Directed Contracts 2007/08
Quantification and Pricing
Decision Paper

16 May 2007

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I. INTRODUCTION

An integral part of the development of the Single Electricity Market (SEM) has been the development of a Market Power Mitigation Strategy to ensure that the benefits associated with the SEM are not undermined by the abuse of market power. To that end the Commission for Energy Regulation and the Northern Ireland Authority for Utility Regulation ("the Regulatory Authorities" or "RAs") have jointly developed a strategy to mitigate market power in the SEM.

A fundamental part of this strategy is the implementation of a suite of Directed Contracts ("DCs"), the purpose of which is to remove the incentives on the incumbent generators to attempt to profit from the exertion of market power. These contracts will mitigate market power by reducing the incentive for the market participants to submit bids above competitive levels, or otherwise withhold capacity, to influence current spot prices or future contract prices. The contracts are a cornerstone of the market power mitigation plan and provide the opportunity and ability to place greater reliance on competitive forces.

This Decision Paper reports on the results of the RAs' implementation of the quantification and pricing methodologies for DCs. The quantities and pricing formulae will apply to the DCs with a term from 1st November 2007 to 30th September 2008.

The methodologies that the RAs have adopted were consulted on at length and in detail with the industry. Of particular relevance to the detailed methodologies and to the DC process for the forthcoming contract round are the following papers which were published on the All Island Project (AIP) website (www.allislandproject.org):

- Market Power Mitigation in the SEM - Directed Contracts: Price, Form and Allocation, 21st June 2006, AIP/SEM/66/06
- Market Power Mitigation in the SEM - Directed Contracts: Price, Form and Allocation: Decision Paper, 8th September 2006, AIP/SEM/115/06
- Market Power Mitigation in the SEM - Directed Contracts: Price, Form and Allocation: Supplemental Decision Paper, 3rd November 2006, AIP/SEM/165/06
- Market Power Mitigation in the SEM: Directed Contract Quantification Methodology Consultation Paper, 22nd September 2006, AIP/SEM/244/06

- Market Power Mitigation in the SEM: Directed Contract Quantification Methodology Decision Paper, 8th December 2006, AIP/SEM/208/06

- Market Power Mitigation in the SEM: Directed Contract Implementation Report, 2nd April 2007, AIP/SEM/07/92

- Master Contract for Differences Agreement, 3rd April 2007

- Directed Contract Subscription Guidelines, 11th May 2007

II. SUMMARY OF DIRECTED CONTRACT IMPLEMENTATION RESULTS

There are three elements to the RAs' work on the implementation of Directed Contracts (DCs). These are the quantification of the DCs required to mitigate market power in the SEM; the pricing of DCs; and the eligibility of suppliers in the SEM to subscribe to DCs.

– **Quantity of Directed Contracts**

For the purpose of determining DC quantities a HHI (Herfindahl-Hirschman Index) level of 1,150 was considered appropriate for the first year of the SEM. At this HHI level ESB Power Generation (ESB PG) will be the sole seller of DCs.[1] The quantities of DCs which ESB PG will be required to make available to eligible suppliers during the subscription window are shown below.

	ESB PG			**NIE PPB**		
	Directed Contract Quantities			**Directed Contract Quantities**		
Quarter	**Baseload Quantity (MW)**	**Mid-Merit Quantity (MW)**	**Peak Quantity (MW)**	**Baseload Quantity (MW)**	**Mid-Merit Quantity (MW)**	**Peak Quantity (MW)**
Nov-Dec 2007	240	138	423	0	0	0
Q1 2008	269	147	239	0	0	0
Q2 2008	72	457	n/a	0	0	n/a
Q3 2008	0	574	n/a	0	0	n/a

– **Pricing of Directed Contracts**

The prices of directed contracts will be determined each day during the subscription period using the regression formulae as determined by the RAs through econometric analysis. The constants and coefficients of the pricing formulae are presented in the table below.

