Expectations of DNOs & Willingness to Pay for Improvements in Service

Final Report

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Executive Summary

Research Objectives & Methodology

- This research has been undertaken to help inform the next price control period, DPCR5, which will run from 2010 until 2015.

- It had a number of objectives, chief of which were to determine domestic and business customer priorities and willingness to pay (wtp) for investments by the Distribution Network Operators (DNOs).

- The research was initially addressed through qualitative research, which consisted of 16 deliberative groups (8 domestic and 8 with small businesses) and 16 face-to-face depth interviews (8 with large/medium businesses and 8 with vulnerable customers). This informed the design of the quantitative research, in particular, determining which attributes and levels should be tested in the stated preference.

- The qualitative research was followed by 2154 in-home interviews covering a broad range of domestic consumers. 1052 business telephone interviews were also conducted covering a broad range of companies.

Background Findings

- The research showed that, overall, 45% of the domestic sample had experienced a power cut in the past 12 months; slightly fewer businesses (38%) stated that they had experienced a power cut in this period.

- On average domestic consumers believed they had experienced 1.9 unplanned cuts in that timeframe, whilst businesses believed they had experienced 2.3 cuts. The average duration cited by domestic consumers was 74 minutes and by business customers was 145 minutes.

- Seven percent of domestic consumers and 9% of businesses had experienced planned cuts in the previous twelve months. On average domestic consumers believed they had experienced 1.2 planned cuts in that timeframe, whilst businesses believed they had experienced 1.4 planned cuts. The average duration cited by domestic consumers for planned cuts was 99 minutes and by business customers was 128 minutes.

- There was only limited contact with distributors when cuts occurred, although more businesses made contact than domestic consumers.

- Awareness of standards was very low, particularly amongst domestic consumers where 7% were aware of GS2 (cf 14% of businesses), 4% were aware of GS2A (cf 7% of businesses) and 10% were aware of GS4 (cf 15% of businesses).

- Almost half of the domestic consumers (45%) and 55% of businesses felt that distribution companies should be doing more to reduce their impact of severe weather on their network.

- Over half of domestic consumers (56%) and almost three quarters of business respondents (71%) felt that distribution companies should be doing more to reduce their company's impact on the environment.

Stated Preference Analysis

- Stated preference choice experiments have been successfully undertaken to provide detailed valuations on how domestic and business customers value a range of potential improvements and deteriorations in the distribution of their electricity services. Respondents have reported that they have been able to undertake the SP choice exercises and the model outputs are highly significant.

- Each respondent participated in three SP exercises trading off detailed electricity distribution service improvements and price. Each respondent also participated in a fourth experiment trading off blocks of services and prices, which was designed to allow measurement of the extent of any packaging or aggregation effects.

- Analysis of the lower-level and package experiment have indicated substantial adjustments in the willingness-to-pay values obtained from the lower level experiments, with larger adjustments to the domestic model valuations compared to the business valuations. We have recommended that the adjusted values be considered by Ofgem.

- The report contains a detailed presentation of the valuations for each attribute for each DNO. Key findings include:

  - Replacement of equipment and vehicles with alternatives using less polluting fuels was valued as the most important attribute for domestic customers, undergrounding of 5% of overhead lines in areas of outstanding natural beauty and national parks for amenity reasons was also valued highly by non-London DNO customers;

  - Domestic customers also value reductions in the time to restore the electricity supply and reductions in power cuts very highly;

  - Business customers value reductions in the time to restore the electricity supply most highly, but replacement of equipment and vehicles using less polluting vehicles and reductions in power cuts were also valued highly by these customers;

  - In relation to communication with their DNO, respondents valued call backs to provide information updates the most, followed by a helpline for customers reliant on medical equipment. Text messages to provide information updates were valued least amongst the information options tested;

  - No significant valuations for compensation were identified for business customers.

- The following table shows the total maximum willingness-to-pay for the largest service improvements investigated in the stated preference survey for London (LPN) and non-London DNOs. Average values have been used across DNOs in the table whilst DNO-specific values have been obtained in the detailed analysis, in some

cases. For domestic users, the values are presented as pounds on their annual electricity bill. For business users, the values are presented as the percentage increase in their bill. The table also contains the maximum willingness-to-pay values reported by customers when asked how much they would be willing to pay for a whole package of the best electricity distribution service available. These values are substantially lower than those obtained from the detailed stated preference models, which explicitly test the value of each individual attribute. This is typical and expected, as asked directly, with less context, respondents are more prone to decline to pay much more. The value of the stated preference is that it sets each of the possible improvements (and potential price increases) in context both with existing performance and gives a broader picture of the entire distribution service. As a consequence, the stated preference results are considered more robust than the contingent valuation results, whereby respondents were asked to report the maximum that they would be willing to pay for the best electricity distribution service available. The directly reported values from contingent valuation would serve as a lower limit for sensitivity tests, if desired.

Table 1: Valuations for maximum improvements for all attributes for domestic customers (£)

	Non-LPN	LPN
Reduction of 3 cuts in 5 years (non-LPN) and 10 years (LPN)	£2.41	£4.04
Reduction to average duration of cut by 20 mins	£1.60	£1.20
Reduction of 2 short interruptions in 5 years (non-LPN) and 10 years (LPN)	£1.64	£0.69
Provision of call backs, texts etc.	£1.06	£0.52
From 18 hours to 6 hours for restoration of supply	£4.29	£1.54
Fixed and variable compensation levels improved	£1.00	£0.50
Compensation after multiple interruptions (4 interruptions to 3)	£1.47	£0.41
Notice for planned interruptions from 2 to 5 days	£0.81	£0.43
Undergrounding of 5% of overhead lines in areas of outstanding natural beauty & national parks for amenity reasons	£4.36	
20% reduction in number of customers affected by storms	£1.83	
Number of sites exposed to flood risk reduced from 1000 to 850 sites	£1.32	£2.37
Replace 10% equipment & vehicles with those using less polluting fuels	£5.43	£4.54
Total	£27.23	£16.24
CV Responses	£9.11* or £12.52**	£9.50* or £11.55**

*** = including 0s; ** = excluding 0s**

- And the following valuations for maximum improvements for all attributes for business customers:

Table 2: Valuations for maximum improvements for all attributes for business customers (% bill)

	Non-LPN		LPN	
	SM	**L**	**SM**	**L**
Reduction of 3 cuts in 5 years	1.7%	1.4%	3.8%	1.4%
Reduction to average duration of cut by 20 mins	1.0%	0.8%		
Reduction of 2 interruptions in 5 years	1.1%	0.1%		
From 18 hours to 6 hours for restoration of supply	6.5%	7.2%	7.7%	2.9%
Fixed and variable compensation levels improved				
Notice for planned interruptions from 2 to 5 or 10 days	0.3%	0.3%		
20% reduction in number of customers affected by storms	1.4%	1.1%		
Number of sites exposed to risk reduced from 1000 to 850	0.5%	0.4%		
Replace 10% equip & vehicles with those using less polluting fuels	2.1%	1.7%	2.4%	0.9%
Provision of advice to improve energy efficiency	0.7%	0.5%		
Provision of call backs, texts etc.			1.9%	0.7%
Total	15.3%	13.4%	15.7%	6.0%
CV Responses	SML 8.4%* or 11.7%**		9.3%* or 13.2%**	

*** = including 0s; ** = excluding 0s**

- In our opinion, the valuations are reasonable, when compared with previous studies and the contingent valuation results. We recommend that the SP-based (weighted) valuations be used in the DPCR5 process.

1. INTRODUCTION

1.1 Background & Objectives

Ofgem, as the industry regulator, administers a price control regime which ensures DNOs can, through efficient operation, earn a fair return after capital and operating costs while maintaining an appropriate level of service and limiting costs passed onto consumers.

As input to the next price control negotiations, OFGEM commissioned Accent and RAND Europe to undertaken research to provide an understanding of:

- consumers' experience and satisfaction with the quality of service they receive;
- the areas of quality of service, environmental and social outputs that consumers value and their relative priorities amongst these;
- consumers' awareness of the guaranteed standards, their views on improvements or extensions to the guaranteed standards, their relative priorities for improvements and their willingness to pay for such changes;
- consumers' expectations regarding planned and unplanned interruptions to their electricity supply;
- consumers' expectations regarding notification of planned interruptions and of when they can expect to be restored after unplanned interruptions to their electricity supply;
- consumers' expectations regarding the resilience of their power supply to bad weather or other exceptional events and willingness to pay for improvements in this area
- consumers' views on the importance of undergrounding overhead lines, of improving network resilience to storms and flooding, and reduction of carbon emissions, as well as their willingness to pay for these;
- how expectations and willingness to pay for service improvements vary:
  - for different consumer groups such as domestic consumers, business consumers, and consumers in rural areas
  - for consumers within the different distribution service areas of each DNO; and
  - according to the quality of supply customers have experienced.

1.2 Background To RAND Europe & Accent

Accent

Accent was responsible for leading the management of this study, the drafting and analysis of the background elements of the research, input into the design of the discrete choice experiments (stated preference) and for conducting all of the fieldwork.

Accent is a full service MRQSA accredited research agency, with offices in London, Bristol and Edinburgh and the resources and equipment to undertake both qualitative and quantitative studies of significant size.

Accent is expert in research using trade-off techniques. The agency is the market leader in the use of stated preference research, a sophisticated form of conjoint or trade-off research. Accent staff have been instrumental in the introduction and development of the technique in the UK, and have conducted many hundreds of studies using these methods for high profile clients in transportation, utilities, telecommunications, retail, healthcare and financial services sectors, among others.

RAND Europe

RAND Europe was responsible for the research to address this last objective. To quantify consumer's willingness to pay for service improvements, stated preference discrete choice experiments have been undertaken with residential and business consumers of electricity. In these experiments, consumers have been asked to choose between alternative hypothetical electricity distribution services, which differ in the quality of specific service attributes and cost. Discrete choice models have been developed from these data to provide estimates of the willingness-to-pay for different service improvements. This report describes the design of the choice experiments and the modelling analysis leading to the recommended willingness-to-pay values.

RAND Europe is an independent not-for-profit policy research organisation that serves the public interest by improving policymaking and informing public debate. Our clients are European governments, institutions, and companies with a need for rigorous, impartial, multidisciplinary analysis.

1.3 Acknowledgements

Accent and RAND Europe would like to acknowledge the contributions of the OFGEM team and the industry stakeholders who provided guidance at a number of key points in the research.

2. METHODOLOGY

2.1 Introduction

Qualitative Research[1]

This report focuses upon the conduct and findings of a comprehensive phase of quantitative research with domestic and business consumers. However, it should be noted that this followed a comprehensive programme of qualitative research (which has been previously reported), which consisted of:

- 16 deliberative groups:
  - 8 with domestic consumers
  - 8 with small businesses

- 16 face-to-face depth interviews:
  - 8 with large and medium businesses
  - 8 with vulnerable customers.

This informed the design of the quantitative research; in particular, determining which attributes and levels should be tested in the stated preference.

Quantitative Research

This research, which forms the focus of this report, comprised stated preference interviews with both domestic and business consumers across England, Wales and Scotland. Stated preference discrete choice experiments (DCE) provide an analytical method for understanding and predicting how individuals will choose between discrete (mutually exclusive) alternatives; for example, whether to travel by bus or train. It is a technique that has been widely used in transport economics and is increasingly used in environmental and health economics.

Within the DCE framework it is possible to investigate and quantify the importance of specific drivers of customers' choices. These modelling techniques provide empirically-derived data for making informed decisions, providing insight into the trade-offs that customers are prepared to make; for example, how important an improvement in the time take to restore power after a power cut is compared to investment to reduce carbon emissions or the risk of flooding.

The use of Stated Preference (SP) DCE data enables researchers to quantify and understand how customers would choose between different service packages. SP data also has many useful statistical properties; for example, because the

[1] "Expectations of DNOs and Willingness to Pay for Improvements in Service, Stage one: Qualitative Report" December 2007, www.ofgem.gov.uk

researcher controls the choices that are presented to respondents, correlation between explanatory variables can be reduced or limited, and a wide range of variations in explanatory variables can be tested. The technique is also data efficient: more than one choice scenario can be presented to respondents within one interview. Its one drawback, however, is that such data are based around what individuals state they would do in hypothetical situations, although substantial effort has been spent to present realistic alternatives. Stated preference procedures are recommended by the UK Treasury Green Book for valuing public sector services when no revealed preference data are available.

In a SP discrete choice experiment, hypothetical choice situations – where each alternative in the choice set is described by a set of attributes (average number of power cuts, average duration of power cuts, etc) - are presented to each individual. Each of the attributes in the experiment is described by a number of levels. The attribute levels are combined using principles of experimental design to define different service packages, which respondents evaluate in surveys by choosing one of the alternatives within the choice situation, dependent upon the levels offered and their own personal preferences. Of key interest for this study is the trade-offs that customers are prepared to make when comparing increases and decreases in electricity distribution service attributes with changes in bill size. This provides a measure of willingness-to-pay, which provides a quantification of the customer benefits to feed in to a cost-benefit analysis.

Box 1 describes in more detail the theoretical underpinning and statistical modelling for a discrete choice experiment.

Box 1: Theoretical background to modelling discrete choice data

Discrete choice models are used to gain insight into what drives the decisions that individuals make when faced with a number of alternatives. These models are constructed by specifying the range of alternatives that were available to the decision maker, and describing each of these alternatives with a utility equation which reflects the levels of each of the attributes that were present in the choice that they faced. Each term in the model is multiplied by a coefficient which reflects the size of its impact on the decision making process (Ben-Avika and Lerman, 1985; Train, 2003).

It is the model coefficients that are estimated in the model calibration procedure. The model is based on the assumption that each respondent chooses the alternative that provides him or her with the highest utility. An error term is included on each utility function to reflect unobservable factors in the individual's utility. The estimation can therefore be conducted within the framework of random utility theory ie accounting for the fact that the analyst has only imperfect insight into the utility functions of the respondents.

The most popular and widely available estimation procedure is logit analysis, which assumes that the error terms on the utilities are independently, identically distributed extreme value. The estimation procedure produces estimates of the model coefficients, such that the choices made by the respondents are best represented. The standard statistical criterion of Maximum Likelihood is used to define best fit. The model estimation provides both the values of the coefficients (in utility terms) and information on the statistical significance of the coefficients.

Additional terms and non-linear variations in the variables can be added to these utility functions, with the testing of the appropriate forms for the utility functions being an important part of the model estimation process. By examining different functional forms we can investigate whether different groups of respondents place different values on the attributes in the choices, and can also test whether there are certain groups of respondents that are more likely to systematically choose one alternative over another.

2.2 Domestic Interviews

Timescale

The domestic fieldwork was undertaken between 27 February 2008 and 6 April 2008. The interviews were conducted in the respondents' homes using CAPI (a computer assisted personal interview). The interviews lasted 27 minutes on average and respondents received a £5 Boots voucher as a thank you for sparing the time to take part.

Sample

The target for the total sample was 2100 interviews, 150 within each of the 14 DNO areas. Within each DNO area minimum targets were also set by age, in three categories (16-29 years, 30-49 years, and 50 and above), socio-economic groups (SEG), previous experience of cuts and fuel poor. Socio-economic groups (SEG) are a standard method of classifying households. They are defined by asking a standard classification question as follows:

> *What is the job title of the chief wage earner of your household or, if you are the chief wage earner, your own job title?*
>
> *What are/were his/her/your qualifications/responsibilities? PROBE*

Respondents are then classified accordingly using a comprehensive glossary which is shown in Appendix A.

A quota was also set on type of location (urban/rural), except for the EDF Energy Networks (LPN) area, which does not include any rural locations, to ensure adequate representation of all groups in the sample.

As interviews were conducted in the home and a cluster sampling method was used. Within each of the 14 DNO areas a large number of different sampling points were selected. The sampling points were selected by allocating the postcodes in the DNOs' area to either the rural or the urban category, and then selecting postcodes at random from each list to make up the number of sampling points required, aiming to have coverage in the North, South, East and West of each DNO area, as far as was possible. In some DNO areas this proved less easy than others, as postcodes which bordered more than one DNO could not be used in order to ensure that we knew for certain which DNO each customer was served by. A full list of the postcodes covered is shown in Appendix B.

Interviewers then recruited respondents house to house within the given postcode, using a random quota sampling method, which involved approaching every third address and recruiting on the doorstep using a short recruitment questionnaire to identify the decision-maker and to determine whether they fell

within the required quotas for the study. A copy of the recruitment questionnaire is included as Appendix C and the main questionnaire as Appendix D. Those agreeing to take part were then interviewed at that time or at a further appointment if more convenient.

In total, 2154 interviews were conducted with domestic consumers, against a target of 2100, some interviewers having slightly exceeded their targets. However, in order to ensure all data was representative of DNO customer spread by location, the sample was weighted by the given urban/rural splits for each DNO. As the given targets for urban and rural interviews added to 150 for each DNO, this weighting results in all of the data for each DNO presented in this section being based upon a base cell size of 150 interviews.

For each DNO area the targets set on SEG, experience of cuts, age and the fuel poor were as shown in Table 3. The same broad targets were set for each DNO, in the absence of specific customer profiling data being available by DNO for setting individual quotas. The targets were based upon the profile of the UK population as a whole.

Table 3: Residential DNO Quotas on SEG, Experience of Cuts, Age Group and Fuel Poor

	Target
SEG	
AB	Minimum 20
C1C2	Minimum 40
DE	Minimum 22
EXPERIENCE OF CUTS	
Yes	minimum 75
No / Can't Remember	no quota
AGE GROUP	
16-29	Minimum 18
30-49	Minimum 28
50+	Minimum 32
FUEL POOR	
Yes	Minimum 5-8
No / Don't know	No quota
TOTAL	**150**

The targets set on rural versus urban interviews were provided by the DNOs themselves and are as follows (this excludes EDF Energy Networks LPN who has urban customers only):

Table 4: Residential Urban/Rural Quotas by DNO

	% Splits		Actual Splits		
DNO	Urban	Rural	Urban	Rural	Total
CE NEDL	80%	20%	120	30	150
CE YEDL	82%	18%	124	26	150
Central Networks (East)	79%	21%	119	31	150
Central Networks (West)	80%	20%	120	30	150
EDF (Eastern)	77%	23%	116	34	150

EDF (London)	100%	0%	150	0	150
EDF (South East)	83%	17%	125	26	150
Scottish Power	85%	15%	127	23	150
SP MANWEB	81%	19%	121	29	150
SSE Hydro	63%	37%	94	56	150
SE Southern	82%	18%	123	27	150
United Utilities	90%	10%	135	15	150
WPD (South Wales)	73%	27%	110	40	150
WPD (South West)	64%	36%	95	55	150
Total			**1678**	**422**	**2100**

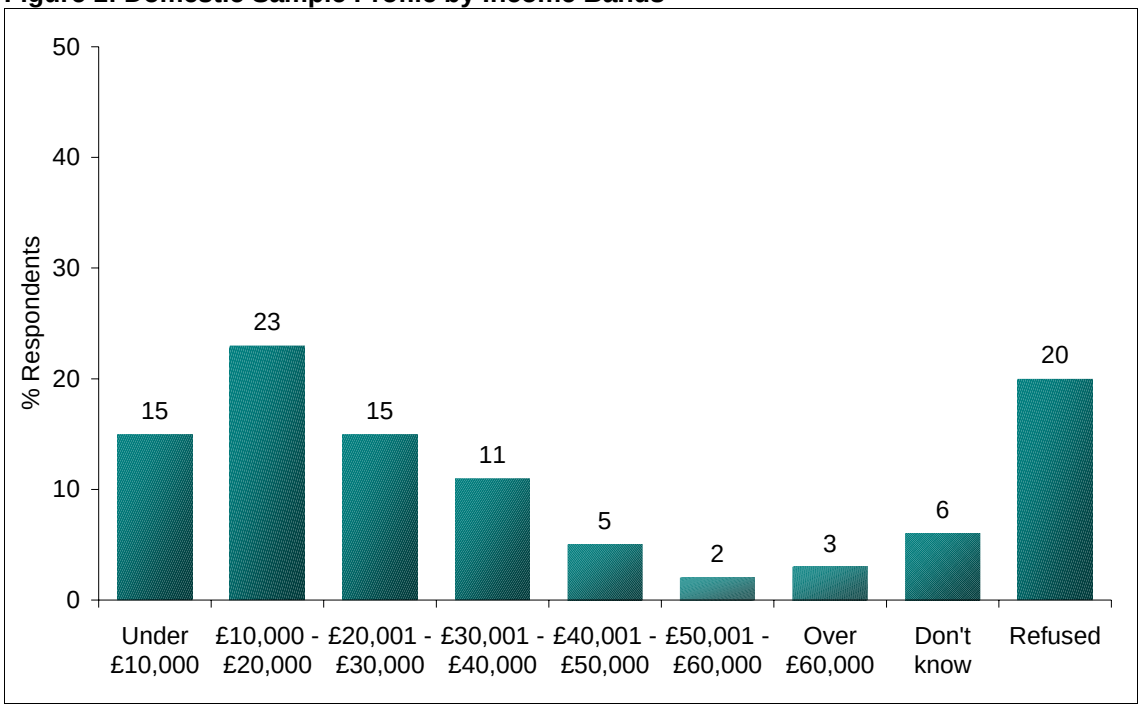
Interviews achieved were as shown in Appendix E. They are broadly in line with the quotas set, the key difference being in the number of fuel poor who were found through a relatively random sampling approach, this being 16% as opposed to an anticipated hit rate in the region of 4%. Other differences include:

- difficulties finding sufficient numbers who had experienced an unplanned power cut in the previous 3 years for EDF Energy Networks LPN, SSE Hydro, CE YEDL, CE NEDL and SP Distribution

- low incidence of ABs in the CE YEDL and WPD South Wales areas.

No quotas were set on household income, but respondents were asked to state their total household income, before tax and deductions, in order to assist in the stated preference analysis. The profile of the sample by income band is shown below.

Figure 1: Domestic Sample Profile by Income Bands



Base: all respondents - 2100

As getting hold of banded income data for the UK as a whole is extremely difficult, it is hard to know how close this profile is to the actual UK profile. However, the random methodology used should have resulted in a good distribution and figures that we have been able to source (albeit for taxpayers only, not for households) suggest this is probably a good representation, as does the known average household income for 2005 (all households) which was £28,210, compared to our estimated average of £24,050[2].

	Our Data **HMRC Data**	
Under £10,000 (for HMRC it is for taxpayers only, ie income from £5225 upwards)	15% 19%	
£10,000 - £20,000	23% 36%	
£20,001 - £30,000	15% 21%	
£30,001 - £50,000	16% 17%	
£50,000+	5%	7%

2.3 Business

The fieldwork was carried out between 27 February 2008 and 18 April 2008. Interviews were conducted by telephone from Accent's dedicated telephone units based in Bristol and Edinburgh using CATI (a computer-assisted telephone interview). Interviews lasted 25 minutes on average. There was no incentive for taking part.

Sample

The target for the total sample was 1050 interviews, 75 within each of the 14 DNO areas. Within each DNO area minimum targets were set by experience of cuts and company size, the latter measured by maximum demand or bill size, in three categories: large (over 1MW or £275,000 annual bill), medium (over 100kW or £30,000-£275,000 per year) and small (<100kW or <£30,000 annual bill). This was to ensure adequate representation of all groups in the sample.

The sample source was purchased from Sample Answers based upon postcodes provided by each of the DNOs. Sample was not purchased for postcodes which overlapped more than one DNO, as each interview was DNO-specific and we needed to ensure that the respondents were being asked to give their opinions based upon data which related to the DNO they were served by. Companies

[2] We say "estimated" average as respondents were only asked to provide this figure within a banded range. We have used the following to calculate this mean: £5k for <£10k, £15k for £10-£20k, £25k for £20k-£30k, £35k for £30k-£40k, £45k for £40k-£50k, £55k for £50k-£60k and £80k for over £60k. It could be argued that by selecting just £80k for the top level our mean is on the low side.

were selected at random from the given postcodes by the sample company and then again at random by Accent (using our interviewing software) from the sample lists for interview.

Respondents were recruited by telephone using a short recruitment questionnaire to identify the decision-maker for the organisation, establish whether they were in-scope for the study and obtain agreement for the further interview. The recruitment section of the questionnaire can be found at the beginning of the main questionnaire in Appendix F. Respondents were then sent – by post, fax or email – the show material relating to the stated preference exercise choices, and contacted at a prearranged time for the further interview to take place. The initial refusal rate was 91% (ie 9% of those contacted agreed to take part). The conversion rate between recruitment and interview was 38%. This conversion rate is slightly lower than typical (50%).

In total, 1052 interviews were conducted with business consumers against the target of 1050.

For each DNO area the targets set were as follows:

Table 5: Business Quotas

QUOTA	TARGET
Power Cuts	
Experienced in past 3 years	minimum 35
Not experienced in past 3 years	no quota
Size	
1MW+ or more than £275,000 spend	5-15
100KW-<1MW or £30,000-£275,000 spend	20-30
<100KW or <£30,000 spend	35+
Business Sector	
Representative spread	Min. 1 per sector
TOTAL	**75**

However, it should be noted that the size quotas were set as a guide only, as we have no information available to suggest what the size distribution is of businesses in each area, particularly bearing in mind that we were determining size according to energy usage rather than more standard splits such as turnover or employee numbers. By setting broad quotas it ensured that we had a good spread of business size in each DNO, whilst also aiming to reflect a representative spread of business size in each. The numbers achieved fit within the broad quotas set for large and small businesses in all DNOs.

However, fewer than 20 interviews were achievable with medium businesses (in terms of energy consumption) in the following DNO areas: CN West, EDF Energy Networks EPN, SSE Hydro, CE NEDL, WPD South West, WPD South Wales and SP Manweb. As a random sampling approach was being used, this "may" suggest that there are fewer medium sized businesses in these areas, in terms of energy consumption. However, this cannot and should not be taken as a statistically robust finding. The number of interviews achieved in each DNO area by size and experience of cuts, as well as the number achieved by business sector, are shown in Appendix G.

2.4 Questionnaires and Stated Preference Exercises

The recruitment questionnaire for the residential survey, the main residential questionnaire and the combined business recruitment and main questionnaire can be found in Appendix C, D and F. The show material can be found in the Appendix H.

The questionnaires included some background questions on electricity consumption and experience of cuts, and attitudinal questions about consumers' expectations in terms of quality of service and service standards. Awareness of three of the service standards was also measured.

The main part of the interview was a series of stated preference exercises, the methodology for which is described in Section 5.

3. DOMESTIC CONSUMERS' EXPERIENCE AND ATTITUDES

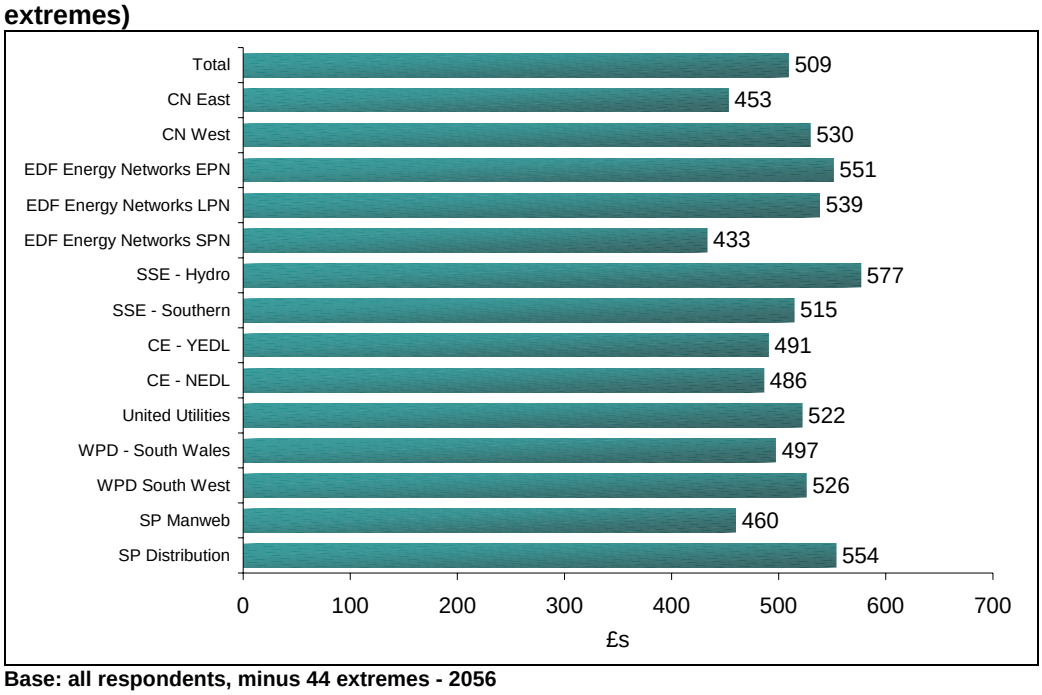
Please note that numbers in tables and figures may not add to 100% due to rounding.

It should also be noted that quotas were set on experiences of cuts to ensure, as far as possible, that at least half of the sample had experienced a power cut in the past 3 years. This was to assist in achieving robust data for those stated preference attributes that related to power cuts. As a consequence, statistics presented regarding experience of cuts should be taken as a reflection of the profile of our sample in this respect, rather than as a reflection of experiences as a whole, and are unlikely to tally with Ofgem's performance statistics.

3.1 Bill Size

As part of the interview, consumers were asked to state what they paid monthly, quarterly or annually for their electricity; where possible they were asked to check this against their latest bill. The average bill size reported was £509 (excluding the top and bottom 1% of extremes).

Figure 2: Average Domestic Customer Bill Size (excluding top and bottom 1% extremes)



Base: all respondents, minus 44 extremes - 2056

Despite excluding extremes, this average bill size still seems high and higher than the latest information Ofgem has for average consumption (ie 3300kWh/yr)

across standard tariffs for customers on standard credit, direct debit and pre-payment meters, which is shown below.

Table 6: Average Big 6 National Average Electricity Prices (£/yr) – 20.05.08

SC	412
DD	387
PPM	420

Assuming standard consumption of 3300kKWh per annum

We have examined the data to see if there is any obvious reason for the high bill figures. The possibility was raised that people giving a quarterly amount (who may be more likely to over estimate for the year by taking their latest winter bill as a typical bill) might be inflating the overall mean. However, although the mean for this group is slightly higher than the mean for those that gave an annual figure (£534 cf £509) there is not a big difference. In fact, it is those that knew their monthly amount (which we would expect to be most accurate, as it would be a known Direct Debit) that give the highest annual average of £574.

Another possible explanation is that customers on dual fuel tariffs have found it difficult to disaggregate the electricity element and have inflated it.

It is also possible that people with higher bills might be more interested in participating in research of this type. However, as far as profile is concerned – as far as we are able to determine – we seem to have a very representative spread of SEGs and income.

3.2 Experience of Cuts

Just fewer than half of the respondents (45%) reported that they had experienced any unplanned power cuts lasting more than 3 minutes in the past twelve months. It was higher in rural areas where 56% reported that they had experienced an unplanned cut versus 42% in urban areas.

Over 50% of respondents reported that they had experienced cuts in the following areas:

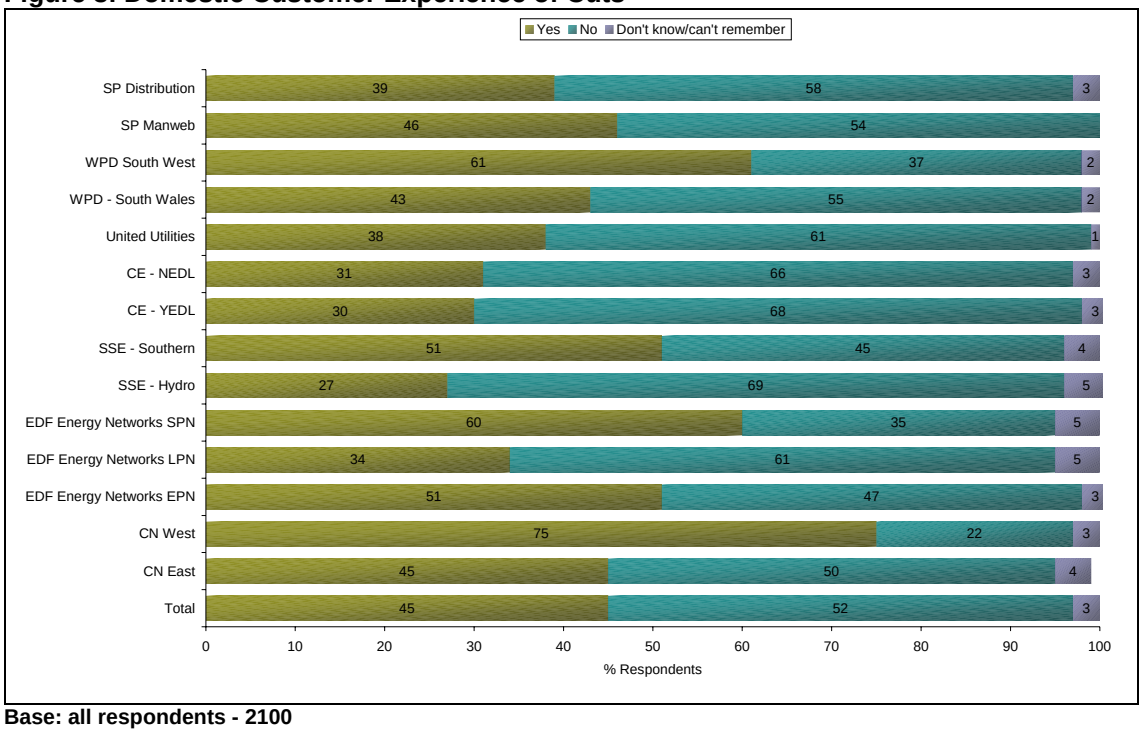
- WPD South West
- SSE Southern
- EDF Energy Networks SPN
- EDF Energy Networks EPN
- CN West.

The figures are particularly high for WPD South West and CN West. Given that this pattern is not also reflected in the business data (see Figure 22) it seems likely that these differences are due to us having to adopt a clustered sampling approach for the face to face domestic interviews, rather than using an entirely

random, geographically dispersed, telephone approach as for the business interviews.

Although a high number of different sampling points were selected for each DNO to aim to ensure as random and representative a sample as possible, this approach does run the risk of one or more areas being selected where a high number of people have experienced cuts within some DNOs and not in others. However, as minimum quotas were set on number of cuts experienced to ensure robust stated preference data, this has no impact on the robustness of the data. It does re-emphasize, though, the point made at the beginning of this section about the experience of cuts data being used as a guide to the profile of the people we were talking to, rather than as a guide to customers as a whole.

