SEM Committee

Proposed Costs and Estimation of Benefits of the Introduction of additional Intra Day Gate Closures in the SEM

Information Paper

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1. Background

Regulation 2003/1228 (2nd Package) of the European Parliament and of the Council on conditions for access to the network for cross-border exchanges in electricity provides that all Member States must have intra-day trading mechanisms in place on their borders by 1 January 2008. On 28 June 2010, Ireland and the UK received Reasoned Opinions from the European Commission in relation to provisions of Regulation 1228/2003 (the Regulation).

One of the specific issues raised by the European Commission relates to the inability for market participants to 'take part in intraday trade after the issuing of the indicated or actual day-ahead production schedules' and further the apparent lack of coordination of congestion management procedures. The Republic of Ireland and Northern Ireland replied to the Commission setting out the substantial progress being made by the RAs in conjunction with the system operators and market participants on intra-day trading with an assurance that the SEM would be compliant with the provisions of the Regulation when the East West Interconnector is fully operational in 2012.

Similar commitments were made to the Commission by the UK Authorities with regard to the Moyle Interconnector, though the UK still considers Moyle to be an internal tie-line. The Commission has made it clear through various channels that it sees compliance with the Second Package as an absolute requirement, even as Third Package target models are being developed.

The SEM Committee decided that a Modification to the Trading and Settlement Code to facilitate intra-day trading in the SEM should be developed and submitted to the SEM Committee by the end of 2010. On 16 March 2010 the Regulatory Authorities submitted Modification 18_10 Intra-Day Trading to the Modifications Committee. The Modification was subsequently developed through the course of seven working group meetings with market participants. The Modifications Committee unanimously approved the high level design of the Modification on 25 November 2010.

The high level design was presented to the SEM Committee in November 2010 for its consideration. The SEM Committee agreed that the Modification should be brought to the January 2011 meeting of the SEM Committee along with the associated costs and benefits. The below note sets out the SEMO proposed costs of introducing intra-day trading into the SEM and an estimation of the social welfare gains from increased trading across the Moyle and East West Interconnectors.

2. Costs Of Intra-Day Trading

Eirgrid has submitted the implementation and recurring costs for the introduction of additional intra day gate closures in the SEM. The RAs are currently assessing these costs and will shortly be publishing their decision along with details of the incentivisation mechanism to be employed.

In summary, SEMO and the TSOs are proposing the following direct costs for intra-day trading:

- **€13m** implementation costs
- **€6.6 m** costs already approved under the current SEMO Revenue Determination
- **€1.5m to €2m** annual costs mainly related to increased TSO resource requirements and ongoing systems requirements post implementation

2.1 Implementation costs

This envisaged cost to SEMO and the TSOs of implementing the intra-day solution is €13 million and is broken down as follows:

Item	Cost
SEMO Functional Costs (ABB/Navita/Amor):	**€3.4m**
SEMO Hardware & Software Costs:	**€4.6m**
SEM Website	**€0.3m**
SEMO Resources:	**€2.0m**
TSO Costs:	**€1.5m**
Contingency @ 10%	**€1.2m**
Total	**€13m**

2.2 Enduring costs

SEMO and the TSOs estimate that there will be an enduring cost associated with the continuing operation of the intra-day arrangements, of the order of €1.5m to €2m a year for both the SOs and SEMO.

3. Potential Social Welfare Gains from Increased Trading across the Moyle and East West Interconnectors

This section attempts to estimate the social welfare gains that would result from the elimination of price differentials between the SEM and the electricity market in Great Britain (GB) in those periods where there is spare capacity on the interconnectors with GB. The analysis uses 2010 data on flows across the Moyle interconnector, half hourly *ex post* system marginal prices, capacity payments to generators and spot prices in the GB market from APX. The aim is to estimate the potential social welfare gains that might result from being able to trade closer to real time across the interconnectors with GB.

