



Model documentation: Update  
models & guidance for DCP 266  
(Request A08-I)

07 December 2018

DCUSA/ElectraLink

**CONFIDENTIAL**

## **IMPORTANT NOTICE**

This document was prepared by Cambridge Economic Policy Associates (CEPA) and TNEI Services Ltd for the exclusive use of the recipient(s) named herein.

The opinions expressed in this document are valid only for the purpose stated herein and as of the date of this document. No obligation is assumed to revise this document to reflect changes, events or conditions, which occur subsequent to the date hereof.

CEPA does not accept or assume any responsibility in respect of the document to any readers of the document (third parties), other than the stated recipient(s). To the fullest extent permitted by law, CEPA will accept no liability in respect of the document to any third parties. Should any third parties choose to rely on the document, then they do so at their own risk.

## I. INTRODUCTION

This document describes charging models and supporting documentation developed for DCUSA. The following sections set out the:

- specification for the new files, including the identity of the reference files for the revisions noted here within and the new file names;
- revisions to the models, and the impact of those changes; and
- revisions to the user guides.

## 2. SPECIFICATION

The models and supporting documentation described herein were developed in response to a request to produce versions of the PCDM, CDCM and EDCM (LRIC & FCP) models that implement DCP 266 – “*calculation and application of IDNO discounts*”. The reference files noted below were developed in line with the draft DCUSA text first shared with the modelling team on 08/11/18, then in revised form on 29/11/18. In all other areas, we assumed that the model should implement the 01 April 2020 DCUSA Charging Methodologies Pre-Release (released 09/10/2018).

### 2.1. REFERENCE FILES

The following table sets out the reference versions of the charging models and user guides used as the starting point for the revisions described in this document.

Table 2.1: Reference files

Model	Model file name	User guide file name	Date sent
PCDM	PCDM_v3_20181016.xlsx	PCDM_v3_20181016.pdf	16/10/2018
CDCM	CDCM_v3_20181016.xlsx	CDCM_v3_20181016.pdf	16/10/2018
EDCM (LRIC)	EDCM-LRIC_v3_20181016.xlsx	EDCM-LRIC_v3_20181016.pdf	16/10/2018
EDCM (FCP)	EDCM-FCP_v3_20181016.xlsx	EDCM-FCP_v3_20181016.pdf	16/10/2018

### 2.2. NEW FILES

The following table sets out the versions of the charging models, user guides and impact assessment provided to the DCP 266 Working Group in response to the request described above.

Table 2.2: New files

Model	Model file name	User guide file name	Date sent
PCDM	PCDM_v3(266)_20181207.xlsx	PCDM_v3(266)_20181207.pdf	07/12/2018
CDCM	CDCM_v3(266)_20181207.xlsx	CDCM_v3(266)_20181207.pdf	07/12/2018
EDCM (LRIC)	EDCM-LRIC_v4(266)_20181207.xlsx	EDCM-LRIC_v4(266)_20181207.pdf	07/12/2018
EDCM (FCP)	EDCM-FCP_v4(266)_20181207.xlsx	EDCM-FCP_v4(266)_20181207.pdf	07/12/2018
Impact assessment	ImpactAssessment(266)_20181207.xlsx	-	07/12/2018

The EDCM model files are named “v4” to denote that they include a correction for a non-material error brought to our attention on 02/11/18.

The ARP was not commissioned under this service request. If required at a later date (alongside a service 2 request for the other charging models), we would expect it to be commissioned as a service 1 + 2 request.

We understand that the new files listed in Table 2.2 will be considered by the DCP 266 Working Group and may be shared for consultation.

## 2.3. NEW MODELLING SPECIFICATION ASSUMPTIONS

The modelling team shared a model issues log with the Working Group on 20/11/18, raising five issues and seeking advice on the intended interpretation of the draft text. The Working Group returned a copy of the issues log on 29/11/18 clarifying all five issues and amending the draft text accordingly.

We have interpreted the draft text shared by the Working Group under the same set of assumptions applied in the reference files. In particular, we have applied the definition of ‘U’ logged as an assumption in annex A of the PCDM user guide, rather than following paragraph 46 precisely.<sup>1</sup> That is, we interpreted paragraph 46 as:

*“U is the percentage that the [Revenue not to share per unit] represents of the sum of the [Revenue to share per unit] across all network levels and the [Revenue not to share per unit].”*

We implemented this step in the revised PCDM using revenue to share and not to share after the revenue / volume scaler had been applied. ‘U’ is a ratio, so its value is not affected by whether the scaler is applied here – so long as it is applied or not applied consistently to both revenue to share and revenue not to share. The Working Group may wish to clarify the definition of ‘U’ accordingly.