The regression formulae for the calculation of the DC strike prices take the following form:

[1] In fact, the HHI level of 1,150 resulted in NIE PPB DC quantities of 18MW and 17MW in Quarters 2 and 3 2008, respectively. The RAs have decided to invoke a de minimis threshold and have set the PPB DC quantities to zero in all periods on the grounds that the costs of NIE PPB implementing the DC subscription process would outweigh the benefits of allocating the small quantity of NIE PPB DCs to all suppliers in the SEM.

$$DCStrike_{q,p} = \alpha_{q,p} + \beta_{q,p} * NG_q + \gamma_{q,p} * LSFO_q + \delta_{q,p} * (NG_q * LSFO_q) + \varepsilon_{q,p} * GO_q + \zeta_{q,p} * C_q + \eta_{q,p} * (NG_q * C_q)$$

The regression constants and coefficients are shown in the table below.

			Coefficients					
			Multiply Gas Coefficient by Euros/therm Gas Price and all other coefficients by Euros/tonne fuel or Euros/tonne C02 Price. The Gas * LSFO coefficient should be multiplied by the product of the gas price and LSFO price and the Gas*CO2 coefficient by the product of the Gas & CO2 prices.					
Contract (p)	**Quarter (q)**	**Constant ($\alpha_{q,p}$)**	**Gas (NG) ($\beta_{q,p}$)**	**LSFO ($\gamma_{q,p}$)**	**Gas * LSFO ($\delta_{q,p}$)**	**Gasoil ($\varepsilon_{q,p}$)**	**CO2 ($\zeta_{q,p}$)**	**Gas*CO2 ($\eta_{q,p}$)**
Baseload	Nov-Dec '07	26.59	36.41	-0.03038	0.08980	0.01167	0.5113	0.0000
Mid-Merit	Nov-Dec '07	36.92	26.68	-0.03197	0.12235	0.01911	0.5642	0.0000
Peak	Nov-Dec '07	71.01	2.52	-0.04106	0.21422	0.01671	0.6863	0.0000
Baseload	Q1 '08	22.62	39.89	-0.02098	0.07911	0.00534	0.6116	0.0000
Mid-Merit	Q1 '08	35.62	28.58	-0.04534	0.14238	0.00837	0.6759	0.0000
Peak	Q1 '08	57.63	6.07	-0.06377	0.22704	0.01042	0.8091	0.0000
Baseload	Q2 '08	-7.74	93.70	0.02916	0.00000	0.00491	1.8875	-2.5902
Mid-Merit	Q2 '08	-15.45	117.55	0.04178	0.00000	0.00710	2.5229	-3.8053
Baseload	Q3 '08	1.68	76.71	0.02614	0.00000	0.00426	1.8866	-2.5262
Mid-Merit	Q3 '08	-2.73	94.04	0.03781	0.00000	0.00652	2.6006	-3.8148

- **Supplier Eligibility**

Using supplier MIC data and historical energy and load shape for each customer type the RAs have calculated the MW eligibility for each type of DC for each supplier, given that supplier's MVA of MIC for each customer class. Suppliers' MICs will be monitored on a monthly basis by the RAs to ensure that suppliers are not opportunistically putting load back onto the Public Electricity Suppliers (PES) on a seasonal basis to profit from DCs.

Supplier eligibility will be communicated to each supplier and to the DC seller separately.

III. DIRECTED CONTRACT QUANTITIES

Directed Contracts will be offered in quarterly segments for the period 1st November 2007 to 30th September 2008. There are three DC products in the market: Baseload, Mid-Merit and Peak. Supplier elections for any given product will be for that product in all of the quarterly segments across the eleven-month period. The definitions of the products are set out in the Master Agreement. These are as follows:

- Baseload Product: For Trading Periods at the Contract Quantity arising in all hours.
- Mid-merit Product: For Trading Periods at the Contract Quantity during the hours beginning at 07:30 and ending at 23:00 on Business Days and for Trading Periods on days that are not Business Days at 80% of the Contract Quantity.
- Peak: For Trading Periods arising during the hours beginning at 16:30 and ending at 20:00 on all days during, October, November, December, January, February and March at the Contract Quantity.

In the Quantification Methodology decision paper the RAs committed to using concentration measures as a means of assessing market power in the SEM, and specifically on HHI (Herfindahl-Hirschman Index) levels, to set DC quantities. The RAs also stated that they would select a HHI in the range of 1,000 to 1,500 and it was anticipated that a threshold of between 1,000 to 1,250 would be appropriate.