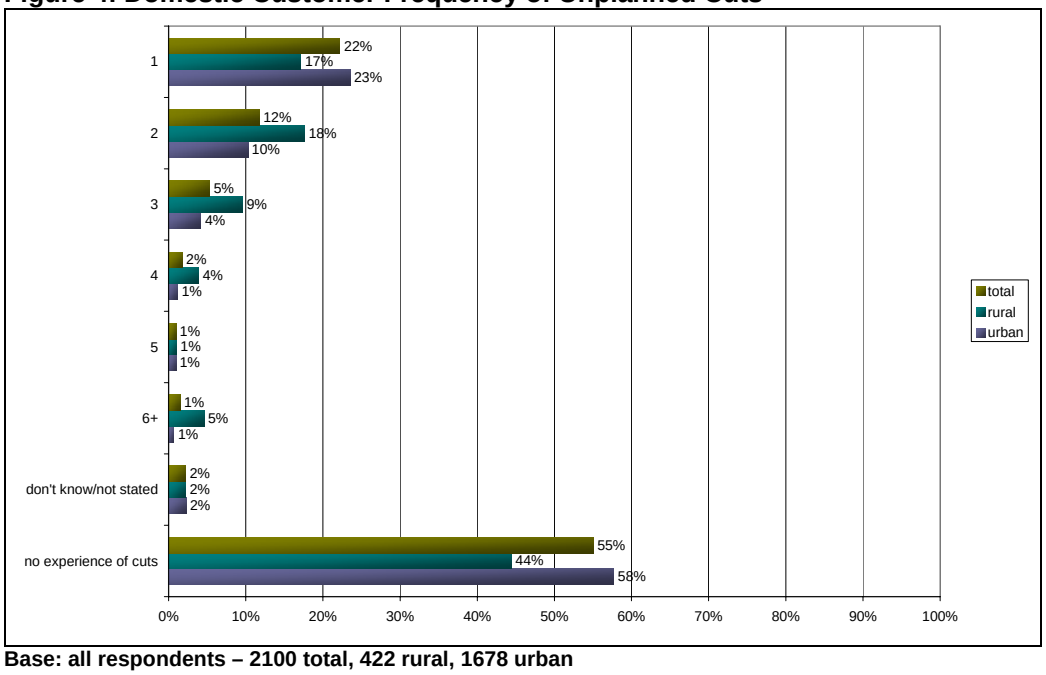
Figure 3: Domestic Customer Experience of Cuts



Base: all respondents - 2100

However, frequent cuts are rare; most consumers reported that they had experienced only one or two in the past year. Rural consumers were more likely to report that they have experienced more frequent power cuts than urban consumers.

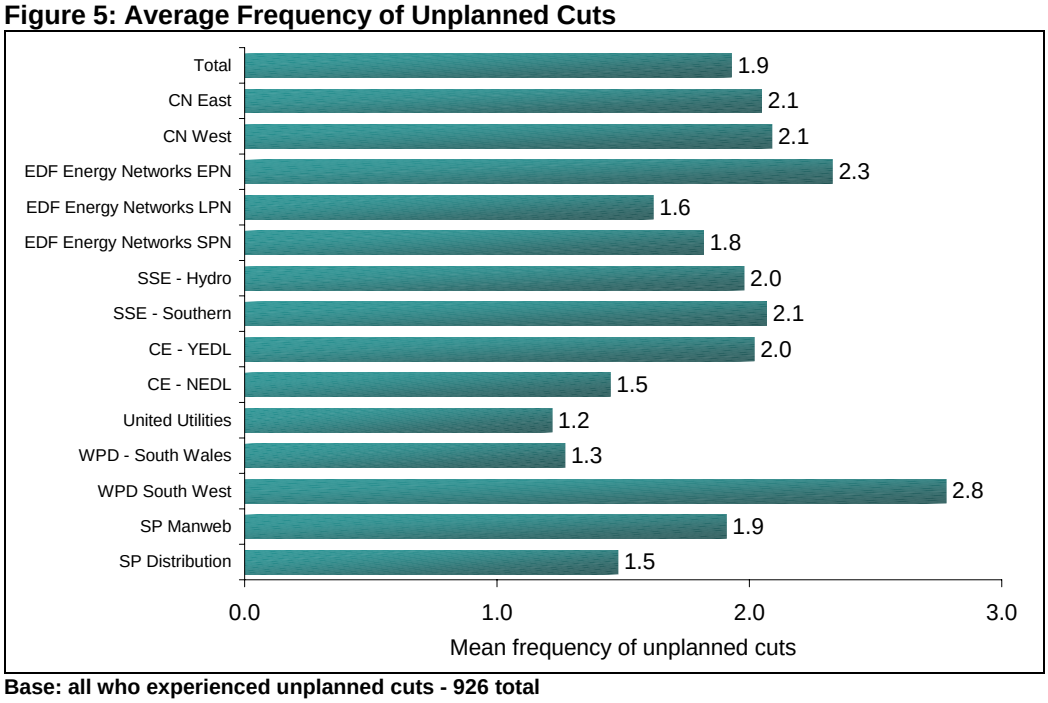
Figure 4: Domestic Customer Frequency of Unplanned Cuts



Base: all respondents – 2100 total, 422 rural, 1678 urban

The average number of cuts domestic customers reported that they had experienced was 1.9, with the highest average numbers for WPD South West and EDF Energy Networks EPN.

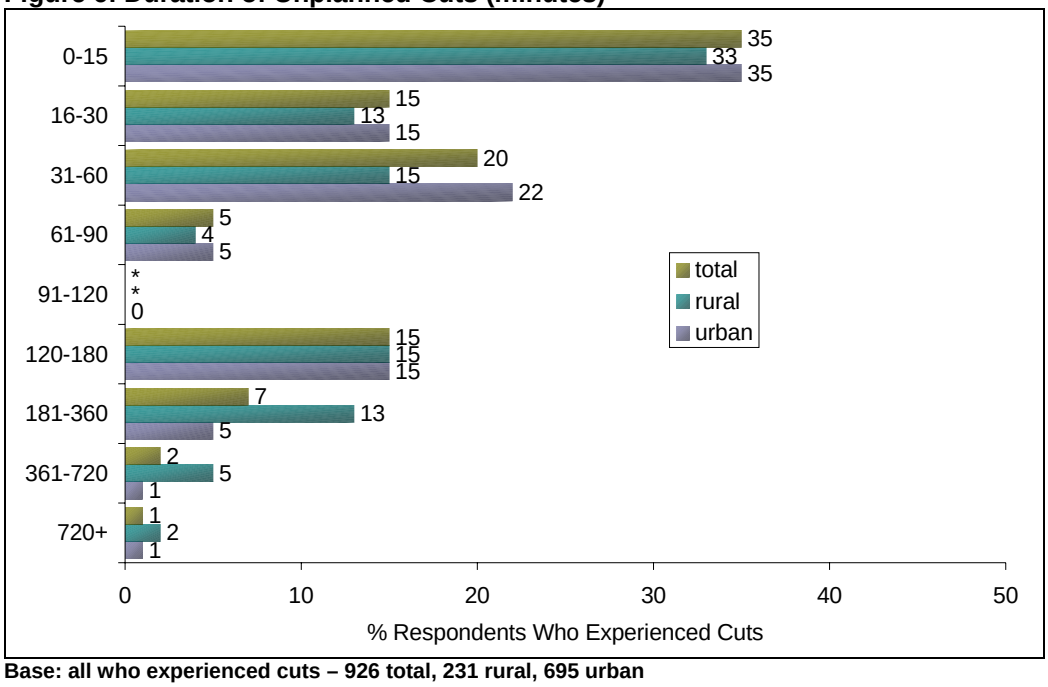
Figure 5: Average Frequency of Unplanned Cuts



Base: all who experienced unplanned cuts - 926 total

Rural consumers were also more likely to report that they had experienced longer cuts.

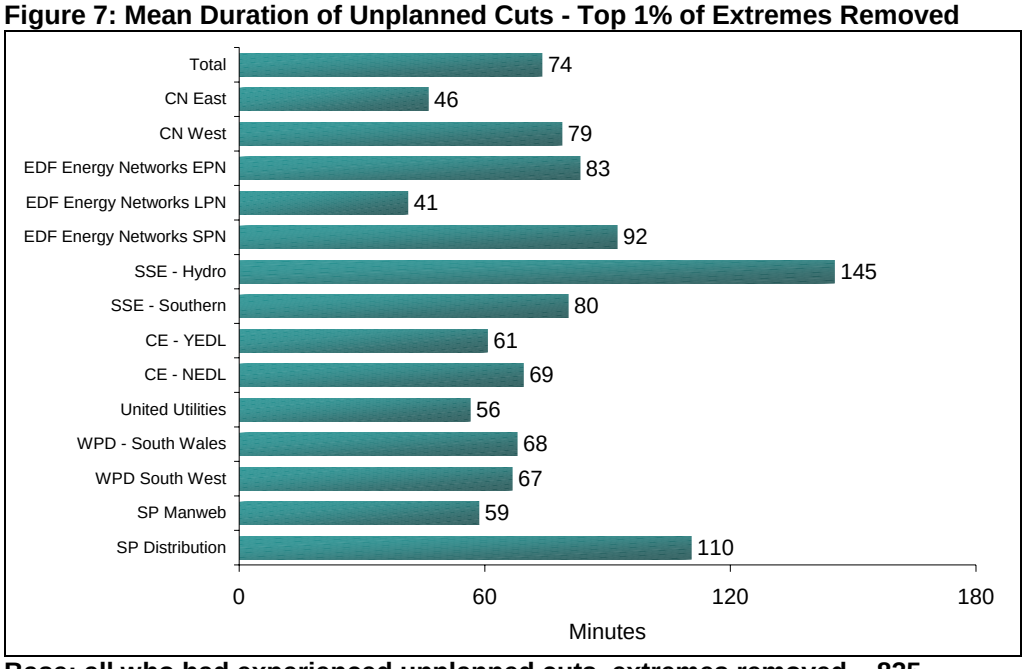
Figure 6: Duration of Unplanned Cuts (minutes)



Base: all who experienced cuts – 926 total, 231 rural, 695 urban
Note: * = less than 1%

The average duration, excluding the top 1% of extremes, was reported as 74 minutes, so approximately 1¼ hours. The longest average durations were perceived by customers of SSE Hydro and SP Distribution.

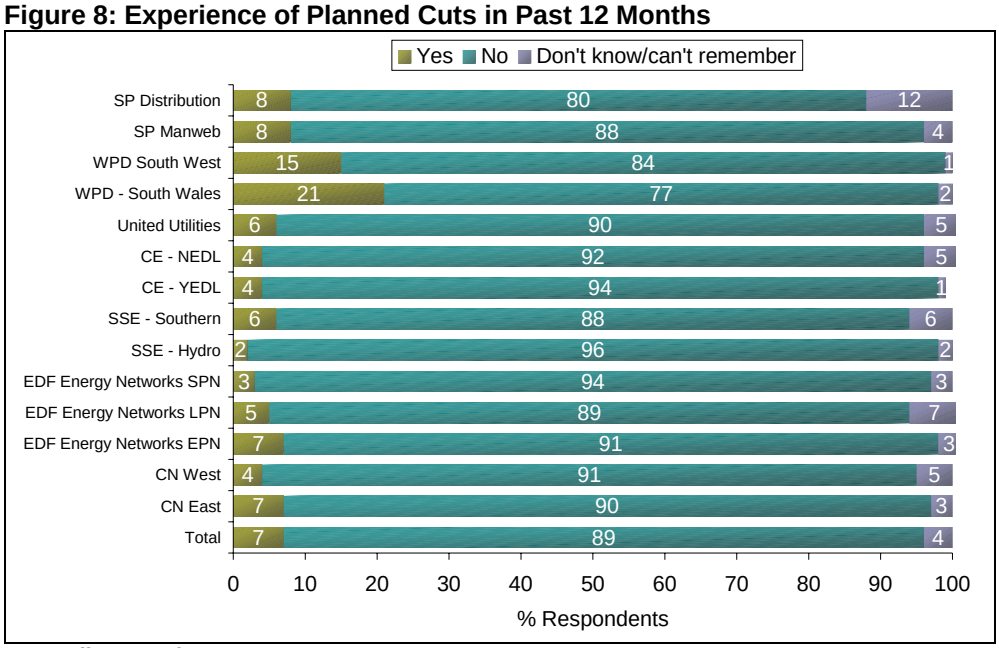
Figure 7: Mean Duration of Unplanned Cuts - Top 1% of Extremes Removed



Base: all who had experienced unplanned cuts, extremes removed – 835

Only 7% of consumers said that they had experienced planned cuts in the past year. However, consumers in the two WPD areas reported experiencing a much higher number than average.

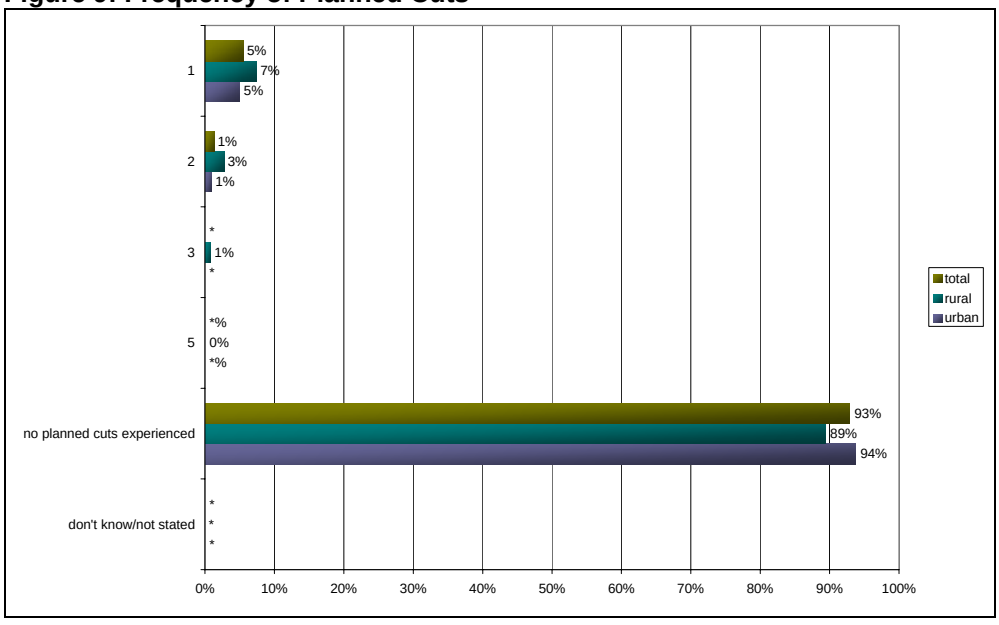
Figure 8: Experience of Planned Cuts in Past 12 Months



Base: all respondents – 2100

Those in rural areas were more likely to report that they had experienced a planned cut (11%) than those in urban areas (6%). Rural consumers were also more likely to report that they had experienced a higher number of planned cuts per year, although planned cuts rarely occurred more than twice a year and most typically just once.

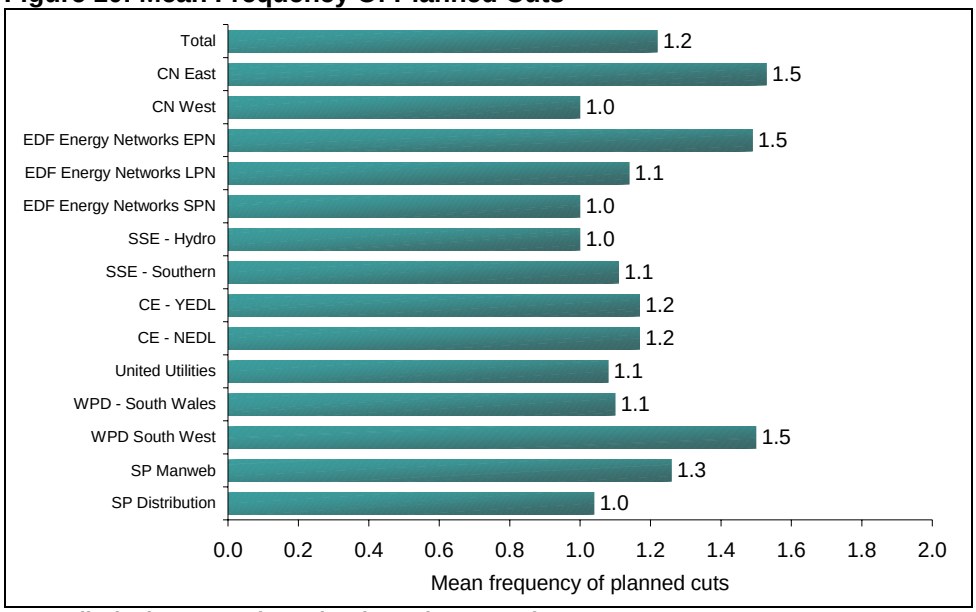
Figure 9: Frequency of Planned Cuts



Base: all respondents – 2100 total, 422 rural, 1678 urban

The average reported frequency of planned cuts was 1.2 in a twelve-month period, with frequencies being highest for CN East, EDF Energy Networks EPN and WPD South West.

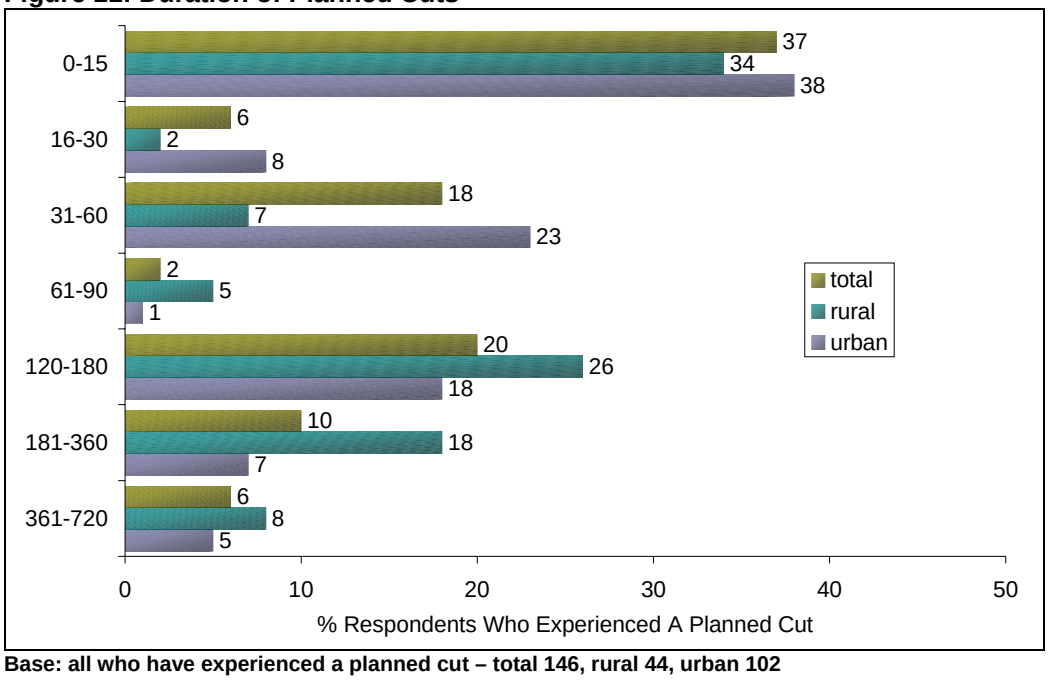
Figure 10: Mean Frequency Of Planned Cuts



Base: all who have experienced a planned cut – total 146

Rural consumers also typically reported experiencing lengthier planned cuts than urban consumers.

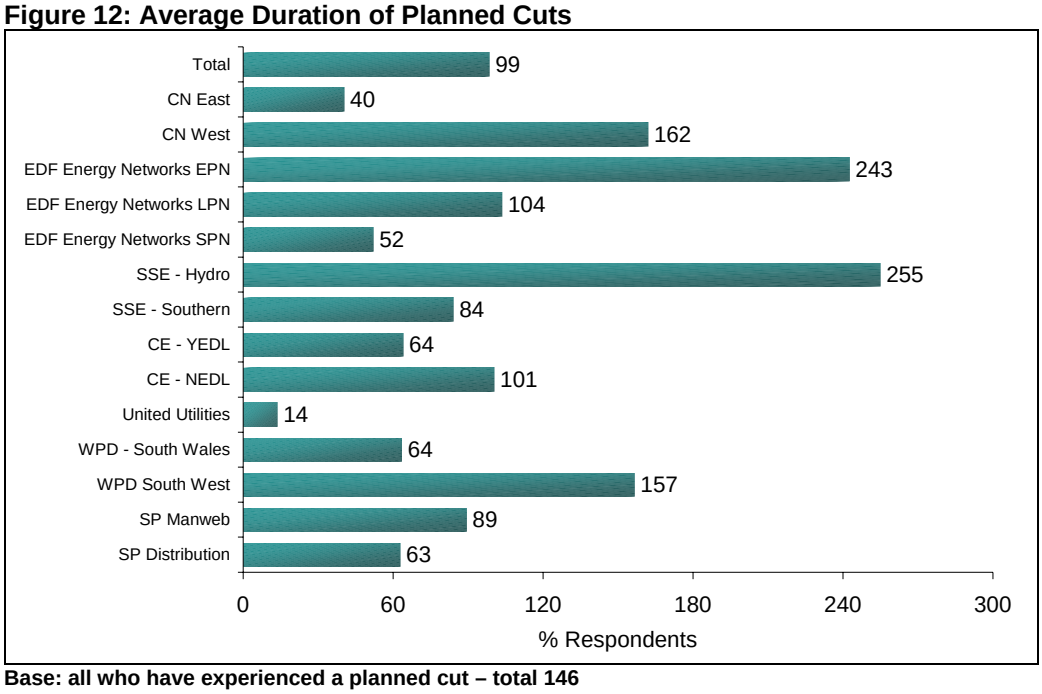
Figure 11: Duration of Planned Cuts



Base: all who have experienced a planned cut – total 146, rural 44, urban 102

The average duration of these planned cuts was reported to be 99 minutes, with considerable variations by DNO, as shown in Figure 12.

Figure 12: Average Duration of Planned Cuts

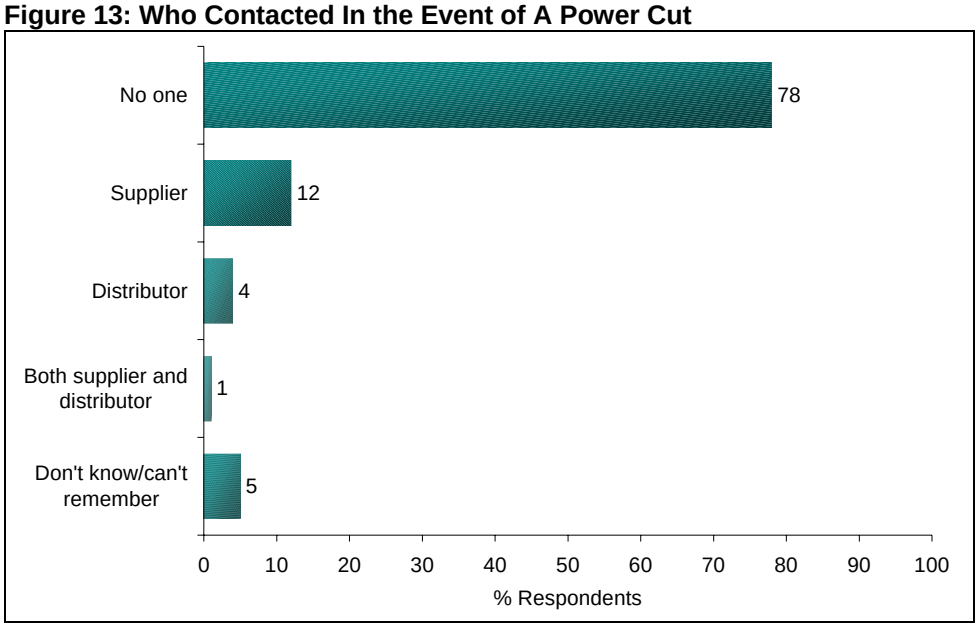


Base: all who have experienced a planned cut – total 146

3.3 Experience of Contacting Distributor During Power Cut

Most domestic consumers (78%) did not attempt to contact anyone when they experienced a power cut. Of the 17% who did, most (12%) believed that they had contacted their supplier rather than their distributor.

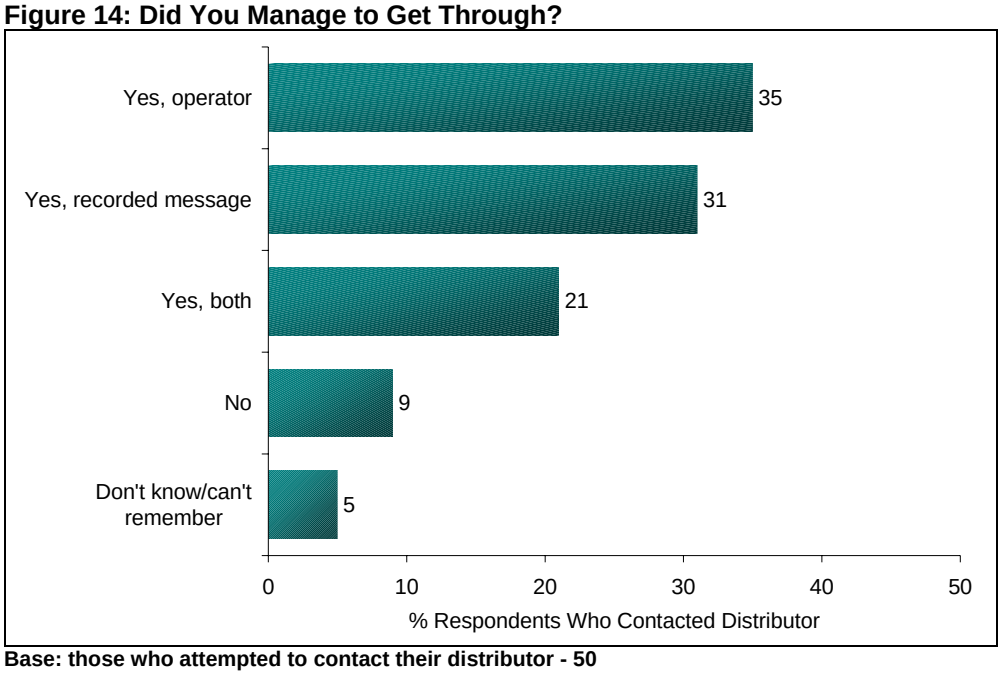
Figure 13: Who Contacted In the Event of A Power Cut



Base: all who experienced a planned or unplanned cut – 992 total

The vast majority (87% of the 5% that said they had contacted their distributor; n=50) of those who attempted to contact their distributor were able to get through, slightly more to an operator than a recorded message, with 84% in total getting all of the information they wanted.

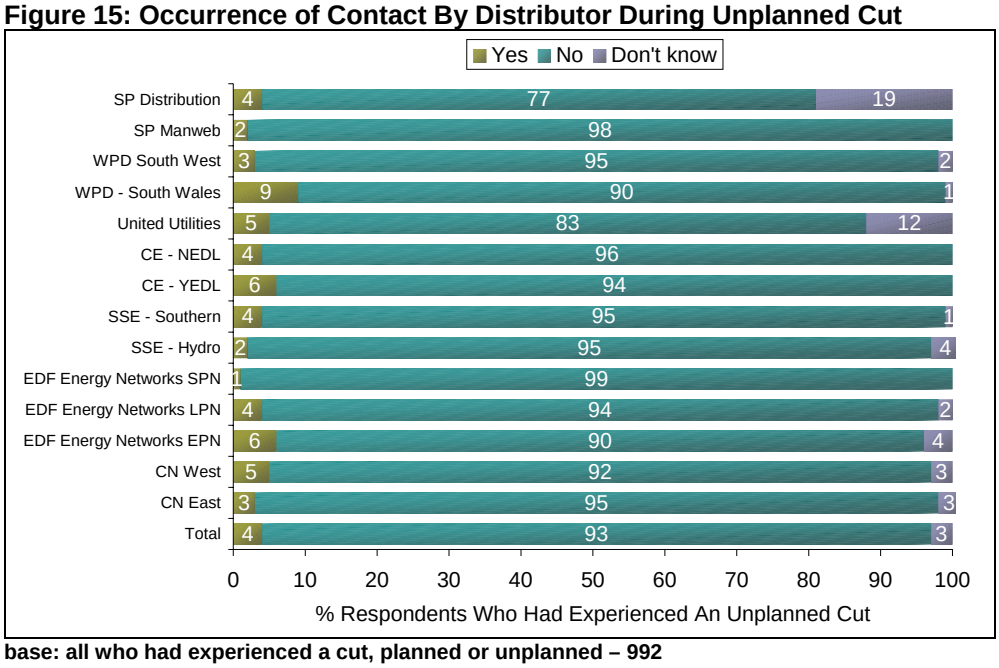
Figure 14: Did You Manage to Get Through?



Base: those who attempted to contact their distributor - 50

Only 4% who had experienced a power cut stated that they had ever been contacted or called back by their distributor during the unplanned cut.

Figure 15: Occurrence of Contact By Distributor During Unplanned Cut



base: all who had experienced a cut, planned or unplanned – 992

3.4 Awareness of Standards and Targets

Awareness of the standards currently in place is very low among domestic consumers. Less than 10% of consumers are aware of any of the standards.

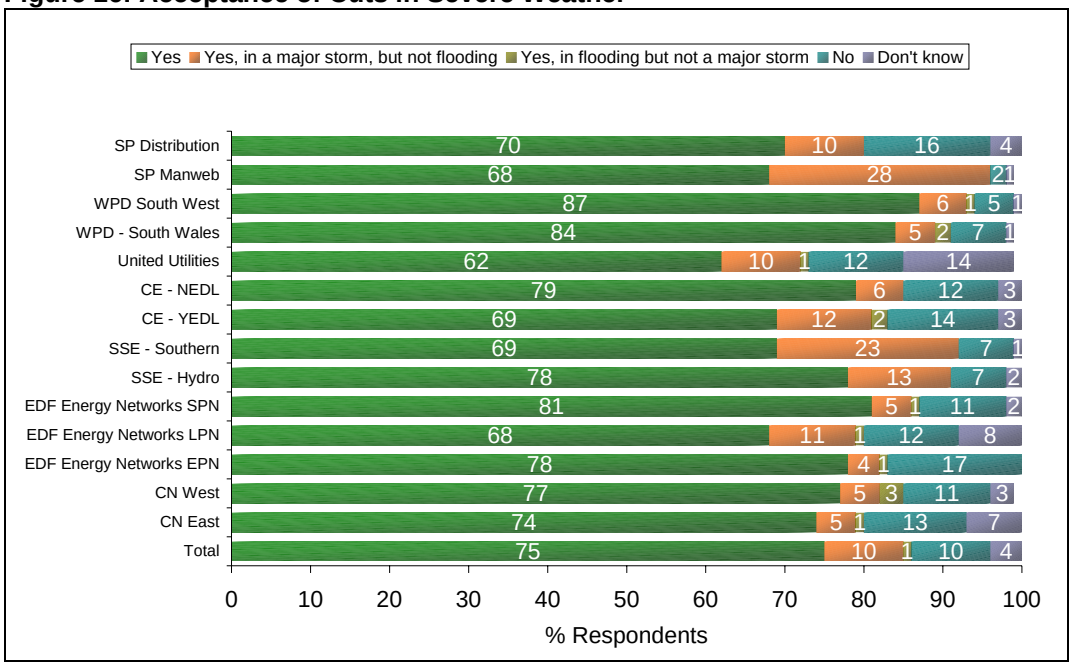
Table 7: Awareness of standards

Standard	% aware
If your electricity supply fails during normal weather conditions because of a problem on your distribution system, your distributor will restore it within 18 hours of first becoming aware of the problem. If they fail and you make a valid claim within three months of the date the supply is restored, they will arrange for you to receive a compensation payment. You will also receive further compensation for each additional 12 hours you are without supply.	7
If your electricity supply fails because of a problem on the distribution system and you are without power for three hours or more, on four or more different occasions in any single year (April to March) you are entitled to a compensation payment. You must make a valid claim for this payment within three months of the end of the year to which the claim applies.	4
If your distributor needs to switch off your power to work on the network they will give you at least 2 days' notice. If they fail to give 2 days' notice or switch your electricity off on a different day, then you can claim (within 1 month of the failure) a compensation payment.	10

3.5 Expectations of Quality of Service

The majority of consumers (75%) felt that it was reasonable for a power cut to occur in severe weather, ie a major storm or flooding. However, 10% felt it was reasonable in a major storm, but not in flooding.

Figure 16: Acceptance of Cuts in Severe Weather

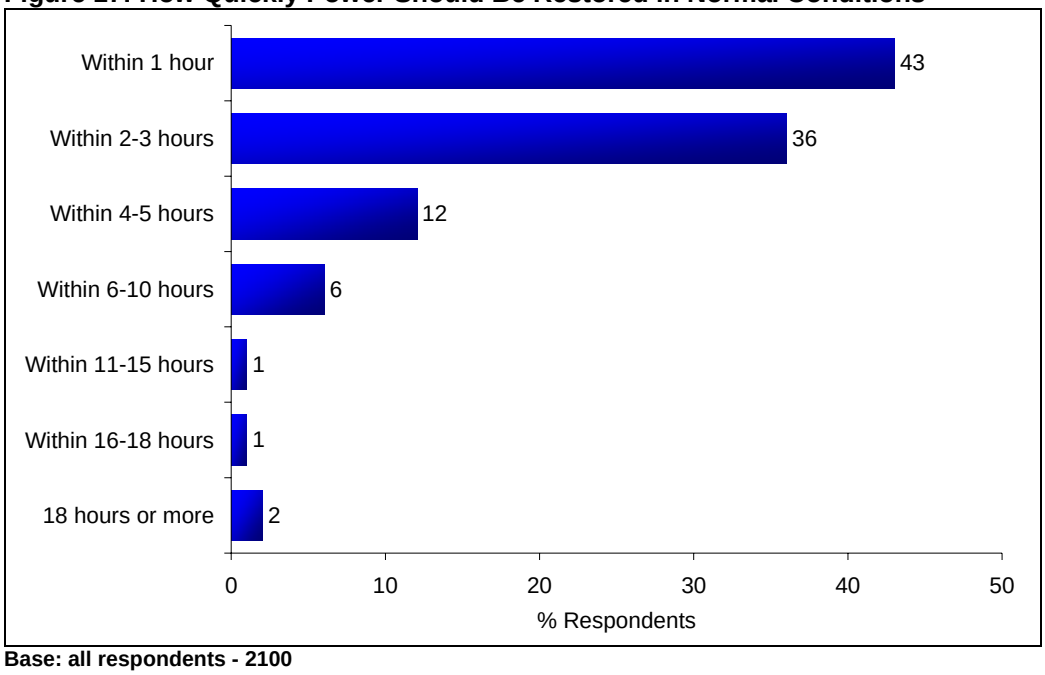


Base: all respondents - 2100

The results for the maximum number of cuts lasting more than 3 hours that they felt a DNO should be allowed in any one year before paying compensation show a small number citing 10 or more. However, as only a very small proportion (1%) cited such high numbers, we have excluded any saying 10 or above from the calculation of the average to avoid these responses unduly skewing the average. That done, the average number they felt should be allowed was 2.

Most (79%) felt that power should be restored within 3 hours. The current average UK duration is 1 and a half hours.