## 3. MODEL REVISIONS

### 3.1. STRUCTURAL CHANGES

The following structural changes were made to implement DCP 266:

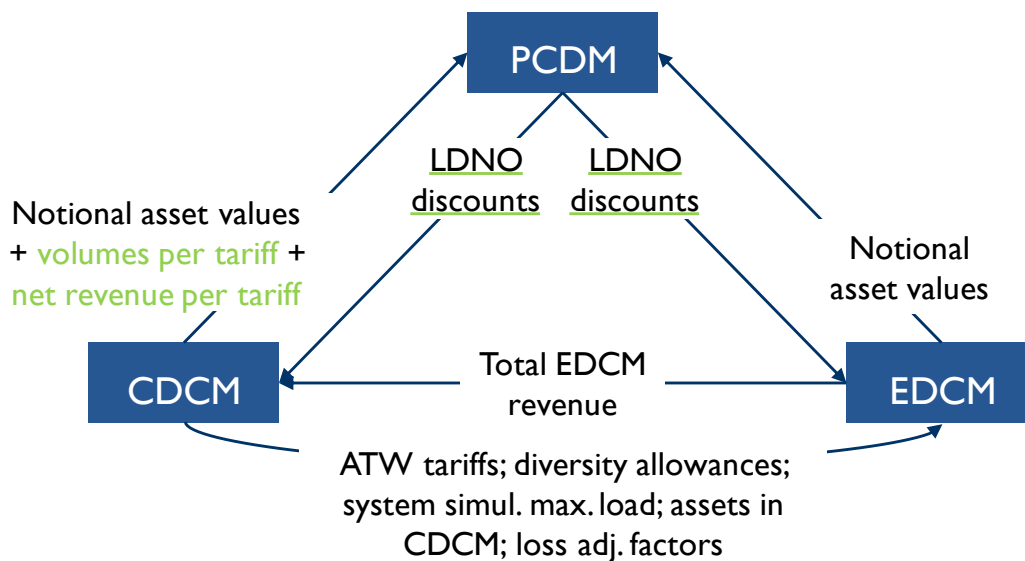
- revenue (£) per all-the-way tariff is exported from the CDCM to the PCDM;
- volumes (MWh) per all-the-way tariff are exported from the CDCM to the PCDM;
- LDNO discounts are exported from the PCDM to the CDCM / EDCM on a per tariff basis, rather than by LDNO boundary / end-user connection level. Discount mapping tables have therefore been moved from the CDCM / EDCM to the PCDM; and
- a new sheet (‘Discount mapping’) was added to the PCDM to convert LDNO discounts to percentages per customer category, rather than per LDNO boundary / end-user connection level.

These additions have an impact on how model interactions should work because they introduce a new output table to be passed from the CDCM to the PCDM. Figure 3.1 illustrates the interactions between the three charging models, with changes brought about by DCP 266 highlighted in green. LDNO discounts are underlined in green because their dimensions and values have changed. This can have a knock-on effect on CDCM outputs, which will feed through to other models in turn.

---

<sup>1</sup> We understand that DCUSA is planning to implement this assumption (and others) through a “house-keeping” change proposal.

Figure 3.1: Changes to model interactions arising from DCP 266



We discuss the impact of the new circularity introduced between the CDCM and PCDM in sub-section 3.6.

### 3.2. ADDITIONAL OR MODIFIED INFORMATION SECTIONS

The following revisions were made in the PCDM:

- **‘Cover’**. Subtitle updated.
- **‘Version control’**. Version control updated (including model date, DCUSA text version, and description of changes).
- **‘Model map’**. Updated to account for new sheet (‘Discount mapping’).
- **‘Index’**. Updated to account for revised section structure.

The following revisions were made in the CDCM:

- **‘Cover’**. Subtitle updated.
- **‘Version control’**. Version control updated (including model date, DCUSA text version, and description of changes).
- **‘Index’**. Updated to account for revised section structure.