2.3 Methodology

The methodology used to assess the size of the potential social welfare gains is based on that adopted by the French energy regulator, the *Commission de Régulation de l'Energie* (CRE), in assessing the loss in social welfare associated with the absence of implicit auctions at the day ahead stage on the France-England interconnector (IFA).[1] The CRE's methodology is described as follows:

> *" .... for each hour, it is the product of the positive part of the price differential between the exchanges in the two countries and the daily capacity that remains unused or is used in the opposite direction."*

On the assumption that price differentials between two interconnected markets will result in an increased flow of energy across an interconnector as arbitrage opportunities are exploited, there will be gains in producers' and consumers' surpluses if the net transfer capacity of the interconnector is sufficiently large for flows across it to have an influence on prices in either of the two markets. Consumers' surplus and producers' surplus are the standard concepts in economics for the measurement of social benefits.[2]

The CRE methodology can be illustrated in diagrammatic terms. The diagrams below show the case where demand in the SEM is totally inelastic (i.e., where demand does not respond to changes in half-hourly prices), which is a good approximation to reality in a market like the SEM, which does not have significant demand side participation. They also assume that increased flows across the interconnectors with GB do not affect electricity prices in GB, i.e., that the aggregate supply curve in GB is perfectly elastic.

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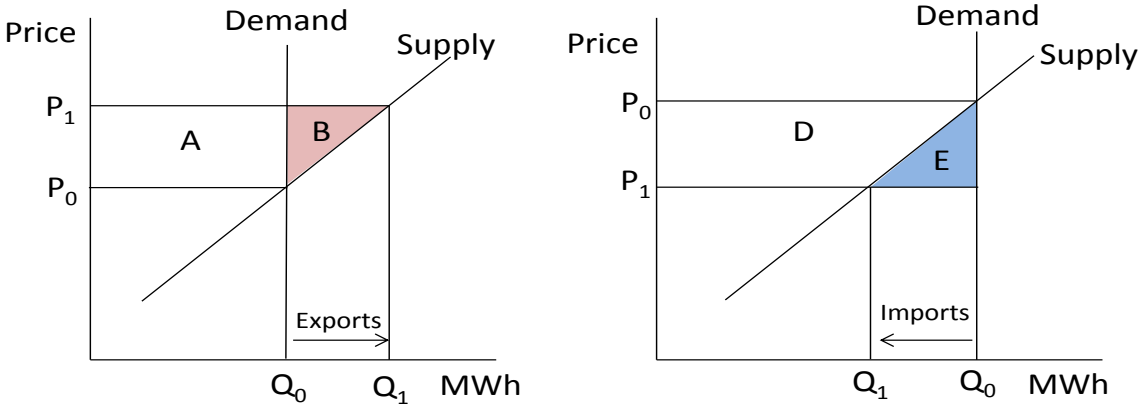
1 As described on page 21 in *Regional Reporting on Electricity Interconnections Management and Use in 2008 in FUI region,* CRE, CER, NIAUR and Ofgem, 2009

2 A simple definition of a consumer's surplus is the maximum sum of money a consumer would be willing to pay for a given amount of a good or service, less the amount the consumer actually pays, which is measured by the area under the demand curve. A producer's surplus is simply economic rent, which is the difference between the price a producer gets for the good or service supplied and the economic cost of the inputs required to produce it, which is measured by the area above the supply curve.

The diagram on the left shows what the social welfare gains to the SEM will be when there are increased flows from the SEM to GB in response to price differentials; and that on the right what the gains to the SEM will be when there are increased flows from GB to the SEM in response to price differentials. Thus, as price differentials are exploited:

- when electricity flows out of the SEM into GB, producers' surplus in the SEM rises by A + B and consumers' surplus falls by A, giving a net social welfare gain of B;
- when electricity flows out of GB into the SEM, producers' surplus in the SEM falls by D and consumers' surplus rises by D + E, giving a net gain of E;
- so the total gain in social welfare, taking both increased imports into the SEM and exports from the SEM into account, is equal to B + E.