Figure 17: How Quickly Power Should Be Restored in Normal Conditions

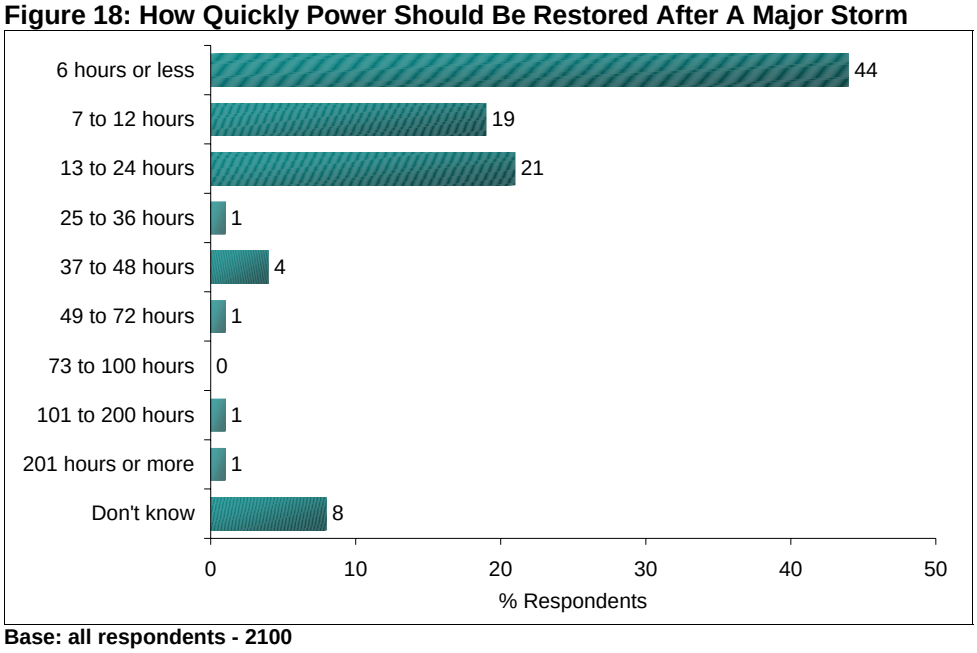


Base: all respondents - 2100

In normal conditions, it was felt that a distributor should be required to pay compensation to a consumer after an average of 8 hours. This mean has been calculated after removing the top 1% of extremes.

After a major storm affecting 100,000 customers, there were high expectations with respect to power restoration, the highest single proportion expecting it to be restored in 6 hours or less (44%), although a further two fifths felt within 24 hours was acceptable.

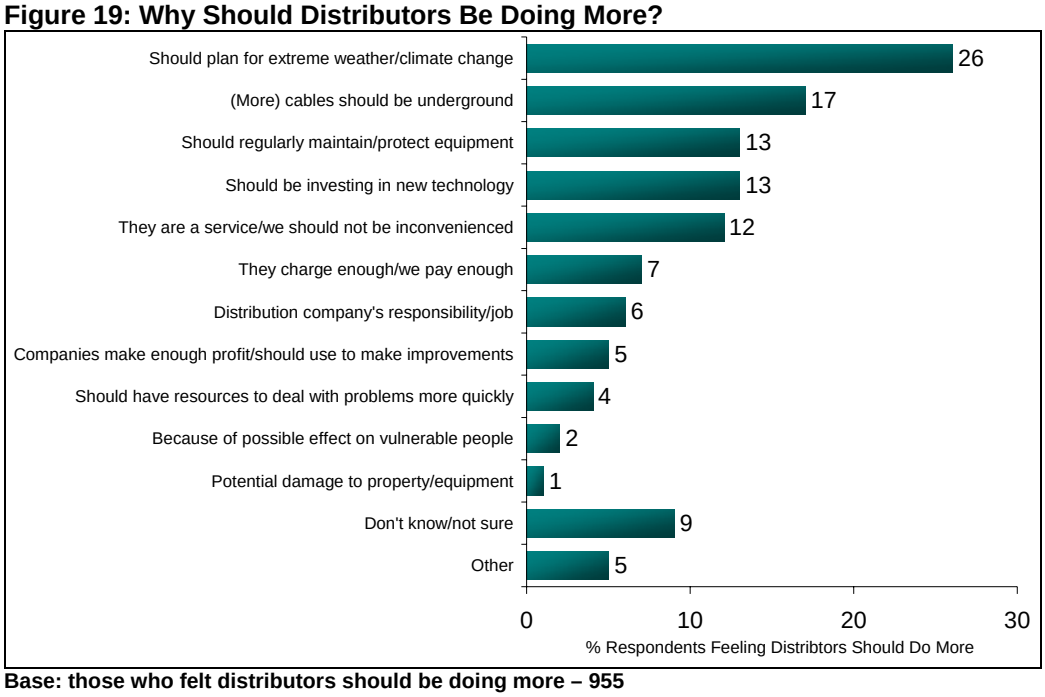
Figure 18: How Quickly Power Should Be Restored After A Major Storm



Base: all respondents - 2100

Almost half (45%) felt that distribution companies should be doing more to reduce the impact of severe weather on their networks, most talking about the need for planning against climate change and undergrounding cables.

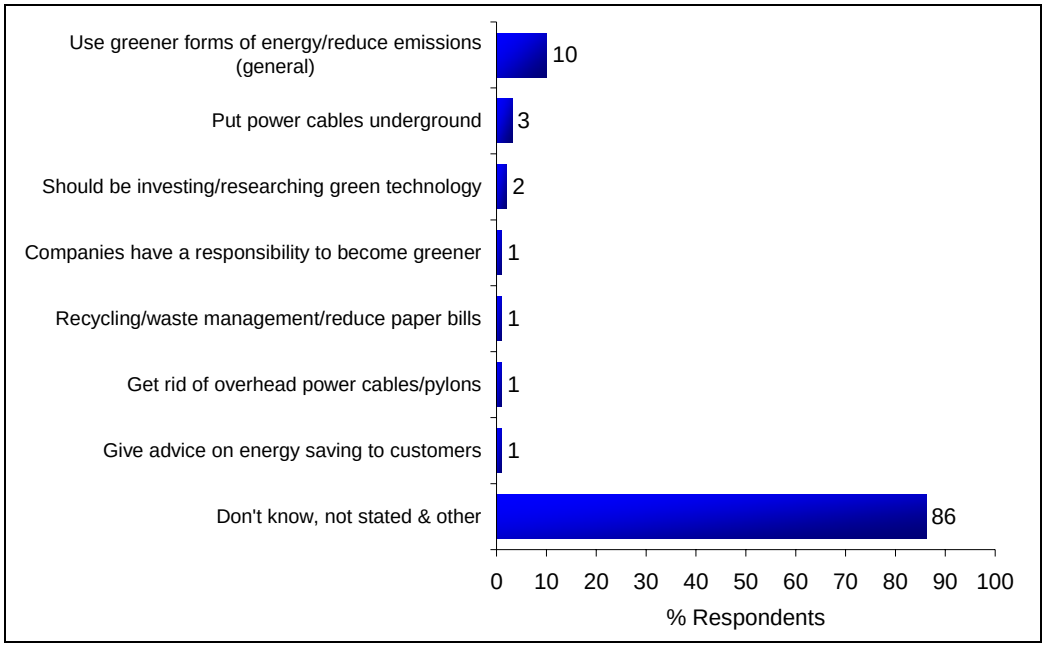
Figure 19: Why Should Distributors Be Doing More?



Base: those who felt distributors should be doing more – 955

Over half (56%) felt distribution companies should be taking steps to reduce their company's impact on the environment; few were able to say what.

Figure 20: What Distributors Should Be Doing To Reduce Their Impact On The Environment



Base: those who think they should be doing more – 1180

4. BUSINESS CONSUMERS' EXPERIENCE AND ATTITUDES

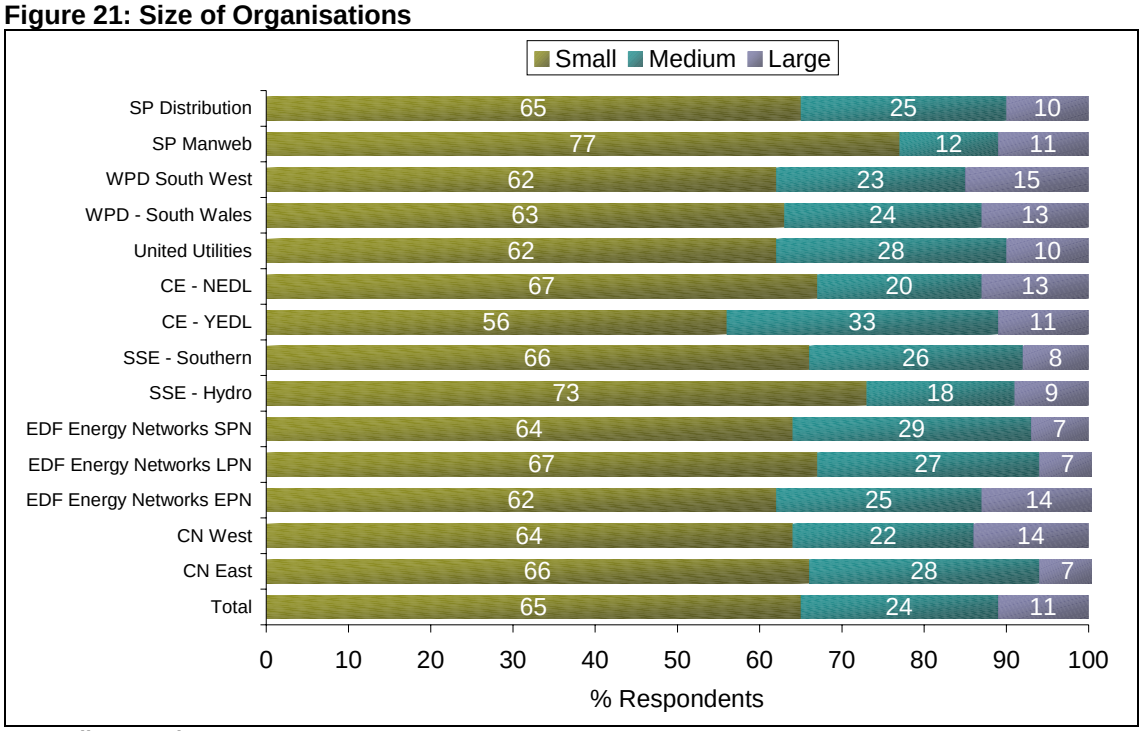
Please note that numbers in tables and figures may not add to 100% due to rounding.

Please also note that quotas were set on experiences of cuts to ensure, as far as possible, that at least half of the sample had experienced a power cut in the past 3 years. This was to assist in achieving robust data for those stated preference attributes that related to power cuts. As a consequence, statistics presented regarding experience of cuts should be taken as a reflection of the profile of our sample in this respect, rather than as a reflection of experiences as a whole, and are unlikely to tally with Ofgem's performance statistics.

4.1 Size of Organisations

The percentage of business consumers with large (over £275,000 per annum), medium (£30,000 to £275,000 per annum) and small (less than £30,000) bills is shown for each DNO below.

Figure 21: Size of Organisations

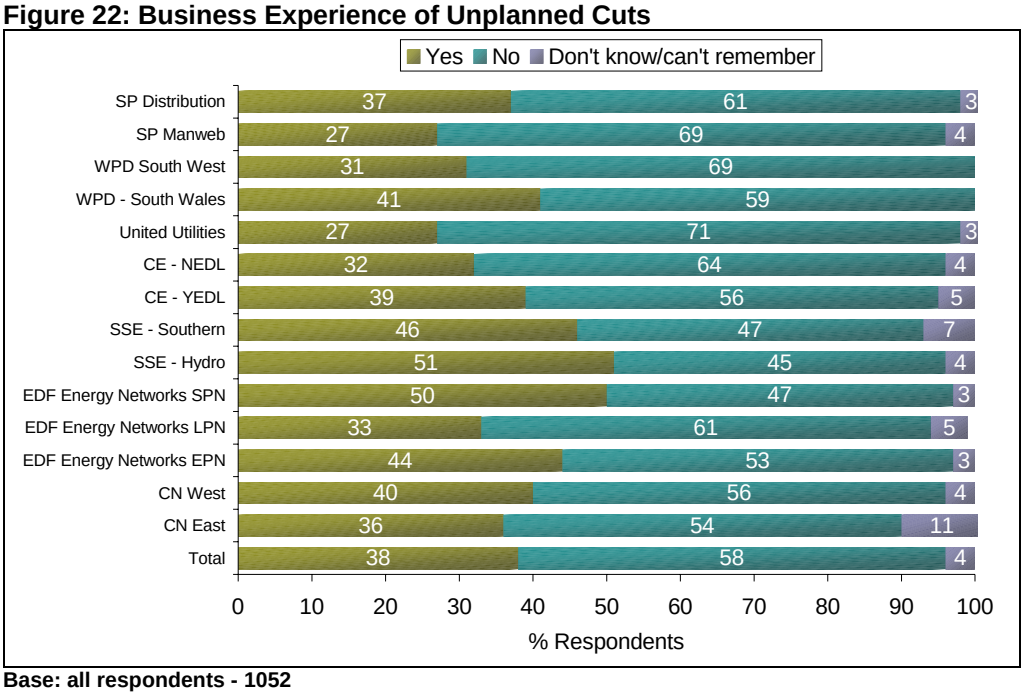


Base: all respondents - 1052

4.2 Experience of Outages

Roughly two fifths (38%) of organisations stated that they had experienced an unplanned cut in the past 12 months. However, it should be remembered that quotas were set to ensure, as far as possible, that half of the respondents had experienced a power cut within the past 3 years, in order to assist in producing robust data for those attributes of the stated preference that were related to outages. These figures should consequently be used to determine the profile of the sample base, rather than as an indication of experiences of the business market as a whole and are unlikely to tally with Ofgem's figures.

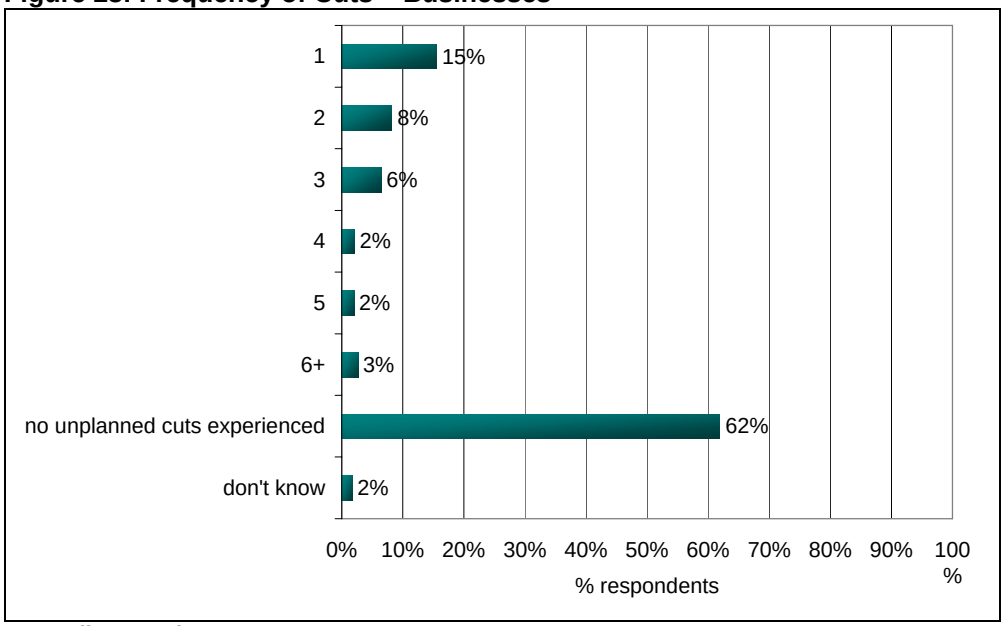
Figure 22: Business Experience of Unplanned Cuts



Base: all respondents - 1052

Businesses had typically experienced just 1 or 2 unplanned cuts in the previous 12 months.

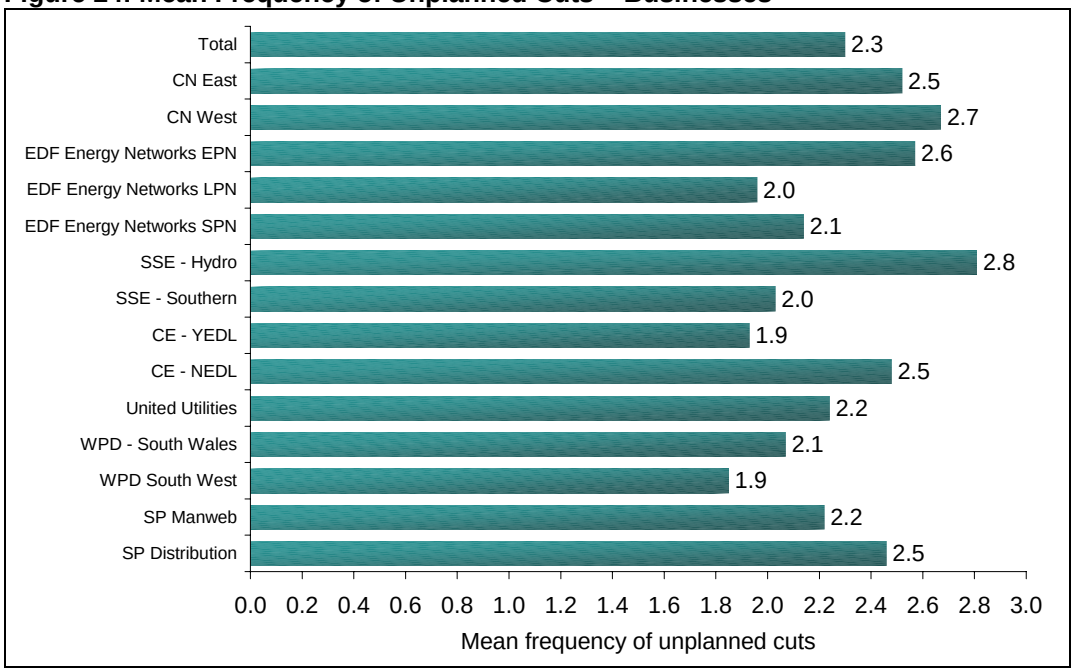
Figure 23: Frequency of Cuts – Businesses



Base: all respondents – 1052

The average number of unplanned cuts experienced was 2.3 (with the top 1% of extremes excluded).

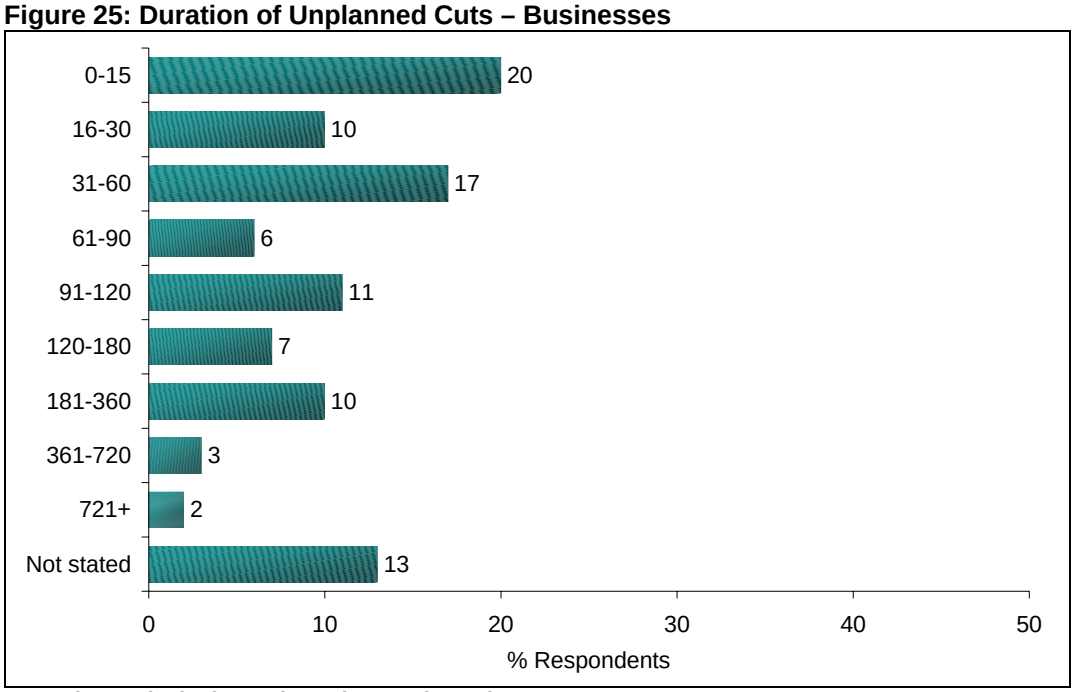
Figure 24: Mean Frequency of Unplanned Cuts – Businesses



Base: All who have experienced an unplanned cut, minus top 1% of extremes - 377

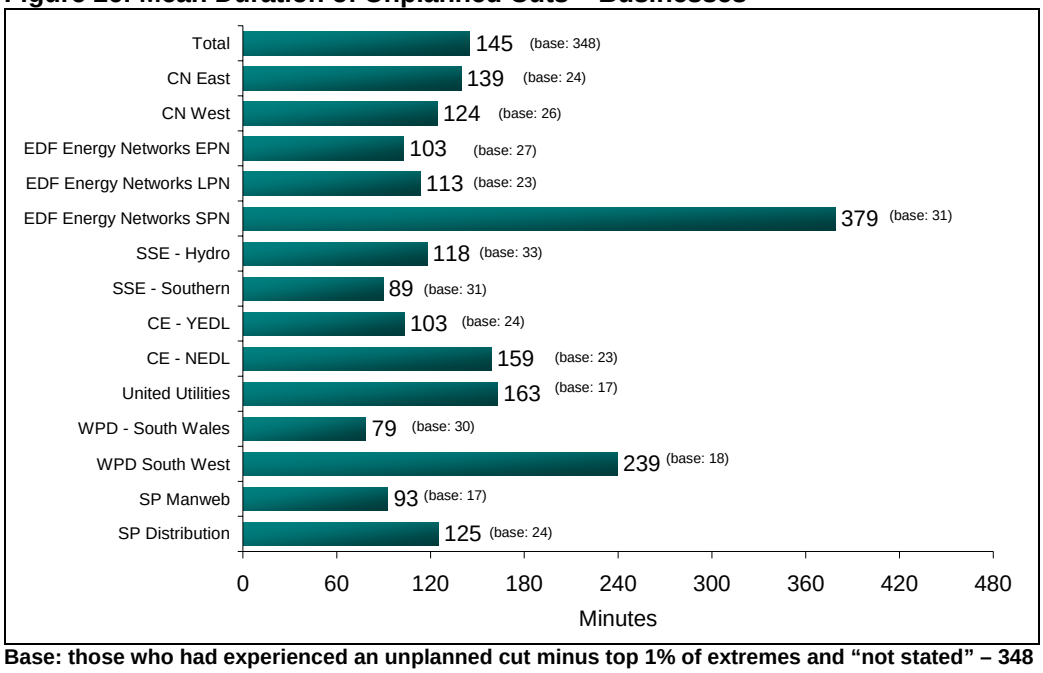
These unplanned cuts lasted an average of 145 minutes or roughly two and a half hours. This excludes 1% of extremes. The very high SPN figure is driven by one respondent stating they had been without power for 48 hours and another for 72 hours.

Figure 25: Duration of Unplanned Cuts – Businesses



Base: those who had experienced an unplanned cut – 401

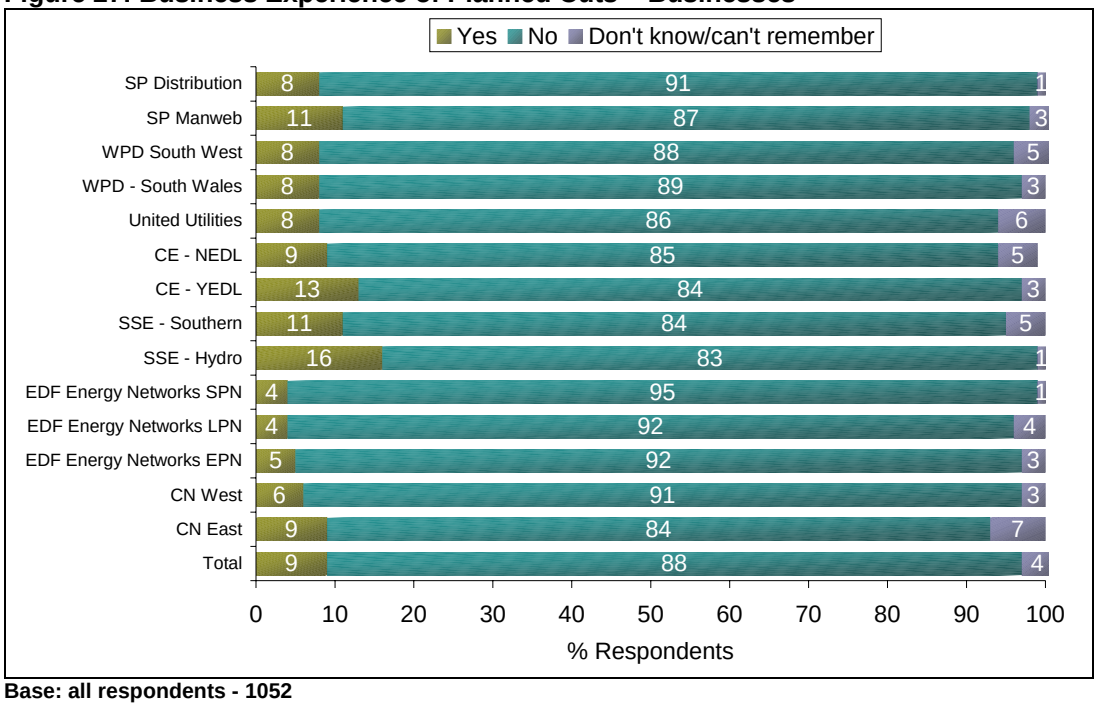
Figure 26: Mean Duration of Unplanned Cuts – Businesses



Base: those who had experienced an unplanned cut minus top 1% of extremes and "not stated" – 348

Around one tenth (9%) of business consumers had experienced a planned power cut in the past year.

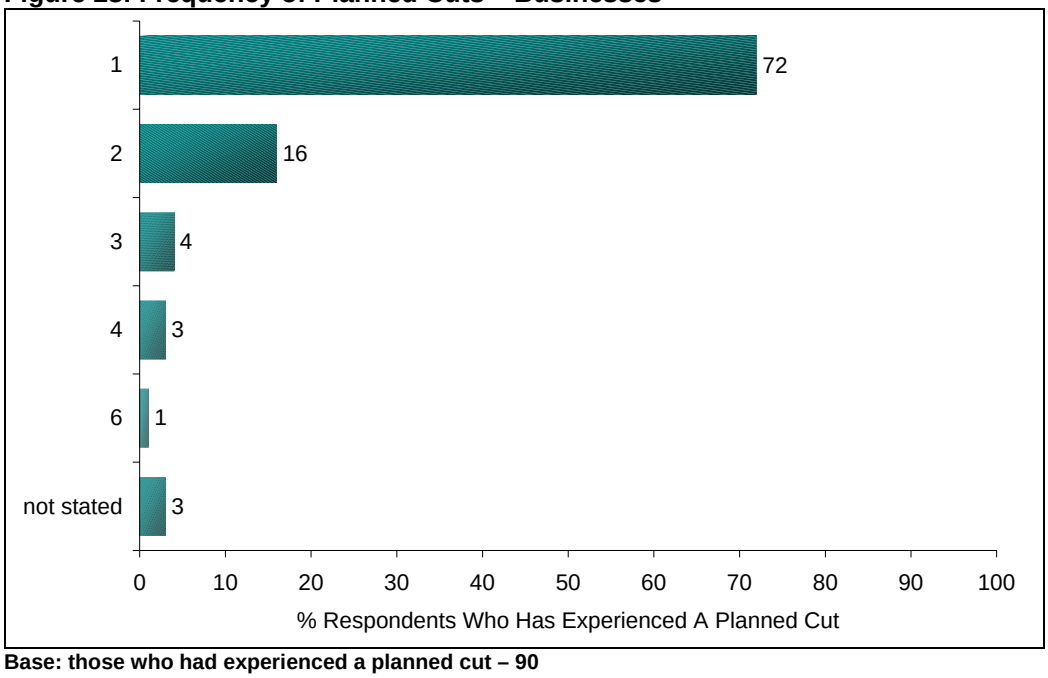
Figure 27: Business Experience of Planned Cuts – Businesses



Base: all respondents - 1052

Generally they only experienced one planned cut (72% had only one cut).

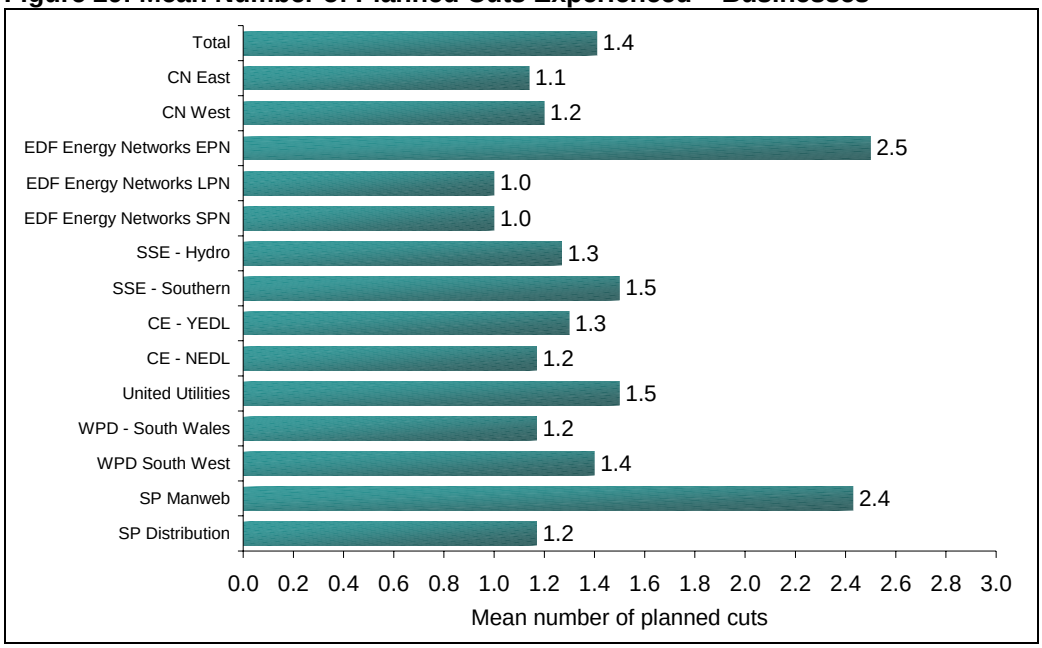
Figure 28: Frequency of Planned Cuts – Businesses



Base: those who had experienced a planned cut – 90

The average number of planned cuts experienced was 1.4.

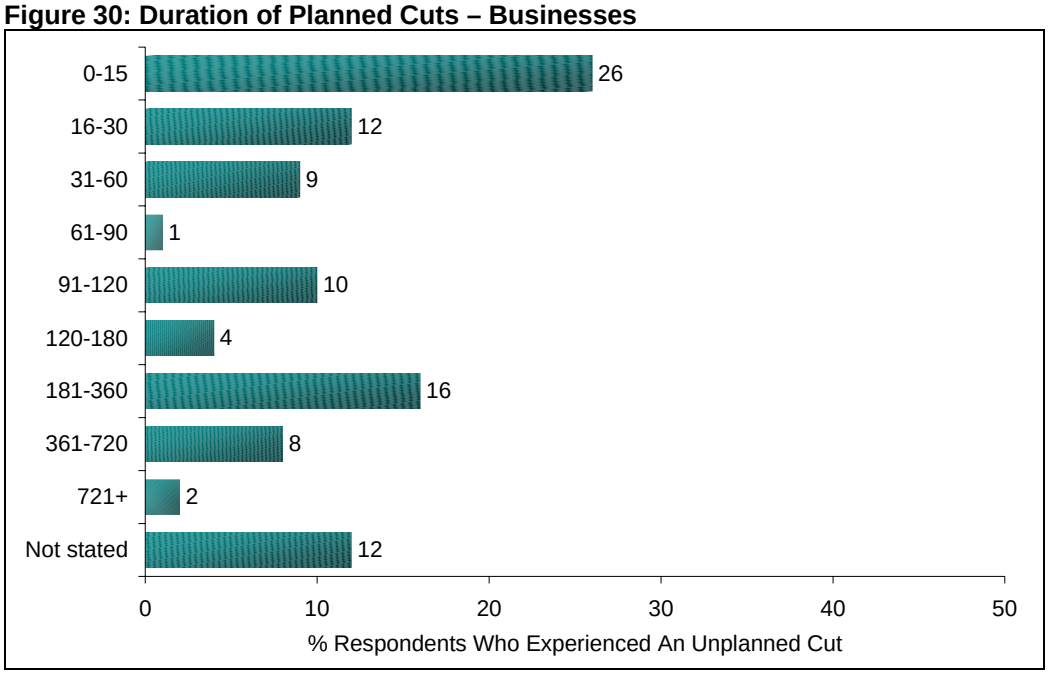
Figure 29: Mean Number of Planned Cuts Experienced – Businesses



Base: those who had experienced a planned cut and stated frequency – 87

Most unplanned cuts lasted less than two hours.

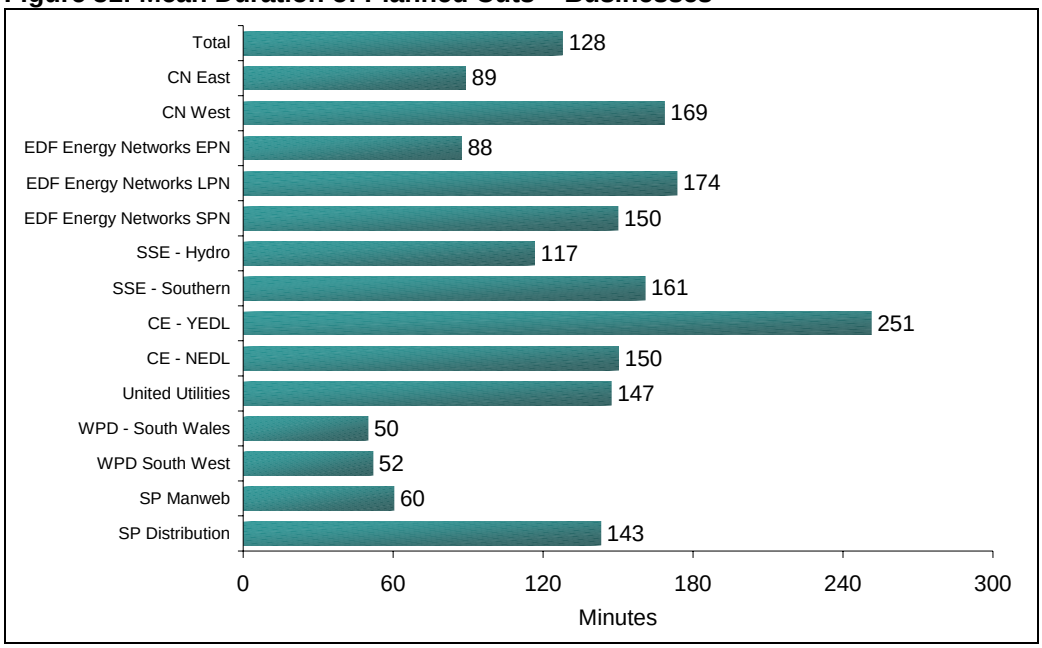
Figure 30: Duration of Planned Cuts – Businesses



Base: all who had experienced a planned cut - 90

The average duration of these cuts was 128 minutes or just over 2 hours (with top 1% of extremes removed). There were some considerable variances by DNO.

