

# Response to Regulatory Authorities' request on Capacity Payment Portions

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27<sup>th</sup> August 2013

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# 1 Executive Summary

## Introduction

EirGrid has been requested by the Regulatory Authorities to produce a concise report on the effectiveness of the current payment proportions in the Capacity Payment Mechanism (CPM), in particular the proportions allocated to the Ex-post and Ex-ante elements, and if these current proportions are a potential barrier to trade on the interconnectors. See letter dated 27th June 2013.

It has been observed that for the vast majority of Trading Periods, the flow on both the EWIC and Moyle Interconnectors is from Great Britain to SEM. This is largely driven by lower prices in the Great Britain market than in the SEM. Even when substantial wind curtailment has been required in Ireland, the trading behaviour has been observed to favour importing. It is not an easy task to determine what influence the CPM proportions have on this behaviour.

## Analysis

Data from the SEM was used to investigate the trading behaviour of Interconnector Users. However, as EWIC has only been in full commercial operation for a short while, only 2 months of data has been available for analysis.

Many factors were examined such as the System Marginal Price, the Wind Forecast, the demand forecast, the Loss of Load Probability and the nominations of individual Interconnector Users. The following is a summary of the key points from the analysis.

- For some Interconnector Users there is some positive correlation between forecast demand and their interconnector nominations, i.e. they import less at times of low demand. To a lesser extent, the same Interconnector Users' nominations are correlated to forecast Loss of Load Probability.
- However the remaining Interconnector Users show no correlation with any of the market parameters listed above.
- An analysis of the Ex-post capacity payments showed that payments are low at times of high wind generation in the SEM. This is because wind generation is an input to the outturn Loss of Load Probability calculation, i.e. there is unlikely to be a shortage of generation at times of high wind generation.
- Ex-post capacity payments are also low at times of low demand in the SEM. Demand is an input to the Loss of Load Probability calculation, i.e. there is unlikely to be a shortage of generation at time of low demand.
- High Ex-post capacity payments occurred at times of high demand and low generation margins, which is providing the correct market signal to reward generation when it is needed.
- The Ex-ante capacity payments provide an incentive to import power into the SEM, and a disincentive to export power. This could be seen as influencing economic trading on Moyle and EWIC.

## Conclusion

The analysis seems to suggest that the ex-post portion of Capacity Payments is providing the correct incentives, and does not represent a barrier to trade. However, the Ex-ante portion, which has been as high as €7/MWh at times of wind curtailment, could be influencing economic trading on the interconnectors. If a greater proportion of the capacity payment were applied Ex-post, this effect would be reduced.

On a whole, the present CPM is providing the correct signals to generators to reward generation availability at times of stress on the system, and EirGrid does not see any compelling new evidence to change the CPM proportions at this moment.

Clearly, capacity payments in SEM will influence trading on the interconnectors. There are a number of complicated factors involved which may merit further consideration. Our analysis shows the significant level of Ex-ante capacity payments to parties importing power to the SEM on the interconnectors. Eirgrid/SONI would recommend that the appropriate way of rewarding capacity that is provided by interconnection should be considered in the design of the new market arrangements for implementing the Target Model.

## 2 Background

The aim of the Capacity Payment Mechanism (CPM) is to give a degree of financial security to generators, allowing them to recover their fixed costs. It incentivises available capacity to meet the required adequacy standard.

The Capacity Period Payment Sum for each Capacity Period is split into three different portions. Currently, the ratio employed is 0.3 : 0.4 : 0.3 for the Fixed, Variable and Ex-Post Capacity Sums respectively<sup>1</sup>.

For each Trading Period, the Capacity Generation Prices are dependent on 3 different variables:

1. The Fixed Capacity Generation Price is derived from the demand forecast (which is known a year in advance).
2. The Variable Capacity Generation Price is derived from the forecast Loss of Load Probability (LOLP, which is known a month in advance).
3. The Ex-post Capacity Generation Price is derived from the outturn value of LOLP calculated Ex-Post.

The Capacity Payment Generation Prices have a distinct diurnal pattern (see Figure A1) with higher payments during the high demand peak hours and lower payments in the lower demand off-peak hours. The CPM is also designed so that the payments are higher at times of the year in which there is higher demand (see Figure A2). For full details of the calculation methodology see sections 4.94 to 4.124 and Appendix M of the SEM Trading and Settlement Code.

It is very difficult to quantify how generator units or Interconnector Users (IUs) would respond to significant change in the Capacity Payment portions by examining past behaviour. Previous analysis has shown that in general, generator units tend to aim for high availability at all times as opposed to reacting to capacity payment signals associated with specific trading periods<sup>2</sup>.

The trading behaviour of Interconnector Users could be influenced by a number of variables including factors affecting the price spread between the SEM and BETTA and whether the Interconnector Users are seeking arbitrage or hedging opportunities. The purpose of this report is to investigate if the CPM and, in particular, the existing payment portions are affecting trade on the interconnector. The following sections give a description of the data used, analysis of the data and a brief discussion of the some of the other factors that can influence trade on the interconnectors.

It should be noted that this report is based on a limited dataset of two months of the EWIC Interconnector operating at full capacity. Caution should be taken in trying to draw any firm conclusions from this short dataset.

## 3 Data Sources

For the purposes of this report, a limited dataset was examined. In particular, only two months of data was available for EWIC operating at full capacity. All data used in this report are publicly available from the SEMO dynamic reporting database or via the SEMO market helpdesk. A combination of ex-ante (forecast) and ex-post (actual) data has been used.

### 3.1 Modified Interconnector Unit Nominations

An Interconnector User's Modified Interconnector Unit Nomination (MIUN) is a quantity nominated for import or export for an Interconnector Unit as calculated within the Market Scheduling and Pricing (MSP) software. Data for the months of May and June 2013 have been obtained as EWIC has only been operating at full capacity since May 2013 and capacity settlement for July 2013 has not occurred at the time of writing. All averages, correlations and figures have been compiled using half-hourly data as each trading period in the SEM is a half hour. For this report we have used the EA2 Gate Window MIUNs.

### 3.2 Capacity Payments and SMP

Ex-post data for the different portions of the Capacity Payments and the System Marginal Price (SMP) for the months of May and June 2013 have been obtained from the market database.

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<sup>1</sup> Single Electricity Market Capacity Payment Mechanism FCPPy and ECPPy for Trading Year 2013 (SEM-12-102)

<sup>2</sup> Proposed Value for the Flattening Power Factor for the year 2013, 27th August 2012 (SEM-12-082b)

### 3.3 Loss of Load Probability, System Margin and Wind Generation

As the Loss Of Load Probability (LOLP) is a key determining factor in the Capacity Payment calculations, data for LOLP and the related system margin have been obtained from the market database. Wind generation can strongly affect the system margin and SMP so it is also presented in the analysis.