Increased imports of electricity into Ireland will result in a lower wholesale price of electricity in Ireland, other things being equal. Consumers in Ireland will benefit by these lower prices, but Irish producers will lose out because less infra-marginal rent is earned. The net benefit is what is referred to as consumers' surplus below. Increased exports of electricity from Ireland will result in a higher wholesale price of electricity in Ireland, other things being equal. This will benefit producers in Ireland, because they earn more infra-marginal rent, but Irish consumers will lose out. The net benefit is referred to as producers' surplus below. The sum of the two is referred to as the total gain in social welfare.

On the assumption of perfectly inelastic demand (i.e., vertical demand curves) and of a perfectly elastic supply curve in GB, the size of the potential gain in social welfare from increased trade will therefore depend on:

- the difference between prices in the SEM and those in GB in each half hour;

- the amount of spare capacity on the interconnector in each half hour, in the direction which the price differentials indicate the flows should be; and
- the price elasticity of supply in the SEM.

2.4 Data and Calculations

To calculate the size of the two triangles B and E in the diagram above, the following data were used:

1. National Grid data from the Moyle website on half hourly flows of energy (in MWh) across the Moyle interconnector in calendar 2010;

2. the availability of the Moyle interconnector (in MW) in 2010;[3]

3. half hourly system marginal prices (SMP) and capacity payments made to generators in the SEM; and

4. half hourly APX spot prices in the British electricity market, using the most liquid price series published by APX, which is a volume weighted average price of APX's half-hour, 2 hour block and 4 hour block continuously traded products.[4]

Estimating the potential social welfare gains from the exploitation of price differentials between the SEM and GB then involved calculating:

1. both the size and 'direction' of the differential in half hourly prices between the SEM and GB;

2. how much capacity on the Moyle interconnector, which amounted to 450MW of import capacity in the winter, 410MW in the summer and 80MW of export capacity year round, was already being used in each half hour in the right direction, i.e., in the direction the price differential would suggest energy should flow and how much capacity was therefore spare in that half hour, both in the direction it was being used and in the direction that the price differential suggests it should have been used. So, in those half hours where the direction of the energy flow should have been in the opposite direction to that which in which it actually took place, the amount of import capacity being used was added to the 80MW of available export capacity on the Moyle to derive a 'super-positioned' or net potential capacity in that half hour for export;
3. how much of that spare capacity (including that released/created by super-positioning), together with 500MW of capacity on the East West

[3] Note that only 290MW of Moyle import capacity (out of 450MW) was available for more than two months in 2010, between 9th September and 17th November 2010.

[4] Almost all (98.5%) of the volume in the APX half hour, 2 hour block and 4 hour block spot contracts during 2009/2010 was traded within 20 hours of gate closure, with most of the liquidity concentrated in the 12 hours ahead of gate closure.

interconnector, could be used before prices in the SEM would be 'pushed down' to the APX price (in the case of additional imports) or 'pulled up' to the APX price (in the case of additional exports).

This is necessary because there were a potentially large number of half hours in 2010 in which the price differentials between the SEM and GB were not that large. Simply assuming that all of the additional 500MW of East West interconnector capacity would be used for trade in that half hour, without allowing for the fact that the price differential would likely be eliminated by a relatively small increase in flows, would overestimate the potential gains from exploiting price arbitrage opportunities.

This step – of calculating the size of the potential capacity available for additional flows – requires knowing the slope of the SEM supply curve.[5] An annual average estimate of the supply price elasticity was derived from runs of a half hourly dispatch model (Plexos), in which demand was 1% higher (1% lower) in each half hour over a year than in a base case. To work out how much additional *exporting* could take place for a given price differential, a price elasticity of 1.5 was derived; and one of 0.70 for the case of working out how much additional *importing* could take place.[6]

By definition the price elasticity of supply is as follows:

$$\text{Supply price elasticity} = \frac{(Q_1 - Q_0)}{Q_0} * \frac{P_0}{(P_1 - P_0)}.$$

So the potential increase in exports or imports $(Q_1 - Q_0)$ for a given price differential $(P_1 - P_0)$ in any half hour can be worked out as follows, once the starting conditions (Q_0 and P_0) are known is:

$$(Q_1 - Q_0) = \frac{\text{Supply Price Elasticity} * Q_0 * (P_1 - P_0)}{P_0}$$

4. the areas of the triangles B and E in the diagrams above were calculated by taking the price differential in each half hour between the SEM and GB, less a deadband to allow for flow-based charges and risk, and multiplying that differential by the feasible available capacity in each half hour, calculated using the equation above. This was done separately for increased imports into the SEM and increased exports to GB.