Figure 31: Mean Duration of Planned Cuts – Businesses

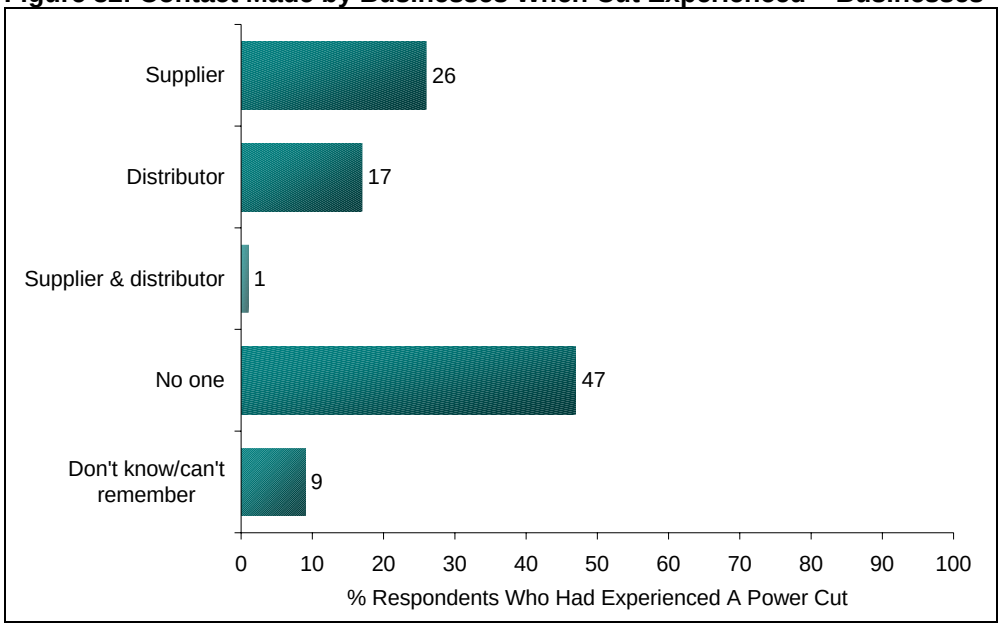


Base: all who had experienced a planned cut and stated duration – 77

4.3 Experience of Contacting Distributor During Power Cut

Business consumers were much more likely to contact someone during a cut and far more likely to contact the distributor than domestic consumers.

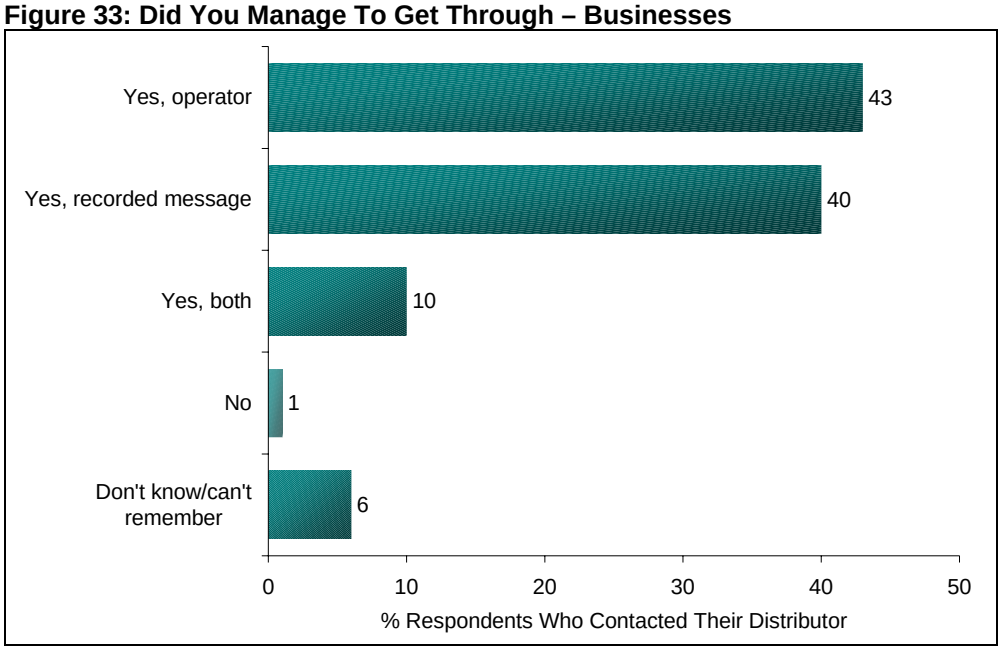
Figure 32: Contact Made by Businesses When Cut Experienced – Businesses



Base: those who had experienced a power cut - 441

Of the 81 businesses who attempted to get through to their distributor, the vast majority were successful (93%), with – again – a fairly even split in those that reached an operator versus those that reached a recorded message.

Figure 33: Did You Manage To Get Through – Businesses

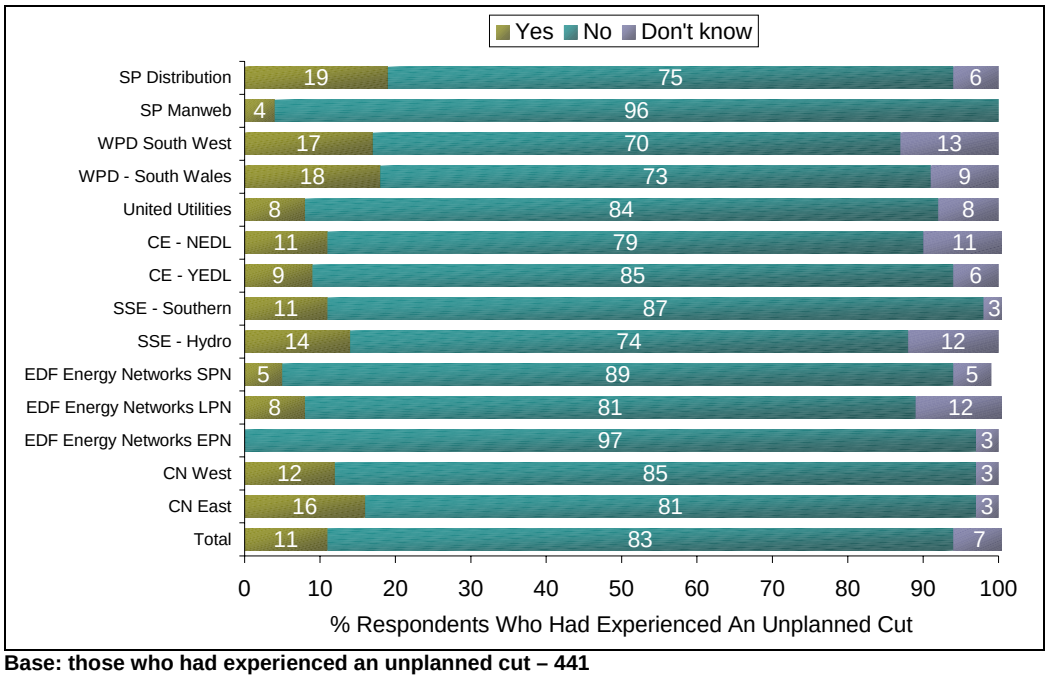


Base: respondents who attempted to get through to their distributor - 81

Slightly fewer businesses than domestic consumers (73%) got the information that they wanted when they made contact, although it was still the majority that did.

One tenth of all businesses who had experienced a cut in the past 12 months (11%) had been contacted or called back by their distributor at this time.

Figure 34: Experience of Contact By Distributor In The Event of An Unplanned Cut – Businesses

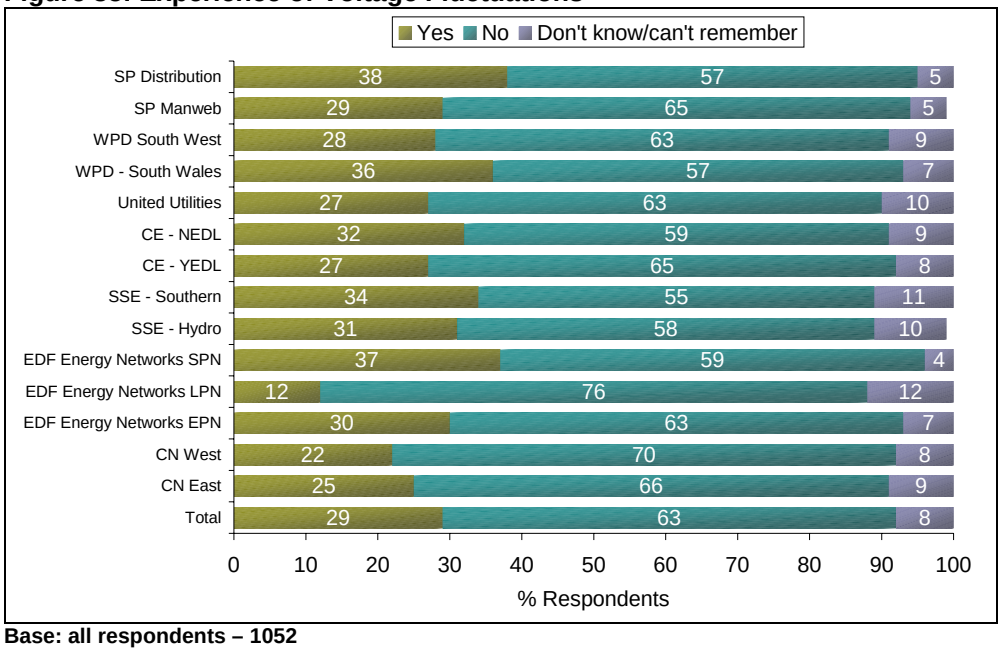


Base: those who had experienced an unplanned cut – 441

4.4 Experience and Measures Taken Against Voltage Fluctuations

Just less than a third (29%) of businesses had experienced voltage fluctuations in the previous 12 months.

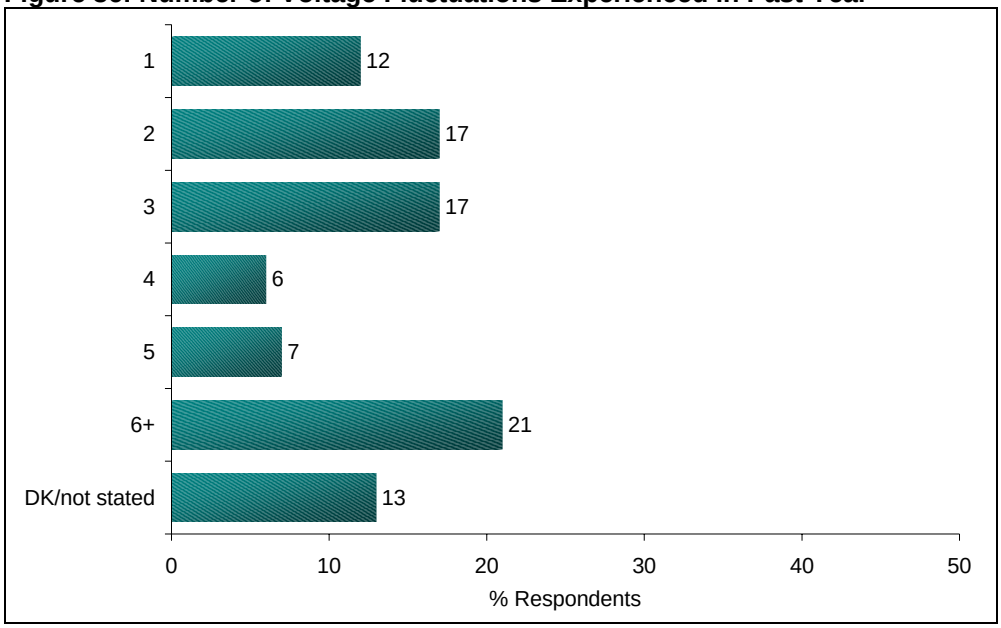
Figure 35: Experience of Voltage Fluctuations



Base: all respondents – 1052

Some claimed to experience them on a daily basis (1%), but most experienced them up to 5 times a year.

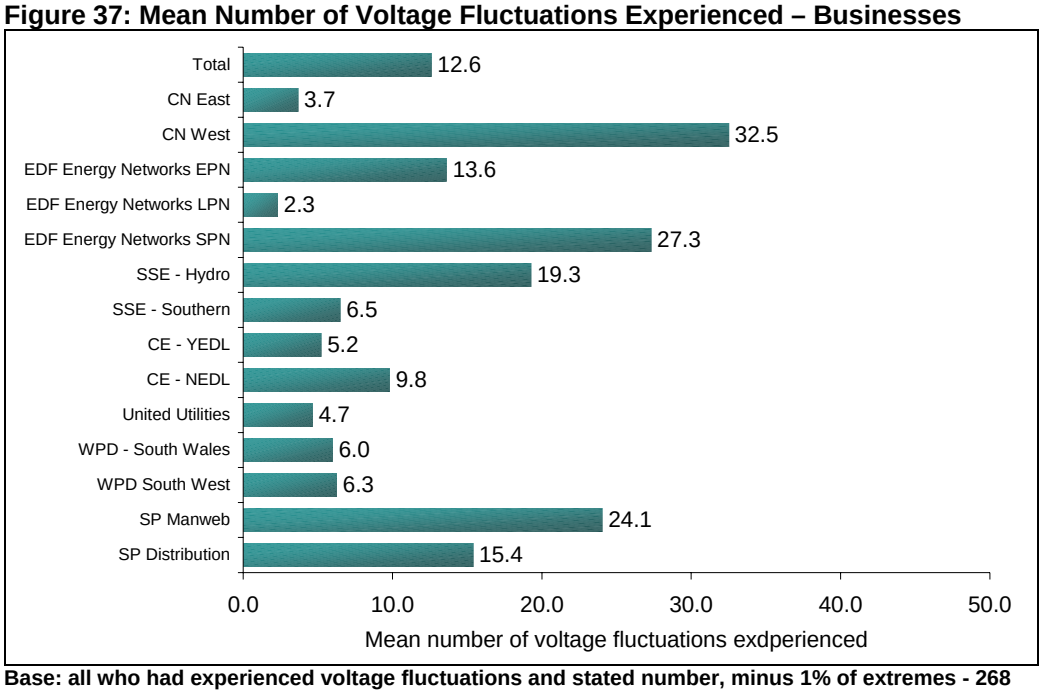
Figure 36: Number of Voltage Fluctuations Experienced in Past Year



Base: those who had experienced a voltage fluctuation – 307

The average number experienced annually (the top 1% of extremes removed) was 12.6.

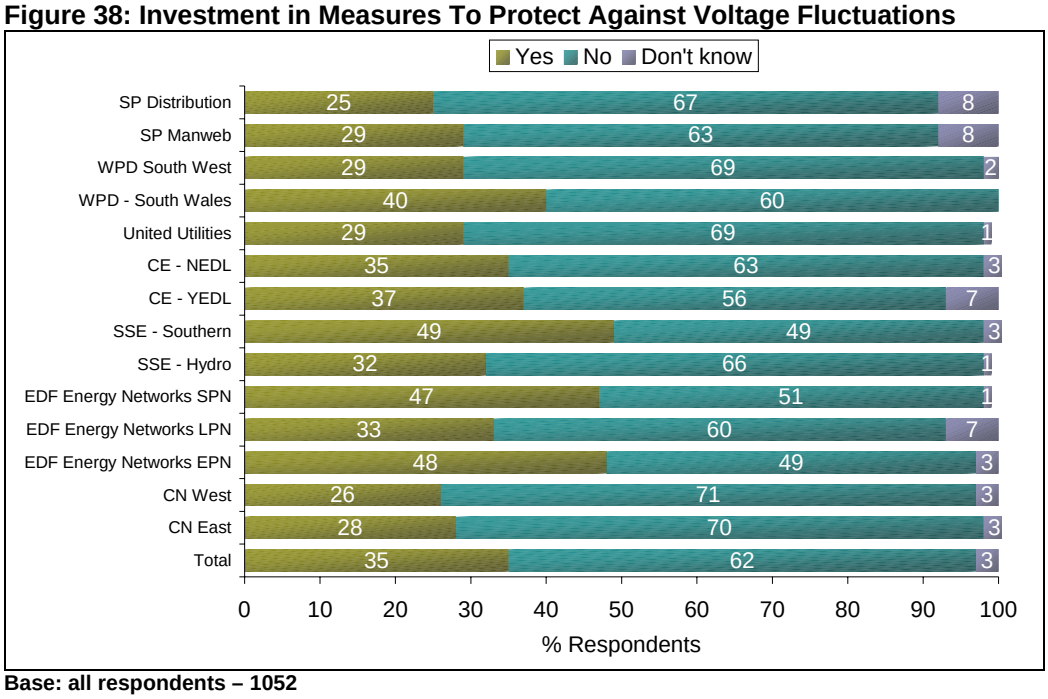
Figure 37: Mean Number of Voltage Fluctuations Experienced – Businesses



Base: all who had experienced voltage fluctuations and stated number, minus 1% of extremes - 268

Over one third of businesses had implemented measures, or invested in equipment, to protect the business in the event of a power dip or surge in supply.

Figure 38: Investment in Measures To Protect Against Voltage Fluctuations



Base: all respondents – 1052

Levels of investment ranged from the odd pound to as much as £25,000,000[3] for two organisations. One of these was an Oil Company and the other a manufacturer of paper products.

The average levels of investment by business size (with the top 1% of extremes removed) were:

- Small: £3.8K
- Medium: £33.3K
- Large: £87.4K

Just less than one third of businesses stated that their business's insurance covered them in the event of a loss of business as a result of a power cut. Large businesses were more likely to be covered than small businesses (39% large, 30% medium and 27% small).

[3] Note: the industry working group felt that this was a disproportionate amount, despite the size of the industries concerned.

4.5 Awareness of Standards

Awareness of the standards currently in place is low among all businesses, but higher amongst larger organisations.

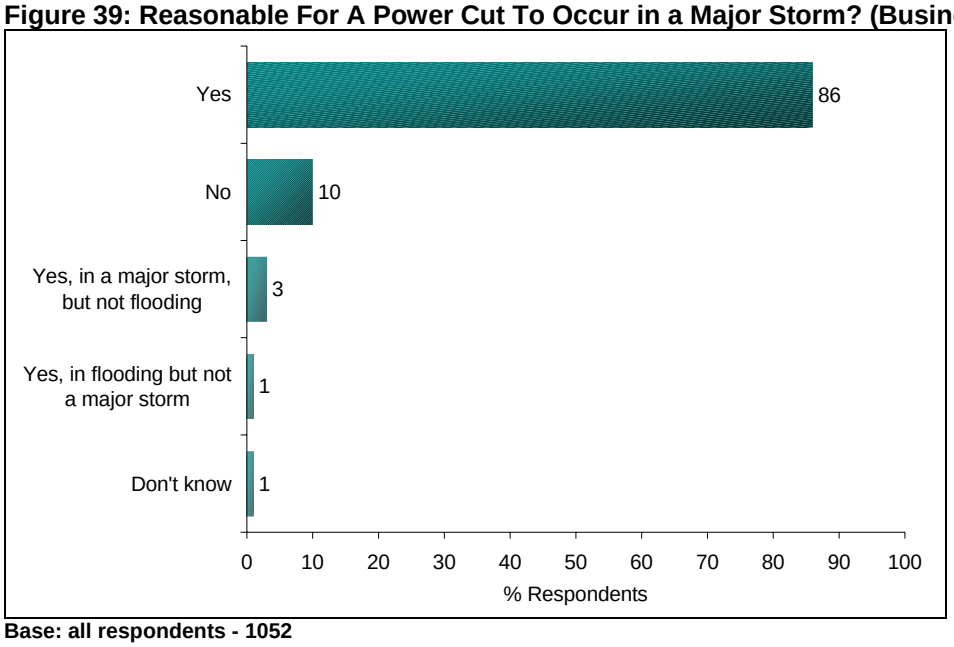
Table 8: Awareness of Standards

	Small %	Medium %	Large %	Total %
If your electricity supply fails during normal weather conditions because of a problem on your distribution system your distributor will restore it within 18 hours of first becoming aware of the problem. If they fail and you make a valid claim within three months of the date the supply is restored, they will arrange for you to receive a compensation payment. You will also receive further compensation for each additional 12 hours you are without supply	11	17	22	14
If your electricity supply fails because of a problem on your distribution system and you are without power for three hours or more, on four or more different occasions in any single year (April to March), you are entitled to a compensation payment. You must make a valid claim for this payment within three months of the end of the year to which the claim applies	4	9	15	7
If your distributor needs to switch off your power to work on the network they will give you at least 2 days' notice. If they fail to give 2 days' notice or switch your electricity off on a different day, then you can claim (within 1 month of the failure) a compensation payment	13	19	24	15

4.6 Expectations of Quality of Service

The majority of businesses (86%) think it is reasonable for a power cut to occur in a major storm, with few making a distinction between major storms and flooding.

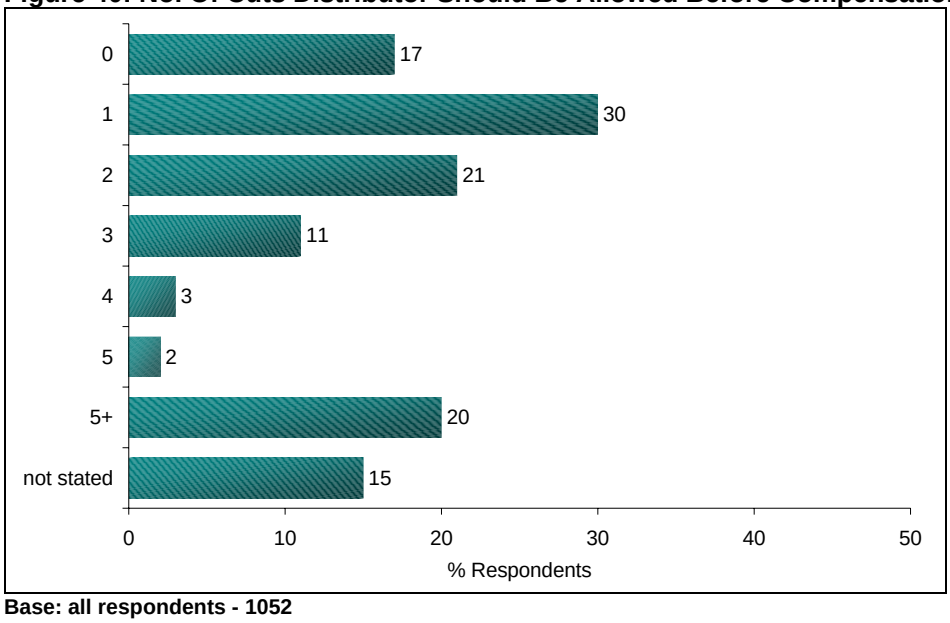
Figure 39: Reasonable For A Power Cut To Occur in a Major Storm? (Businesses)



Base: all respondents - 1052

Seventeen percent believe that compensation should be paid after the first cut. Roughly half (51%) of businesses believe that compensation should be paid after the second or third (ie they should be allowed 1 or 2 before they become liable to pay compensation.

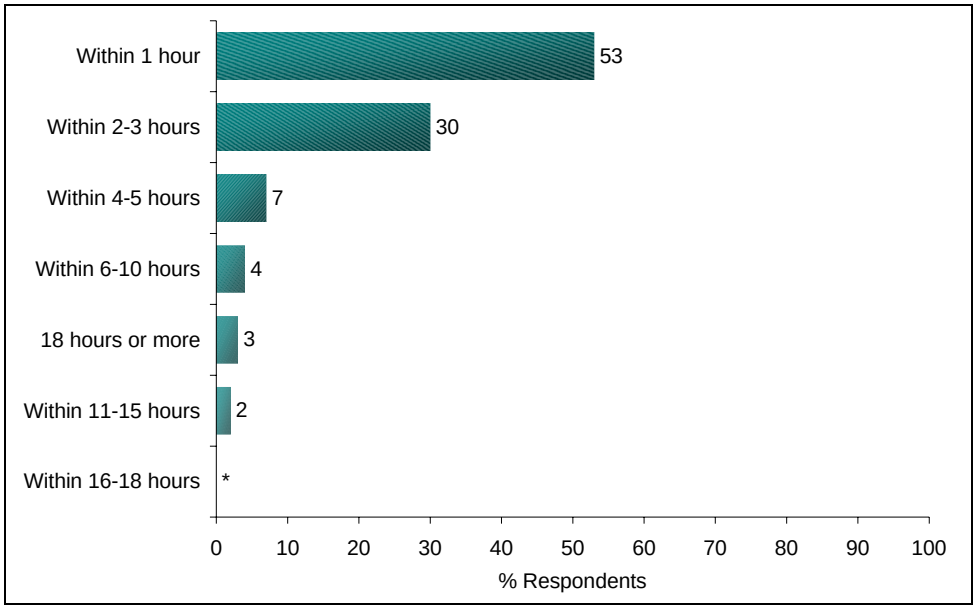
Figure 40: No. Of Cuts Distributor Should Be Allowed Before Compensation Paid



Base: all respondents - 1052

Over half (53%) believe power should be restored within one hour following an unplanned cut.

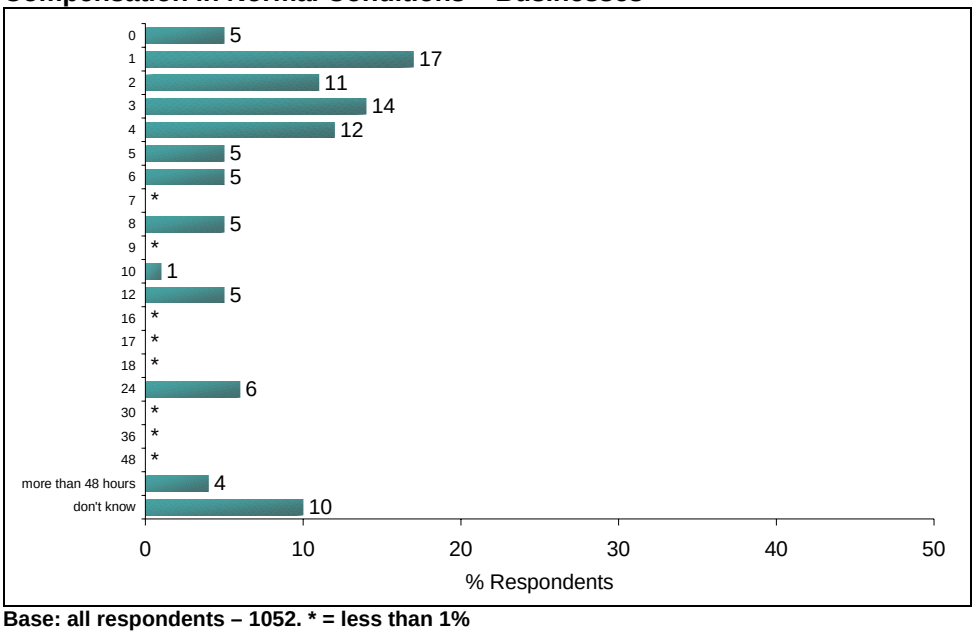
Figure 41: How Quickly Power Should Be Restored In Normal Conditions – Businesses



Base: all respondents – 1052. * = less than 1%

Although responses varied widely, on average businesses felt that a distributor should be required to pay compensation after 6 hours of an unplanned cut in normal conditions.

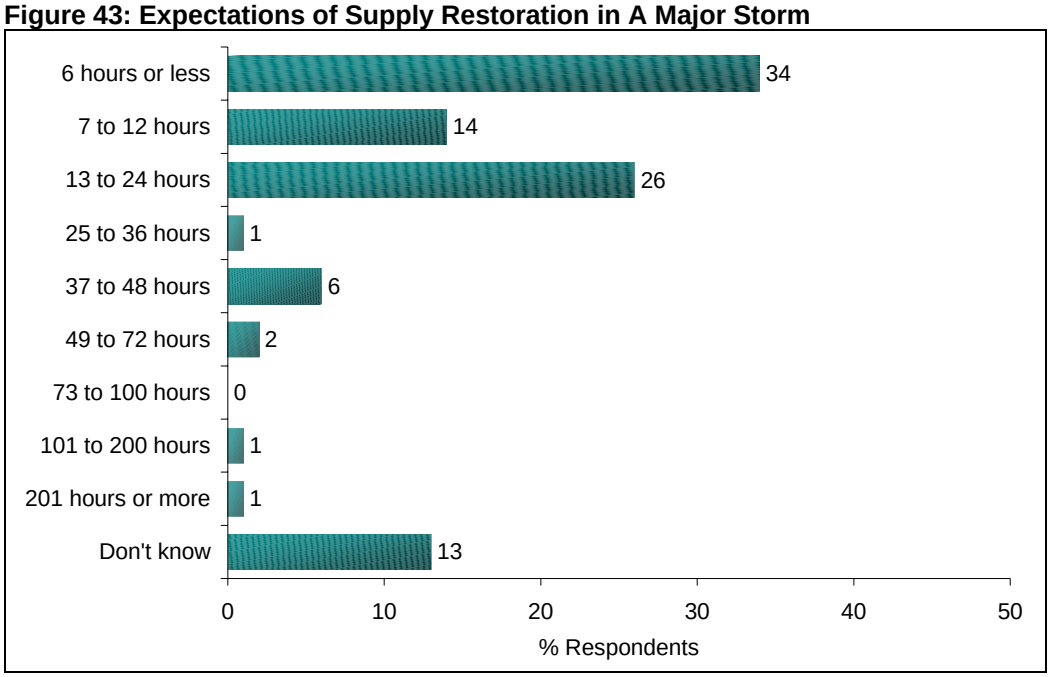
Figure 42: Hours After Which Distributor Should Be Required To Pay Compensation in Normal Conditions – Businesses



Base: all respondents – 1052. * = less than 1%

Even in a major storm one third of businesses expected that power would be restored within 6 hours. This proportion was higher amongst larger businesses (44% large, 38% medium and 31% small).

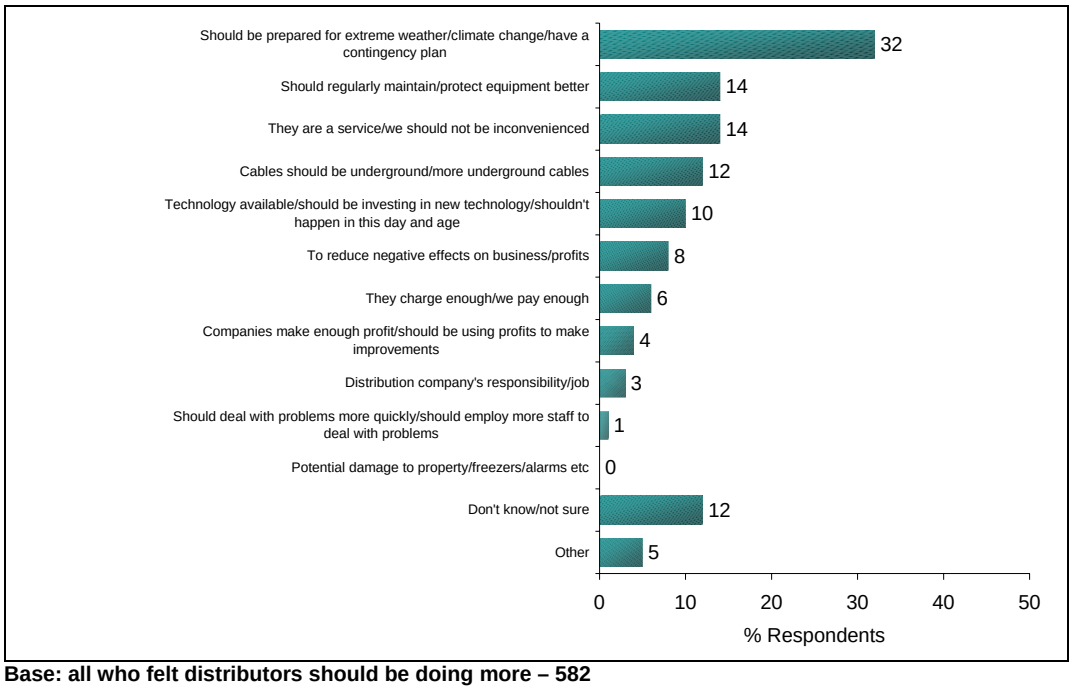
Figure 43: Expectations of Supply Restoration in A Major Storm



Base: all respondents – 1052

Just over half (55%) of businesses felt that distribution companies should be doing more to reduce their impact of severe weather on their networks. As with the domestic sample, most felt they should have contingency plans in place.

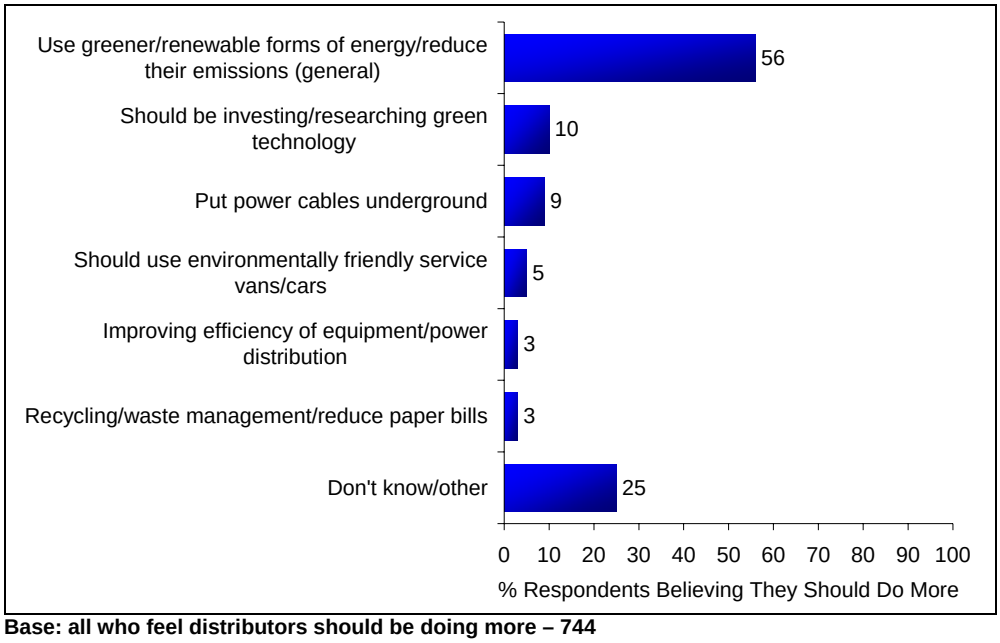
Figure 44: What Distributors Should Be Doing To Reduce Impact of Severe Weather on Their Networks



Base: all who felt distributors should be doing more – 582

A much higher proportion (71%) felt that their distribution company should be taking steps to reduce their company's impact on the environment.