The RAs have decided to set the target HHI level at 1,150. This HHI level is an input into the concentration model which is used to determine the DC allocations to ESB Power Generation (ESB PG) and NIE Power Procurement Business (NIE PPB) for each product by reducing monthly HHI levels to the target of 1,150. The concentration model relies on the inputs and outputs of the market simulation model, PLEXOS. These include hourly System Marginal Prices (SMPs), generation average unit costs, unit capacities etc.. The concentration model is described in detail in the Implementation Report (AIP/SEM/07/92).

ESB Power Generation (ESB PG) is the only participant in the generation market that is required to have DCs imposed on it in order to reduce the market's HHI level to the target of 1,150.[1] The DC quantities are set out below.

	ESB PG			NIE PPB		
	Directed Contract Quantities			Directed Contract Quantities		
Quarter	**Baseload Quantity (MW)**	**Mid-Merit Quantity (MW)**	**Peak Quantity (MW)**	**Baseload Quantity (MW)**	**Mid-Merit Quantity (MW)**	**Peak Quantity (MW)**
Nov-Dec 2007	240	138	423	0	0	0
Q1 2008	269	147	239	0	0	0
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IV. DIRECTED CONTRACT PRICING

The prices of Directed Contracts are determined by regression formulae that express the DC strike price in a given quarter and for a given product (Baseload, Mid-Merit or Peak) as a function of forward fuel and carbon prices. The dependent variable in the regression formulae is the Directed Contract strike price; the independent variables are forward fuel and carbon prices.

Base prices of directed contracts were derived from the validated market simulation model, PLEXOS, by taking the average of 20 PLEXOS runs, each based on different forced outage schedules. Fuel and carbon prices on 27th April 2007 were used. PLEXOS was then run 167 times using a realistic range of fuel and carbon price combinations to derive for the three products (Baseload, Mid-Merit and Peak) market prices (SMPs). These SMPs were then regressed on the range of fuel and carbon prices to derive a regression equation for each product and each quarter using an econometric pricing model, which measures the effects of changes in fuel prices on SMP. Therefore, the pricing formulae will estimate the relationship between fuel and carbon prices on the one hand and electricity prices in the SEM on the other and essentially mimic PLEXOS SMPs.

ESB PG, the sole DC seller in the SEM, will apply the approved published fuel and carbon indices to the regression formulae each day throughout the subscription window.

It should be noted that if, between the publication date of the pricing formula and a time at which it is applied during the subscription period, forward fuel or carbon markets move to a point outside the range of values for which there is sufficient confidence in the pricing formula, the Regulatory Authorities reserve the right to suspend subscription and rerun the econometric pricing model or otherwise to amend the determination of the DC strike prices to correct any mis-pricing. The rerun would be done using the prevailing forward fuel and carbon prices as inputs. In this case, the resulting formulae would replace the original formulae and would be used to establish DC strike prices. The formulae may also be rerun if there is significant change to plant availability. The subscription window would reopen once the formulae have been revised.

The Directed Contract regression formulae take the following form:

$DCStrike_{q,p} = \alpha_{q,p} + \beta_{q,p} * NG_q + \gamma_{q,p} * LSFO_q + \delta_{q,p} * (NG_q * LSFO_q) + \varepsilon_{q,p} * GO_q + \zeta_{q,p} * C_q + \eta_{q,p} * (NG_q * C_q)$

where:

$DCStrike_{q,p}$ = Directed Contract Strike Price (in €/MWh) for the relevant quarter (q) and product (p), i.e., baseload, mid-merit and peak

$\alpha_{q,p}$ = formula constant, which may vary by quarter (q) and product (p)

$\beta_{q,p}$, $\gamma_{q,p}$, $\delta_{q,p}$, $\varepsilon_{q,p}$, $\zeta_{q,p}$ and $\eta_{q,p}$ = formula coefficients, which may vary by quarter (q) and product (p)

NG_q = the price (in pence sterling per therm) for quarterly Intercontinental Exchange Natural Gas Futures for the relevant quarter, as reported in *European Spot Gas Futures*, published by Heren Energy ÷ (GBP/EURO Exchange Rate) / 100.