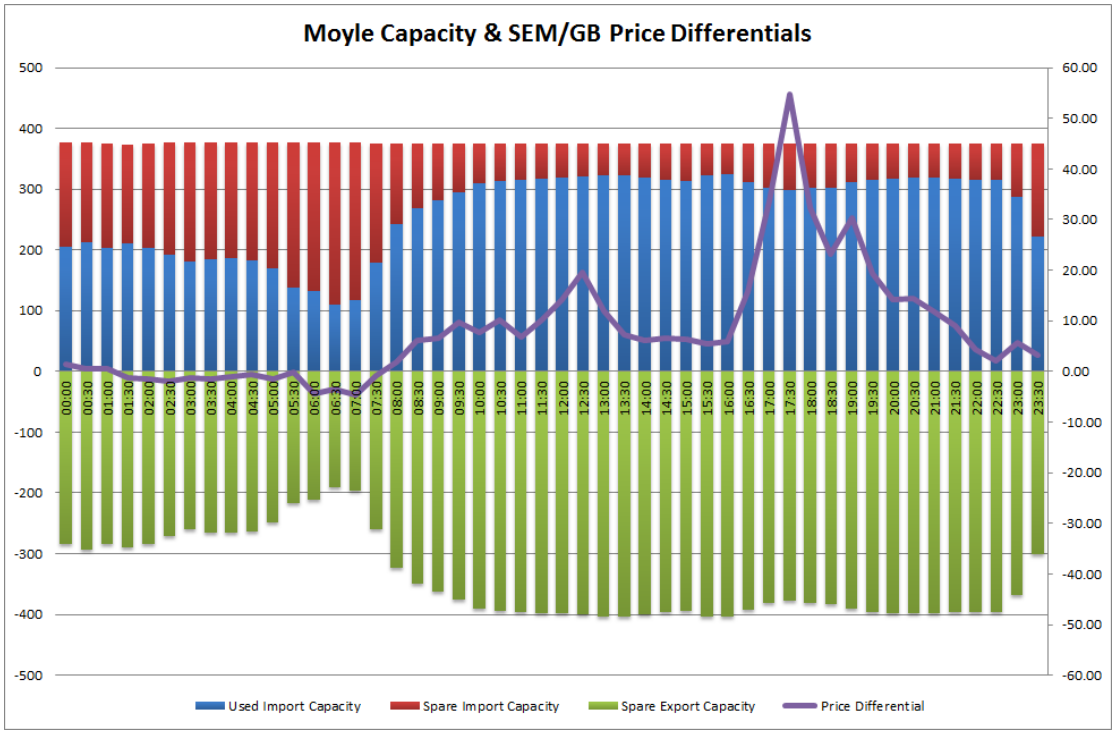
5. the sum of the product of the price differential and the feasible capacity over all the half hours in the year was then divided by 2 to get the area of the

[5] The flatter the supply curve (i.e., the more elastic the price elasticity of supply), the larger the potential increase in flows for a given price differential. A 45° line has an elasticity of 1. Anything less than 1 (i.e., steeper than 45°) is described as inelastic; anything greater than 1 (i.e., flatter than 45°) is described as elastic.

[6] To test the sensitivity of the results to these assumptions, a case where both elasticities were equal to 0.5 was also looked at.

triangles B (which is labelled producer surplus) and E (which is labelled consumer surplus).

The chart below shows, on an average half hourly basis across the whole of 2010, how much of Moyle's capacity (in MW) was used in both directions in 2010, how much was therefore spare and the average differential between prices in the SEM and prices in GB over the half hours in the day.[7] It is clear that the correlation between the price differential and flows across Moyle was not close. In particular, prices in GB tended to be higher than those in the SEM between midnight and 07:00 and yet the flow of energy was predominantly from GB into the SEM and significantly so. It is also apparent that flows across the late afternoon/evening peak were invariant to the marked rise in the price differential.