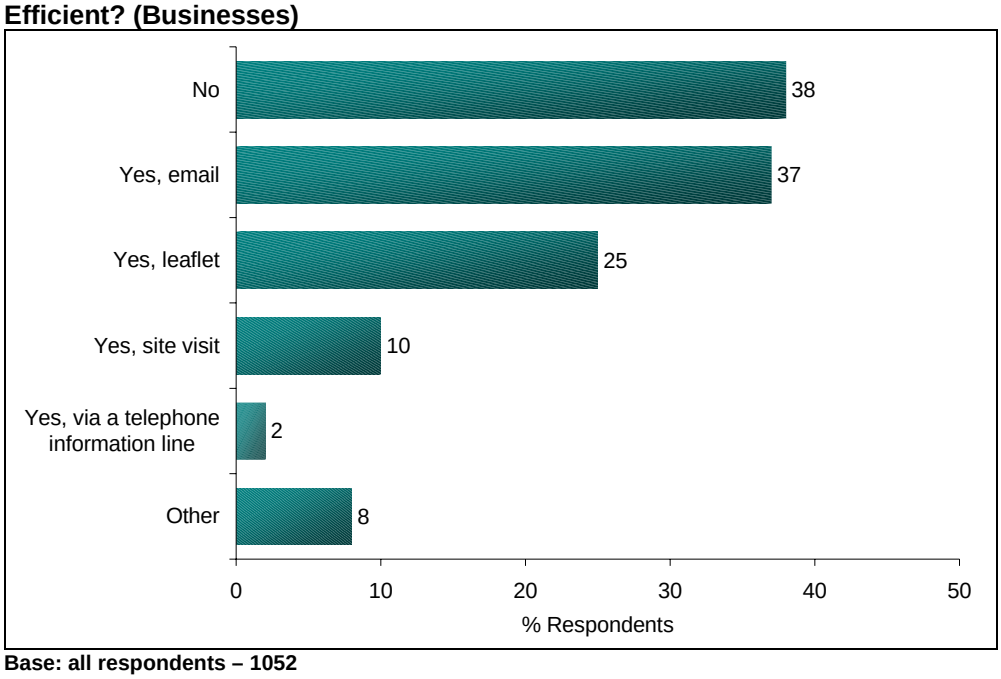
Figure 45: What Distributors Should Be Doing To Reduce Impact On The Environment – Businesses



Base: all who feel distributors should be doing more – 744

Almost two thirds stated that they would like information to be available from their DNO on how they could be more energy efficient, most via email or leaflet, although 10% wanted a visit.

Figure 46: Would You Like Information From DNO On How To Be More Energy Efficient? (Businesses)



Base: all respondents – 1052

5. STATED PREFERENCE (SP) SURVEY DESIGN

5.1 Specification of Attributes

OFGEM supplied the project team with a list of prioritised service attributes and associated service levels to be explored in the stated preference (SP) experiments. The attributes considered in the stated preference experiments differed for business and domestic customers, and between London's DNO (LPN) and those in other regions (non-LPN DNOs), and are shown in the following tables. Both service improvements and reductions were tested, and thus bill size increases and decreases were investigated in the stated preference experiments.

Because it is not feasible for respondents to evaluate this number of attributes within one experiment, the attributes were divided across three choice experiments, as is shown in the tables. In grouping the attributes into these blocks we attempted to select attributes that were related, or could be considered as being similar. The rationale behind this was to provide some coherence to respondents: grouping in this way also allows us to test for correlation between attributes, bearing in mind design limitations as discussed below.

Table 9: Stated Preference Attributes for domestic users of LPN and non-LPN customers

	All Distributors except LPN	LPN
Experiment 1	Frequency of power cuts over 3 mins	Frequency of power cuts over 3 mins
	Average duration of power cuts over 3 mins	Average duration of power cuts over 3 mins
	Number of short power interruptions	Number of short power interruptions
	Provision of Information	
Experiment 2	Restoration of supply (time)	Restoration of supply (time)
	Compensation for restoration of supply	Compensation for restoration of supply
	Compensation for multiple interruptions	Compensation for multiple interruptions
	Planned interruptions - notice	Planned interruptions – notice
Experiment 3	Undergrounding	Provision of Information
	Network resilience to major storms	Network resilience to flooding
	Network resilience to flooding	Reduction in carbon emissions
	Reduction in carbon emissions	

Table 10: Stated Preference Attributes for business users of LPN and non-LPN customers

	All Distributors except LPN	LPN
Experiment 1	Frequency of power cuts over 3 mins	Frequency of power cuts over 3 mins
	Average duration of power cuts over 3 mins	Average duration of power cuts over 3 mins
	Number of short power interruptions	Number of short power interruptions
	Provision of Information	
Experiment 2	Restoration of supply (time)	Restoration of supply (time)
	Compensation for restoration of supply	Compensation for restoration of supply
	Making and keeping appointments	Making and keeping appointments
	Planned interruptions - notice	Planned interruptions – notice
Experiment 3	Network resilience to major storms	Network resilience to flooding
	Network resilience to flooding	Reduction in carbon emissions
	Reduction in carbon emissions	Energy efficiency advice
	Energy efficiency advice	Provision of Information

The detailed attribute definitions and levels are summarised in Appendix I. It is noteworthy that the levels tested for power cuts, average duration of power cuts, number of short interruptions and network resilience to storms (measured as the number of customers affected by storms) were based around the DNO's current service levels in these areas.

In addition, each experiment contained a price attribute, representing the change to the annual electricity bill for the proposed set of service attributes. It is emphasised that this price does not at all reflect the actual costs of making the proposed service changes, but rather is there to test respondent's willingness to pay for the service levels tested.

5.2 Price Adjustments

Within each experiment, we incorporated the monetary cost implication for the electricity distribution service changes through changes in the respondent's annual electricity bill. It is important to include price in the experiments for a number of reasons, including:

- the inclusion of price is necessary in order to compute willingness-to-pay (wtp) or willingness-to-accept (wta);
- we believe that including price makes the choices more meaningful to respondents, specifically linking changes in services levels (eg improved services) with prices;

- lastly, it encourages people to consider the real importance of the attributes – it is a metric that almost everyone can understand.

The price levels were specified as percent changes to the electricity distribution component (DUOS) of the consumer's annual bill. Again, it is emphasised that these levels are not at all related to the actual cost of implementing such service changes but rather are specified to test and quantify respondent's willingness to pay for service improvements. The DUOS for each respondent was determined in two ways:

- domestic sample: a database was provided by OFGEM which automatically calculated the amount destined for the distributor based upon the annual bill of the respondent, as determined through the survey questioning

- business sample: for all businesses 20% of their given bill was allocated for their distributor.

However, for clarity of presentation in the choice exercises, the total absolute bill, with the changed DUOS component, was presented.

A series of questions was asked at the start of the survey to ascertain the existing level of their electricity bill, and if necessary provide the respondent with this information (for an average consumer with similar circumstances).

Because price is such an important variable for measuring willingness-to-pay the stated preference choice experiment design incorporated nine different price levels. In experiment 1, because both service improvements and reductions were equally represented, price increases and reductions, were equally tested. The price levels were tested in the pilot, reviewed with the working group, and amended for the main survey. The price levels used for experiment 1 are presented in Table 11.

Table 11: DUOS price adjustments for experiment 1 (all purposes)

Price level	Change in annual electricity bill
1	30 %
2	20 %
3	10 %
4	5 %
5	No change
6	-5 %
7	-10 %
8	-20 %
9	-30 %

In experiments 2 and 3, more service increases than decreases were tested, so more price increases were also tested. The price levels for experiments 2 and 3 are presented in Table 12.

Table 12: DUOS price adjustments for experiments 2 and 3 (all purposes)

Price level	Change in annual electricity bill
1	30 %
2	25 %
3	20 %
4	15 %
5	10 %
6	5 %
7	No change
8	-5 %
9	-10 %

5.3 Design of the Experiment

The stated preference experiments are constructed to gather data on how respondents make trade-offs between the different service attributes and prices. One way to gather this information would be to examine every possible combination of attribute levels: this is called a full factorial design. However, for the number of attributes and levels to be evaluated in this study this would be a very large and inefficient task. Instead a subset of the combinations is used, termed a fractional factorial design, in which the combinations presented to respondents allow the independent importance of the attributes and levels to be measured. While it may not be possible to analyse all possible interactions of effects with such a design, the main interactions can be quantified.

5.4 Format of the Choice Experiments

Many of the attribute levels were based around the current service level for a particular DNO, for example number of power cuts, duration of power cuts, etc. It is reasonable to assume that the general public would be largely unfamiliar with the quality of their electricity distribution service, and therefore in each choice exercise one of the alternatives presented to respondents showed all of the attributes at their current levels and the respondent's current bill. In this way, respondent's were reminded of what service they currently pay for, when making comparisons with changes to that service with price changes. Respondents were also presented with two additional hypothetical electricity distribution service alternatives with differing service characteristics and prices.

The current alternative was always placed first in the presentation of the three alternatives to respondents. This inclusion of the current alternative also aimed to bring more realism to the choice exercises, allowing respondents to indicate that they would stay with their current service should they not value either of the alternatives offered.

Figure 47 below shows an example choice card from the first experiment (Domestic, non-LPN). More examples of the choice experiments are presented in Appendix J.

Figure 47: Example choice experiment (Domestic Non-LPN)

Which electricity distribution service would you choose?

	As Now	Alternative 1	Alternative 2
Average number of power cuts longer than 3 mins in normal weather conditions	4 in 5 years	4 in 5 years	**7 in 5 years (worse than now)**
Average duration of power cut	100 mins on average	**80 mins on average (better than now)**	**120 mins on average (worse than now)**
Average number of power cuts shorter than 3 mins in normal weather conditions	5 in 5 years	**6 in 5 years (worse than now)**	**6 in 5 years (worse than now)**
Information provided during power cuts	Automated messages or telephone operators to respond to customer calls	**Automated messages or telephone operators to respond to customer calls, plus helpline for customers reliant on medical equipment**	**Automated messages or telephone operators to respond to customer calls, plus call backs to provide information updates**
Annual Electricity Bill	£200 (no change)	**£202 (£2 increase)**	**£191 (£9 decrease)**
Choice (mark "X" in preferred option)	☐	☐	☐

The introductions to the experiments in the survey informed respondents to the attributes and were worded to make it clear about the questions put to them. The introductions are presented in Appendix I.

Within each experiment respondents were presented with six choice situations. These choices were specifically generated for each individual, allowing for good coverage across all possible combinations of attributes and levels in the design space.

5.5 Design of the Packaging Experiment

The data from the first three experiments allow us to estimate customers' willingness-to-pay for improvements in each of the service attributes. However, there is concern that the estimation of willingness-to-pay from multiple experiments using a subset of the attributes can lead to an overstatement of the total willingness-to-pay for all of the improvements ie respondents may indicate that they are willing to pay a certain amount for the service improvements in experiment 1, and another amount for the service improvements in experiment 2 and a further amount for the service improvements in experiment 3. However, together these may add up to more than the respondent would be willing to pay in total. Many theories exist to explain this effect including budgeting effects (as discussed), non-linearities in price, and halo effects (where respondents assume that because one attribute is improving that there are other improvements in other dimensions, which can then lead to double-counting in aggregation). Either way, it is advisable in studies that split the total attribute list into a number of sub-groups to then test whether an aggregation effect can

be observed. If such an effect is observed then this should be taken into account in the calculation of the final valuations. The findings from the packaging experiment are reported in section 8.1.

As a result respondents participated in a fourth experiment to explore these packaging effects, where all of the attributes were presented simultaneously. As discussed earlier, it was judged that there were too many attributes to be varied simultaneously, so the experiment was simplified by presenting these attributes in blocks (as aggregated in the first three experiment) and presenting the attributes within each of these blocks simultaneously at one of two levels (better or worse), such that all of the attributes in the same block are better or worse.

This was explained to respondents in the introduction to the experiment. Shading was also used to help respondents identify which blocks corresponded to improved service attributes. This experiment always followed the first three experiments, so respondents had already been introduced to the attributes in an earlier exercise.

Respondents were provided an option "Neither" if they felt unable to choose among the Alt 1 and Alt 2. An example choice card from the packaging experiment of business non-LPN is shown in Figure below. More example choices from this additional experiment are shown in Appendix H. The detailed findings derived from this experiment are described in Section 8.1.

Figure 48 Example choice card from packaging experiment (Business Non-LPN)

Choice 1 — **Which electricity distribution service would you choo**

	Alternative 1	**Alternative 2**
Average number of power cuts longer than 3 mins in normal weather conditions	7 in 5 years (worse than now)	**1 in 5 years (better than now)**
Average duration of power cut	115 mins on average (worse than now)	**75 mins on average (better than now)**
Average number of power cuts shorter than 3 mins in normal weather conditions	5 in 5 years (worse than now)	**1 in 5 years (better than now)**
Information provided during power cuts	Automated messages or telephone operators to respond to customer calls	**Automated messages or telephone operators to respond to customer calls, plus call backs to provide information updates**
Restoration of electricity supply in normal weather	Guaranteed within 18 hours	Guaranteed within 18 hours
Compensation provided if your electricity is not restored in this time	£50 plus £25 for every additional 12 hour period	£50 plus £25 for every additional 12 hour period
Scheduling of appointments with customers	Offer and keep appointments within a 2 hour slot	Offer and keep appointments within a 2 hour slot
Amount of notice that customers must be given before planned interruptions	2 days notice	2 days notice
Number of customers affected by major storms	120000 customers on average in a year (20% worse than now)	120000 customers on average in a year (20% worse than now)
Number of major electricity sites across GB exposed to a potential flood risk	Around 1000 major electricity sites	Around 1000 major electricity sites
Investment to reduce carbon emissions	Continue usage of current equipment and vehicles	Continue usage of current equipment and vehicles
Provision of energy efficiency advice by energy distributor	No information provided	No information provided
Annual Electricity Bill	**£25300 (£300 increase)**	**£27800 (£2800 increase)**
Choice (mark "X" in preferred option)	☐	☐

Again, because of the range of possible valuations that could result, a large range of price adjustments were tested. The same price adjustments were used for all purposes, and these are shown in Table 13.

Table 13: DUOS price adjustments for the packaging experiment (domestic, LPN)

Price level	Randomly select from		
1	52 %	56 %	60 %
2	44 %	48 %	50 %
3	32 %	36 %	40 %
4	20 %	24 %	28 %
5	12 %	14 %	16 %
6	4 %	6 %	8 %
7	0 %	0 %	0 %
8	-16 %	-12 %	-8 %
9	-30 %	-24 %	- 20 %

Respondents were presented with six choice scenarios in this experiment.

5.6 Pilot Testing

The designs were tested and refined through the use of a pilot survey. Details of the pilot analysis and findings are provided in Appendix M.

6. STATED PREFERENCE BACKGROUND ANALYSIS

Prior to the development of the discrete choice models, a number of different analyses were undertaken to understand the choices and the quality of these stated preference choice data. These analyses are reported in this chapter.

6.1 Sample Characteristics

Table 14 shows the number of SP data files delivered to RAND for analysis, by type of survey ie LPN business and domestic and non-LPN business and domestic. The fifth row of information shows the number of respondents who reported that they did not understand the choice exercises (these have been excluded from all further analysis). The proportion of respondents excluded from the model analysis ranged from 3% for non-LPN domestic customers to 5.8% for non-LPN business customers. Interviews were excluded for two other reasons:

- One interview was excluded because of what was judged to be an unreasonably large electricity bill (LPN-business, reported electricity bill £39,600,000);
- 4 non-LPN business surveys were dropped because incorrect SP material was sent to the respondent.

The total number of surveys used for the modelling work, for each segment is shown in the last row of Table 14.

Table 14: Summary of SP Data

	LPN		Non-LPN	
	Domestic	Business	Domestic	Business
Total No. of SP	151	76	2003	976
Missing recruitment data	0	0	0	11 (1.1%)
Mismatched SP Card ID	0	1 (1.3%)	0	1 (0.1%
Incorrect SP material	0	0	0	4 (0.4%)
Didn't understand	5 (3.3%)	3 (3.9%)	61 (3.0%)	56 (5.7%)
Unreasonably large bill	0	1 (1.3%)	0	0
Total No. after data cleaning	146	71	1942	904

6.2 Checking Trading Behaviour

A series of checks have been undertaken across the four types of interviews to investigate the extent to which respondents traded between alternatives.

The following four tables show how respondents traded between the different options for the different experiments, by type of interview. It is noteworthy that in the first three experiments, respondents could choose between three

alternatives: an 'as now' alternative and two hypothetical alternatives, while in the fourth experiment the choices were between two hypothetical alternatives and a 'neither' option.

It should be noted that consistently choosing the "as now" alternative in the first three experiments is a valid response and indicates that the customer does not wish to pay for any of the service improvements offered. In terms of development of a model it would be concerning if a very high proportion of respondents always chose the "as now" alternative, because it would not then be possible to identify wtp values for service improvements or wta for service reductions. The price levels were chosen to encourage trading and this was something that was reviewed in the pilot analysis. The degree of choosing the "as now" alternative is not judged to be problematic in this study. Few respondents consistently choose the "Alt1" or "Alt2" alternatives in all choice scenarios.

In the packaging experiment (Experiment 4), only a small number of respondents across all sectors and areas have consistently chosen either "Alt 1" or "Alt 2" but for business consumers in the LPN area over 14% of them were unable to make a choice and always opted for the "Neither" alternative.

Table 15: Trading behaviour for domestic consumers in LPN area

Trading	Experiment 1		Experiment 2		Experiment 3		Experiment 4	
	obs	%	obs	%	obs	%	obs	%
Always current option	21	14.4%	27	18.5%	17	11.6%		
Always alternative 1	2	1.4%	0	0.0%	3	2.1%	3	2.1%
Always alternative 2	0	0.0%	1	0.7%	2	1.4%	0	0.0%
Neither / No choice							6	4.1%
Trading among Alternatives	123	84.2%	118	80.8%	124	84.9%	137	93.8%
Total number of respondents	146		146		146		146	

Table 16: Trading behaviour for business consumers in LPN area

Trading	Experiment 1		Experiment 2		Experiment 3		Experiment 4	
	obs	%	obs	%	obs	%	obs	%
Always current option	13	18.3%	9	12.7%	8	11.3%		
Always alternative 1	3	4.2%	4	5.6%	5	7.0%	1	1.4%
Always alternative 2	0	0.0%	2	2.8%	1	1.4%	1	1.4%
Neither / No choice							10	14.1%
Trading among Alternatives	55	77.5%	56	78.9%	57	80.3%	59	83.1%
Total number of respondents	71		71		71		71	

Table 17: Trading behaviour for domestic consumers in non-LPN areas

Trading	Experiment 1		Experiment 2		Experiment 3		Experiment 4	
	obs	%	obs	%	obs	%	obs	%
Always current option	191	9.8%	159	8.2%	182	9.4%		
Always alternative 1	31	1.6%	26	1.3%	23	1.2%	36	1.9%
Always alternative 2	8	0.4%	18	0.9%	14	0.7%	28	1.4%
Neither / No choice							91	4.7%
Trading among Alternatives	1712	88.2%	1739	89.5%	1723	88.7%	1787	92.0%
Total number of respondents	1942		1942		1942		1942	

Table 18: Trading behaviour for business consumers in non-LPN areas

Trading	Experiment 1		Experiment 2		Experiment 3		Experiment 4	
	obs	%	obs	%	obs	%	obs	%
Always current option	141	15.6%	94	10.4%	89	9.8%		
Always alternative 1	13	1.4%	18	2.0%	27	3.0%	26	2.9%
Always alternative 2	11	1.2%	13	1.4%	12	1.3%	9	1.0%
Neither / No choice	0		0		0		55	6.1%
Trading among Alternatives	739	81.7%	779	86.2%	776	85.8%	814	90.0%
Total number of respondents	904		904		904		904	

Further analysis was undertaken to examine how respondents made choices across the different price levels. The following figures show the proportion of respondents choosing each alternative ie alternative a or alternative b, at different bill size levels. The figures exhibit a distribution of willingness-to-pay across the sample, although this simple analysis does not take into account the price of the alternative eg in some cases both alternatives may have high prices.

The figures indicate, in general, that only a small percentage of respondents chose alternatives at the highest price levels, well below 20%, for domestic consumers in the first three experiments. This wasn't the case in the pilot, where a substantial proportion of domestic consumers ie 15 to 20% indicated that they would be willing to choose the most expensive alternatives. This suggests that the highest levels of prices considered in the main survey have been adequate to test customer's upper bound of their willingness to pay. For business consumers, however, a substantial number of respondents have still chosen alternatives with the highest price levels.

Figure 49 and Figure 50 show the trading at different price levels for experiment 1, where we see the proportion of choices for the specific alternative drop as the price level increases. It is also worth noting that in the first experiment we observe that, when considering all of the choices in the sample, in over 40% of the choices the respondents have chosen the "As Now" alternative.

Similar graphs have been produced for the other experiments and are included in Appendix M.

Figure 49: Choices in Experiment 1 at given levels of cost for domestic consumers

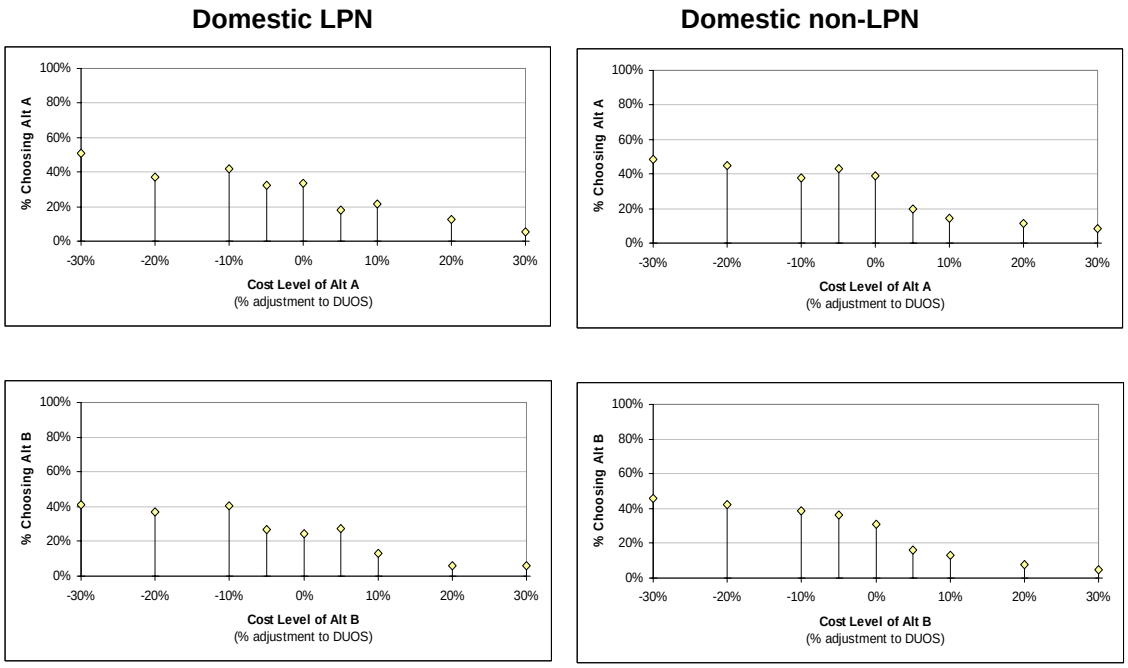
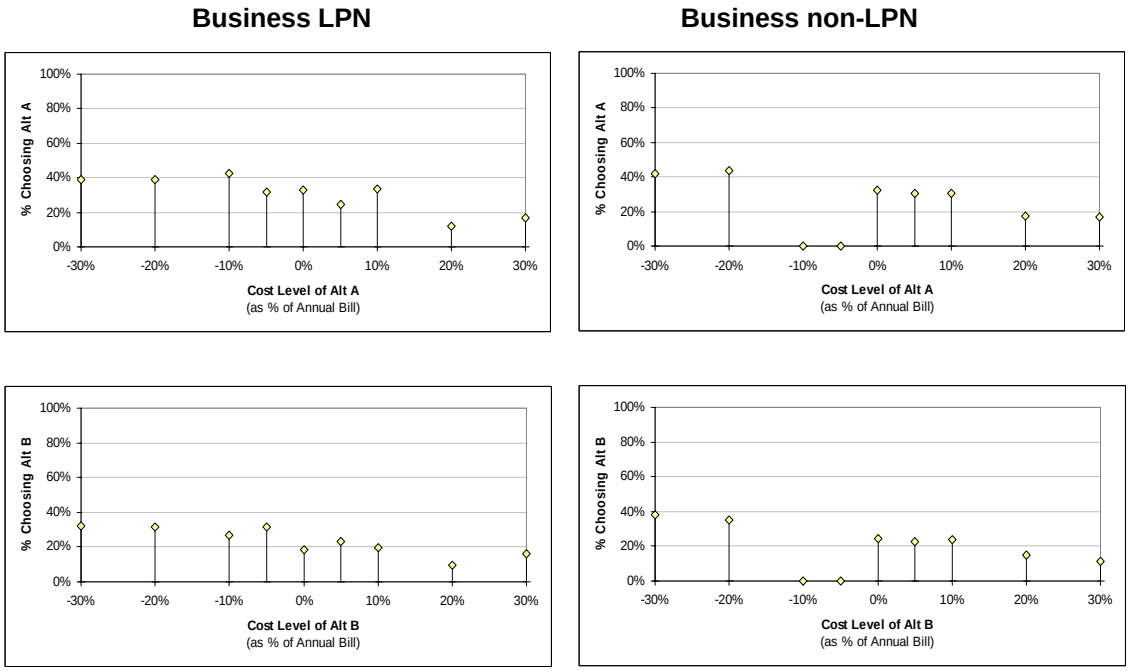


Figure 50: Choices in Experiment 1 at given levels of cost for business consumers



7. DEVELOPMENT OF THE DISCRETE CHOICE MODELS

7.1 Strategy For Estimation Of The Discrete Choice Models

Stated preference data was collected for each DNO, so one of the key issues in the model analysis was to what extent these data should be merged across DNOs. We followed the following 3 principles, in this regard:

Principle 1: Except for the LPN DNO, the data should be aggregated across DNOs, unless analysis indicates that customers from a specific DNO have statistically significant different valuations. The benefit of this approach is that model noise will not result in different valuations between DNOs. For attributes, like number of power cuts, average duration of power cuts, number of short interruptions and network resilience to major storms, where the base levels varied by DNO, the levels were measured as differences from the base (service) level, in the same units across all DNOS eg cuts or interruptions per year (rather than per 5 or 10 years, as presented to respondents), minutes or numbers of customers affected. This allowed us to test whether the WTP values were equal across DNOs, even if the level itself was different across DNOs. It is noteworthy that aggregation of data is particularly important for the estimation of customers' sensitivity to price, which is in the denominator of the calculation of willingness-to-pay and therefore is a key input into the wtp valuation. When the data are aggregated across DNOs, we observe differential price sensitivity by income for domestic customers and by size of company for business customers. These patterns are not necessarily identifiable when estimating models from the data for one specific DNO. Additionally, in some cases, the price coefficients are insignificant in some of the DNO-specific models, particularly in the business sector, which may lead to large and unreliable estimates of wtp. When we found that the model fit was significantly improved by retaining DNO-specific terms, these have been retained. We have not, then, tried to find ways to aggregate the values across the 13 non-LPN DNOs.

Principle 2: Because of the different structure of the SP experiments, the LPN data were not aggregated with the data from the other DNOs, in the model analysis. It is noteworthy that this would be possible, but it was outside the scope of what was possible within the time and cost budget for this work. Instead, to increase the sample size, the pilot data have been used in the models for LPN, taking specific account of differences in error between the pilot data and main data. This means that it has not been possible to identify as many significant attribute values for the LPN models.

Principle 3: Continuous variables, for example the number of power cuts, average duration of power cuts, number of short power interruptions, have been defined as ***differences*** from the current level, which is different for different DNOs. We have spent considerable effort looking at whether the willingness to

pay for service improvements (per improvement) are different from the willingness to accept payment for service reductions (per reduction), and whether a linear formulation is justified and, as in 1 and 2 above, whether the values are really different between DNOs.

7.2 Modelling Background

In the first three experiments, each respondent made a choice between three alternatives: an "as now" alternative which reflected the current level of service at the current bill, and two alternatives, with different service levels and an increase or decrease in electricity bill.

As a result the choice models for these first three experiments contained three utility functions, one for each of the alternatives:

1. As Now
2. Alternative A
3. Alternative B

The variables in the utility functions for each alternative reflect the levels of each of the attributes that were present in the choice that they faced. Each variable in the model is multiplied by a coefficient (β_x) which reflects the size of its impact on the decision making process.

For example, a simple utility function for "Alternative A" (and Alternative B) from the first experiment may be expressed as follows:

$$
\begin{aligned}
U(AltA) = {} & \beta_{PowerCuts} * \text{number of power cuts (expressed as differences from base)} \\
& + \beta_{Duration} * \text{average duration of power cuts (expressed as differences from base value)} \\
& + \beta_{interruption} * \text{number of short power interruptions (expressed as differences from base value)} \\
& + \beta_{Info} * \text{level of information} \\
& + \beta_{Price} * \text{change in electricity bill}
\end{aligned}
$$

The utility formulation for the "As Now" terms will reflect the service characteristics for that alternative (in this study mostly zero to reflect the base value), plus a constant, reflecting an inherent preference for the current situation, over and above the attribute levels eg:

$$U(\text{As Now}) = \beta_{AsNow}$$

The model coefficients (β_x) are estimated in the model estimation procedure. The sensitivity to a certain attribute level is assumed to be the same across

alternatives, that is: the coefficients are assumed to be generic across utility functions.

The model is based on the assumption that each respondent chooses the alternative that provides him/her with the highest utility. An error term is included on the utility function to reflect unobservable factors in the individual's utility. The estimation can therefore be conducted within the framework of random utility theory ie accounting for the fact that the analyst has only imperfect insight into the utility functions of the respondents (McFadden, 1974).

Initially, a series of multinomial logit (MNL) models were estimated and in the latter stages of development more complex (nested) model structures were tested. Systematic differences in preferences among different segments of the sample were also statistically tested. These are described further in the following sections.

All the models within this report were estimated using the Alogit software package, a widely used package for estimating models within the logit model family (Alogit 4.2, 2005).

7.3 Model Development

All models have been estimated by pooling the data from all of the experiments, taking account of differing error variation across the four experiments[4].

A number of statistical specification tests have been undertaken during the model estimation as described below.

Testing For Differences In Valuation Of Service Attributes By Characteristics Of The Respondent

Initial models were developed using generic coefficients for all respondents in the sample ie representing the average values attributed to each of the attributes across all respondents.

In developing the models we specifically examined whether different groups of respondents placed different valuations on any of the attributes eg by DNO or other socio-economic characteristic. To identify possible differences we examined cross tables that summarised the in-sample predictive ability of the model. This approach allowed us to approach the problem in a systematic and thorough way. Through using such an approach we could satisfy ourselves that the model we developed addressed the key differences within the sample. These

[4] See Bradley and Daly (1991) for further details on estimating models allowing for different error variation.

tests were conducted on a comprehensive list of variables, as are described below:

Domestic:

- DNO
- urban or rural locality
- respondent's age
- household income
- electricity usage level
- whether respondent had experienced any power cuts
- whether respondent had experienced an unplanned power cut
- whether respondent had experienced a planned power cut.

Business:

- DNO
- business size
- urban or rural locality
- electricity usage level
- industry type
- region
- whether company had experienced any power cuts
- whether company had experienced an unplanned power cut
- whether company had experienced a planned power cut.

Where significant differences have been found, these are reported in the discussion of the model results.

Testing For Differences In Valuation Of Price By Characteristics Of The Respondent

Similarly, tests were undertaken to explore whether there was variation across the samples in terms of the "value" placed on the price attribute ie price sensitivity.

We found a plausible trend across the income bands, with customers from households with higher incomes demonstrating less sensitivity to increases in their electricity bill (and therefore higher willingness-to-pay for service increases) than those from lower income households. Similarly, we observed that large business were less sensitive to increases in their electricity bill than small and medium-sized businesses.

Testing For Inertia/Preference On The "As Now" Alternative

As discussed above, the model contained a constant that explained a general preference for the "as now" alternative over and above that predicted by the service attributes and price. In developing the models, prediction cross-tables were produced that examined whether the "as now" alternative was chosen more or less frequently by different groups of respondents listed in Section 4.3.1. When such differences were found, these are discussed in the detailed findings.

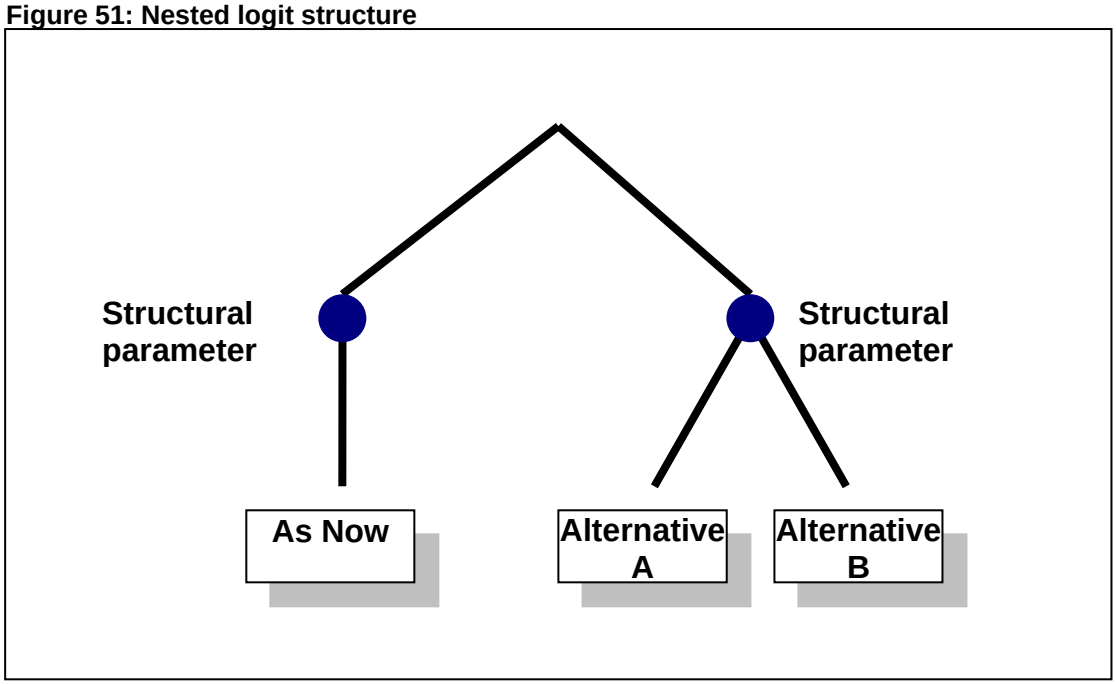
Testing For Best Representation of Service Attributes

For continuous variables, such as power cuts, linear models have been specified, so that the results will indicate the value per unit change eg per power cut. As discussed, separate functions have been tested for service improvements (wtp) and service reductions (wta). When the slopes for these functions have been found to be not significantly different, then one slope has been estimated. Cross tables have been produced to examine the fit across the range of the function and across DNOs. In cases, where the values differ significantly by DNO, separate coefficients have been estimated. In cases where the fit across the range of improvements or reductions is not good, formulations with differing slopes, say for gains and losses, have been tested.

Testing For Correlation Between The "New" Alternatives

The initial models developed were multinomial logit (MNL) models, in which we assumed there was no correlation between the three alternatives offered in experiments 1 through 3. These models are quicker to run than nested model structures, which allowed a substantial number of model tests to be undertaken. Once the best MNL models had been identified, a nested logit model structure was tested, allowing for higher cross-elasticities between the two hypothetical service alternatives (see Train, 2003 for a detailed description of nested logit). This model was then compared to the MNL model by examining the change in model likelihood, and testing the consistency of the tree with utility theory, i.e. structural parameters with values between 0 and 1.