## 4 Analysis

### 4.1 Drivers of Capacity Payments

The LOLP is forecast a month in advance, taking into account the scheduled outages, demand forecast, etc. The outturn LOLP is generally lower than the forecast, and hence the Ex-Post component of Capacity Payments are usually lower than the Variable component of Capacity Payments. The few times that the Ex-Post Capacity Payment price is higher than the Variable Capacity Payment price are most often caused by an unexpected event such as a large generator unit tripping. But these are precisely the times when the generators that are available should be rewarded more. In this, the CPM seems to be providing the right price signals.

### 4.2 Trading behaviour on the Interconnectors

The following two cases are examples of scenarios that could be driving trade on the interconnector:

#### Case 1

EWIC is importing heavily because:

- SMP is High (in comparison to BETTA price)
  - Due to High Demand (e.g. during daytime) and/or Low Wind
    - Low Margin => Capacity Payments are high  
(Interconnector User receives these Capacity Payments)

In the first few months of its full commercial operation, most of the activity on EWIC has been in the import direction, because generally, the SMP tends to be higher than the price in BETTA, making it attractive to import energy.

#### Case 2

EWIC is exporting because:

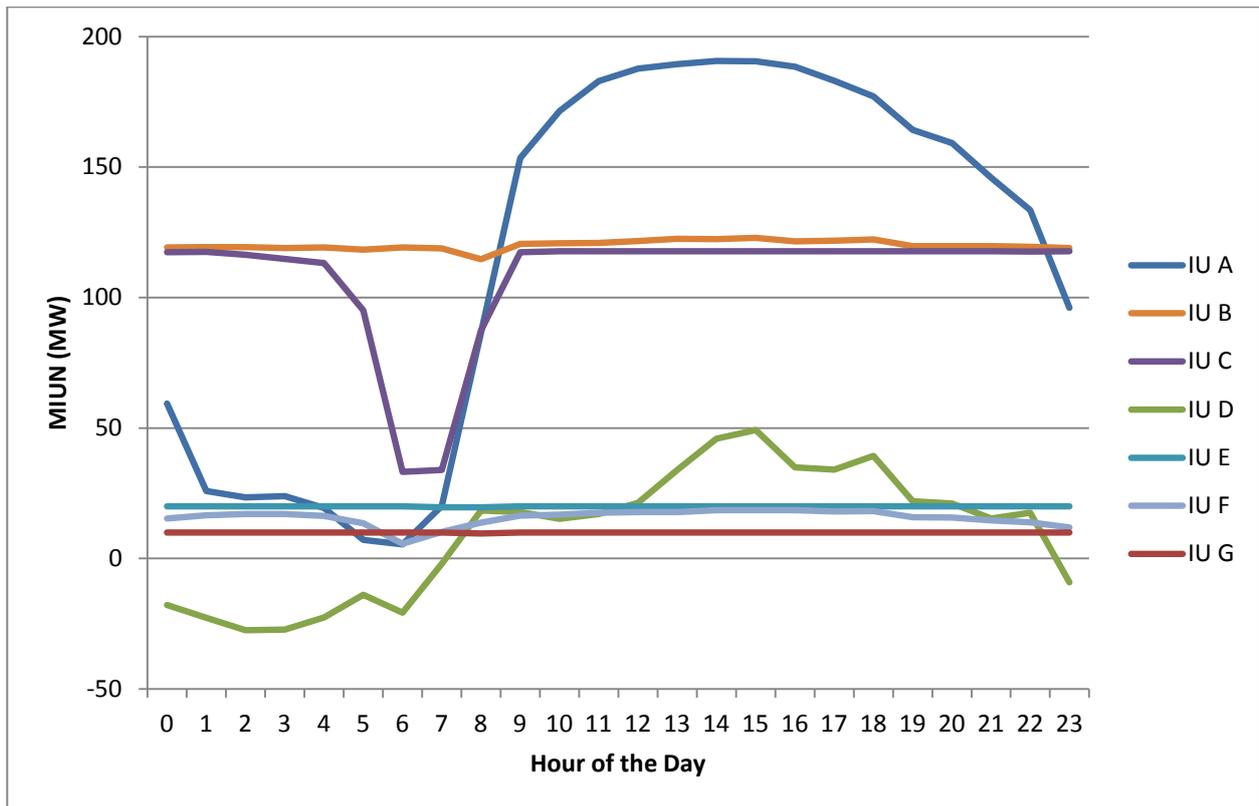
- SMP is Low (in comparison to BETTA price)
  - Due to Low Demand (e.g. during night time) and/or High Wind
    - High Margin => Capacity Payments are Low  
(Interconnector User has to pay Capacity Payments on energy exports)

The Interconnector User knows the monthly Capacity Payments pot sizes, the Fixed and Variable Weighting Factors (FCPWF and VCPWF) in advance. While they do not know the Eligible Availability (CPEALF) exactly in advance, we don't think this is overly significant in comparison to the ex-ante weighting factors (FCPWF and VCPWF). They trade on the expectation that Ex-Post Capacity Payments will be low. This could change if a large unit trips at times of high demand causing the margin to drop and the Loss Of Load Probability (LOLP) to rise.

The Ex-post Capacity price increases in proportion to the outturn LOLP (which increases quasi exponentially with changes in margin). If the Ex-post Capacity price increases significantly, it could decrease the profit made by the Interconnector User on the export, or even push the trade into a loss for that period. From the limited dataset available, instances where an Interconnector User exports from the SEM tend to occur at night. These instances coincide with lower FCPWFs and VCPWFs. We assume that the Interconnector User's expectation is that the ECPWFs will also be low.

### 4.3 Modified Interconnector Unit Nominations

From the half-hourly dataset over May and June 2013, the Modified Interconnector Unit Nominations (Ex-Ante 2) were processed to give the average nomination for each hour, resulting in the figure below.



