the service	
	Gradual	Third party	2018-20	• Lack of market reach	• Upfront cost for customer	
Device disaggregation	Accelerated	Device & appliance manufacturers	2015-16	• Device and appliance manufacturers prove hard to convince	• Relatively slow uptake of new appliances and devices • Cost of energy hub	All-non domestics
	Gradual		2020 onwards			
Demand-side response	Accelerated	Third party	2015-16	• Lack of market reach	• Inability of customers to defer load • Incentives are too low to encourage participation	Larger non-domestics & groups
	Gradual	Utilities	2018-19	• Lack of incentive for retail utilities		

93. The timing for device disaggregation differs from the other services as the potential for uptake depends on the specific technology solutions adopted (use of the <10 second consumption data available over the HAN, smart plugs or technology implanted in cables) and will also depend upon the asset renewal schedule for non-domestic energy customers.

Conclusions and recommendations

94. Our research has identified five key innovation areas that could provide significant value for non-domestic customers. Our key conclusions are:

- It is very important that smart meter data is accessible at a low cost for third party or direct providers of innovative products and services. The stakeholders interviewed for this report highlighted the need for smart meter data to be available via Application Programming Interface (API). The Carbon Trust is satisfied that this will be available via the DCC or CADs at a reasonable cost, although some uncertainty remains around those customers that are operated outside of the DCC systems.
- Innovative products and services could help support energy management by smaller non-domestic customers more effectively than the provision of basic data analysis and charting. Time-poor smaller businesses are less likely to be prepared to analyse or interpret smart meter data or pay for experts to do this for them. New products and services described in this report could help overcome such barriers.
- Automated building performance evaluation can help eliminate waste. Theoretical energy consumption models can be built for any building using an asset register, fabric information and weather data. These models can be compared against actual consumption information from smart meters to identify wasted energy.
- Customised, actionable advice can engage even the smallest of customers. The analysis of smart meter data with other data items such as building location and weather data can be combined to provide customised, actionable advice to non-domestic energy customers. Whilst the EU-mandated Energy Savings Opportunity Scheme (ESOS) will require all non-SMEs to have a physical energy audit, data analytics could support remote audits at a much lower cost, making them available for SMEs.
- “Tell them how much they can save.” Innovative products for non-domestic customers, particularly those that provide customised, actionable advice, should tell non-domestic customers how much they could save or what the payback period would be if they follow a specific piece of advice.
- Device disaggregation and the Internet of Things can provide new solutions. Technologies that fingerprint and measure the energy consumption at a device level can provide a further layer of insight and advice for non-domestic energy customers. Eventually, Internet of Things enabled appliances and devices could facilitate optimising the energy performance of a building.
- Based on the interviews conducted, we are more sceptical of the economics for non-domestic customers enrolling in virtual power plant demand response programmes prior to 2020. This is due in part to nature of electricity demand in the UK, compared to other countries where these services are currently being provided, and in part due to the relatively low penetration of intermittent renewables in the UK. Where these services do emerge, they are likely to start at the distribution network level in networks with a higher proportion of onshore wind or solar PV, or via third parties that manage to attract a significant number of non-domestic customers with profile class 3 and 4 meters. We have two key recommendations that could help to unlock this innovation potential, which are outlined at the end of the report.

- Whilst utilities are the natural route-to-market for smart meter enabled innovation, there is a conflict of interest with their existing business models, as they currently generate higher profits from higher sales. However, some utilities are looking at the use of innovative technology to increase customer engagement and reduce churn and therefore costs. Whether and when this shift in business model is likely to happen is still far from certain.
- Most, but not all, innovation is likely to benefit larger energy consumers first. However, these services and technologies could trickle down once they will become more firmly established within this market. The more smart meter data can enable the provision of practical, targeted and actionable recommendations to small businesses, the more likely small businesses will be to act.