Figure 51: Nested logit structure



Identifying And Removing Outliers From The Data Set

The models developed to this point included all of the usable data from the surveys. However, there remained the possibility that there could be a small number of respondents that had extremely different responses to those of the rest of the sample which could have a substantial impact on the model results. This could be the case if there were respondents that were either significantly different in some immeasurable way that we could not discover from the characteristics we have available for the models or respondents that were responding to the choices in a less rational way than other respondents. The existence of outliers was tested by examining the forecasts of the model and outputting those observations that had a very low predicted probability of choosing the alternatives they were observed to choose. Tests were then run to examine the impact of excluding these respondents from the analysis.

The analysis showed that there were a small number of businesses (5) with very large bill sizes which had a substantial impact on the non-LPN business model. These were dropped with significant improvement in model fit.

Corrections For The Repeated Measures Resulting From The Multiple Data Points Collected From Each Respondent

An important advantage of stated preference discrete choice experiments is that several responses can be collected from each individual. This reduces substantially the cost of data collection and allows for more advanced experimental designs. However, the collection of multiple responses means that each respondent's basic preferences apply to the series of responses that he or

she has given: those responses are therefore interdependent. Naïve analysis methods that assume the independence of observations are therefore, in principle, invalid.

While a number of methods can be used to correct for the interdependence of SP observations, experience has shown that a good practical method is to use the "jack-knife" procedure (Bissell and Ferguson, 1975; Miller, 1974). This is a standard statistical method for testing and correcting model misspecifications. RAND Europe has pioneered its use in connection with SP data and has found it to be effective and reliable in this context (Cirillo et al, 1998).

The jack-knife procedure is described in more detail in Appendix O This procedure was applied to the models (using 30 subsamples) to provide corrected estimates of the coefficients and their standard errors.

Calculating Willingness To Pay And Testing For Packaging Effects

The coefficients from the discrete choice models provide us with a measure of the value that respondents place on changes in each of the service attributes eg reduction in number of power cuts ($\beta_{PowerCuts}$). In addition, because we have asked respondents to consider varying electricity bill charges in their choices, the models also provide a measure of the value that respondents place on changes in their electricity bill when considering these changes to service attributes (β_{Price}). These two results can be combined to illustrate the relative importance placed on each of the service factors ie we can calculate the marginal rates of substitution of each change in the service attributes with respect to price.

$$\text{WTP for reduction in power cuts} = \frac{\beta_{PowerCuts}}{\beta_{Price}}$$

This provides us with a measure of the willingness-to-pay of respondents, expressed in electricity bill changes, for each of the service improvements considered. When we observe different price sensitivity by income level or company size, then we report differing wtp values by income group or size of company.

As discussed earlier, there is concern that the estimation of willingness-to-pay from multiple experiments using a subset of the attributes can lead to an overstatement of the total willingness-to-pay for all of the improvement and therefore an additional "packaging" experiment has been included in this study to allow such effects to be measured. Here we have included all of the service attributes (and price) in a single experiment.

It is not possible in this experiment to explore all of the levels of all of the attributes, or to isolate the value placed on any of the individual attributes, but

we can make judgements about how attributes are valued in aggregate blocks. Specifically, in the model we have included terms that reflect the value placed on each of the blocks of attributes within the experiment. These provide a willingness-to-pay value for moving from the lowest to the highest level of all of the attributes in each block, and can be compared with the values of from the first three experiments to obtain an estimate of the "package effect".

These tests have demonstrated that there are quite significant packaging effects.

8. ATTRIBUTE VALUATIONS

This chapter presents the resulting valuations for each service improvement tested in the SP experiments. The detailed model coefficients, which have been used to calculate the wtp valuations are presented in Appendix N.

8.1 Package Adjustment

Two valuations have been calculated for each service improvement:

- an 'unadjusted' willingness to pay, which reflects the values obtained directly from the lower-level experiments, which does not incorporate the impact of package effects

- an 'adjusted' willingness to pay, which reflects the values obtained from the lower-level experiments, adjusted by the ratio of the value of the package of improvements as measured from the higher-level package experiment and the lower-level experiments. These adjustments are then applied to all of the factors included within the specific package.

From the model results, we observe substantial package effects, particularly for the domestic customers as shown in Table 22. For example, the adjustment to the package 1 attributes ie power cuts, duration of power loss and number of short interruptions, for non-LPN customers is 0.19. It is noteworthy that the adjustment factors for the non-LPN DNOs reflects the average factor across DNOs. Because of the different structure of the LPN experiments, we have had to use the adjustments calculated for the LPN area only, although these will be less reliably estimated because of the smaller sample of data. In general, we see larger adjustments to the values from experiment 1 compared to those for experiments 2 and 3. It is not clear why this is the case, but it suggests that the experiment 1 attributes are not as important when compared with the attributes in experiment 2 and 3.

It is interesting to note that we observe adjustment factors greater than 1 for the experiment 2 values for businesses. This highlights the importance of the experiment 2 attributes, particularly tightening the guaranteed standard relating to restoration of power, to businesses, relative to the attributes tested in experiment 1 and 3.

Table 19: Package Adjustments

Experiment	Residential	Package value / "lower level" value		Business	Package value / "lower level" value	
		LPN	non-LPN		LPN	non-LPN
1	Power Cuts Duration of Power loss Short interruptions (Info: non-LPN)	24%	19%	Power Cuts Duration of Power loss Short interruptions (Info: non-LPN)	42%	51%
2	Restoration of power Compensation – multiple interruption Notice before interruption	15%	41%	Restoration of power Compensation – not restoring Notice before interruption Appointments	142%	113%
3	Undergrounding Storms (non-LPN) Resilience to flood Carbon reduction (Info: LPN)	86%	52%	Storms Resilience to flood Carbon reduction Energy efficiency advice (Info: LPN)	49%	69%

8.2 Price Sensitivity

For domestic customers we observe differential price sensitivity by household income, whereby high income households have lower price sensitivity and therefore higher willingness-to-pay valuations for service attribute improvements compared to lower income households. Because the measure of price sensitivity is constant across all models, and price sensitivity is in the denominator of the calculation of willingness-to-pay, we see the same ratio between the values across income bands, across attributes. In the tables that are presented in this chapter, average willingness to pay values for all attributes are calculated based on the household income proportions derived from the survey sample, on the basis that the sample is nationally representative of the domestic electricity market. We have used separate income distributions for LPN and other non-LPN areas, on the basis that the income distribution within London is different from the rest of Great Britain. Average values are reported both including and excluding those who did not report household income levels.

The household income distributions for non-LPN and LPN customers, observed from the sample, are shown in Table 20 below.

Table 20: Household Income Distribution Within The Domestic Sample

Household income	Non-LPN DNOs	LPN
Unknown	26%	26%
Over £60,000	2%	12%
£50,001 - £60,000	2%	3%
£40,001 - £50,000	5%	4%
£30,001 - £40,000	11%	7%
£20,001 - £30,000	15%	12%
£10,000 - £20,000	24%	18%
Under £10,000	14%	19%
Total	**100%**	**100.0%**

For the business models, the best model fit[5] was obtained when the price was divided by the company's annual bill, thus reflecting the additional prices in proportion to the total bill size. The resulting wtp values are therefore reported in percentage of the bill size. This is consistent with the modelling in DPCR4. We observe differential price sensitivity between small and medium users of electricity compared to those companies which use large amounts of electricity. The distribution of the business sample by the size of the company (as measured by their use of electricity) is presented in Table 21 below.

Table 21: Company Size Distribution Within The Business Sample

Company Size	All DNOs
Small – < 100 kWh	65.1%
Medium – 100 kWh - < 1 MW	24.3%
Large – 1 MW +	10.6%
Total	**100.0%**

It may be appropriate to adjust these weights to reflect the true distribution of household income or company size for electricity customers, perhaps even for each DNO, should these be known and differ significantly from the distribution within the sample.

5 Model fit is assessed through comparisons of the log-likelihood of the models.

8.3 Attribute Valuations

The valuations for the different service attributes are presented and discussed below. All values that are presented reflect the values after scaling for packing effects (see Table 22). Each section begins with a box summarising the attribute levels that were tested in the exercises, the resulting valuations are then discussed. In all cases, significance has been assessed at the 95% confidence level.

Power Cuts > 3 minutes

Power Cuts
7 levels
+1, +2, +3
Base (differs by DNO)
-1, -2, -3
Unit: frequency of power cuts in 5 years or 10 years, depending on the DNO

For both the domestic and business models, we tested whether the willingness-to-pay for power cut reductions, ie improvements in service, is different from the willingness-to-accept payment for increases in power cuts ie deteriorations in service. All valuations are presented as values per power cut change per year ie a level of 1 power cut in 5 years would be measured as a change of 0.2 power cuts per year and a level of 1 power cut in 10 years would be measured as a change of 0.1 power cuts per year. Thus, we can compare the power cut coefficients, in the unit of power cut change per year, between those DNOs for which changes were presented in 10 years (LPN, UU, SP Manweb and SP Distribution) and those with which changes were presented in 5 years (the rest). However, when applying the values, we need to take account of the range of levels actually tested in the survey, so for those DNOs which had values presented in 10 years, we need to multiply the value (reflecting the value per year) by the actual frequency tested in the experiment eg 1/10, 2/10 and 3/10, for DNOs which had levels varying over 10 year and 1/5, 2/5 and 3/5 for other DNOs. For example, for CN East domestic customers, an improvement of 1 power cut per year is valued at £4.02. Therefore, an improvement from its current level (4 in 5 years) to its best level (1 in 5 years) is valued at £2.41, i.e. £4.02*(4/5-1/5).

The values (£ per power cut per year) for power cut changes for domestic customers are presented in Table 22. For non-LPN domestic customers, we have identified significant differences[6] between wtp and wta values, whereby

[6] Significance is determined by likelihood ratio tests, whereby the model fit of models with separate wtp and wta are significantly better at the 95% confidence level than models with wtp equal to wta.

customers would have to be recompensed more for a deterioration in the number of power cuts compared to what they are willing to pay for improvements ie a reduction in the number of power cuts. One single coefficient reflecting the value for improvements in power cut levels was identified across all DNOs (shaded in the table); however, separate valuations for deteriorations, by DNO, were identified. Because the data for the LPN models was not able to be pooled with the other data sets, we were only able to identify a single coefficient for the domestic LPN segment, reflecting the same value for reductions and increases in power cuts.

Table 22: WTP and WTA for Power Cut Reductions and Increases for domestic customers (£ per power cut per year)

Frequency of Power Cuts (£ per cuts per year)																
		CN East	CN West	EDF - EPN	EDF - LPN	EDF - SPN	SSE - Hydro	SSE - Souther	CE - YEDL	CE - NEDL	UU	WPD S. Wales	WPD S. West	SP Manwe	SP Distrib
income level 8	deterioration	-4.02	-5.47	-6.01	-9.30	-6.21	-3.69	-4.69	-2.34	-8.31	-15.92	-6.34	-6.90	-6.52	-6.52
(unknown income)	improvement	3.67	3.67	3.67	9.30	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
income level 7	deterioration	-10.07	-13.69	-15.04	-25.34	-15.53	-9.23	-11.75	-5.86	-20.81	-39.85	-15.86	-17.27	-16.32	-16.32
(Over £60,000)	improvement	9.18	9.18	9.18	25.34	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18	9.18
income level 6	deterioration	-6.98	-9.49	-10.42	-25.34	-10.76	-6.40	-8.14	-4.06	-14.42	-27.61	-10.99	-11.97	-11.31	-11.31
(£50,001 - £60,000)	improvement	6.36	6.36	6.36	25.34	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36	6.36
income level 5	deterioration	-6.73	-9.14	-10.04	-25.34	-10.38	-6.17	-7.85	-3.91	-13.90	-26.62	-10.60	-11.54	-10.90	-10.90
(£40,001 - £50,000)	improvement	6.13	6.13	6.13	25.34	6.13	6.13	6.13	6.13	6.13	6.13	6.13	6.13	6.13	6.13
income level 4	deterioration	-4.89	-6.65	-7.30	-25.34	-7.54	-4.48	-5.70	-2.84	-10.10	-19.35	-7.70	-8.39	-7.92	-7.92
(£30,001 - £40,000)	improvement	4.46	4.46	4.46	25.34	4.46	4.46	4.46	4.46	4.46	4.46	4.46	4.46	4.46	4.46
income level 3	deterioration	-4.70	-6.38	-7.01	-10.19	-7.24	-4.31	-5.48	-2.73	-9.70	-18.58	-7.40	-8.05	-7.61	-7.61
(£20,001 - £30,000)	improvement	4.28	4.28	4.28	10.19	4.28	4.28	4.28	4.28	4.28	4.28	4.28	4.28	4.28	4.28
income level 2	deterioration	-3.81	-5.18	-5.69	-10.19	-5.88	-3.50	-4.45	-2.22	-7.88	-15.09	-6.01	-6.54	-6.18	-6.18
(£10,000 - £20,000)	improvement	3.48	3.48	3.48	10.19	3.48	3.48	3.48	3.48	3.48	3.48	3.48	3.48	3.48	3.48
income level 1	deterioration	-3.25	-4.42	-4.86	-7.41	-5.02	-2.98	-3.80	-1.89	-6.72	-12.87	-5.13	-5.58	-5.27	-5.27
(Under £10,000)	improvement	2.97	2.97	2.97	7.41	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97
Weighted average (all income levels)	deterioration	-4.42	-6.00	-6.59	-13.46	-6.81	-4.05	-5.15	-2.57	-9.12	-17.47	-6.96	-7.57	-7.16	-7.16
	improvement	4.02	4.02	4.02	13.46	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02
Unscaled weighted average (all income levels)*	deterioration	-23.05	-31.32	-34.41	-56.43	-35.54	-21.13	-26.88	-13.40	-47.61	-91.19	-36.30	-39.52	-37.34	-37.34
	improvement	21.01	21.01	21.01	56.43	21.01	21.01	21.01	21.01	21.01	21.01	21.01	21.01	21.01	21.01

*Scaling factors: 0.19 for non-LPN DNOs; and 0.24 for LPN

For the business non-LPN models, we have again identified significant differences between wtp and wta values. We observe that manufacturing businesses have higher wtp for power cut reductions than non-manufacturing businesses. Additionally, we observe higher valuations for two DNOs: SP Distribution and SP Manweb, both which have low number of power cuts and for which a 10 year timescale for power cut differences was used. As noted above, this does not necessarily mean that the valuations for changes in the level of power cuts for these DNOs is higher, the higher numbers may simply reflect the fact that they are multiplying smaller changes, when converted to a per year change. This is illustrated in more detail below. Again, for the LPN models, we were only able to identify one coefficient to represent the value for reductions and increases in power cuts.

Table 23: WTP and WTA for Power Cut Reductions and Increases for business customers (% bill per power cut per year), scaled value

Scaled value	LPN			non-LPN		
Frequency of power cuts	**S**	**M**	**L**	**S**	**M**	**L**
Deterioration	-12.5%	-12.5%	-4.8%	-5.3%	-5.3%	-4.2%
Deterioration - SP Distribution				-15.2%	-15.2%	-12.1%
Power Cut Improvement	12.5%	12.5%	4.8%			
Power Cut Improvement – Manufacturing				3.7%	3.7%	2.9%
Power Cut Improvement - Non-Manufacturing				2.6%	2.6%	2.0%
Power Cut Improvement - SP Manweb				8.4%	8.4%	6.6%

* Scaling factors: 0.51 for non-LPN and 0.42 for LPN

These figures may appear large but they are multiplied by relatively small values, because they reflect the ***value applied to a change in number of power cuts per year***, ie 1, 2 or 3 per year, whereas in the SP exercises the changes that were tested were in the order of 1, 2 or 3 in 5 or 10 years. The table below shows the total valuations obtained, by DNO, for business customers for the range of power cut changes tested in the SP experiment (see Appendix J for details of the levels). For example, for CN East, for companies with small electricity requirements, an increase of 1 power cut per year is valued at -5.3% of their electricity bill. But the actual frequency of power cuts is less than 1 power cuts per year; it is at 4 in 5 years. Thus, a deterioration from the current level to the worst level (from 4 in 5 years to 7 in 5 years) should be valued at -3.18%, i.e. -5.3%*(7/5 - 4/5). Again, the values in the table reflect the values which have been scaled for package effects.

Table 24: WTP and WTA Valuations for Power Cut Reductions and Increases for business customers (% bill), scaled

Value of Power Cuts Tested (% bill)															
WTP Small/Medium Businesses		CN East	CN West	EDF - EPN	EDF - LPN	EDF - SPN	SSE - Hydro	SSE - Southern	CE - YEDL	CE - NEDL	UU	WPD S. Wales	WPD S. West	SP Manweb	SP Distribution
Pcut Increases	Current + 3	-3.2%	-3.2%	-3.2%	-3.8%	-3.2%	-3.2%	-3.2%	-3.2%	-3.2%	-1.6%	-3.2%	-3.2%	-1.6%	-4.6%
	Current + 2	-2.1%	-2.1%	-2.1%	-2.5%	-2.1%	-2.1%	-2.1%	-2.1%	-2.1%	-1.1%	-2.1%	-2.1%	-1.1%	-3.0%
	Current + 1	-1.1%	-1.1%	-1.1%	-1.3%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-0.5%	-1.1%	-1.1%	-0.5%	-1.5%
	Current Service	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
PCut Reductions	Current - 1	0.6%	0.6%	0.6%	1.3%	0.6%	0.6%	0.6%	0.6%	0.6%	0.3%	0.6%	0.6%	0.8%	0.3%
	Current - 2	1.2%	1.2%	1.2%	2.5%	1.2%	1.2%	1.2%	1.2%	1.2%	0.6%	1.2%	1.2%	1.7%	0.6%
	Current - 3	1.7%	1.7%	1.7%	3.8%	1.7%	1.7%	1.7%	1.7%	1.7%	0.9%	1.7%	1.7%	2.5%	0.9%

Value of Power Cuts Tested (% bill)															
WTP Large Businesses		CN East	CN West	EDF - EPN	EDF - LPN	EDF - SPN	SSE - Hydro	SSE - Southern	CE - YEDL	CE - NEDL	UU	WPD S. Wales	WPD S. West	SP Manweb	SP Distribution
Pcut Increases	Current + 3	-2.5%	-2.5%	-2.5%	-1.4%	-2.5%	-2.5%	-2.5%	-2.5%	-2.5%	-1.3%	-2.5%	-2.5%	-1.3%	-3.6%
	Current + 2	-1.7%	-1.7%	-1.7%	-1.0%	-1.7%	-1.7%	-1.7%	-1.7%	-1.7%	-0.8%	-1.7%	-1.7%	-0.8%	-2.4%
	Current + 1	-0.8%	-0.8%	-0.8%	-0.5%	-0.8%	-0.8%	-0.8%	-0.8%	-0.8%	-0.4%	-0.8%	-0.8%	-0.4%	-1.2%
	Current Service	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
PCut Reductions	Current - 1	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.2%	0.5%	0.5%	0.7%	0.2%
	Current - 2	0.9%	0.9%	0.9%	1.0%	0.9%	0.9%	0.9%	0.9%	0.9%	0.5%	0.9%	0.9%	1.3%	0.5%
	Current - 3	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	0.7%	1.4%	1.4%	2.0%	0.7%

* Power cut changes over 10 years for LPN, UU, SP Manweb and SP Distribution, power cut changes over 5 years for the rest

Average Duration of Power Cuts

Average Duration of Power Cuts
9 levels
+5, +10, +15,+20
Base (differs by DNO)
-5, -10, -15, -20
Unit: average duration in minutes

For domestic customers in non-LPN DNOs, we have identified significant coefficients for reductions and increases in the average duration of power cuts, where again respondents require higher levels of compensation for increases in the average duration of power cuts compared to their willingness to pay for reductions in average duration levels. The resulting values are shown in Table 25 (again values which are estimated from a common coefficient across DNOs have been shaded). As for power cuts, for LPN domestic customers, we were not able to identify any significant difference between the (wtp) values for reductions or the (wta) values for increases.

The values in the tables are presented in units of £ per minute. Therefore the total value of a 20 minute reduction in the average duration of a power cut, for CN East, for example would be £1.40 per year.

Table 25: WTP and WTA for Reductions and Increases for in average duration of power cuts for domestic customers (£ per minute per year)

Change in average duration of power cuts (£ per minute)																	
		CN East	CN West	EDF - EPN	EDF - LPN	EDF - SPN	SSE - Hydro	SSE - Southern	CE - YEDL	CE - NEDL	UU	WPD S. Wales	WPD S. West	SP Manweb	SP Distribution
income level 8	deterioration	-0.12	-0.12	-0.12	-0.04	-0.12	-0.11	-0.09	-0.12	-0.19	-0.15	-0.12	-0.12	-0.04	-0.12
unknown income	improvement	0.06	0.06	0.06	0.04	0.06	0.11	0.06	0.06	0.06	0.15	0.06	0.06	0.04	0.06
income level 7	deterioration	-0.29	-0.29	-0.29	-0.10	-0.29	-0.28	-0.22	-0.29	-0.47	-0.37	-0.29	-0.29	-0.10	-0.29
Over £60,000	improvement	0.15	0.15	0.15	0.10	0.15	0.28	0.15	0.15	0.15	0.37	0.15	0.15	0.10	0.15
income level 6	deterioration	-0.20	-0.20	-0.20	-0.10	-0.20	-0.19	-0.15	-0.20	-0.32	-0.26	-0.20	-0.20	-0.07	-0.20
£50,001 - £60,000	improvement	0.11	0.11	0.11	0.10	0.11	0.19	0.11	0.11	0.11	0.26	0.11	0.11	0.07	0.11
income level 5	deterioration	-0.20	-0.20	-0.20	-0.10	-0.20	-0.19	-0.15	-0.20	-0.31	-0.25	-0.20	-0.20	-0.07	-0.20
£40,001 - £50,000	improvement	0.10	0.10	0.10	0.10	0.10	0.19	0.10	0.10	0.10	0.25	0.10	0.10	0.07	0.10
income level 4	deterioration	-0.14	-0.14	-0.14	-0.10	-0.14	-0.13	-0.11	-0.14	-0.23	-0.18	-0.14	-0.14	-0.05	-0.14
£30,001 - £40,000	improvement	0.07	0.07	0.07	0.10	0.07	0.13	0.07	0.07	0.07	0.18	0.07	0.07	0.05	0.07
income level 3	deterioration	-0.14	-0.14	-0.14	-0.04	-0.14	-0.13	-0.10	-0.14	-0.22	-0.17	-0.14	-0.14	-0.05	-0.14
£20,001 - £30,000	improvement	0.07	0.07	0.07	0.04	0.07	0.13	0.07	0.07	0.07	0.17	0.07	0.07	0.05	0.07
income level 2	deterioration	-0.11	-0.11	-0.11	-0.04	-0.11	-0.10	-0.08	-0.11	-0.18	-0.14	-0.11	-0.11	-0.04	-0.11
£10,000 - £20,000	improvement	0.06	0.06	0.06	0.04	0.06	0.10	0.06	0.06	0.06	0.14	0.06	0.06	0.04	0.06
income level 1	deterioration	-0.10	-0.10	-0.10	-0.03	-0.10	-0.09	-0.07	-0.10	-0.15	-0.12	-0.10	-0.10	-0.03	-0.10
Under £10,000	improvement	0.05	0.05	0.05	0.03	0.05	0.09	0.05	0.05	0.05	0.12	0.05	0.05	0.03	0.05
Weighted average (all income levels)	**deterioration**	**-0.13**	**-0.13**	**-0.13**	**-0.06**	**-0.13**	**-0.12**	**-0.10**	**-0.13**	**-0.20**	**-0.16**	**-0.13**	**-0.13**	**-0.04**	**-0.13**
	improvement	**0.07**	**0.07**	**0.07**	**0.06**	**0.07**	**0.12**	**0.07**	**0.07**	**0.07**	**0.16**	**0.07**	**0.07**	**0.04**	**0.07**
Unscaled weighted average (all income levels)*	**deterioration**	**-0.67**	**-0.67**	**-0.67**	**-0.23**	**-0.67**	**-0.63**	**-0.51**	**-0.67**	**-1.06**	**-0.84**	**-0.67**	**-0.67**	**-0.23**	**-0.67**
	improvement	**0.35**	**0.35**	**0.35**	**0.23**	**0.35**	**0.63**	**0.35**	**0.35**	**0.35**	**0.84**	**0.35**	**0.35**	**0.23**	**0.35**

*Scaling factors: 0.19 for non-LPN DNOs; and 0.24 for LPN

For business customers, in non-LPN DNOs, we were able to identify significant model coefficients for reductions and increases in the average duration of power cuts, but we were not able to identify any significant differences in the value of changes in the average duration of power cuts across the non-LPN DNOs. We were also not able to identify any significant value for changes in the average duration of power cuts for the London customers.

Table 26: WTP and WTA for Reductions and Increases in average duration of power cuts for business customers (% bill per minute), scaled values

Scaled value	LPN			non-LPN		
Average duration of power loss	S	M	L	S	M	L
Deterioration				-0.07%	-0.07%	-0.06%
Improvement				0.05%	0.05%	0.04%

* Scaling factors: 0.51 for non-LPN and 0.42 for LPN

The table below shows the total valuations obtained for business customers, by DNO, for the range of duration levels tested in the SP experiment (see Appendix G for details of the levels). For example, for CN East, for companies with small and medium electricity requirements, a decrease of 5 minutes in the average duration of power cuts is equal 0.2% (0.048% x 5). Again, the values in the table reflect the values which have been scaled for package effects.

Table 27: WTP and WTA for Reductions and Increases in average duration of power cuts for business customers (% bill), scaled values

Value of Duration Levels Tested (% bill)															
WTP Small/Medium Businesses		CN East	CN West	EDF - EPN	EDF - LPN	EDF - SPN	SSE - Hydro	SSE - Southern	CE - YEDL	CE - NEDL	UU	WPD S. Wales	WPD S. West	SP Manweb	SP Distribution
Duration Increases	Current + 20 mins	-1.5%	-1.5%	-1.5%		-1.5%	-1.5%	-1.5%	-1.5%	-1.5%	-1.5%	-1.5%	-1.5%	-1.5%	-1.5%
	Current + 15 mins	-1.1%	-1.1%	-1.1%		-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%
	Current + 10 mins	-0.7%	-0.7%	-0.7%		-0.7%	-0.7%	-0.7%	-0.7%	-0.7%	-0.7%	-0.7%	-0.7%	-0.7%	-0.7%
	Current + 5 mins	-0.4%	-0.4%	-0.4%		-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%
	Current Service	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Duration Reductions	Current - 5	0.2%	0.2%	0.2%		0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
	Current - 10 mins	0.5%	0.5%	0.5%		0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
	Current - 15 mins	0.7%	0.7%	0.7%		0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%	0.7%
	Current - 20 mins	1.0%	1.0%	1.0%		1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%

Value of Duration Levels Tested (% bill)															
WTP Large Businesses		CN East	CN West	EDF - EPN	EDF - LPN	EDF - SPN	SSE - Hydro	SSE - Southern	CE - YEDL	CE - NEDL	UU	WPD S. Wales	WPD S. West	SP Manweb	SP Distribution
Duration Increases	Current + 20 mins	-1.2%	-1.2%	-1.2%		-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%
	Current + 15 mins	-0.9%	-0.9%	-0.9%		-0.9%	-0.9%	-0.9%	-0.9%	-0.9%	-0.9%	-0.9%	-0.9%	-0.9%	-0.9%
	Current + 10 mins	-0.6%	-0.6%	-0.6%		-0.6%	-0.6%	-0.6%	-0.6%	-0.6%	-0.6%	-0.6%	-0.6%	-0.6%	-0.6%
	Current + 5 mins	-0.3%	-0.3%	-0.3%		-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%	-0.3%
	Current Service	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Duration Reductions	Current - 5	0.2%	0.2%	0.2%		0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
	Current - 10 mins	0.4%	0.4%	0.4%		0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
	Current - 15 mins	0.6%	0.6%	0.6%		0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%	0.6%
	Current - 20 mins	0.8%	0.8%	0.8%		0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%	0.8%

Short Interruptions

Short Interruptions
Non-LPN DNOs: 5 levels
+1, +2
Base (differs by DNO)
-1, -2
Unit: frequency of short interruptions in 5 years or 10 years, depending on the DNO
LPN: 5 levels
1/6, 1/8, 1/10 (base), 1/12 and 1/14 years

For both the domestic and business models, we tested whether the willingness-to-pay for reductions in the number of short interruptions, ie improvements in service, is different from the willingness-to-accept payment for increases in the number of short interruptions, ie deteriorations in service. As power cuts, all valuations have been converted to values per interruption change per year. As noted in Chapter 2, changes in the number of short interruptions for LPN, UU, SP Manweb and SP Distribution were presented over 10 years, whilst changes for the other DNOs were presented over 5 years. Again, this has implications when interpreting the results, specifically that the values presented have to be multiplied by the number of short interruption changes, which are relatively small numbers, ie 1/5, 2/5 or 3/5 for most of the DNOs, and 1/10, 2/10 and 3/10 for the four DNOs which had interruption levels varying over 10 years.

For domestic customers, we have again identified significant differences between wtp and wta for changes in short interruptions, except for CE YEDL, where the values for short interruption changes were lower, on average, than for other DNOs, but where we could not identify significantly different values for wtp and wta. As noted, we have identified generic values across most of the DNOs; those DNOs where we observed significantly different values from the rest included CE YEDL, CE NEDL, SP Distribution, UU, SSE Hydro and for improvements (only) for EDF-EPN. We have observed particularly high valuations for SP Distribution customers – but again it is noted that these are for short interruption changes in ten years.

As for power cuts, for the LPN customers, we were not able to identify any significant difference between reductions (wtp) and increases (wta). The resulting valuations for LPN appear high, but the values are applied to small changes in frequency, for example an improvement from 1 in 10 years to 1 in 14 years is valued at £0.69, i.e. £24.07 * (1/10 – 1/14).

The values for domestic customers, shown in the following table, are presented in units of £ per interruption change per year. As for power cuts, these have been derived by multiplying changes that have occurred over a 5 or 10 year period for non-LPN DNOs.

Table 28: WTP and WTA for Short Interruptions for domestic customers (£ per interruption per year)

Number of short interruptions (£ per interruption per year)																	
		CN East	CN West	EDF - EPN	EDF - LPN	EDF - SPN	SSE - Hydro	SSE - Southern	CE - YEDL	CE - NEDL	UU	WPD S. Wales	WPD S. West	SP Manweb	SP Distribution
income level 8	deterioration	-3.66	-3.66	-3.66	-16.63	-3.66	-7.49	-3.66	-2.56	-6.93	-18.87	-3.66	-3.66	-3.66	-12.14
unknown income	improvement	2.81	2.81	5.10	16.63	2.81	2.81	2.81	2.56	4.01	2.81	2.81	2.81	2.81	11.70
income level 7	deterioration	-9.16	-9.16	-9.16	-45.31	-9.16	-18.74	-9.16	-6.41	-17.36	-47.23	-9.16	-9.16	-9.16	-30.38
Over £60,000	improvement	7.03	7.03	12.77	45.31	7.03	7.03	7.03	6.41	10.05	7.03	7.03	7.03	7.03	29.27
income level 6	deterioration	-6.35	-6.35	-6.35	-45.31	-6.35	-12.99	-6.35	-4.44	-12.03	-32.73	-6.35	-6.35	-6.35	-21.05
£50,001 - £60,000	improvement	4.87	4.87	8.85	45.31	4.87	4.87	4.87	4.44	6.96	4.87	4.87	4.87	4.87	20.29
income level 5	deterioration	-6.12	-6.12	-6.12	-45.31	-6.12	-12.52	-6.12	-4.28	-11.59	-31.55	-6.12	-6.12	-6.12	-20.29
£40,001 - £50,000	improvement	4.70	4.70	8.53	45.31	4.70	4.70	4.70	4.28	6.71	4.70	4.70	4.70	4.70	19.55
income level 4	deterioration	-4.45	-4.45	-4.45	-45.31	-4.45	-9.10	-4.45	-3.11	-8.43	-22.94	-4.45	-4.45	-4.45	-14.75
£30,001 - £40,000	improvement	3.42	3.42	6.20	45.31	3.42	3.42	3.42	3.11	4.88	3.42	3.42	3.42	3.42	14.22
income level 3	deterioration	-4.27	-4.27	-4.27	-18.22	-4.27	-8.74	-4.27	-2.99	-8.09	-22.02	-4.27	-4.27	-4.27	-14.16
£20,001 - £30,000	improvement	3.28	3.28	5.95	18.22	3.28	3.28	3.28	2.99	4.69	3.28	3.28	3.28	3.28	13.65
income level 2	deterioration	-3.47	-3.47	-3.47	-18.22	-3.47	-7.09	-3.47	-2.43	-6.57	-17.88	-3.47	-3.47	-3.47	-11.50
£10,000 - £20,000	improvement	2.66	2.66	4.83	18.22	2.66	2.66	2.66	2.43	3.80	2.66	2.66	2.66	2.66	11.08
income level 1	deterioration	-2.96	-2.96	-2.96	-13.26	-2.96	-6.05	-2.96	-2.07	-5.61	-15.26	-2.96	-2.96	-2.96	-9.82
Under £10,000	improvement	2.27	2.27	4.13	13.26	2.27	2.27	2.27	2.07	3.25	2.27	2.27	2.27	2.27	9.46
Weighted average (all income levels)	**deterioration**	**-4.02**	**-4.02**	**-4.02**	**-24.07**	**-4.02**	**-8.22**	**-4.02**	**-2.81**	**-7.61**	**-20.71**	**-4.02**	**-4.02**	**-4.02**	**-13.32**
	improvement	**3.08**	**3.08**	**5.60**	**24.07**	**3.08**	**3.08**	**3.08**	**2.81**	**4.41**	**3.08**	**3.08**	**3.08**	**3.08**	**12.84**
Unscaled weighted average (all income levels)*	**deterioration**	**-20.96**	**-20.96**	**-20.96**	**-100.89**	**-20.96**	**-42.88**	**-20.96**	**-14.67**	**-39.72**	**-108.09**	**-20.96**	**-20.96**	**-20.96**	**-69.52**
	improvement	**16.09**	**16.09**	**29.22**	**100.89**	**16.09**	**16.09**	**16.09**	**14.67**	**23.00**	**16.09**	**16.09**	**16.09**	**16.09**	**66.99**

*Scaling factors: 0.19 for non-LPN DNOs; and 0.24 for LPN

For business customers, we have also identified significant coefficients for reductions and increases in the number of short interruptions. In this case, reductions are valued more highly, on average, although the (negative) value for increases within the EDF-SPN DNO is very high. For the LPN customers, we were not able to identify a value for wtp for reductions in the number of short interruptions, but we were able to identify values that business customers would have to be recompensed for increases in the number of short interruptions.