The following revisions were made in the EDCM:

- **‘Cover’**. Subtitle updated.
- **‘Version control’**. Version control updated (including model date, DCUSA text version, and description of changes).
- **‘Index’**. Updated to account for revised section structure.

### 3.3. ADDITIONAL OR MODIFIED INPUT SECTIONS

The following revisions were made in the PCDM:

- **‘Fixed inputs’**. Discount mapping tables transferred from CDCM / EDCM; and universal values added for conversions from pounds to pence / GWh to kWh.

- **‘DNO inputs’**. New inputs added for DCP 266 – net revenue per tariff from CDCM; volumes per tariff from CDCM; charging year units distributed; charging year network losses; and charging year total allowed revenue.

The following revisions were made in the CDCM:

- **‘Fixed inputs’**. LDNO discount mapping table removed.
- **‘Inputs by customer type’**. LDNO discounts table added (relocated from ‘General inputs’ sheet due to altered dimensions).
- **‘General inputs’**. LDNO discounts table removed (relocated to ‘Inputs by customer type’ sheet due to altered dimensions).

The following revisions were made in the EDCM:

- **‘General inputs’**. LDNO discounts table removed (relocated to ‘LDNO inputs’ sheet due to altered dimensions).
- **‘LDNO inputs’**. LDNO discounts table added (relocated from ‘General inputs’ sheet due to altered dimensions).

### 3.4. ADDITIONAL OR MODIFIED CALCULATION SECTIONS

The following revisions were made in the PCDM:

- **‘Rev allocation’**. Revised from Section G onwards to implement DCP 266 – namely the application of revenue and unit scalers and calculation of revenue to share / not to share in p/kWh rather than as percentages.
- **‘EDCM discounts’**. Revised to express discounts in p/kWh.
- **‘CDCM discounts’**. Revised to express discounts in p/kWh.
- **‘Discount mapping’ [new sheet]**. Added to map discounts from the LDNO boundary / end-user connection level to the tariff level; to calculate average all-the-way tariffs in p/kWh (including adjustment for dual tariffs described in Schedule 29, Paragraph 46A); and then to express discounts as a percentage of average all-the-way tariffs.

The following revisions were made in the CDCM:

- **‘Volume adjustments’**. Dimensions of initial discounts table altered, and first discount mapping stage removed.
- **‘Net revenue summary’**. Rows added to express net revenue and combined volumes per all-the-way tariff for export to the PCDM.

The following revisions were made in the EDCM:

- **‘LDNO calculations’**. Dimensions of initial discounts table altered, and discount mapping stage removed.

### 3.5. ADDITIONAL OR MODIFIED OUTPUT SECTIONS

The following revisions were made in the PCDM:

- **‘Outputs to other models’**. Table dimensions altered to export discounts by customer category.

The following revisions were made in the CDCM:

- **‘Outputs to other models’**. Table added to export net revenue and combined volumes per all-the-way tariff to the PCDM.

No revisions were made to outputs in the EDCM.

### 3.6. IMPACT STATEMENT

#### 3.6.1. Background

The impact assessment submitted under this service request sets out the impact of DCP 266 on:

- **‘PCDM discounts (Dec)’**. % LDNO discounts produced by the PCDM;
- **‘CDCM tariffs’**. Tariffs produced by the CDCM;
- **‘CDCM net rev’**. Net revenue for each CDCM tariff;
- **‘CDCM per kWh’**. Net revenue per kWh for each CDCM tariff;
- **‘CDCM per MPAN’**. Net revenue per MPAN for each CDCM tariff; and
- **‘CDCM other outputs’**. Other CDCM outputs not shown elsewhere (e.g. notional EHV asset values, system simultaneous maximum load, assets in CDCM model, and breakdown of total net revenue).

It also includes a copy of the impact assessment published in February 2018 in support of the DCP 266 consultation on the **‘PCDM discounts (Feb)’** sheet, which is compared to discounts from the present service request on the **‘PCDM discounts (Dec – Feb)’** sheet. CDCM outputs are not compared, since material changes have been made to the CDCM since the February consultation.

In each case the impact assessment presents values before DCP 266, after DCP 266, absolute difference, and percentage change.

Impact assessments were generated using inputs from the 2018/19 published models for consistency with previous impact assessments, as per the Working Group’s request. New inputs introduced by DCP 266 were provided by the Working Group. Pre-266 outputs were generated in accordance with the reference files noted above using non-zero volumes.