**Figure 1.** Average daily profile of Interconnector Users' Ex-Ante 2 Nominations based on data from May and June 2013

It can be seen that three Interconnector Users' nomination profiles are usually flat, while four Interconnector Users' nominations vary according to the daily demand curve. Examining this more closely, a correlation table helps to determine the most important factors in Interconnector Users' nomination profiles:

	Modified Interconnector Unit Nominations						
	IU A	IU B	IU C	IU D	IU E	IU F	IU G
Demand forecast	<b>0.7</b>	0.0	0.2	<b>0.5</b>	0.0	0.1	0.0
LOLP forecast	<b>0.4</b>	-0.1	0.2	<b>0.4</b>	-0.1	0.1	0.0
Wind forecast	0.1	-0.3	0.2	0.1	-0.3	0.0	0.0
Fixed Capacity Payment	0.7	0.1	0.2	0.5	0.0	0.1	0.0
Variable Capacity Payment	0.4	0.0	0.1	0.4	0.0	0.1	0.0
Ex-Post Capacity Payment	0.2	0.0	0.0	0.2	0.0	0.1	-0.1

**Table 1.** Correlation table using data from May and June 2013, for seven Interconnector Users (in order from A to G, according to the size of their largest nomination).

There are two Interconnector Users (A and D) whose nominations are correlated most strongly with the Demand forecast, i.e. they follow the diurnal and weekly trends in demand.

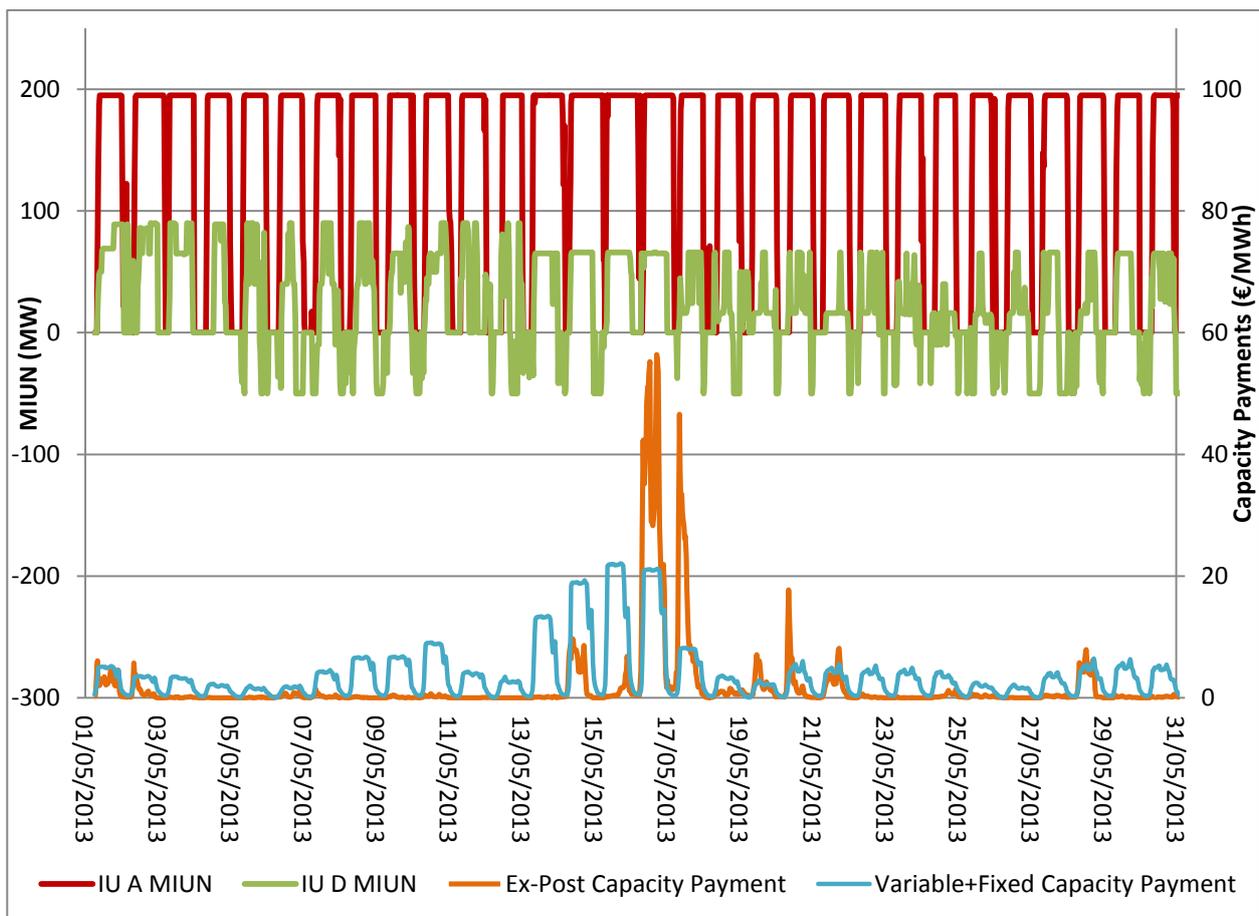
As previously stated, the monthly Capacity Payments pot size, and the Fixed and Variable Weighting Factors (FCPWF and VCPWF) are known in advance. Interconnector Users are more certain of the revenue that comes from these payments, and so can plan their Interconnector offers accordingly if they so wish.

The same two Interconnector Users' nominations (A and D) are correlated to a lesser extent to the forecast LOLP, which is based on the margin (as calculated from the demand forecast and the amount of plant scheduled available). The Interconnector Users' nominations are not strongly correlated with the wind forecast.

For the Interconnector Users whose nominations change significantly, the major influence seems to be the demand forecast, so that they tend to import more at times of high demand. A closer examination of Interconnector Commercial Offer data could be performed to investigate this further.

#### 4.4 Monthly Analysis

The Capacity Payments for May 2013 are plotted below in Figure 2 with the nominations of those trading with a variable profile (Interconnector Users with flat daily profiles have been excluded). The Variable and Fixed portions are added together, as these can be estimated in advance (based on the forecast LOLP and Forecast demand, respectively). The Ex-Post portion is determined afterwards, and is largely based on the outturn LOLP.



**Figure 2.** Nominations for Interconnector User A and D, and Ex-post and Variable+Fixed Capacity Payments for May 2013.

The Variable+Fixed portions are relatively stable. They rose in the week of 13-17<sup>th</sup> May due to tighter margins as many generators were on scheduled outage. If an Interconnector User was contemplating exporting during this time, they could estimate the value of the Variable+Fixed Capacity Payments which could dissuade them. It seems sensible to discourage exports when the margin is small, and so the CPM is providing the correct signals.