Demonstrations are needed to prove certain technologies in the UK

95. We believe that additional support for innovation in some key technologies could accelerate the innovation process in preparation for the main roll-out of smart meters to SMEs between 2015 and 2020. Steps could be taken to demonstrate and validate the innovative technologies outlined in this report particularly focusing on:

- Analytics and pattern recognition;
- Device disaggregation; and
- Automated demand-side response

These would provide valuable insights as to the maturity of these technologies, and the development pathways to ensure they become both viable from a market perspective and deliver maximum benefits to customers.

96. There are various ways that demonstrations could be promoted by an appropriate funding body. Two initial suggestions are:

- Consortia of technology owners, building owners/energy users and utilities could be invited to compete for funding to support technology demonstrations.
- For analytics and pattern recognition, an additional prize could be offered to consortia whose remote audits are the most accurate when compared to physical audits undertaken by independent, accredited ESOS assessors.

Further investigation about building data is needed

97. The availability and accessibility of data concerning buildings was beyond the scope of this study and warrants further investigation. Whilst it would be possible for building owners and energy users to provide information about their building in order to optimise the innovative services outlined in this report, the lack of access to central sources of such data may act as a barrier for their widespread adoption by non-domestic customers. One US provider of analytics and pattern recognition software claims that it only needs one year's worth of interval consumption data and an address in order to offer the service, and the Carbon Trust's understanding is that centralised building information, particularly in certain cities, is more readily available and of a higher quality in the US than in the UK.

98. DECC has made a start to this with its ND NEED (Non Domestic National Energy Efficiency Data-Framework) database, although it remains somewhat incomplete. The database currently encompasses buildings that account for approximately 30% of non-domestic electricity consumption and DECC hopes to improve its coverage by undertaking work to

improve the database's address matching. DECC's report on the subject[16] notes that although a high level of consistency between energy consumption, floor space and data from the Display Energy Certificate programme is observed in the database, the sample size is small and non-representative so more work must be done to validate the data.

99. The availability of quality, accessible, centralised building information in the UK therefore needs to be assessed and opportunities for improvement identified. With funding from the Government-funded Green Construction Board, the UK Green Buildings Council is currently undertaking a scoping study[17] into operational energy use data availability and barriers, which seems relevant to this task. Indeed, the technology demonstrations outlined above, if successful, could provide evidence for a cost-benefit analysis of how building information could be collected and managed centrally in the UK, thereby enabling the efficient uptake of innovative solutions to energy management.

Innovative products and services will only be attractive to consumers if they deliver benefits

100. Whilst the analysis of some barriers to energy efficiency in the non-domestic sector were beyond the scope of this report, they are pertinent to the uptake of innovative products and services. The split incentives between landlord and tenant where the cost of energy is recovered via the services charge will be one of the most significant barriers to uptake, and this should be addressed by government if widespread success in this sector is to be achieved.

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[16] https://www.gov.uk/government/publications/the-non-domestic-national-energy-efficiency-data-framework-nd-need

[17] http://www.ukgbc.org/content/understanding-operational-energy-use

Appendix 1 – electricity profile classes

Profile Class 1 – Domestic Unrestricted Customers

Profile Class 2 – Domestic Economy 7 Customers

Profile Class 3 – Non-Domestic Unrestricted Customers

Profile Class 4 – Non-Domestic Economy 7 Customers

Profile Class 5 – Non-Domestic Maximum Demand (MD) Customers with a Peak Load Factor (LF) of less than 20%

Profile Class 6 – Non-Domestic Maximum Demand Customers with a Peak Load Factor between 20% and 30%

Profile Class 7 – Non-Domestic Maximum Demand Customers with a Peak Load Factor Between 30% and 40%

Profile Class 8 – Non-Domestic Maximum Demand Customers with a Peak Load Factor over 40%

Profile Class 0 – Half hourly metered sites

Source: “Load Profiles and their use in Electricity Settlement” - ELEXON, 2013

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URN 15D/002