We have not included impact assessments for EDCM outputs because we do not have access to actual EDCM data. Likewise, we are not able to determine the final impact of DCP 266 without resolving inter-model circularities, as we do not have the actual EDCM data needed to do that. **All impacts are presented before resolution of inter-model circularities.** That is, revenue and volumes per tariff were passed from the CDCM to the PCDM and LDNO discounts were passed back into the CDCM, but no further interactions were carried out. We discuss model interactions further in sub-section 3.6.4 below.

#### 3.6.2. Impacts

On average<sup>2</sup>, LDNO discounts increase under DCP 266, though impacts vary in size and direction.

Figure 3.2 summarises the impact of DCP 266 on all discounts produced by the PCDM (before model interactions) as a ‘box and whisker’ plot. Median discounts increase for almost every DNO, and mean discounts increase for every DNO. Mean increases are modest in some cases (e.g. LPN, 2.0 percentage points) and large in others (e.g. SWEST, 20.7 percentage points). There are a range of impacts across tariffs,

---

<sup>2</sup> Using a simple arithmetic average per tariff across all DNOs, rather than being weighted by volumes for instance.

with some individual discounts falling by up to 40 percentage points, and others increasing by up to 80 percentage points.

Figure 3.2: Impact of DCP 266 on LDNO discounts (percentage point change)

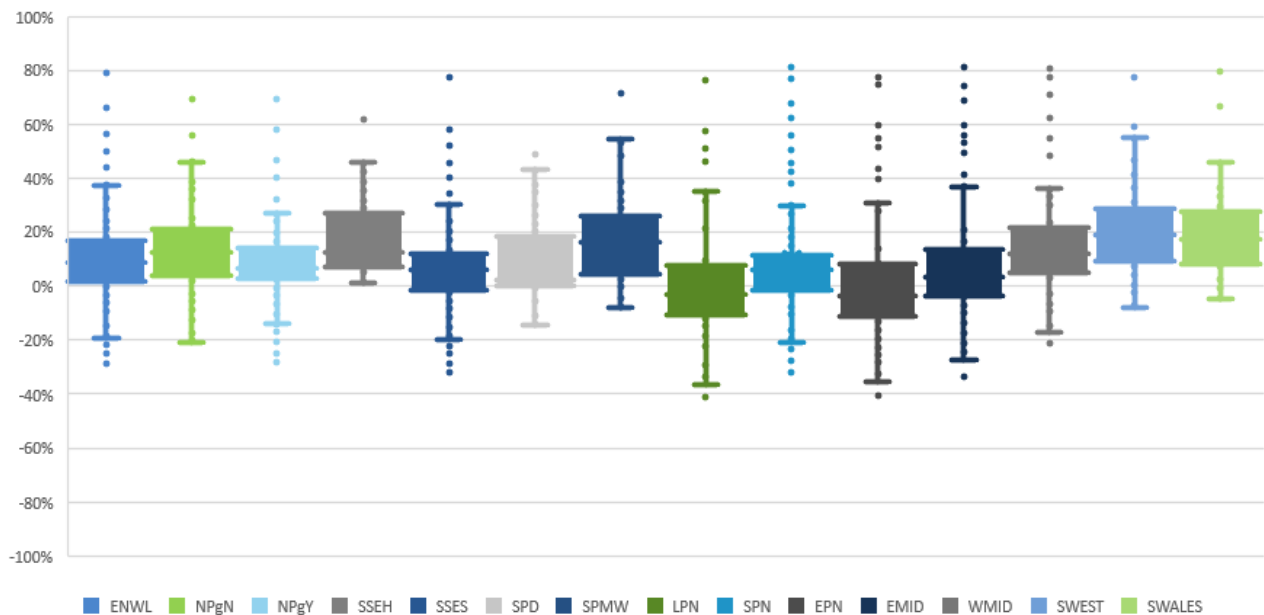
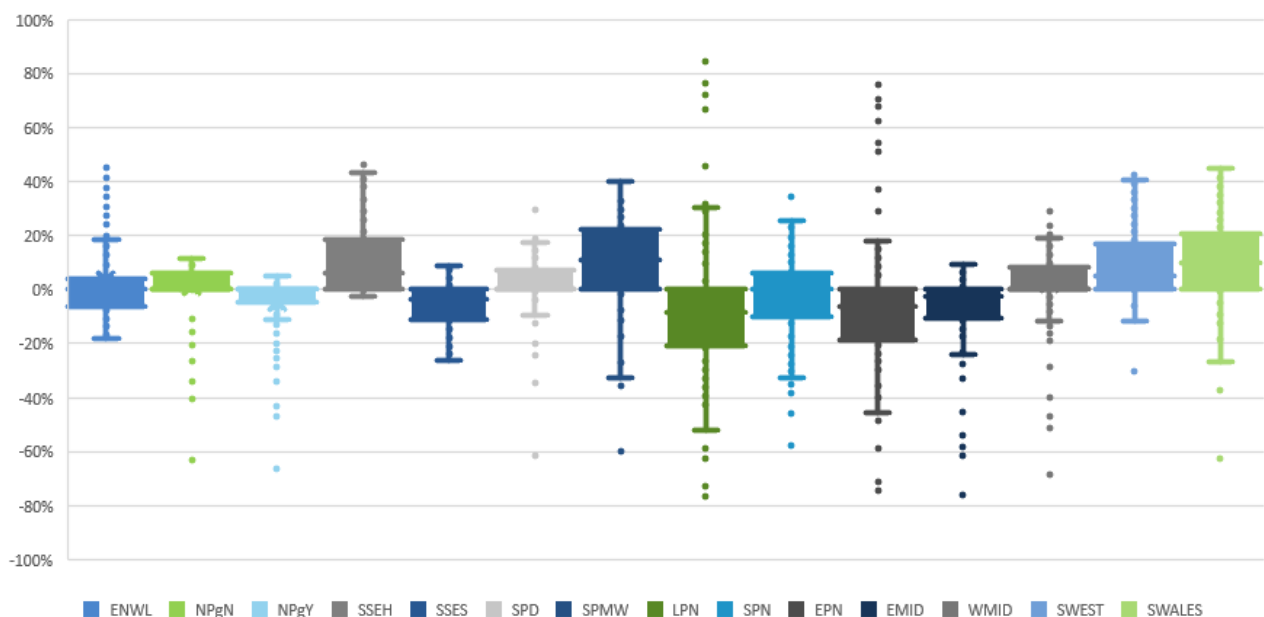