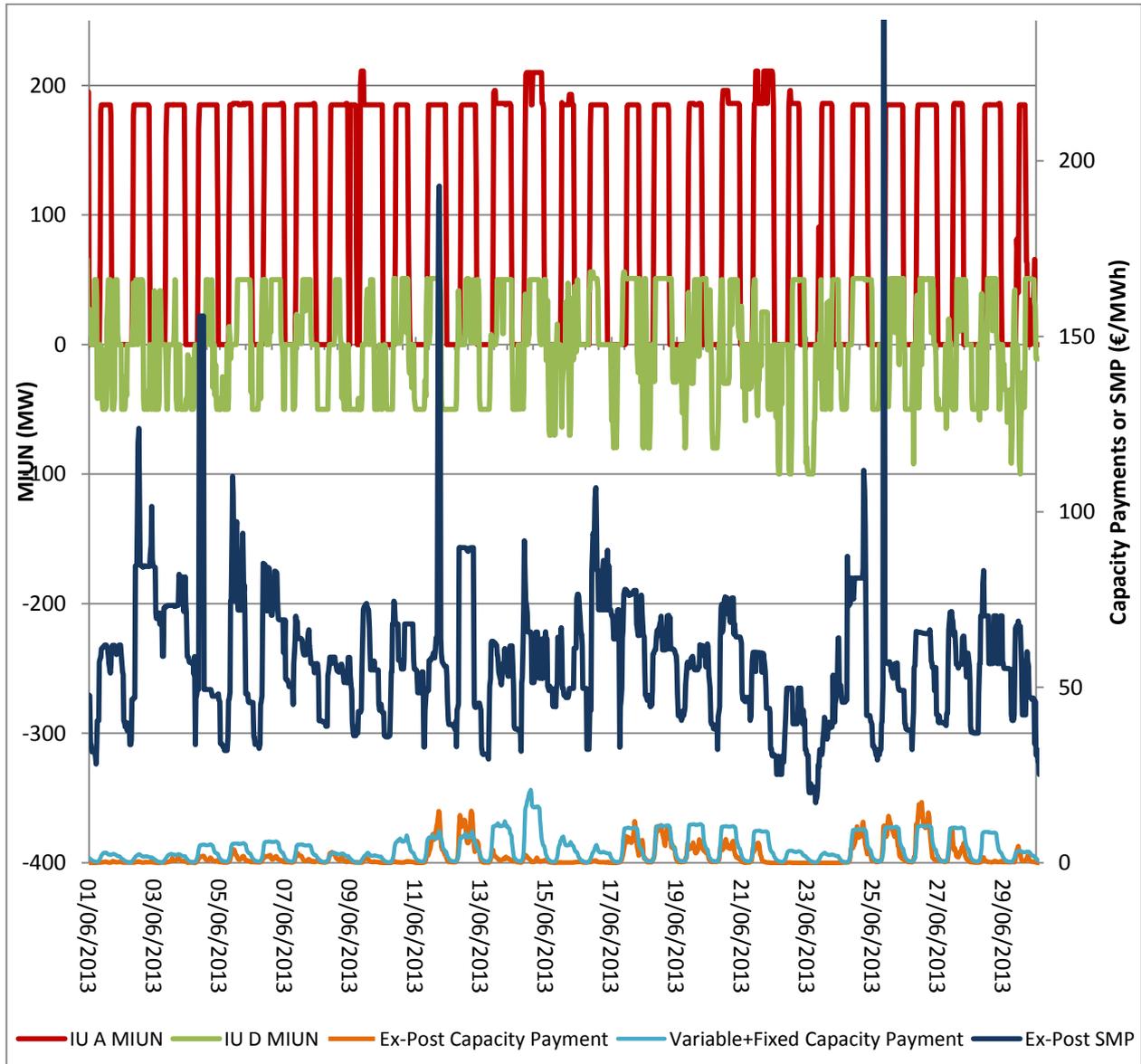
However, on May 16<sup>th</sup>, a large generator tripped in the morning and caused the margin to drop. This increase in LOLP drove the Ex-Post Capacity Payment higher than the Variable+Fixed portion (it was the only occasion that the Ex-Post Capacity Price rose above €20/MWh in this 2 month period). It could be said that the CPM was acting to reward those generators still available at this time of low margin.

Figure A3 shows Capacity Payment data for a one-year period from the beginning of July 2012 to the end of June 2013. From the figure, it is clear that while the Ex-post capacity price peak of 56 €/MWh on May 16<sup>th</sup> was high for the time of the year it was not a unique occurrence with similar peaks occurring in July

(64 €/MWh) and August (53 €/MWh) 2012. Figure A4 gives the forecast LOLP, out-turn LOLP and Margin for the same period.

Even though the Variable portion rose quite significantly on May 16<sup>th</sup>, there was no particular response from the Interconnector Users. Their nominations remained largely the same as before, i.e. they imported during the day, and exported or dropped to zero at night.

In Figure 3 below, it can be seen that one Interconnector User increased its export nomination on June 23<sup>rd</sup>. This is probably in response to the signals that were lowering the SMP, mainly by high wind. As it was night-time, the Capacity Payments were very low.

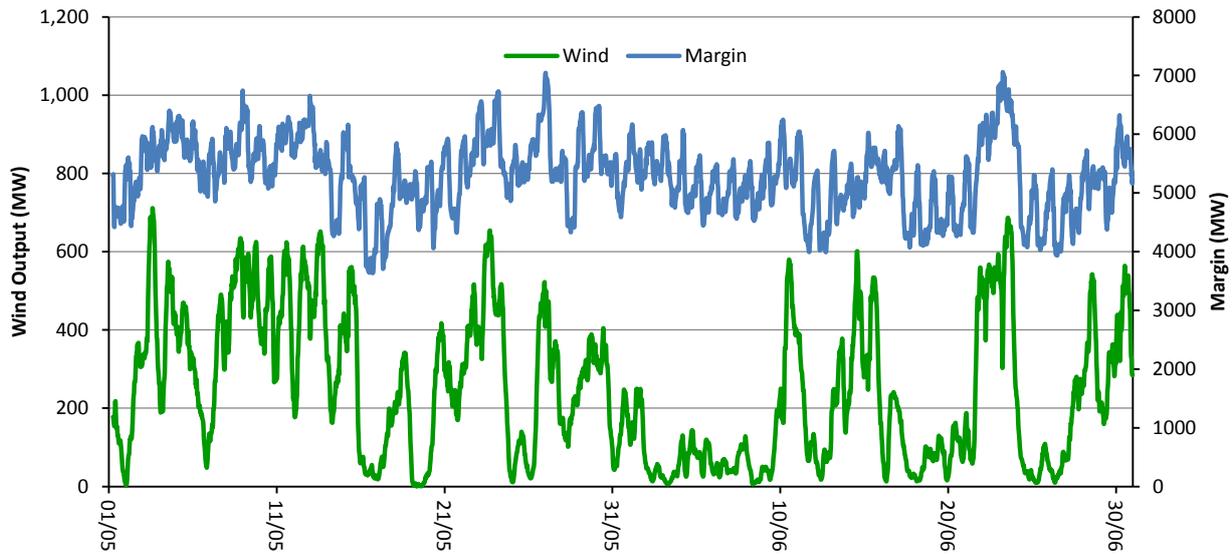


**Figure 3.** Nominations for Interconnector User A and D, Ex-post SMP, Ex-post and Variable+Fixed Capacity Payments for June 2013.