Deadband

When the RAs consulted users of the Moyle interconnector in late 2009, many Moyle users identified a deadband of €10-15/MWh between half hourly GB prices and expected *ex post* SEM prices, within which they would not risk trading across the Moyle interconnector. Market participants identified a number of reasons for a deadband of this size, including the risks created by the misalignment of the SEM and the GB markets (e.g., very different gate closure times and *ex-post* pricing in the SEM); and other trading risks such as the lack of liquidity in day ahead markets in both Ireland and GB and the risk of importing

[7] Note that the maximum average import capacity on Moyle in the chart is around 380MW, somewhat less than the average 430MW of import capacity that would be expected at 100% availability. The difference is largely attributable to the fact that one of Moyle's two lines was out for more than two months in 2010, between 9th September and 17th November.

into the SEM from GB in the three hours of system peak demand in GB and thereby incurring Transmission Network Use of System (TNUoS) triad charges.

Ofgem approved the removal of TNUoS charges in September 2010 for users of interconnectors between GB and neighbouring countries, with the result that the deadband of €10-15/MWh is now likely to be lower than was estimated by traders back in 2009. Moreover, to the extent that traders have become more adept at forecasting *ex-post* SMP over time, the risk of making a loss (or less profit than expected) may also have diminished over time.

Nonetheless, it is unlikely that the risk premium applied to expected price differentials will have been removed altogether. The analysis therefore included a range of deadbands, from €0/MWh to €15/MWh, partly to test the sensitivity of the results to the size of the deadband and partly to avoid over-estimating the potential gains in social welfare.

2.5 Results

The results were as follows, for the various cases looked at. In all cases the figures refer to *annual* gains.

Moyle and East West interconnectors (950/910MW imports, 580MW exports)

Deadband (€/MWh)	Consumer Surplus (€ millions)	Producer Surplus (€ millions)	Total Potential Gain in Social Welfare (€ millions)
0	28.6	12.1	40.7
5	23.7	7.0	30.7
10	19.6	4.1	23.8
15	16.6	2.8	19.4

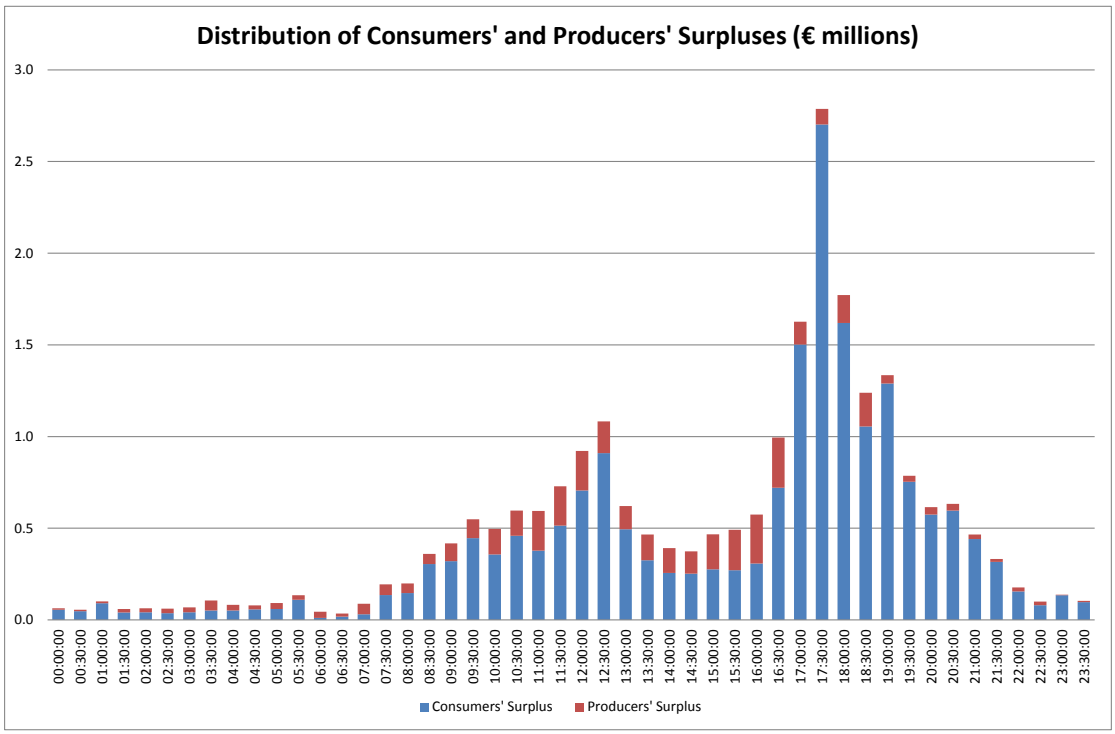
Supply Price Elasticity Variant (i.e., 0.5 for both increase and decrease in demand)