$LSFO_q$ = the price (in US dollars per metric tonne) for quarterly swap transactions for 1% sulphur free on board (FOB) fuel oil cargoes in North West Europe (NWE) for the relevant quarter, as reported by Platts *Forward Oil Curve* ÷ USD/EURO Exchange Rate

GO_q = the price (in US dollars per metric tonne) for swap transactions for 0.2% Gasoil cargoes in NWE including cost, insurance and freight (CIF), as reported by Platts *Forward Curve Oil* ÷ USD/EURO Exchange Rate.

For pricing periods including and subsequent to January 2008, the price will be that for 0.1% Gasoil CIF cargoes in NEW, as reported by Platts *Forward Curve Oil*.

C_q = the weighted-average price (in Euro per tonne of Carbon Dioxide) published by the London Energy Brokers Association on their website (www.leba.org.uk) for a given calendar year. The calendar price for a given year will apply to all quarters falling within that year;

The values of the constants and the independent variable coefficients are set out in the table below.

			Coefficients					
			Multiply Gas Coefficient by Euros/therm Gas Price and all other coefficients by Euros/tonne fuel or Euros/tonne C02 Price. The Gas * LSFO coefficient should be multiplied by the product of the gas price and LSFO price and the Gas*CO2 coefficient by the product of the Gas & CO2 prices.					
Contract (p)	**Quarter (q)**	**Constant ($\alpha_{q,p}$)**	**NG ($\beta_{q,p}$)**	**LSFO ($\gamma_{q,p}$)**	**NG * LSFO ($\delta_{q,p}$)**	**Gasoil ($\varepsilon_{q,p}$)**	**CO2 ($\zeta_{q,p}$)**	**NG*CO2 ($\eta_{q,p}$)**
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Peak	Q1 '08	57.63	6.07	-0.06377	0.22704	0.01042	0.8091	0.0000
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Baseload	Q3 '08	1.68	76.71	0.02614	0.00000	0.00426	1.8866	-2.5262
Mid-Merit	Q3 '08	-2.73	94.04	0.03781	0.00000	0.00652	2.6006	-3.8148

Worked Example:

The following example uses hypothetical fuel and carbon prices to illustrate the calculation of DC strike prices given the relevant regression formulae.

Given the following spot exchange rates, and Q1 2008 fuel and carbon prices:

Fuel and Carbon Prices		
Gas	50	GBP pence /therm
Low Sulphur Fuel Oil	338.00	USD per tonne
Gasoil	625.00	USD per tonne
CO_2	19.00	Euro/tonne
Exchange Rates		
USD/EURO	1.35	
GBP/EURO	0.68	

And converting the fuel and carbon prices to Euros using spot exchange rates (e.g. Gas: 50/100 ÷ 0.68) results in the following Euro prices:

Conversion of Fuel Prices to Euro		
Gas	0.74	Euro/therm
Low Sulphur Fuel Oil	250.37	Euro per tonne
Gasoil	462.96	Euro per tonne
CO_2	19.00	Euro/tonne

The contract strike prices for the Baseload, Mid-merit and Peak products in Quarter 1

2008 are calculated as follows:

- Baseload Q1 ’08 Strike Price = 22.62 + (39.89 * 0.74) + (-0.02098 * 250.37) + (0.07911 * 0.74 *250.37) + (0.00534 * 462.96) + (0.6116 * 19.00) + (0.0000 *0.74 * 19.00)
  = €75.35 per MWhr

- Mid-Merit Q1 ’08 Strike Price = 35.62 + (28.58 * 0.74) + (-0.04534 * 250.37) + (0.14238 * 0.74 * 250.37) + (0.00837 * 462.96) + (0.6759 * 19.00) + (0.0000 * 0.74 * 19.00)
  = €88.21 per MWhr

- Peak Q1 ’08 Strike Price = 57.63 + (6.07 * 0.74) + (-0.06377 * 250.37) + (0.22704 * 0.74 * 250.37) + (0.01042 * 462.96) + (0.8091 * 19.00) + (0.0000 * 0.74 * 19.00)
  = €108.11 per MWhr

The following table shows indicative Directed Contract prices as of 27th April 2007.

ESB PG Indicative Directed Contract Prices			
Quarter	Baseload Price (€/MWh)	Mid-Merit Price (€/MWh)	Peak Price (€/MWh)
Nov-Dec 2007	62.34	74.55	104.22
Q1 2008	73.20	85.87	105.65
Q2 2008	56.59	65.35	n/a
Q3 2008	56.98	66.98	n/a