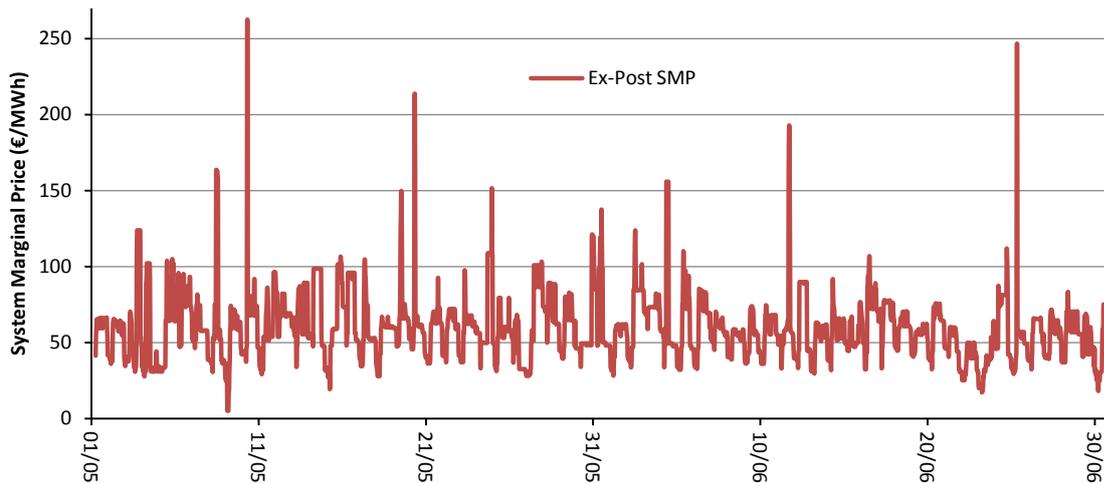
#### 4.5 Influence of Wind, Margin and SMP

Based on analysis of this limited dataset, it would seem that a dominant factor on interconnector trading is the System Marginal Price (SMP). The SMP itself varies with the margin of available generators over the demand (usually by a predictable daily and weekly pattern, and generator outages), and is influenced significantly by the amount of wind. When there is a lot of wind power on the system and the margin is greater, the SMP tends to decrease. When there is less wind, the SMP rises. Figure 4 gives half-hourly data of wind generation output and the system margin for the analysis period. Figure 5 shows the system

marginal price for the same period. All data in these figures are ex-post values. Note in particular the dip in SMP around June 23<sup>rd</sup>, coinciding with a period of high wind output.



**Figure 4.** Wind generation output and System Margin for May and June 2013



**Figure 5.** Ex-post System Marginal Price for May and June 2013

#### 4.6 Curtailment of wind

For the two month data period, data was gathered for the dispatch-down of wind generators<sup>3</sup>. As a rough estimate, the dispatch-down was considered to be curtailment for system security reasons when five or more regions were affected at the same time. Otherwise, a more isolated incident of dispatch-down would be considered as due to local transmission constraints.

For all the periods when wind was being curtailed in May and June 2013, the Ex-post Capacity Generation Price was very low, almost zero – this is explained by the fact that if wind is being curtailed, it's probably because there is more wind generation than can be accommodated on the system, and the margin is therefore quite high (and the LOLP very low), see Figure 6.

<sup>3</sup> Only information from variable price taking wind generation (VPTG) was available at this stage, which gives a good indication, though not incorporating all dispatch down.

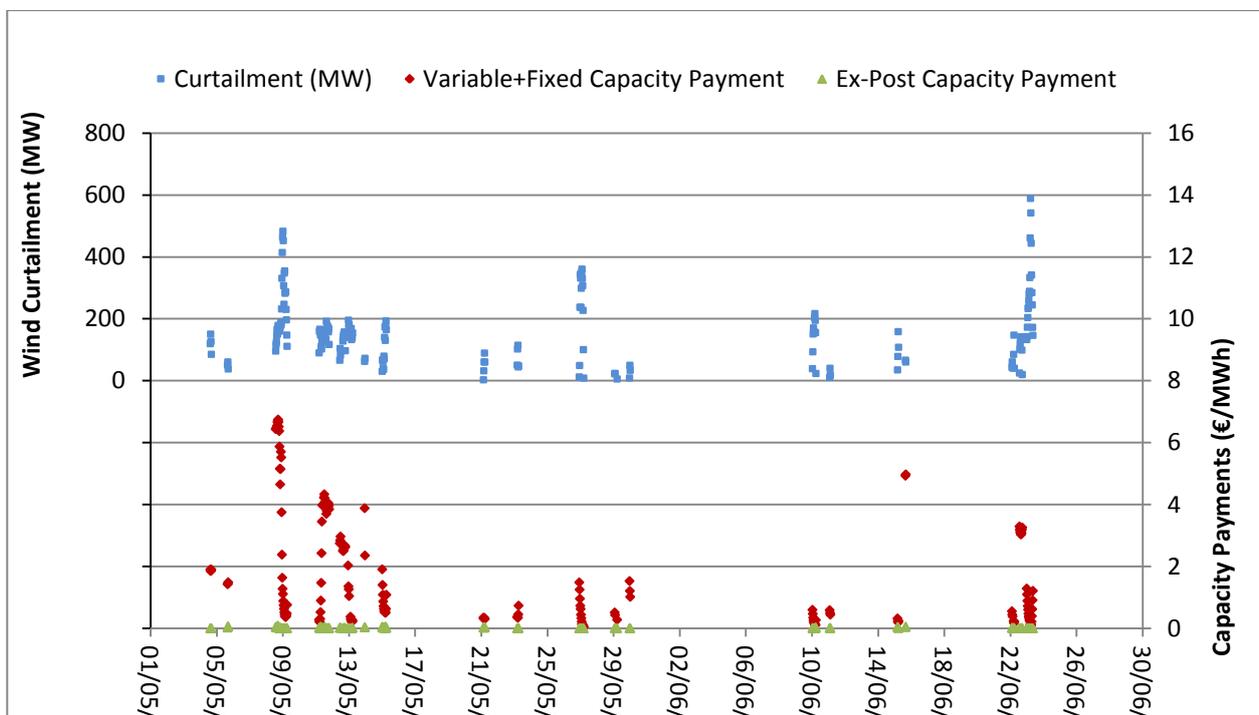
So in the case of wind curtailment, it would appear that changing the proportion of Ex-post Capacity Generation Price would have practically no effect. In other words, there would seem to be no clear evidence that the Ex-Post Capacity payment is producing perverse trading behaviour.