Deadband (€/MWh)	Consumers' Surplus (€ millions)	Producers' Surplus (€ millions)	Total Potential Gain in Social Welfare (€ millions)
0	28.4	9.5	37.9
5	23.7	6.8	30.4
10	19.6	4.8	24.4
15	16.5	3.6	20.1

The second table suggests that the results are not particularly sensitive to assumptions about SEM supply price elasticities, given a non-zero deadband between SEM and GB prices.

The chart below shows the distribution of the calculated gains in social welfare across the half hours of the day, assuming a €10/MWh deadband. As might be expected, there are significant gains from exploiting price differentials are likely to be seen around the peak hours in the early evening (from 16:30 through to 19:30). But it is also apparent that here are significant gains to be made from exploiting price differentials during the day as well.

Moreover, it is apparent that, had the East West interconnector been in operation in 2010, the predominant gains from exploiting spare interconnector and GB/SEM price differentials would have been captured by Irish electricity consumers, if only because the predominant flow of energy would have been from GB into the SEM, thereby tending to reduce prices in the SEM by displacing indigenous generation.



2.6 Caveats

The CRE recognises that estimates derived in this way of the potential gains in social welfare resulting from making full use of price arbitrage opportunities between two markets should be treated with caution. The CRE points out that the estimate of social welfare loss assumes "all else being equal" and in particular that it does not take account of the possible change in behaviour of the market participants in the two markets following the introduction of market coupling on the interconnector between GB and France in the CRE's analysis case and intra-

day trading in this case. In its defence the CRE make the point that it is difficult to make an *ex ante* assessment of the impact of introducing market coupling on the buying and selling offer strategies of market participants in the organised markets.

In this particular case, the methodology also assumes that traders have perfect foresight, in the sense that they know, when the two additional intra-day trading gates in the SEM open for the use of spare capacity on the interconnectors for trading, exactly what *ex post* SMP and capacity payments in the SEM in each half hour will turn out to be. It also assumed that the APX prices used to derive the price differentials are a good representation of what traders can trade at or around the time of the two additional gate closures in the SEM now being implemented to facilitate intraday trading in the SEM.

2.7 Summary of Benefits Analysis

The analysis shows that the estimated potential annual gains from being able to trade closer to real time and to make use of unused capacity on the interconnectors, assuming a deadband of €10/MWh, are comparatively large. It is recognised that not all these potential gains will be realised, principally as a result of the combination of long gate closures in the SEM, even after the implementation of two new intra-day gate closures, and the lack of liquidity in the GB markets beyond 20 hours ahead of gate closure in GB. Nonetheless, the size of the potential gains, even after using a generous deadband to allow for risk, suggests that facilitating trade at the margin on the Moyle and East West interconnectors will yield benefits to SEM market participants and end-customers on the island of Ireland.

4. Conclusions

In conclusion, the SEM Committee has reviewed the proposed costs and estimated benefits of the introduction of additional gate closures in the SEM and decided that on balance, and in combination with the fact that within day re-allocation of interconnector capacity is essential for compliance with the congestion management guidelines, this change to the SEM should be implemented.