Table 29: WTP and WTA for Short Interruptions for business customers (% bill per interruptions per year), scaled value

Scaled value	LPN			non-LPN		
Number of short interruption	**S**	**M**	**L**	**S**	**M**	**L**
Deterioration	-12.6%	-12.6%	-4.8%	-2.5%	-2.5%	-2.0%
Improvement				2.7%	2.7%	2.1%
Improvement (EDF – SPN)				4.7%	4.7%	3.7%

* Scaling factors: 0.51 for non-LPN and 0.42 for LPN

Again, at first glance the numbers may appear large, but as in the case of power cuts, they are multiplied by relatively small values, because they reflect the ***value applied to a change in number of short interruptions per year***, ie 1 or 2 per year, whereas in the SP experiments we tested changes of 1 or 2 in 5 or 10 years. The following table below shows the total valuations obtained for business customers, by DNO, for the range of short interruption changes tested in the SP experiment (see Appendix G for details of the levels). For example, for CN East, for companies with small and medium electricity requirements, a reduction of 1 short interruption in 5 years is equal to 0.54% (decrease of 1 short interruption is equal to 0.54% (2.7% x 1 / 5)). Again, the values in the table reflect the values which have been scaled for package effects.

Table 30: WTP and WTA for Short Interruptions for business customers (% bill), scaled values

Value of Short Interruption Changes Tested (% bill)															
WTP Small/Medium Businesses		**CN East**	**CN West**	**EDF - EPN**	**EDF - LPN**	**EDF - SPN**	**SSE - Hydro**	**SSE - Southern**	**CE - YEDL**	**CE - NEDL**	**UU**	**WPD S. Wales**	**WPD S. West**	**SP Manweb**	**SP Distribution**
Incs	Current + 2	-1.00%	-1.00%	-1.00%	-0.84%	-1.00%	-1.00%	-1.00%	-1.00%	-1.00%	-0.50%	-1.00%	-1.00%	-0.50%	-0.50%
	Current + 1	-0.50%	-0.50%	-0.50%	-0.32%	-0.50%	-0.50%	-0.50%	-0.50%	-0.50%	-0.25%	-0.50%	-0.50%	-0.25%	-0.25%
	Current Service	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Reds	Current - 1	0.54%	0.54%	0.54%	0.00%	0.93%	0.54%	0.54%	0.54%	0.54%	0.27%	0.54%	0.54%	0.27%	0.27%
	Current - 2	1.07%	1.07%	1.07%	0.00%	1.87%	1.07%	1.07%	1.07%	1.07%	0.54%	1.07%	1.07%	0.54%	0.54%

Value of Short Interruption Changes Tested (% bill)															
WTP Large Businesses		**CN East**	**CN West**	**EDF - EPN**	**EDF - LPN**	**EDF - SPN**	**SSE - Hydro**	**SSE - Southern**	**CE - YEDL**	**CE - NEDL**	**UU**	**WPD S. Wales**	**WPD S. West**	**SP Manweb**	**SP Distribution**
Incs	Current + 2	-0.05%	-0.05%	-0.05%	-0.32%	-0.05%	-0.05%	-0.05%	-0.05%	-0.05%	-0.03%	-0.05%	-0.05%	-0.03%	-0.03%
	Current + 1	-0.03%	-0.03%	-0.03%	-0.12%	-0.03%	-0.03%	-0.03%	-0.03%	-0.03%	-0.01%	-0.03%	-0.03%	-0.01%	-0.01%
	Current Service	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Reds	Current - 1	0.03%	0.03%	0.03%	0.00%	0.05%	0.03%	0.03%	0.03%	0.03%	0.01%	0.03%	0.03%	0.01%	0.01%
	Current - 2	0.06%	0.06%	0.06%	0.00%	0.10%	0.06%	0.06%	0.06%	0.06%	0.03%	0.06%	0.06%	0.03%	0.03%

* Power cut changes over 10 years for LPN, UU, SP Manweb and SP Distribution, power cut changes over 5 years for the rest

Provision of Information

Provision of Information 4 levels
Automated messages or telephone operators to respond to customer calls (base)
Base, plus call backs to provide information updates
Base, plus text messages to provide information update
Base, plus helpline for customers reliant on medical equipment (not in business survey)

Information was presented in the first experiment for non-LPN DNOs, and in the third experiment for LPN DNOs, both for domestic and business surveys.

In the non-LPN domestic models, we have observed values for all levels of information provision, ranging from £0.53 from those in the lowest income group to £2.42 from those in the highest income group. Among the different levels, respondents valued call backs to provide information updates the most, followed by a helpline for customers reliant on medical equipment. Text messages to provide information updates were valued least amongst the information options tested. For the LPN models, we observe a positive value for call backs, and a positive value for text updates, the latter only significant for those under 30 years of age.

Table 31: Information valuations for domestic customers (£)

Provision of Information (£, relative to base)			
		All DNOs, apart from EDF - LPN	EDF - LPN
income level 8 (unknown income)	Base, plus helpline for customers reliant on medical equipment	0.81	0.00
	Base, plus text messages to provide information updates	0.66	1.45
	Base, plus call backs to provide information updates	0.97	1.28
	Automated messages or telephone operators to respond to customer calls (base)	0.00	0.00
income level 7 (Over £60,000)	Base, plus helpline for customers reliant on medical equipment	2.04	0.00
	Base, plus text messages to provide information updates	1.64	3.94
	Base, plus call backs to provide information updates	2.42	3.50
	Automated messages or telephone operators to respond to customer calls (base)	0.00	0.00
income level 6 (£50,001 - £60,000)	Base, plus helpline for customers reliant on medical equipment	1.41	0.00
	Base, plus text messages to provide information updates	1.14	3.94
	Base, plus call backs to provide information updates	1.67	3.50
	Automated messages or telephone operators to respond to customer calls (base)	0.00	0.00
income level 5 (£40,001 - £50,000)	Base, plus helpline for customers reliant on medical equipment	1.36	0.00
	Base, plus text messages to provide information updates	1.10	3.94
	Base, plus call backs to provide information updates	1.61	3.50
	Automated messages or telephone operators to respond to customer calls (base)	0.00	0.00
income level 4 (£30,001 - £40,000)	Base, plus helpline for customers reliant on medical equipment	0.99	0.00
	Base, plus text messages to provide information updates	0.80	3.94
	Base, plus call backs to provide information updates	1.17	3.50
	Automated messages or telephone operators to respond to customer calls (base)	0.00	0.00
income level 3 (£20,001 - £30,000)	Base, plus helpline for customers reliant on medical equipment	0.95	0.00
	Base, plus text messages to provide information updates	0.76	1.58
	Base, plus call backs to provide information updates	1.13	1.41
	Automated messages or telephone operators to respond to customer calls (base)	0.00	0.00
income level 2 (£10,000 - £20,000)	Base, plus helpline for customers reliant on medical equipment	0.77	0.00
	Base, plus text messages to provide information updates	0.62	1.58
	Base, plus call backs to provide information updates	0.91	1.41
	Automated messages or telephone operators to respond to customer calls (base)	0.00	0.00
income level 1 (Under £10,000)	Base, plus helpline for customers reliant on medical equipment	0.66	0.00
	Base, plus text messages to provide information updates	0.53	1.15
	Base, plus call backs to provide information updates	0.78	1.02
	Automated messages or telephone operators to respond to customer calls (base)	0.00	0.00
Weighted average (all income levels)	**Base, plus helpline for customers reliant on medical equipment**	**0.89**	**0.00**
	Base, plus text messages to provide information updates	**0.72**	**2.09**
	Base, plus call backs to provide information updates	**1.06**	**1.86**
	Automated messages or telephone operators to respond to customer calls (base)	**0.00**	**0.00**
Unscaled weighted average (all income levels)*	**Base, plus helpline for customers reliant on medical equipment**	**4.66**	**0.00**
	Base, plus text messages to provide information updates	**3.75**	**2.44**
	Base, plus call backs to provide information updates	**5.53**	**2.17**
	Automated messages or telephone operators to respond to customer calls (base)	**0.00**	**0.00**

*Scaling factors: 0.19 for non-LPN DNOs; and 0.86 for LPN

For the business models, we were not able to identify any significant terms for provision of information for non-LPN DNOs, but we were able to identify small values for LPN customers. We were not able to identify separate values for the two information levels tested.

Table 32: Information valuations for business customers (% bill)

Scaled value	LPN			Non-LPN		
Information provided during power cuts	**S**	**M**	**L**	**S**	**M**	**L**
Automated messages or telephone operators to respond to customer calls	0.0%	0.0%	0.0%			
Automated messages or telephone operators to respond to customer calls, plus call backs to provide information updates	1.9%	1.9%	0.7%			
Automated messages or telephone operators to respond to customer calls, plus text messages to provide information updates	1.9%	1.9%	0.7%			

* Scaling factors: 0.51 for non-LPN and 0.49 for LPN

Restoration of Supply

Restoration of Supply
3 levels:
Guarantee within 18 hours (base)
Guarantee within 12 hours
Guarantee within 6 hours

Reductions in the time to restore the electricity supply were valued highly by both domestic and business customers. For domestic customers, we identified significantly different valuations for six DNOs: EDF-EPN, SSE-Hydro, UU, WPD S. Wales, WPD S. West and SP Manweb; the other DNOs were observed to have very similar values. For London customers, we observe higher valuations for guarantees of 6 and 12 hour restorations by those under 30 years of age, we also observe higher valuations for the 6 hour level for those with incomes over £60,000.

Table 33: Valuations for reductions in time for restoration of supply for domestic customers (£)

Restoration of Supply (£ relative to base, i.e. £ per 6 hours for the first improvement level; £ per 12 hours for the best level)																	
		CN East	CN West	EDF - EPN	EDF - LPN	EDF - SPN	SSE - Hydro	SSE - Southern	CE - YEDL	CE - NEDL	UU	WPD S. Wales	WPD S. West	SP Manweb	SP Distribution
income level 8 (unknown income)	Within 6 hours (best level)	3.50	3.50	5.52	1.06	3.50	3.26	3.50	3.50	3.50	6.29	5.23	5.11	0.92	3.50
	Within 12 hours (improvement level 1)	2.08	2.08	3.93	0.67	2.08	0.00	2.08	2.08	2.08	4.66	3.59	3.21	0.00	2.08
	Within 18 hours (base)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
income level 7 (Over £60,000)	Within 6 hours (best level)	8.76	8.76	13.83	2.89	8.76	8.15	8.76	8.76	8.76	15.75	13.10	12.79	2.31	8.76
	Within 12 hours (improvement level 1)	5.20	5.20	9.85	1.81	5.20	0.00	5.20	5.20	5.20	11.67	8.99	8.04	0.00	5.20
	Within 18 hours (base)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
income level 6 (£50,001 - £60,000)	Within 6 hours (best level)	6.07	6.07	9.58	2.89	6.07	5.65	6.07	6.07	6.07	10.91	9.08	8.87	1.60	6.07
	Within 12 hours (improvement level 1)	3.60	3.60	6.83	1.81	3.60	0.00	3.60	3.60	3.60	8.08	6.23	5.57	0.00	3.60
	Within 18 hours (base)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
income level 5 (£40,001 - £50,000)	Within 6 hours (best level)	5.85	5.85	9.23	2.89	5.85	5.45	5.85	5.85	5.85	10.52	8.75	8.54	1.54	5.85
	Within 12 hours (improvement level 1)	3.47	3.47	6.58	1.81	3.47	0.00	3.47	3.47	3.47	7.79	6.01	5.37	0.00	3.47
	Within 18 hours (base)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
income level 4 (£30,001 - £40,000)	Within 6 hours (best level)	4.25	4.25	6.71	2.89	4.25	3.96	4.25	4.25	4.25	7.65	6.36	6.21	1.12	4.25
	Within 12 hours (improvement level 1)	2.52	2.52	4.78	1.81	2.52	0.00	2.52	2.52	2.52	5.66	4.37	3.90	0.00	2.52
	Within 18 hours (base)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
income level 3 (£20,001 - £30,000)	Within 6 hours (best level)	4.08	4.08	6.45	1.16	4.08	3.80	4.08	4.08	4.08	7.34	6.11	5.96	1.08	4.08
	Within 12 hours (improvement level 1)	2.42	2.42	4.59	0.73	2.42	0.00	2.42	2.42	2.42	5.44	4.19	3.75	0.00	2.42
	Within 18 hours (base)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
income level 2 (£10,000 - £20,000)	Within 6 hours (best level)	3.32	3.32	5.23	1.16	3.32	3.09	3.32	3.32	3.32	5.96	4.96	4.84	0.87	3.32
	Within 12 hours (improvement level 1)	1.97	1.97	3.73	0.73	1.97	0.00	1.97	1.97	1.97	4.42	3.40	3.04	0.00	1.97
	Within 18 hours (base)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
income level 1 (Under £10,000)	Within 6 hours (best level)	2.83	2.83	4.47	0.85	2.83	2.63	2.83	2.83	2.83	5.09	4.23	4.13	0.75	2.83
	Within 12 hours (improvement level 1)	1.68	1.68	3.18	0.53	1.68	0.00	1.68	1.68	1.68	3.77	2.91	2.60	0.00	1.68
	Within 18 hours (base)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Weighted average (all income levels)	**Within 6 hours (best level)**	**3.84**	**3.84**	**6.06**	**1.54**	**3.84**	**3.57**	**3.84**	**3.84**	**3.84**	**6.91**	**5.74**	**5.61**	**1.01**	**3.84**
	Within 12 hours (improvement level 1)	**2.28**	**2.28**	**4.32**	**0.96**	**2.28**	**0.00**	**2.28**	**2.28**	**2.28**	**5.11**	**3.94**	**3.52**	**0.00**	**2.28**
	Within 18 hours (base)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Unscaled weighted average (all income levels)*	**Within 6 hours (best level)**	**9.29**	**9.29**	**14.67**	**10.06**	**9.29**	**8.65**	**9.29**	**9.29**	**9.29**	**16.71**	**13.90**	**13.57**	**2.45**	**9.29**
	Within 12 hours (improvement level 1)	**5.51**	**5.51**	**10.45**	**6.31**	**5.51**	**0.00**	**5.51**	**5.51**	**5.51**	**12.38**	**9.54**	**8.53**	**0.00**	**5.51**
	Within 18 hours (base)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

*Scaling factors: 0.41 for non-LPN DNOs; and 0.15 for LPN

Business respondents also placed significant value on restoration of supply, particularly within WPD South Wales. Additionally, for the non-LPN DNOs, we observed that medium and larger businesses value reductions in the time to restore supply more highly than small businesses.

Table 34: Valuations for reductions in time for restoration of supply for business customers (% bill)

Scaled value	LPN			non-LPN		
Restoration of power supplies (% bill)	**S**	**M**	**L**	**S**	**M**	**L**
Within 18 hours - As Now	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Within 12 hours	5.2%	5.2%	2.0%	3.1%	3.1%	2.5%
Within 12 hours - WPD. South Wales				4.9%	4.9%	3.9%
Within 6 hours	7.7%	7.7%	2.9%	4.6%	4.6%	6.0%
Within 6 hours – WPD. South Wales				6.5%	6.5%	7.2%

* Scaling factors: 1.13 for non-LPN and 1.42 for LPN

Compensation for Restoration of Supply

Restoration of Supply

Domestic Customers:
3 levels of fixed compensation:
£50(base), £60, £100
plus 2 levels of variables compensation for every additional 12 hour period,
2 levels:
£25 (base), £50

Business Customers:
4 levels of fixed compensation:
For small businesses: £50, £100 (base), £150, £200
For medium or large businesses: 0.5% of DUOS, £100 (base), 1% of DUOS, 2% of DUOS

plus compensation for every additional 12 hour period,
4 levels:
For small businesses: £25 (base), £50, £75, £100
For medium or large businesses: £25 (base), 0.5% of DUOS, 1% of DUOS, 2% of DUOS

The stated preference experiments tested changes in fixed and variable (per day) compensation levels for failure to meet restoration of supply requirements.

For domestic customers in non-LPN DNOs, we obtained small values for the fixed component of compensation, but we could not identify significant values for the variable component. The values are shown in Table 35. These figures reflect the value (in £) for each £ of fixed compensation, so an increase of £100 would be valued by £2 (100 x 0.02) by non-LPN DNO customers.

Table 35: Valuations for compensation levels for failure to restore supply for domestic customers (£ per £ in compensation)

Compensation for Failure to Restore Supply (£ in bill per £ in compensation)			
		All DNOs, apart from EDF - LPN	**EDF - LPN**
income level 8	Variable Compensation	0.00	0.00
unknown income	Fixed Compensation	0.02	0.01
income level 7	Variable Compensation	0.00	0.00
Over £60,000	Fixed Compensation	0.04	0.02
income level 6	Variable Compensation	0.00	0.00
£50,001 - £60,000	Fixed Compensation	0.03	0.02
income level 5	Variable Compensation	0.00	0.00
£40,001 - £50,000	Fixed Compensation	0.03	0.02
income level 4	Variable Compensation	0.00	0.00
£30,001 - £40,000	Fixed Compensation	0.02	0.02
income level 3	Variable Compensation	0.00	0.00
£20,001 - £30,000	Fixed Compensation	0.02	0.01
income level 2	Variable Compensation	0.00	0.00
£10,000 - £20,000	Fixed Compensation	0.01	0.01
income level 1	Variable Compensation	0.00	0.00
Under £10,000	Fixed Compensation	0.01	0.01
Weighted average (all income levels)	Variable Compensation	0.00	0.00
	Fixed Compensation	0.02	0.01
Unscaled weighted average (all income levels)*	Variable Compensation	0.00	0.00
	Fixed Compensation	0.04	0.08

*Scaling factors: 0.41 for non-LPN DNOs; and 0.15 for LPN

No significant valuations for compensation were identified for business customers.

Compensation for multiple interruptions (domestic customers only)

Compensation for Multiple Interruptions
3 levels:
Compensation after 5 interruptions
Compensation after 4 interruptions (base)
Compensation after 3 interruptions

Domestic customers evaluated at what level of interruptions compensation would be made available. We observed that customers were willing to pay about £1.50 for all DNOs except LPN and about £0.45 for LPN customers to improve compensation for multiple interruptions from its current level of "after 4 interruptions" to "after 3 interruptions". We were not, however, able to identify any level of compensation for increasing the level from 4 interruptions to 5 interruptions.

Table 36: Valuations for compensation levels for multiple interruptions for domestic customers (£)

Compensation for multiple interruptions (£ per interruption)			
		All DNOs, apart from EDF - LPN	**EDF - LPN**
	after 3 interuptions (best)	1.34	0.28
income level 8	after 4 interruptions (base)	0.00	0.00
unknown income	after 5 interruptions (worse)	0.00	0.00
	after 3 interuptions (best)	3.34	0.77
income level 7	after 4 interruptions (base)	0.00	0.00
Over £60,000	after 5 interruptions (worse)	0.00	0.00
	after 3 interuptions (best)	2.32	0.77
income level 6	after 4 interruptions (base)	0.00	0.00
£50,001 - £60,000	after 5 interruptions (worse)	0.00	0.00
	after 3 interuptions (best)	2.23	0.77
income level 5	after 4 interruptions (base)	0.00	0.00
£40,001 - £50,000	after 5 interruptions (worse)	0.00	0.00
	after 3 interuptions (best)	1.62	0.77
income level 4	after 4 interruptions (base)	0.00	0.00
£30,001 - £40,000	after 5 interruptions (worse)	0.00	0.00
	after 3 interuptions (best)	1.56	0.31
income level 3	after 4 interruptions (base)	0.00	0.00
£20,001 - £30,000	after 5 interruptions (worse)	0.00	0.00
	after 3 interuptions (best)	1.27	0.31
income level 2	after 4 interruptions (base)	0.00	0.00
£10,000 - £20,000	after 5 interruptions (worse)	0.00	0.00
	after 3 interuptions (best)	1.08	0.22
income level 1	after 4 interruptions (base)	0.00	0.00
Under £10,000	after 5 interruptions (worse)	0.00	0.00
Weighted average (all income levels)	**after 3 interuptions (best)**	**1.47**	**0.41**
	after 4 interruptions (base)	**0.00**	**0.00**
	after 5 interruptions (worse)	**0.00**	**0.00**
Unscaled weighted average (all income levels)*	**after 3 interuptions (best)**	**3.55**	**2.67**
	after 4 interruptions (base)	**0.00**	**0.00**
	after 5 interruptions (worse)	**0.00**	**0.00**

*Scaling factors: 0.41 for non-LPN DNOs; and 0.15 for LPN

Making and keeping appointments (business only)

Making and Keeping Appointments **2 levels:**
Offer and keep appointment within a 2 hour slot (base)
Offer and keep timed appointment

Business users were presented with an attribute defining an improved service level for making and keeping appointments. We were also not able to identify, however, any values for offering and keeping timed appointments for business customers in either non-LPN or LPN DNOs.

Notice for Planned interruptions

Notice for Planned Interruptions **3 levels:**
2 days notice
5 days notice
10 days notice

Domestic non-LPN customers were willing to pay a small value, about 80 pence, to increase the advance notice period for planned interruptions from 2 days to 5 days. However, they are not willing to pay for an even longer advance notice period (10 days). Additionally, we observed that younger respondents (16-29) placed a higher value on notice for planned interruption than older respondents (30-49). We could not identify any value for this attribute for domestic customers over age 50.

Domestic LPN customers also placed a small value on increasing notice periods, and again a 5 day notice period was preferred to a 10 day notice period.

Table 37: Valuations for increases in notice for planned interruptions for domestic customers (£)

Notice for planned interruptions (£ from base, i.e. £ per 5 days for the 1st and £ per 10 days for the 2nd level)						
		non-LPN				LPN
		Age 16-29	Age 30-49	Age 50+	wt. avg. (all ages)	
	10 days notice	0.00	0.00	0.00	0.00	0.19
income level 8	5 days notice	1.77	0.91	0.00	0.74	0.30
unknown income	2 days notice	0.00	0.00	0.00	0.00	0.00
	10 days notice	0.00	0.00	0.00	0.00	0.51
income level 7	5 days notice	4.43	2.28	0.00	1.84	0.81
Over £60,000	2 days notice	0.00	0.00	0.00	0.00	0.00
	10 days notice	0.00	0.00	0.00	0.00	0.51
income level 6	5 days notice	3.07	1.58	0.00	1.28	0.81
£50,001 - £60,000	2 days notice	0.00	0.00	0.00	0.00	0.00
	10 days notice	0.00	0.00	0.00	0.00	0.51
income level 5	5 days notice	2.96	1.52	0.00	1.23	0.81
£40,001 - £50,000	2 days notice	0.00	0.00	0.00	0.00	0.00
	10 days notice	0.00	0.00	0.00	0.00	0.51
income level 4	5 days notice	2.15	1.10	0.00	0.89	0.81
£30,001 - £40,000	2 days notice	0.00	0.00	0.00	0.00	0.00
	10 days notice	0.00	0.00	0.00	0.00	0.21
income level 3	5 days notice	2.06	1.06	0.00	0.86	0.33
£20,001 - £30,000	2 days notice	0.00	0.00	0.00	0.00	0.00
	10 days notice	0.00	0.00	0.00	0.00	0.21
income level 2	5 days notice	1.68	0.86	0.00	0.70	0.33
£10,000 - £20,000	2 days notice	0.00	0.00	0.00	0.00	0.00
	10 days notice	0.00	0.00	0.00	0.00	0.15
income level 1	5 days notice	1.43	0.74	0.00	0.59	0.24
Under £10,000	2 days notice	0.00	0.00	0.00	0.00	0.00
Weighted average (all income levels)	**10 days notice**	**0.00**	**0.00**	**0.00**	**0.00**	**0.27**
	5 days notice	**1.94**	**1.00**	**0.00**	**0.81**	**0.43**
	2 days notice	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Unscaled weighted average (all income levels)*	**10 days notice**	**0.00**	**0.00**	**0.00**	**0.00**	**1.78**
	5 days notice	**4.70**	**2.41**	**0.00**	**1.95**	**2.84**
	2 days notice	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

*Scaling factors: 0.41 for non-LPN DNOs; and 0.15 for LPN

Businesses who used from between 100kWh to 1MW+ of electricity annually valued an increase in the notice for planned interruptions. We were not able to identify significant differences between 5 and 10 days notice periods. We could not identify any values for the London businesses.

Table 38: Valuations for increases in notice for planned interruptions for business customers (% bill), scaled values

Scaled value	LPN			non-LPN		
Advanced notice for planned interruption	**S**	**M**	**L**	**S**	**M**	**L**
2 days As Now						
5 days notice (with electricity usage: 100Kwh - 1MW+)				0.35%	0.35%	0.28%
10 days notice (with electricity usage: 100Kwh - 1MW+)				0.35%	0.35%	0.28%

* Scaling factors: 1.13 for non-LPN and 1.42 for LPN

Undergrounding of overhead lines for amenity reasons (non-LPN DNOs and Domestic only)

Commitment to Underground Overhead Lines
4 levels:
None (base)
1.5% per annum
3% per annum
5% per annum

We observed significant values for undergrounding overhead lines for amenity reasons by non-LPN domestic customers, with high income households valuing this more highly, even when taking into account the lower price sensitivity of higher income households. The resulting valuations are shown in the following table.

Table 39: Valuations for undergrounding overhead lines (£)

Undergrounding (£ from base)		
		non-LPN only
	5% of overhead lines	1.61
income level 8	3% of overhead lines	1.50
unknown income	1.5% of overhead lines	0.00
	5% of overhead lines	11.89
income level 7	3% of overhead lines	11.04
Over £60,000	1.5% of overhead lines	8.39
	5% of overhead lines	8.24
income level 6	3% of overhead lines	7.65
£50,001 - £60,000	1.5% of overhead lines	5.81
	5% of overhead lines	7.94
income level 5	3% of overhead lines	7.37
£40,001 - £50,000	1.5% of overhead lines	5.60
	5% of overhead lines	10.46
income level 4	3% of overhead lines	9.71
£30,001 - £40,000	1.5% of overhead lines	7.38
	5% of overhead lines	4.61
income level 3	3% of overhead lines	3.98
£20,001 - £30,000	1.5% of overhead lines	1.92
	5% of overhead lines	3.74
income level 2	3% of overhead lines	3.23
£10,000 - £20,000	1.5% of overhead lines	1.56
	5% of overhead lines	2.27
income level 1	3% of overhead lines	1.86
Under £10,000	1.5% of overhead lines	1.35
Weighted average (all income levels)	**5% of overhead lines**	**4.36**
	3% of overhead lines	**3.91**
	1.5% of overhead lines	**2.29**
Unscaled weighted average (all income levels)*	**5% of overhead lines**	**8.31**
	3% of overhead lines	**7.46**
	1.5% of overhead lines	**4.36**

Scaling factors: 0.52 for non-LPN DNOs; and 0.86 for LPN

Network resilience to major storms (non-LPN DNOs only)

Network resilience to major storms
5 levels
+10%, +20%
Base (differs by DNO)
-10%, -20%
Unit: number of customers affected

Both domestic and business customers valued improvements that would improve the electricity network's resilience to major storms, as measured by the number of customers affected by major storms.

The values for domestic customers are presented in Table 40. It is noted that the values are per 1000 customers affected, so for CN East customers, for example we estimate an average wtp of £1.26 for a 10% improvement in resilience ie 0.07 x (180,000-162,000) / 1000. For domestic customers, we observed differing values for wta deteriorations in network resilience and wtp for resilience improvements. In most cases, we did not observe differences across DNOs, except for UU, SSE Hydro and SP Distribution (for the latter two DNOs we identified different values for wta for deteriorations in service levels only), where we observed much higher valuations.

Table 40: Valuations for changes in numbers of persons affected by storms by domestic users (£ per 1000 customers affected), non-LPN DNOs only

Network Resilience to Storms (£ per 1000 customers affected)																	
		CN East	CN West	EDF - EPN	EDF - LPN	EDF - SPN	SSE - Hydro	SSE - Southern	CE - YEDL	CE - NEDL	UU	WPD S. Wales	WPD S. West	SP Manweb	SP Distribution
income level 8	deterioration	-0.10	-0.10	-0.10		-0.10	-0.29	-0.10	-0.10	-0.10	-0.27	-0.10	-0.10	-0.10	-0.35
unknown income	improvement	0.07	0.07	0.07		0.07	0.07	0.07	0.07	0.07	0.31	0.07	0.07	0.07	0.07
income level 7	deterioration	-0.25	-0.25	-0.25		-0.25	-0.73	-0.25	-0.25	-0.25	-0.68	-0.25	-0.25	-0.25	-0.88
Over £60,000	improvement	0.16	0.16	0.16		0.16	0.16	0.16	0.16	0.16	0.78	0.16	0.16	0.16	0.16
income level 6	deterioration	-0.18	-0.18	-0.18		-0.18	-0.50	-0.18	-0.18	-0.18	-0.47	-0.18	-0.18	-0.18	-0.61
£50,001 - £60,000	improvement	0.11	0.11	0.11		0.11	0.11	0.11	0.11	0.11	0.54	0.11	0.11	0.11	0.11
income level 5	deterioration	-0.17	-0.17	-0.17		-0.17	-0.49	-0.17	-0.17	-0.17	-0.45	-0.17	-0.17	-0.17	-0.59
£40,001 - £50,000	improvement	0.11	0.11	0.11		0.11	0.11	0.11	0.11	0.11	0.52	0.11	0.11	0.11	0.11
income level 4	deterioration	-0.12	-0.12	-0.12		-0.12	-0.35	-0.12	-0.12	-0.12	-0.33	-0.12	-0.12	-0.12	-0.43
£30,001 - £40,000	improvement	0.08	0.08	0.08		0.08	0.08	0.08	0.08	0.08	0.38	0.08	0.08	0.08	0.08
income level 3	deterioration	-0.12	-0.12	-0.12		-0.12	-0.34	-0.12	-0.12	-0.12	-0.32	-0.12	-0.12	-0.12	-0.41
£20,001 - £30,000	improvement	0.08	0.08	0.08		0.08	0.08	0.08	0.08	0.08	0.36	0.08	0.08	0.08	0.08
income level 2	deterioration	-0.10	-0.10	-0.10		-0.10	-0.28	-0.10	-0.10	-0.10	-0.26	-0.10	-0.10	-0.10	-0.33
£10,000 - £20,000	improvement	0.06	0.06	0.06		0.06	0.06	0.06	0.06	0.06	0.30	0.06	0.06	0.06	0.06
income level 1	deterioration	-0.08	-0.08	-0.08		-0.08	-0.23	-0.08	-0.08	-0.08	-0.22	-0.08	-0.08	-0.08	-0.28
Under £10,000	improvement	0.05	0.05	0.05		0.05	0.05	0.05	0.05	0.05	0.25	0.05	0.05	0.05	0.05
Weighted average (all income levels)	**deterioration**	**-0.11**	**-0.11**	**-0.11**		**-0.11**	**-0.32**	**-0.11**	**-0.11**	**-0.11**	**-0.30**	**-0.11**	**-0.11**	**-0.11**	**-0.38**
	improvement	**0.07**	**0.07**	**0.07**		**0.07**	**0.07**	**0.07**	**0.07**	**0.07**	**0.34**	**0.07**	**0.07**	**0.07**	**0.07**
Unscaled weighted average (all income levels)*	**deterioration**	**-0.21**	**-0.21**	**-0.21**		**-0.21**	**-0.61**	**-0.21**	**-0.21**	**-0.21**	**-0.57**	**-0.21**	**-0.21**	**-0.21**	**-0.73**
	improvement	**0.14**	**0.14**	**0.14**		**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.65**	**0.14**	**0.14**	**0.14**	**0.14**

*Scaling factors: 0.52 for non-LPN DNOs and 0.86 for LPN

For business customers, we did not identify separate wtp / wta values, but we did identify different values by DNO. These values are reported in Table 41. Note that the reported figures represent valuations for changes in number of persons affected by storms in units of % bill per 1000 customers affected.

Table 41: Valuations for changes in numbers of persons affected by storms by business users (% bill per 1000 customers affected, scaled values

Scaled value	LPN			non-LPN		
Number of customers affected by major storms	S	M	L	S	M	L
Storm – CN East				0.04%	0.04%	0.04%
Storm – CN West				0.06%	0.06%	0.05%
Storm - EDF - EPN				0.02%	0.02%	0.01%
Storm - EDF - SPN				0.16%	0.16%	0.13%
Storm – SSE - Hydro				0.09%	0.09%	0.07%
Storm – SSE - Southern				0.04%	0.04%	0.03%
Storm - CE - YEDL				0.08%	0.08%	0.06%
Storm - CE - NEDL				0.06%	0.06%	0.05%
Storm – UU				0.11%	0.11%	0.09%
Storm - WPD S. Wales				0.16%	0.16%	0.13%
Storm - WPD S. West				0.04%	0.04%	0.03%
Storm - SP Manweb				0.13%	0.13%	0.10%
Storm - SP Distribution				0.12%	0.12%	0.10%

* Scaling factors: 0.69 for non-LPN, not applicable for LPN

Applying these values to the levels tested for each DNO results in the following valuations, by DNO (see Appendix J for details of levels tested by DNO).

Table 42: WTP and WTA Valuations for reductions in number of customers affected by storms (% bill), scaled values

Value of Infrastructure to Reduce Number of Customers Affected by Storms (% bill)															
WTP Small/Medium Businesses		CN East	CN West	EDF - EPN	EDF - LPN	EDF - SPN	SSE - Hydro	SSE - Southern	CE - YEDL	CE - NEDL	UU	WPD S. Wales	WPD S. West	SP Manweb	SP Distribution
Incs	Current + 20%	-1.6%	-2.2%	-0.9%		-1.3%	-1.5%	-1.1%	-0.9%	-1.3%	-1.3%	-1.9%	-1.1%	-1.6%	-1.5%
	Current + 10%	-0.8%	-1.1%	-0.4%		-0.7%	-0.7%	-0.6%	-0.5%	-0.6%	-0.7%	-1.0%	-0.6%	-0.8%	-0.7%
	Current Level	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Reds	Current - 10%	0.8%	1.1%	0.4%		0.7%	0.7%	0.6%	0.5%	0.6%	0.7%	1.0%	0.6%	0.8%	0.7%
	Current - 20%	1.6%	2.2%	0.9%		1.3%	1.5%	1.1%	0.9%	1.3%	1.3%	1.9%	1.1%	1.6%	1.5%

Value of Infrastructure to Reduce Number of Customers Affected by Storms (% bill)															
WTP Large Businesses		CN East	CN West	EDF - EPN	EDF - LPN	EDF - SPN	SSE - Hydro	SSE - Southern	CE - YEDL	CE - NEDL	UU	WPD S. Wales	WPD S. West	SP Manweb	SP Distribution
Incs	Current + 20%	-1.3%	-1.7%	-0.7%		-1.0%	-1.2%	-0.9%	-0.7%	-1.0%	-1.1%	-1.5%	-0.9%	-1.2%	-1.2%
	Current + 10%	-0.6%	-0.9%	-0.3%		-0.5%	-0.6%	-0.4%	-0.4%	-0.5%	-0.5%	-0.8%	-0.5%	-0.6%	-0.6%
	Current Level	0.0%	0.0%	0.0%		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Reds	Current - 10%	0.6%	0.9%	0.3%		0.5%	0.6%	0.4%	0.4%	0.5%	0.5%	0.8%	0.5%	0.6%	0.6%
	Current - 20%	1.3%	1.7%	0.7%		1.0%	1.2%	0.9%	0.7%	1.0%	1.1%	1.5%	0.9%	1.2%	1.2%

Network resilience to flooding

Network resilience to flooding
4 levels:
Around 1000 major electricity sites exposed to flood risk (base)
Around 950 major electricity sites exposed to flood risk
Around 900 major electricity sites exposed to flood risk
Around 850 major electricity sites exposed to flood risk

For domestic non-LPN customers, we identified values for improving the resilience of the electricity network against flooding. We were not able to identify separate values for each level of improvement tested; instead we observed one single valuation across the three levels tested (compared to the base). It is noteworthy that the valuations for WPD S. West were much higher than for other DNOs. For domestic LPN customers, we observed (the same) values for reductions to 900 and 850 major electricity sites exposed, but we could not identify any value for the level of 950 major electricity sites exposed, ie it is treated as equivalent to 1000 major electricity exposed.