Figure 3.3 compares the impact of DCP 266 as modelled under this service request with results published in support of the February 2018 consultation. For some DNOs, the two sets of impacts are very similar. However, this may not be a valid comparison if, for example, the February discounts were based on post-interaction results.

Figure 3.3: Impact of DCP 266 on LDNO discounts relative to results published at February consultation (percentage point change)





### 3.6.3. Interpretation

The impact analysis performed as part of this modelling request demonstrates that:

- DCP 266 introduces much more variation in *percentage* discounts than without DCP 266. This is because discounts are now calculated per tariff, instead of several tariffs receiving the same percentage discount. The additional variation corresponds to the differences in average tariffs between customer categories, which is the denominator in the percentage discount formula.
- Although the impact of DCP 266 on LDNO discounts can be large, the knock-on effect on all-the-way tariffs is generally small. The range of impacts on net revenue per all-the-way tariff falls between +0.3% and -0.5%.
- The discounts calculated under this service request are slightly higher than those provided for consultation in February 2018 using the Model GM, though the difference varies in size and direction. The specification and methodology applied for that exercise were not reviewed as part of the current service request, but part of the difference may be because our impact assessment is pre-resolution of circularities while the Model GM solves the additional circularities internally [see discussion of circularities below]. Revenue and unit scaling may also account for some of the differences.

When trying to understand the impact of DCP 266 on a certain discount, it can help to focus on the following three terms:

- The **scaler** used to bring 2007/08 volumes and revenues into line with the charging year. There is just one scaler per DNO per year, so the impact of DCP 266 varies somewhat by DNO. For example, SPN has a larger scaler than EPN or LPN so, other things being equal, DCP 266 will increase LDNO discounts for SPN more than for EPN or LPN.
- **Revenue to share per unit for all network levels**, which was the denominator of the discount percentage formula before DCP 266. There is one term per charging model per DNO, which can explain some of the pattern of impacts between charging models. For instance, the average increase in LDNO discounts is greater in the EDCM (12.8%) than the CDCM (8.3%).
- The **average tariff for a customer category**, which is the denominator of the percentage discount post-DCP 266. Since this is the only term which varies by customer category within the same charging model, the direction of impact is consistent across LDNO boundary levels within the CDCM and EDCM. For example, if DCP 266 lowers the discount received by LDNOs with a boundary at the 0000 level serving a Domestic Unrestricted end-user, then it will also lower discounts at the 132kV, 132kV/EHV, and EHV levels for that customer category (but not necessarily for HV or LV boundary levels, which fall under the CDCM).