In fact, the signal from the Ex-post Capacity Generation Price is such that it is discouraging excessive margin when it is not needed – this is the correct signal in this case.

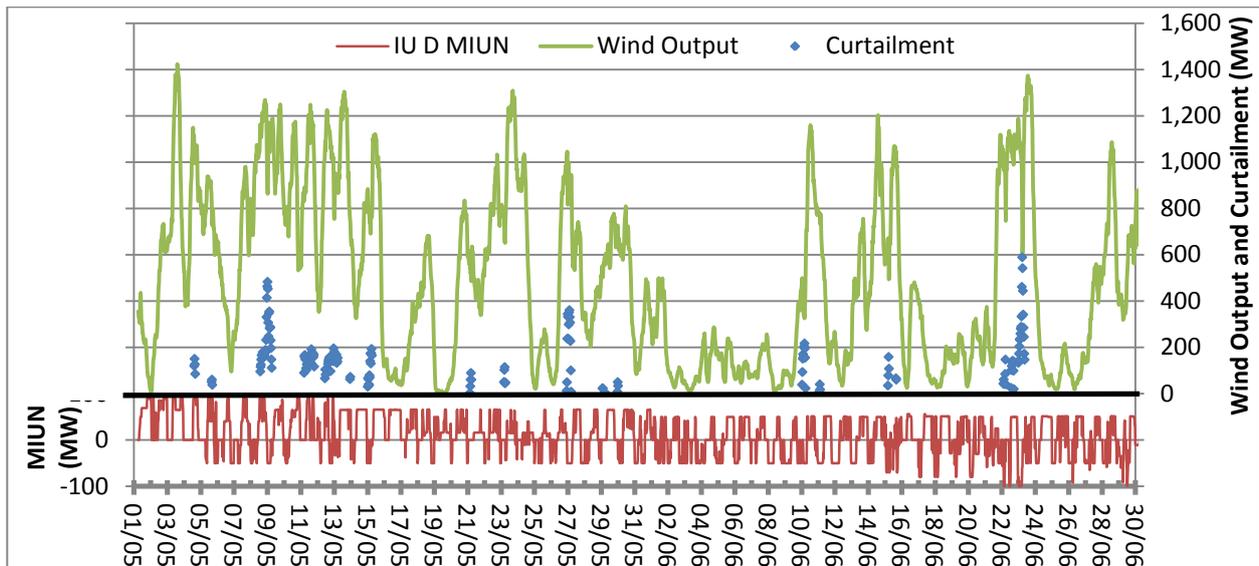
As for the sum of the other two payment portions, Variable+Fixed Capacity Generation Price never exceeds €7/MWh during the periods of wind curtailment, whereas the maximum over the 2 months for this combined price is €22/MWh. i.e. these payment portions have not been excessive at times of curtailment.

However, it's quite possible that this amount could be perceived as a barrier to trade at a time when wind is being curtailed. To mitigate this, it is worth considering what is the most appropriate way to reward capacity provided by the interconnectors. This could be taken into account in the design of the new Irish model for European Market Integration.

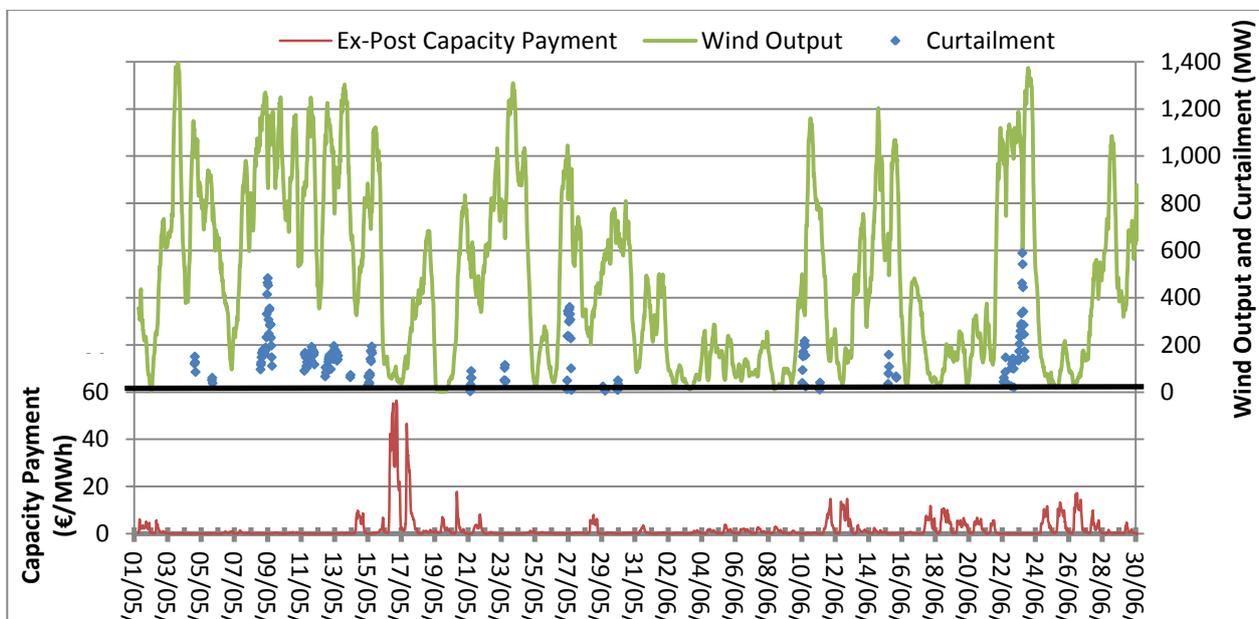
As we have already seen in Table 1 (correlations table), the wind forecast, and by extension the possibility of curtailment, does not tend to influence interconnector user nominations. In Figure 7 below, we can see curtailment happening at times of high wind output. Though on some occasions, notably 22-23 June, Interconnector User D nominated to export more, as previously discussed.



**Figure 6.** Wind Curtailment, plotted alongside the corresponding Capacity Payments.



**Figure 7.** Interconnector User D Nominations, total wind output and wind curtailment for May-June 2013.



**Figure 8.** Ex-Post Capacity Payments are generally low at times of high wind. Note the spike on May 16<sup>th</sup> happens at a time of low wind.