Table 43: Valuations for reductions in the number of electricity sites exposed to potential flood risk for domestic customers

Network resilience to flooding (£ from base, in number of major electricity sites affected)																	
		CN East	CN West	EDF - EPN	EDF - LPN	EDF - SPN	SSE - Hydro	SSE - Southern	CE - YEDL	CE - NEDL	UU	WPD S. Wales	WPD S. West	SP Manweb	SP Distribution
	Around 1000 major sites (base)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Reduce to 950 major sites	1.10	1.10	1.10	0.00	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	2.48	1.10	1.10
income level 8	Reduce to 900 major sites	1.10	1.10	1.10	1.64	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	2.48	1.10	1.10
unknown income	Reduce to 850 major sites	1.10	1.10	1.10	1.64	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	2.48	1.10	1.10
	Around 1000 major sites (base)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Reduce to 950 major sites	2.74	2.74	2.74	0.00	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.74	6.22	2.74	2.74
income level 7	Reduce to 900 major sites	2.74	2.74	2.74	4.47	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.74	6.22	2.74	2.74
Over £60,000	Reduce to 850 major sites	2.74	2.74	2.74	4.47	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.74	6.22	2.74	2.74
	Around 1000 major sites (base)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Reduce to 950 major sites	1.90	1.90	1.90	0.00	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	4.31	1.90	1.90
income level 6	Reduce to 900 major sites	1.90	1.90	1.90	4.47	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	4.31	1.90	1.90
£50,001 - £60,000	Reduce to 850 major sites	1.90	1.90	1.90	4.47	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	4.31	1.90	1.90
	Around 1000 major sites (base)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Reduce to 950 major sites	1.83	1.83	1.83	0.00	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	4.15	1.83	1.83
income level 5	Reduce to 900 major sites	1.83	1.83	1.83	4.47	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	4.15	1.83	1.83
£40,001 - £50,000	Reduce to 850 major sites	1.83	1.83	1.83	4.47	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	4.15	1.83	1.83
	Around 1000 major sites (base)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Reduce to 950 major sites	1.33	1.33	1.33	0.00	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	3.02	1.33	1.33
income level 4	Reduce to 900 major sites	1.33	1.33	1.33	4.47	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	3.02	1.33	1.33
£30,001 - £40,000	Reduce to 850 major sites	1.33	1.33	1.33	4.47	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	3.02	1.33	1.33
	Around 1000 major sites (base)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Reduce to 950 major sites	1.28	1.28	1.28	0.00	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	2.90	1.28	1.28
income level 3	Reduce to 900 major sites	1.28	1.28	1.28	1.80	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	2.90	1.28	1.28
£20,001 - £30,000	Reduce to 850 major sites	1.28	1.28	1.28	1.80	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	2.90	1.28	1.28
	Around 1000 major sites (base)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Reduce to 950 major sites	1.04	1.04	1.04	0.00	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	2.35	1.04	1.04
income level 2	Reduce to 900 major sites	1.04	1.04	1.04	1.80	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	2.35	1.04	1.04
£10,000 - £20,000	Reduce to 850 major sites	1.04	1.04	1.04	1.80	1.04	1.04	1.04	1.04	1.04	1.04	1.04	1.04	2.35	1.04	1.04
	Around 1000 major sites (base)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Reduce to 950 major sites	0.89	0.89	0.89	0.00	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	2.01	0.89	0.89
income level 1	Reduce to 900 major sites	0.89	0.89	0.89	1.31	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	2.01	0.89	0.89
Under £10,000	Reduce to 850 major sites	0.89	0.89	0.89	1.31	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	2.01	0.89	0.89
	Around 1000 major sites (base)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Weighted average (all income levels)	**Reduce to 950 major sites**	**1.20**	**1.20**	**1.20**	**0.00**	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**	**2.73**	**1.20**	**1.20**
	Reduce to 900 major sites	**1.20**	**1.20**	**1.20**	**2.37**	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**	**2.73**	**1.20**	**1.20**
	Reduce to 850 major sites	**1.20**	**1.20**	**1.20**	**2.37**	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**	**1.20**	**2.73**	**1.20**	**1.20**
	Around 1000 major sites (base)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Unscaled weighted average (all income levels)*	**Reduce to 950 major sites**	**2.29**	**2.29**	**2.29**	**0.00**	**2.29**	**2.29**	**2.29**	**2.29**	**2.29**	**2.29**	**2.29**	**2.29**	**5.20**	**2.29**	**2.29**
	Reduce to 900 major sites	**2.29**	**2.29**	**2.29**	**2.77**	**2.29**	**2.29**	**2.29**	**2.29**	**2.29**	**2.29**	**2.29**	**2.29**	**5.20**	**2.29**	**2.29**
	Reduce to 850 major sites	**2.29**	**2.29**	**2.29**	**2.77**	**2.29**	**2.29**	**2.29**	**2.29**	**2.29**	**2.29**	**2.29**	**2.29**	**5.20**	**2.29**	**2.29**

*Scaling factors: 0.52 for non-LPN DNOs; and 0.86 for LPN

Non-LPN business respondents placed a positive and significant value on reducing the number of electricity sites across Great Britain that were exposed to flooding, but as for the domestic customers it was not possible to identify differential values for each level of improvement. It was not possible to identify flooding values for the London DNO.

Table 44: Valuations for network resilience to flooding (% bill), scaled value

Scaled value	LPN			non-LPN		
Number of electricity sites exposed to a potential flood risk	**S**	**M**	**L**	**S**	**M**	**L**
Around 1000 major electricity sites exposed to flood risk (base)				0.00%	0.00%	0.00%
Around 950 major electricity sites exposed to flood risk				0.45%	0.45%	0.36%
Around 900 major electricity sites exposed to flood risk				0.45%	0.45%	0.36%
Around 850 major electricity sites exposed to flood risk				0.45%	0.45%	0.36%

* Scaling factors: 0.69 for non-LPN and 0.49 for LPN

Reduction in carbon emissions

Reduction in carbon emissions
3 levels:
Continue usage of current equipment and vehicles
Replace 5% per year with those using less polluting fuels
Replace 10% per year with those using less polluting fuels

Both domestic and business customers were willing to pay substantial amounts for DNOs to replace equipment and vehicles with those using less polluting fuels.

For domestic customers, those in SEG C1 and those from high income households were willing to pay more than other domestic customers for reductions in carbon emissions. For LPN customers, we were not able to identify different values for the two levels tested, ie replacement values of 5% or 10%.

It should be noted that across a number of studies in the water and energy sectors it appears that there is a stated appetite by consumers to pay for measures to reduce the environmental impact of water and energy services. Unfortunately, these surveys do not incorporate any questions about respondents' revealed preference behaviour of paying additional money to reduce environmental damage from products or services. However, there may well be other revealed preference evidence of this phenomena, eg increased take-up of organic food, demand for foods with low food miles, increased take up of environmentally friendly cleaning products, willingness to pay to offset air

travel, etc which could be usefully used to support the growing evidence of this trend.

It should also be noted that in a recent study undertaken with Utility Week on branding within the utility sector, what people stated that they really wanted was for utilities to enhance their green credentials[7].

Table 45: Valuations for replacing equipment and vehicles with those using less polluting fuels for domestic customers

Carbon reduction (£ from base, replace polluting equiments and vehicles)							
		non-LPN					
		income level 7 (Over £60,000) and SEG3	income level 7 (Over £60,000) and not SEG3	SEG3 and not income level 7 (Over £60,000)	all others	wt. avg. (all seg)	LPN
	Replace 10%			8.14	7.01	7.33	3.13
income level 8	Replace 5%			7.29	5.33	5.89	3.13
unknown income	current level			0.00	0.00	0.00	0.00
	Replace 10%	33.99	19.15			22.86	8.54
income level 7	Replace 5%	19.30	17.23			17.75	8.54
Over £60,000	current level	0.00	0.00			0.00	0.00
	Replace 10%			8.14	7.01	7.33	8.54
income level 6	Replace 5%			7.29	5.33	5.89	8.54
£50,001 - £60,000	current level			0.00	0.00	0.00	0.00
	Replace 10%			7.84	7.01	7.25	8.54
income level 5	Replace 5%			7.02	5.33	5.82	8.54
£40,001 - £50,000	current level			0.00	0.00	0.00	0.00
	Replace 10%			5.70	7.01	6.63	8.54
income level 4	Replace 5%			5.11	5.33	5.26	8.54
£30,001 - £40,000	current level			0.00	0.00	0.00	0.00
	Replace 10%			5.47	2.82	3.59	3.43
income level 3	Replace 5%			4.90	2.14	2.94	3.43
£20,001 - £30,000	current level			0.00	0.00	0.00	0.00
	Replace 10%			4.44	2.82	3.29	3.43
income level 2	Replace 5%			3.98	2.14	2.67	3.43
£10,000 - £20,000	current level			0.00	0.00	0.00	0.00
	Replace 10%			3.79	2.05	2.55	2.50
income level 1	Replace 5%			3.40	1.56	2.09	2.50
Under £10,000	current level			0.00	0.00	0.00	0.00
Weighted average (all income levels)	**Replace 10%**					**5.43**	**4.54**
	Replace 5%					**4.36**	**4.54**
	current level					**0.00**	**0.00**
Unscaled weighted average (all income levels)*	**Replace 10%**					**10.36**	**5.29**
	Replace 5%					**8.32**	**5.29**
	current level					**0.00**	**0.00**

*Scaling factors: 0.52 for non-LPN DNOs; and 0.86 for LPN

Businesses were also willing to pay for companies to reduce their carbon emissions through replacement of current equipment and vehicles, with a higher willingness-to-pay for a 10% replacement compared to 5% replacement. For non-LPN DNOs, we observed that medium and large companies were willing to pay more for a 10% replacement, per year, of current equipment and vehicles. For LPN, business users were willing to pay higher amounts for a 10% replacement level.

[7] Utility Week 27 June 2008

Table 46: Valuations for replacing equipment and vehicles with those using less polluting fuels for business users (% bill)

Scaled value	LPN			non-LPN		
Carbon Reduction	S	M	L	S	M	L
As Now	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
5%	1.47%	1.47%	0.56%	1.47%	1.47%	1.17%
10%	2.38%	2.38%	0.91%	1.96%	2.20%	1.75%

* Scaling factors: 0.69 for non-LPN and 0.49 for LPN

Energy efficiency advice (business customers only)

Energy Efficiency Advice
5 levels:
No information provided
Leaflets or e-mails
Helplines
Proactively telephone customers
Site visits

Across the non-LPN DNOs, there was some appetite for provision of energy efficiency advice, but we were not able to identify separate values for the different approaches tested within the experiments, eg through leaflets or e-mails, helplines, through proactively telephoning customers or site visits. It was not possible to identify valuations from the small LPN business data sample.

Table 47: Valuations for energy efficiency advice for business users (% bill)

Scaled value	LPN			non-LPN		
Provision of energy efficiency advice	S	M	L	S	M	L
No information provided				0.00%	0.00%	0.00%
Leaflets or e-mails				0.66%	0.66%	0.52%
Helplines				0.66%	0.66%	0.52%
Proactively telephone customers				0.66%	0.66%	0.52%
Site visits				0.66%	0.66%	0.52%

* Scaling factors: 0.69 for non-LPN and 0.49 for LPN

8.4 Summing the Values And Comparisons With The Contingent Valuation Questions

Introduction

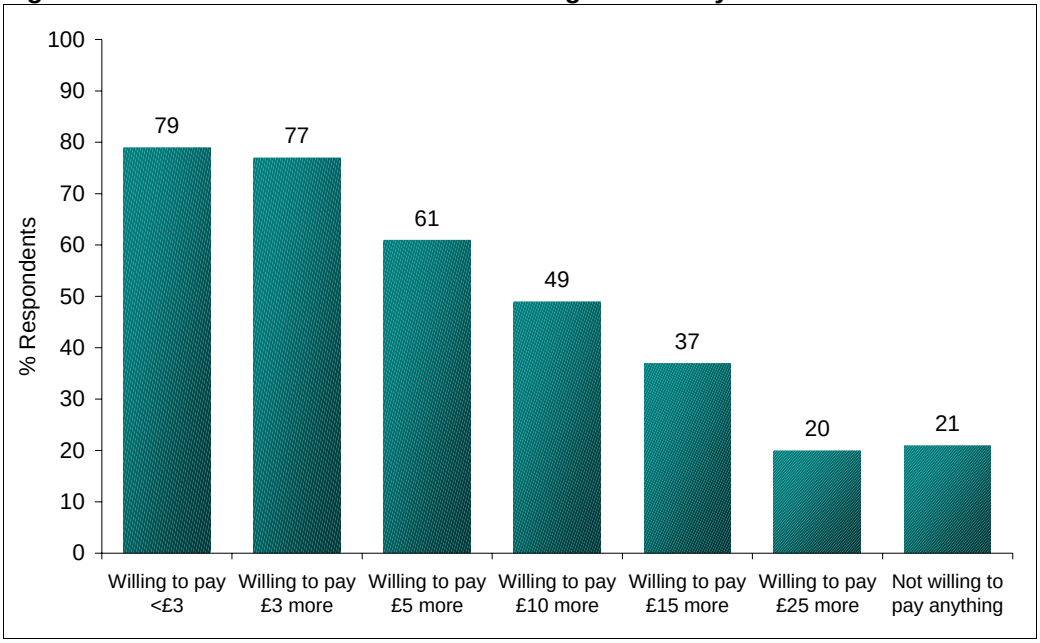
As part of the surveys, both domestic and business customers were asked – following on from the stated preference – to report the maximum that they would be willing to pay for the best electricity distribution service available.

In the following text the results from these questions are compared to the maximum values obtained from the scaled results for each attribute for domestic and business customers.

Valuations for Domestic Customers

Figure 52 shows willingness to pay within the bands that were tested with domestic consumers.

Figure 52: Domestic Consumer Stated Willingness to Pay



Base: all respondents – 2,100

This demonstrates that one fifth of the sample were unwilling to pay anything. Some elements of such a response are often considered "political" and removed from subsequent analysis of mean wtp. However, it should be noted that, in this study, there were signs that many who gave this response were from lower socio economic groupings, the elderly or the fuel poor:

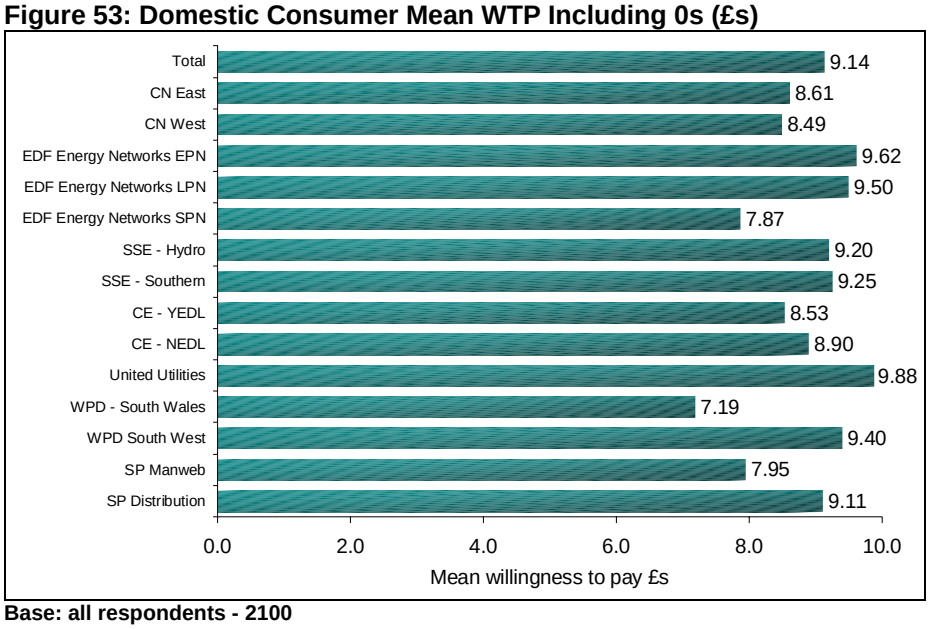
- DEs: 27% (cf 19% and 18% ABs and C1C2s respectively)

- aged 50+: 26% (cf 16% and 18% for 16-29 and 30-49 year olds)
- fuel poor: 27% (cf 19% of non-fuel poor).

That said, it is noteworthy that 73% of the fuel poor were willing to pay something towards improvements in service.

Overall mean willingness to pay (including "0s") is shown below. On average, domestic consumers were willing to pay £9.14.

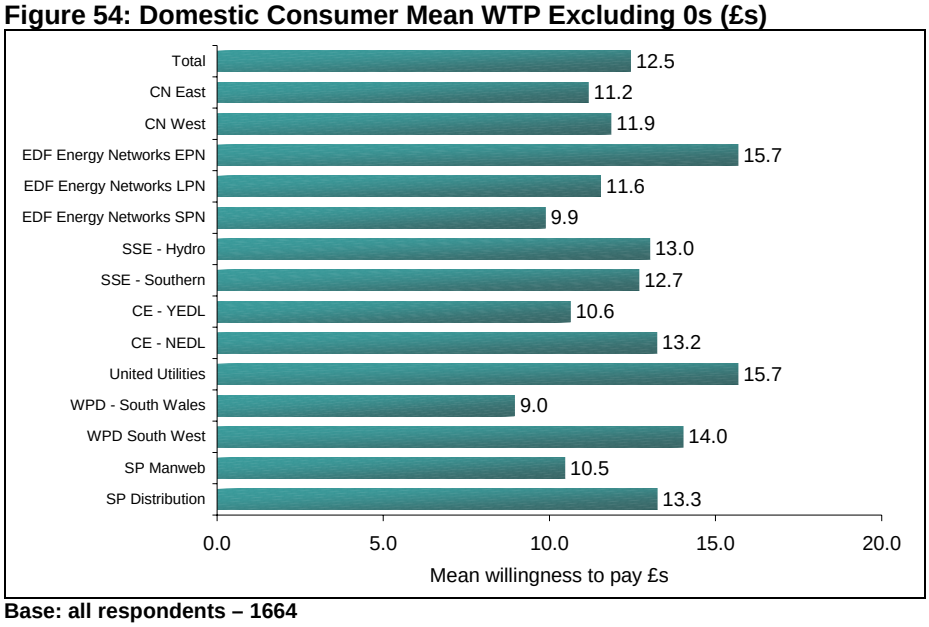
Figure 53: Domestic Consumer Mean WTP Including 0s (£s)



Base: all respondents - 2100

Overall mean willingness to pay excluding 0s was £12.50, as shown in Figure 54.

Figure 54: Domestic Consumer Mean WTP Excluding 0s (£s)



Base: all respondents – 1664

The following table shows the maximum valuations for all attributes evaluated by domestic customers through the stated preference, averaged across DNOs, compared to the CV results. This demonstrates lower willingness to pay figures in the CV questions. This is typical and as expected, as asked directly, with less context, respondents are more prone to decline to pay much more. The value of the stated preference is that it sets each of the possible improvements (and potential price increases) in context both with existing performance and a broader picture of the entire distribution service. As a consequence, the stated preference results are considered more robust, but the CV questions serve as a sensitivity tool if desired (ie to provide a lower bound against a central stated preference based set of valuations).

Table 48: Valuations for maximum improvements for all attributes for domestic customers (£)

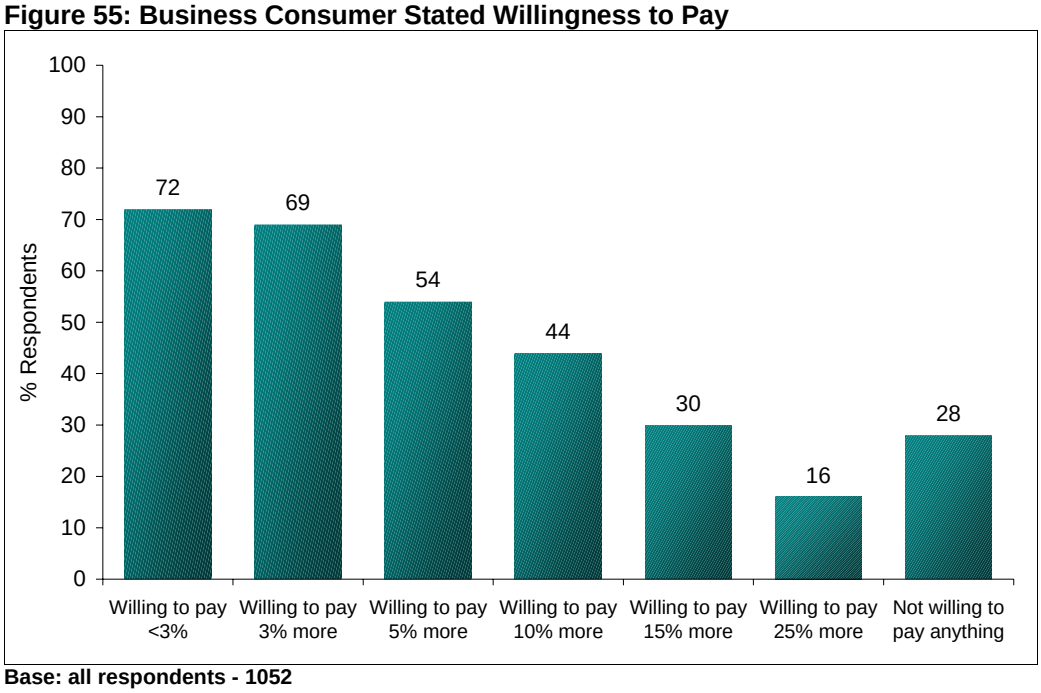
	Non-LPN	LPN
Reduction of 3 cuts in 5 years (non-LPN) and 10 years (LPN)	£2.41	£4.04
Reduction to average duration of cut by 20 mins	£1.60	£1.20
Reduction of 2 interruptions in 5 years (non-LPN) and 10 years (LPN)	£1.64	£0.69
Provision of call backs, texts etc.	£1.06	£0.52
From 18 hours to 6 hours for restoration of supply	£4.29	£1.54
Fixed and variable compensation levels improved	£1.00	£0.50
Compensation after multiple interruptions (4 interruptions to 3)	£1.47	£0.41
Notice for planned interruptions from 2 to 5 days	£0.81	£0.43
Undergrounding of 5% of overhead lines	£4.36	
20% reduction in number of customers affected by storms	£1.83	
Number of sites exposed to risk reduced from 1000 to 850	£1.32	£2.37
Replace 10% equipment & vehicles with those using less polluting fuels	£5.43	£4.54
Total	£27.23	£16.24
CV Responses	£9.11* or £12.52**	£9.50* or £11.55**

*** = including 0s; ** = excluding 0s**

Business Valuations

Figure 55 shows willingness to pay within the percentage bands that were tested with businesses.

Figure 55: Business Consumer Stated Willingness to Pay

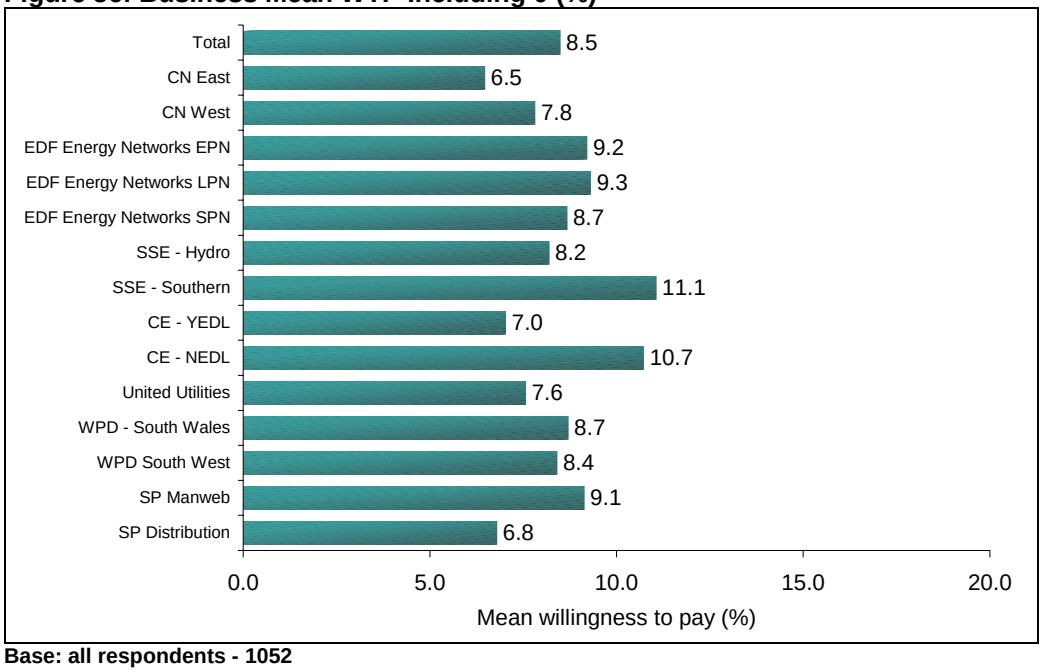


Base: all respondents - 1052

Here 28% have stated that they would not be prepared to pay anything. Interestingly, a much higher proportion of large businesses than small or medium businesses gave this response (40% cf 25% of small businesses and 29% of medium businesses).

Overall mean willingness to pay (including "0%") is shown below. On average, businesses were willing to pay 8.5%.

Figure 56: Business Mean WTP Including 0 (%)



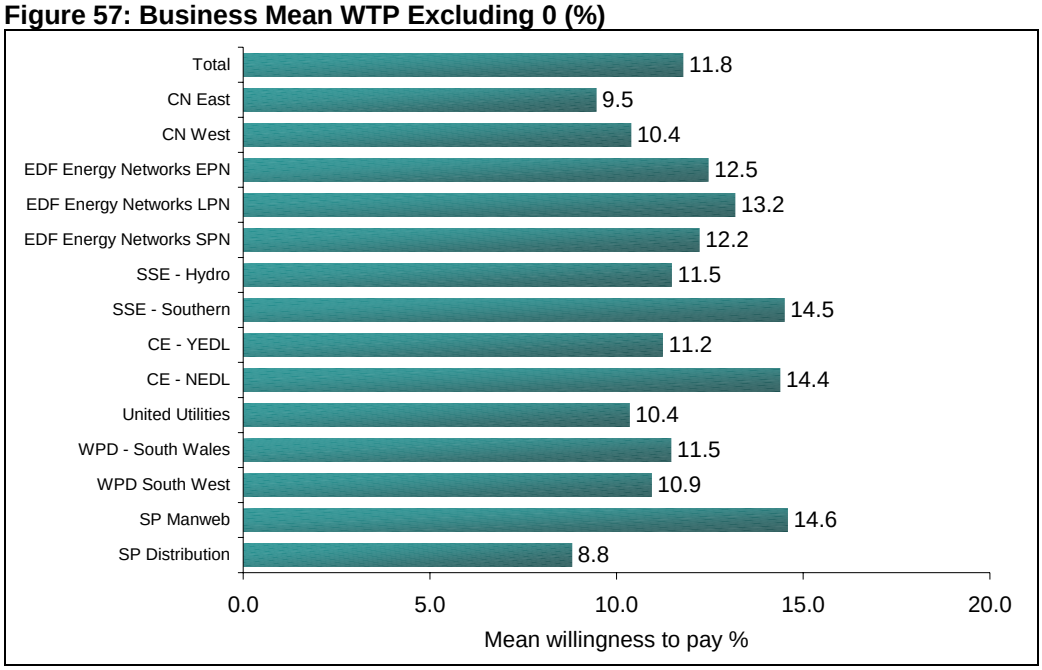
Base: all respondents - 1052

The mean willingness to pay by company size was:

- small: 9.0%
- medium: 8.3%
- large: 7.8%

Overall mean wtp excluding 0% was 11.8% as shown in Figure 57.

Figure 57: Business Mean WTP Excluding 0 (%)



The following table shows the maximum valuations for all attributes evaluated by business users, compared to the CV results. Once again they demonstrate lower willingness to pay in the figures in the CV questions, although the difference is very much less marked than amongst domestic consumers. As previously stated in the domestic results, it is typical to see lower wtp from Contingent Valuation questions. The value of the stated preference is that it sets each of the possible improvements (and potential price increases) in context both with existing performance and a broader picture of the entire distribution service. As a consequence, the stated preference results are considered more robust, but the CV questions serve as a sensitivity tool if desired (ie to provide a lower bound against a central stated preference based set of valuations).

Table 49: Valuations for maximum improvements for all attributes for business customers (% bill)

	Non-LPN		LPN	
	SM	**L**	**SM**	**L**
Reduction of 3 cuts in 5 years	1.7%	1.4%	3.8%	1.4%
Reduction to average duration of cut by 20 mins	1.0%	0.8%		
Reduction of 2 interruptions in 5 years	1.1%	0.1%		
From 18 hours to 6 hours for restoration of supply	6.5%	7.2%	7.7%	2.9%
Fixed and variable compensation levels improved				
Notice for planned interruptions from 2 to 5 or 10 days	0.3%	0.3%		
20% reduction in number of customers affected by storms	1.4%	1.1%		
Number of sites exposed to risk reduced from 1000 to 850	0.5%	0.4%		
Replace 10% equip & vehicles with those using less polluting fuels	2.1%	1.7%	2.4%	0.9%
Provision of advice to improve energy efficiency	0.7%	0.5%		
Provision of call backs, texts etc.			1.9%	0.7%
Total	15.3%	13.4%	15.7%	6.0%
CV Responses	SML 8.4%* or 11.7%**		9.3%* or 13.2%**	

*** = including 0s; ** = excluding 0s**

9. TOPLINE COMPARISON WITH DPCR4 WTP

The table below compares a couple of topline findings from this study with the findings for DPCR4. We have only been able to make comparisons where we feel that the data is directly comparable; changes in wording, context, duration and presentation of the attributes prohibits direct comparisons in the majority areas.

Table 50: Comparison With DPCR4 WTP

	DPCR5					DPCR4	
	Domestic		Business			Dome-stic	Busin-ess
	£s	£	%	%		£s	%
	LPN	Non-LPN	LPN	Non-LPN			
				SM	L		
20 minute reduction to average cut	1.60	1.20	na	1.0	0.8	21.80	2.9
Undergrounding of 5% of network per annum	na	4.36	na	na	na	12.10	na

Although little direct comparison can be made, from what is shown, it is notable that the willingness to pay in the DPCR5 study is much less than in the DPCR4 study. Suggested reasons for this include:

- improvements to the methodology: economists are constantly working to improve the accuracy of willingness to pay data and our recommendations for the best team and approach to this study were based upon work which Accent and RAND had been doing in this area

- they may simply indicate differing priorities for respondents and, in particular, an increase in the importance placed upon other environmental issues over and above the undergrounding of cables

- they may reflect the greater general concern about rising energy prices which have increased considerably and look set to increase further

- they may reflect an improved situation (we found it 4 times as difficult to find people who had experienced a cut in DPCR5 as in DPCR4), where changes in the past few years have resulted in fewer issues and cuts, greater satisfaction and consequently less willingness to pay for improvements.

It should also be noted that, although not all the studies have been completed as yet, research across the water industry also suggests that willingness to pay there is lower this time round than when previously measured. Consumers are typically prepared to pay an additional £15-£20 on top of their existing bill, which is not dissimilar to here. Very little has been done in the business market so we are unable to provide comparisons.

10. SUMMARY

Stated preference choice experiments have been used to collect information on how domestic and business customers value a range of potential improvements in the distribution of their electricity service.

Each respondent participated in three SP exercises trading off detailed electricity distribution service improvements and price. Many of the service attributes changes were defined relative to the levels appropriate for the specific DNO responsible for electricity distribution for the respondent. In addition, price changes were applied to the electricity component of the respondent's electricity bill, to set the changes within a realistic context. Each respondent also participated in a fourth experiment trading off blocks of services and prices, which was designed to allow measurement of the extent of any packaging or aggregation effects.

A formal pilot was undertaken to test the survey instrument, which led to a number of revisions to the design of the choice experiments prior to the main phase of data collection.

Data was collected, and models have been estimated, for both residential and business customers. Following data cleaning, we had 2088 interviews from domestic customers and 975 interviews from business customers.

For the domestic and business customers, data for the non-LPN DNOs were pooled to estimate discrete choice models to explain the choices made by respondents in the different choice exercises. It is noteworthy that aggregation of the data was particularly important for estimation of customers' sensitivity to price, which is a key input for calculation of wtp valuations. When the data were aggregated across DNOs, we observed differential price sensitivity by income for domestic customers and size of company (as measured by electricity use) for business customers. The resulting price coefficients from the pooled dataset were highly significant. We explicitly tested how service attribute values varied across the DNOs (and across other socio-economic segmentations) and retained DNO-specific terms when significant differences were observed for any attribute for any DNO.

Because of the different structure of the SP experiments, the LPN data were not aggregated with the data from the other DNOs in the model analysis. This is technically possible, but was outside the scope of what was possible within the time scale and cost budget for this work. Instead, to increase the sample size for the LPN models, the pilot data have been incorporated in the LPN models.

Attributes that are measured as continuous variables, for example the number of power cuts, average duration of power cuts, number of short power interruptions and resilience of the network to storms (measured as number of customers

affected by storms), have been measured as differences from the current service level for each DNO. For many attribute we observe significant differences between customers' willingness to pay for service improvements and their willingness to accept payment for service reductions. In general, customers require higher payments for service reductions compared to their willingness to pay for service improvements.

The parameters in the resulting models are highly significant, particularly for the non-LPN DNOs. These parameters have been used to calculate the marginal rates of substitution with respect to price and these have been used to calculate the value at each of the key attribute levels, ie the willingness-to-pay for each improvement.

The data from the lower level experiments have allowed us to estimate the willingness-to-pay for improvements in each of the service attributes. However, there is concern that the estimation of willingness-to-pay from multiple experiments using a subset of the attributes can lead to an overstatement of the total willingness-to-pay for all of the improvements. Many theories exist to explain this effect including budgeting effects, non-linearities in price, and halo effects (where respondents assume that because one attribute is improving that there are other improvements in other dimensions, which can then lead to double-counting in aggregation). Either way, it is appropriate in studies that split the total attribute list into a number of sub-groups to then test whether an aggregation effect can be observed. If such an effect is observed then it is appropriate for it to be taken into account in the final valuations.

The adjustments from the packaging experiments in this study have resulted in substantial adjustments to the willingness-to-pay values from the lower level experiments, with larger adjustments made to the domestic model valuations compared to the business valuations.

In our opinion, the resulting valuations are reasonable, when compared with previous studies and the contingent valuation results, which we would expect to give a lower-limit on customers' valuations. As mentioned at the end of the previous section, those studies so far completed within the water industry demonstrate lower willingness to pay in this price review period than previously identified. We recommend that the SP-based (weighted) valuations be used in the DPCR5 process.