Table 3.1 reports revenue, unit and combined scalars between 2018/19 and 2007/08 for the Working Group's information.

Table 3.1: Revenue, unit and combined scalars between 2018/19 and 2007/08

DNO	Revenue	Unit	R / U
ENWL	1.61	0.85	1.90
NPgN	1.56	0.85	1.82
NPgY	1.59	0.87	1.83
SSEH	1.34	0.87	1.54
SSES	1.31	0.88	1.48
SPD	1.20	0.82	1.46
SPMW	1.64	0.88	1.88
LPN	1.54	0.90	1.72
SPN	1.87	0.86	2.18
EPN	1.48	0.90	1.66
EMID	1.66	0.87	1.90
WMID	1.75	0.87	2.01
SWEST	1.56	0.86	1.82
SWALES	1.42	0.86	1.65

### 3.6.4. Impact on model interactions

The DCP 266 Working Group requested that charging models should be developed without measures to resolve the circularity introduced between the CDCM and PCDM, which the Group would assess after this service request was received. We have done our own preliminary assessment which the Group may wish to consider.

We developed an internal model interaction tool which passes all relevant values (typically recorded in 'Outputs to other models') from the PCDM, CDCM and EDCM to their destination input ranges, and records model results after every loop. Interactions were deemed to be resolved after the first loop with no effect on tariffs in the CDCM or EDCM. This is just one approach and may not reflect how each DNO resolves model circularities.

Three DNOs (SPD, LPN, NPgN) were selected for interaction testing with and without DCP 266. Inputs were as per our general impact assessments, with the addition of dummy EDCM data used for Model Design testing in Q2 2018.

We found that the additional circularity introduced by DCP 266 increased the number of loops required by a small number (reported in Table 3.2).

Table 3.2: Loops required to resolve circularities – before & after implementing DCP 266

DNO	Pre-266	Post-266
SPD	5	8
LPN	5	6
NPgN	4	7

We also tested whether the starting values chosen for “inputs from other models” affect the final results or number of loops required. In the one case tested, the models reached the same results as previously after the same number of loops, even though “inputs from other models” were initially set to zero.

Figure 3.4 demonstrates how resolving circularities can affect model outputs by tracing an LDNO percentage discount after each loop with and without DCP 266. Although these values appear to settle by loop 4, they are still changing to the ninth decimal place in the final loop.

Figure 3.4: Impact of model interactions on LDNO discounts – example

Loop	0	1	2	3	4	5	6	7	8
Resolution check (pre-266)		1	1	1	1	0	0	0	0
LV: Domestic Unrestricted	38.70%	37.32%	37.23%	37.23%	37.23%	37.23%			
Resolution check (post-266)		1	1	1	1	1	1	1	0
LV: Domestic Unrestricted	36.72%	35.22%	34.77%	34.69%	34.70%	34.70%	34.70%	34.70%	34.70%

In this example, DCP 266 initially lowers the discount by two percentage points. After the final loop, the discount has dropped in both versions, but by slightly more under DCP 266. The final value is 2.5 percentage points lower with DCP 266 than without.

On average, DCP 266 appears to have raised the typical LDNO discount, while the influence of model interactions seems to partially offset that change.

This analysis was performed for a small number of DNOs using dummy EDCM data. The Working Group may wish to carry out its own testing using actual EDCM data.

## 4. USER GUIDE REVISIONS

The following sections of the user guides were updated to reflect DCP 266.

Table 4.1: Updated user guide sections

CDCM-ARP	PCDM	EDCM-FCP	EDCM-LRIC
Section 1	Section 1	Section 1	Section 1
Section 2	Section 2	Section 2	Section 2
Section 6	Section 3	Section 6	Section 6
Section 7	Section 4	Section 7	Section 7
Section 8	Section 7		
	Section 8		



Queens House  
55-56 Lincoln's Inn Fields  
London WC2A 3LJ  
United Kingdom



CEPA Ltd  
@CepaLtd