#### 4.7 Other Factors

While the above analysis would indicate that the overall Capacity Payment Mechanism is having some influence on interconnector trade, there are a number of other factors outside the scope of this short report that may strongly influence trading behaviour and should be considered (see for example McInerney and Bunn, 2013)<sup>4</sup>. Some of the main factors are discussed here.

One obvious factor is the BETTA price as an Interconnector User would usually consider the price spread. Many of the companies that are engaged in trading on the interconnector are active in both the SEM and BETTA. It would be difficult to make conclusions on the drivers of their trading behaviour without considering their business strategies in both markets. Interconnector Users may be trading to take advantage of arbitrage opportunities or for hedging purposes and their trading activity might exhibit very different characteristics depending on which is their main focus.

<sup>4</sup> C. McInerney and D. Bunn (2013), Valuation anomalies for interconnector transmission rights, *Energy Policy*, Volume 55, Pages 565-578.

Another aspect that needs to be considered is the Interconnector User's Active Capacity Holding (ACH). The availability of interconnector capacity for each Trading Period will impact on the Interconnector User's ability to adjust their nominations. The price paid for ACH on EWIC varies quite considerably with time of day and time of year. The price for ACH for export is usually close to or equal to zero.

## 5 Conclusion

From this limited dataset of only two months of EWIC operation it is difficult to conclude how an alteration to the relative proportions of the Capacity Payments would affect interconnector trading behaviour. This report uses data from just one season and the analysis could change in the winter months when the margins are generally tighter.

Examining the Modified Interconnector Unit Nomination profiles of the Interconnector Users, it appears that the nominations of two Interconnector Users in particular are correlated with Demand Forecast and Forecast LOLP, factors which influence the Fixed and Variable components of the Capacity Payment respectively.

There are a number of other factors outside the scope of this short report that may strongly influence Interconnector trading behaviour. These include the fact that many of the companies that are engaged in Interconnector trading are active in both the SEM and BETTA. It would be difficult to make conclusions on the drivers of their trading behaviour without considering their business strategies in both markets. Interconnector Users may be trading to take advantage of arbitrage opportunities or for hedging purposes and their trading activity might exhibit very different characteristics depending on which is their main focus.

Another aspect that needs to be considered is the Interconnector User's Active Capacity Holding (ACH). The availability of interconnector capacity for each Trading Period will impact on the Interconnector User's ability to adjust their nominations.

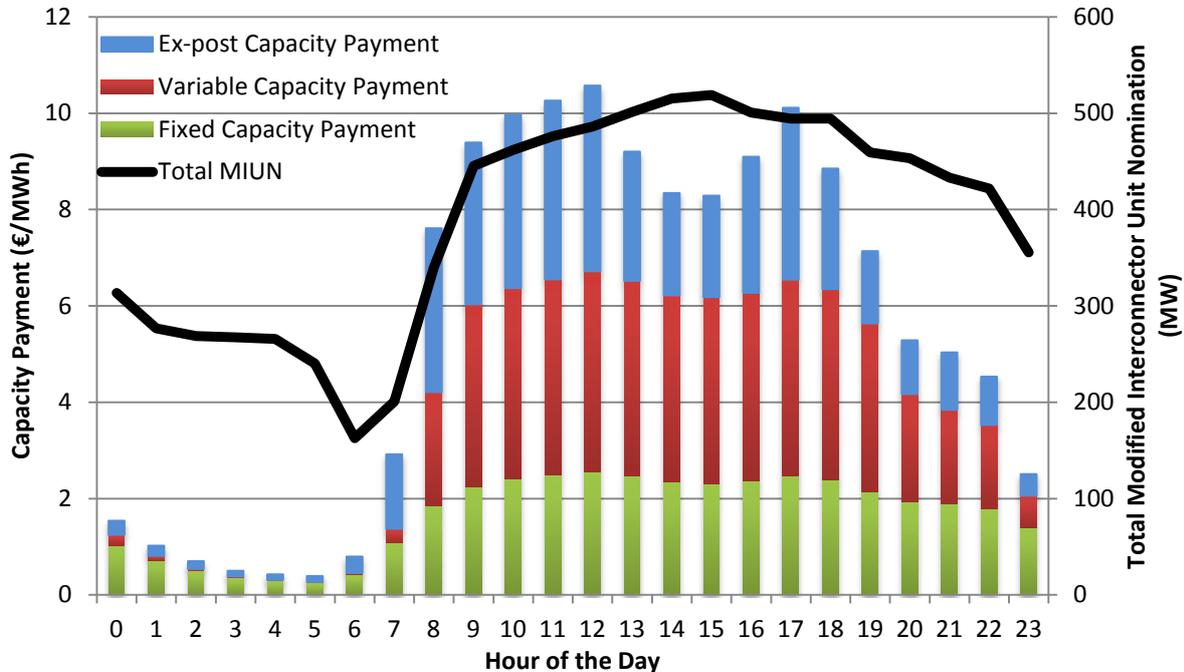
Unharmonised market rules between SEM (Energy and Capacity) and BETTA (Energy only) may result in Interconnector flows against the efficient price spread direction. The issue of what is the appropriate way of rewarding capacity that is provided by interconnection without influencing economic trading is worthy of further consideration. Eirgrid/SONI would recommend that this should be considered in the design of the new market arrangements for implementing the Target Model

For system security it is highly important that participants receive the right price signals to ensure availability at times of low margin. Considering this, firm evidence would be required before any change to the Capacity Payment proportions could be considered.

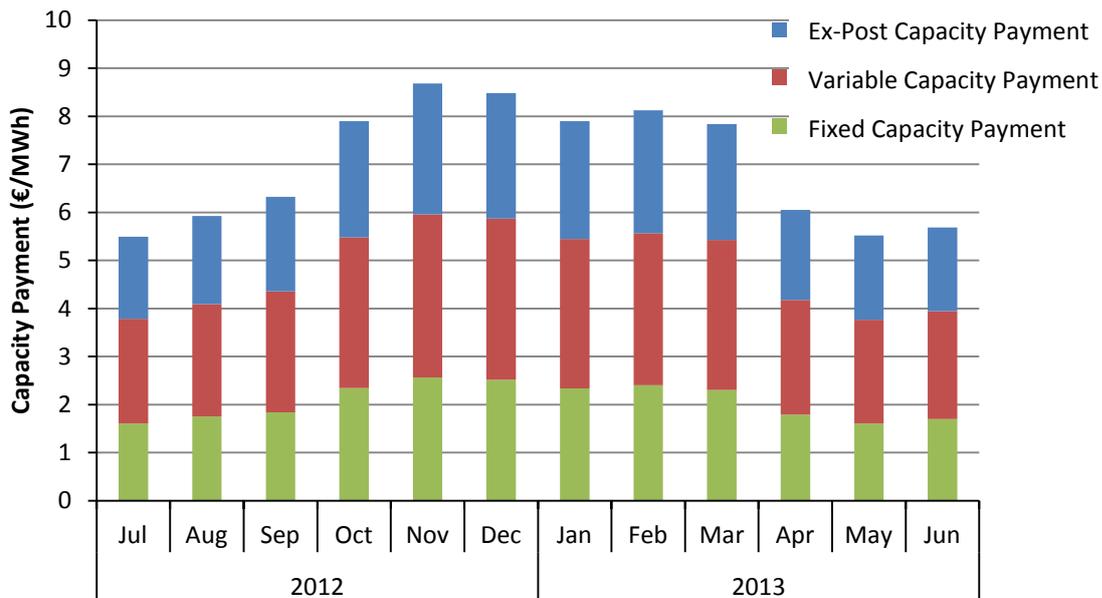
Changing the Ex-Post Capacity Payments Portion in an attempt to address a perceived issue with interconnector trading should not be considered without undertaking a comprehensive impact analysis. As is noted here, the ECPP provides an important investment signal. The signal applies to all generation on the island, not just to interconnector users.

## Appendix – Supplementary Charts

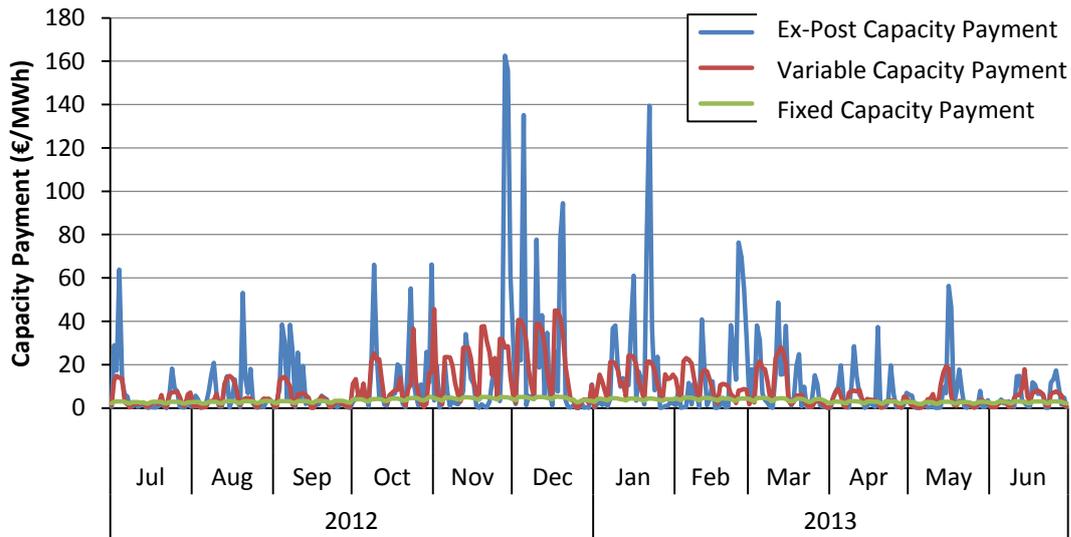
The first two figures in this appendix illustrate the daily and monthly variation in the Capacity Payment Generation Prices. Figure A3 gives the maximum daily values of Capacity Payment portions for a one year period from the beginning of July 2012 to the end of June 2013. The ex-post payment is the most volatile with the largest spikes during the high demand (lower margin) winter months. The figure illustrates that while the large peak in the middle of May 2013 was high for the time of year it was not a unique occurrence with similar spikes occurring in July and August 2012. Figure A4 gives maximum daily values of the Forecast LOLP, Ex-post LOLP and the minimum daily values of Ex-post Margin for the same period as above.



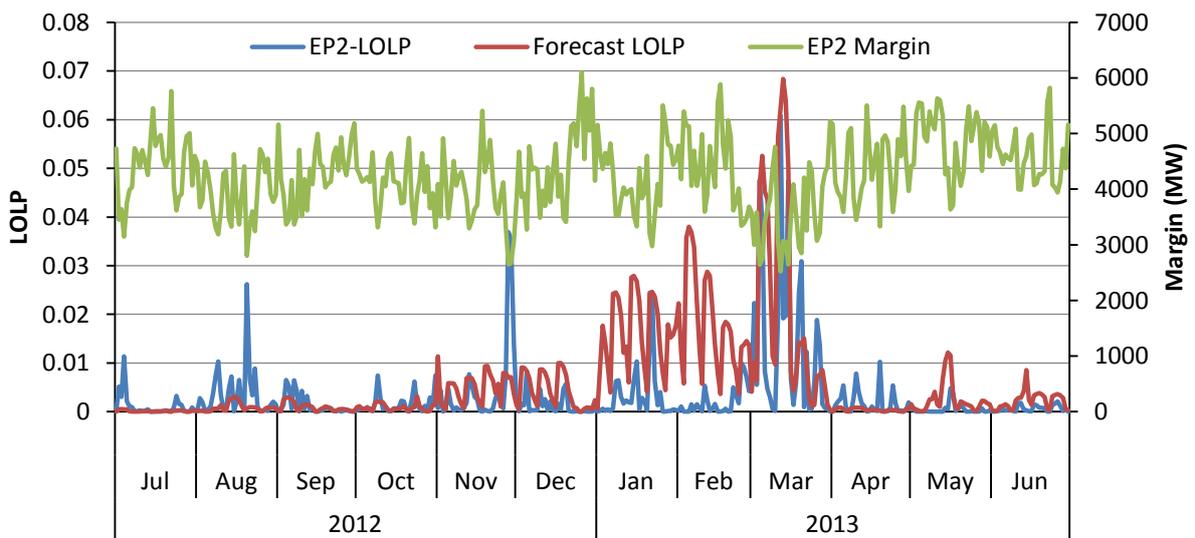
**Figure A1.** Hourly average Capacity Payment Generation Price using data from the months of May and June 2013, and the corresponding total of all the Interconnector Users' Nominations.



**Figure A2.** Monthly average Capacity Payment Generation Prices for a one year period from the beginning of July 2012 to the end of June 2013



**Figure A3.** Maximum daily values of the Capacity Payment portions for a one year period from the beginning of July 2012 to the end of June 2013



**Figure A4.** Maximum daily values of the Forecast LOLP, Ex-Post LOLP and the minimum daily values of Ex-Post Margin for a one year period from the beginning of July 2012 to the end of June 2013