Commission for Energy Regulation
An Coimisiún um Rialáil Fuinnimh

Utility Regulator
ELECTRICITY GAS WATER

Single Electricity Market

Constraints Analysis for 2013

Information Paper

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Contents

1. Introduction

This paper is an ex post report on constraint levels observed in the SEM for the calendar year 2013. Constraint payments are a result of the divergence of the market schedule from actual dispatch.

There is a difference between the market schedule and the real-time dispatch because system operators must dispatch the generator units in real time under additional constraints that are not considered by the SEM market engine. This could be for a number of reasons, including transmission constraints and the need to provide reserve on the network. Constraint payments serve to keep generators financially neutral as far as any difference between the market schedule and actual dispatch is concerned.

To balance supply and demand, generators being constrained down will always result in others being constrained up..Units constrained down will pay back a constraint payment and the corresponding units that are constrained up will receive a payment.

Constraints costs can be attributed to a number of factors. These include[1]:

- Transmission – The necessity to dispatch specific generators to attain certain levels, ensuring the prevention of equipment overloading, voltage limits being exceeded and system instability.
- Reserve – To ensure security of supply, TSOs instruct some generators to run at lower levels than would be warranted by their bid prices, so that there is always spare generation available. In the interests of demand and supply balancing, those generators constrained on will result in others being constrained off; leading to deviation from the market schedule
- Perfect Foresight – Since the market schedule is produced *ex post* and since it is this that is used for energy settlement, TSOs (operating the system in real time) do not have perfect foresight when it comes to generation of market schedule.
- Market Modelling Assumptions – The market schedule will not always be feasible since the modelling assumptions made by the market schedule software will not (necessarily) take into consideration a number of real-world parameters (such as the technical capabilities of the generators), and hence are bound by so-called technical realities implying that the market schedule and dispatch will differ, leading some

[1] More detailed information is contained within the following report produced by the TSOs EirGrid and SONI. [http://www.eirgrid.com/media/Final%20Presentation%2026.05.11.pdf]

generation plants being constrained on to generate at a level above its market schedule, while others will be constrained down below their market schedule.

The decision paper SEM-11-084[2], "Monitoring the Divergence of the Market Schedule from Dispatch and the Impact on Consumers" sets out four metrics to be monitored by the Single Electricity Market Committee (the SEM Committee)[3]. These are monitored for the purpose of assessing material harm that can be shown to impact negatively on the ability of the SEM Committee to meet its objectives in the context its overall strategic direction.

The four metrics adopted, and analysed in the following paper are as follows:

1. Constraint payments;
2. Proportion of energy payment attributable to constraints;
3. Infra-marginal rents earned through constraint payments, and
4. Constrained running.

This paper also sets out high-level findings of this monitoring as well as providing commentary on the trends and an indication of the main drivers behind each metric. The analysis for the first two metrics includes data from 2009 to 2013. Monthly data for 2013 is provided for all four metrics.

Further background information is available on the All Island Project website[4].

[2] http://www.allislandproject.org/en/renewable_current_consultations.aspx?article=892eca3b-6cc5-40cf-a6d8-71d64baba2f9

[3] The SEM Committee is established in Ireland Northern Ireland by virtue of section 8A of the Electricity Regulation Act 1999 and Article 6 (1) of the Electricity (Single Wholesale Market) (Northern Ireland) Order 2007 respectively. The SEM Committee is a Committee of both CER and the Utility Regulator (together the Regulation Authorities) that, on behalf of the Regulatory Authorities, takes any decision as to the exercise of the relevant function of CER or the Utility Regulator in relation to a SEM matter.

[4] http://www.allislandproject.org/en/renewable_current_consultations.aspx?article=892eca3b-6cc5-40cf-a6d8-71d64baba2f9

2. Metric 1 Constraint Payments

A Constraint Payment is made to a Generator when its Dispatch Production Cost differs from its Schedule Production Cost. Where a generator is constrained off such that its Dispatch Quantity is lower than its Market Schedule Quantity, it will receive energy payments for its Market Schedule Quantity and will pay back to the Market Operator a constrained off payment, based on the saving in cost between the dispatch quantity and the market schedule quantity. Where a generator is constrained on such that its Dispatch Quantity is higher than its Market Schedule Quantity, it will receive a constrained on payment from the Market Operator based on the cost of its additional production.

The total additional costs to the market of such constraints can be calculated using publicly available data from SEMO.

The Constraint Payment (CP_y) is calculated as follows:

$$\mathrm{CP}_y = \sum_{uh}^{y} \mathrm{CONP}_{uh}$$

Where

- $CONP_{uh}$ is the Constraint Payment payable to Generator Unit u for Trading Period h;
- $\sum_{uh}^{y}$ is the sum of all Generating Unities, u, in all trading periods in year y

Figure 1 below highlights the variability of constraint payments from 2009 to 2013. The total constraint payments for 2013 were close to €189m. This figure is an increase on 2012's total of close to €123m.

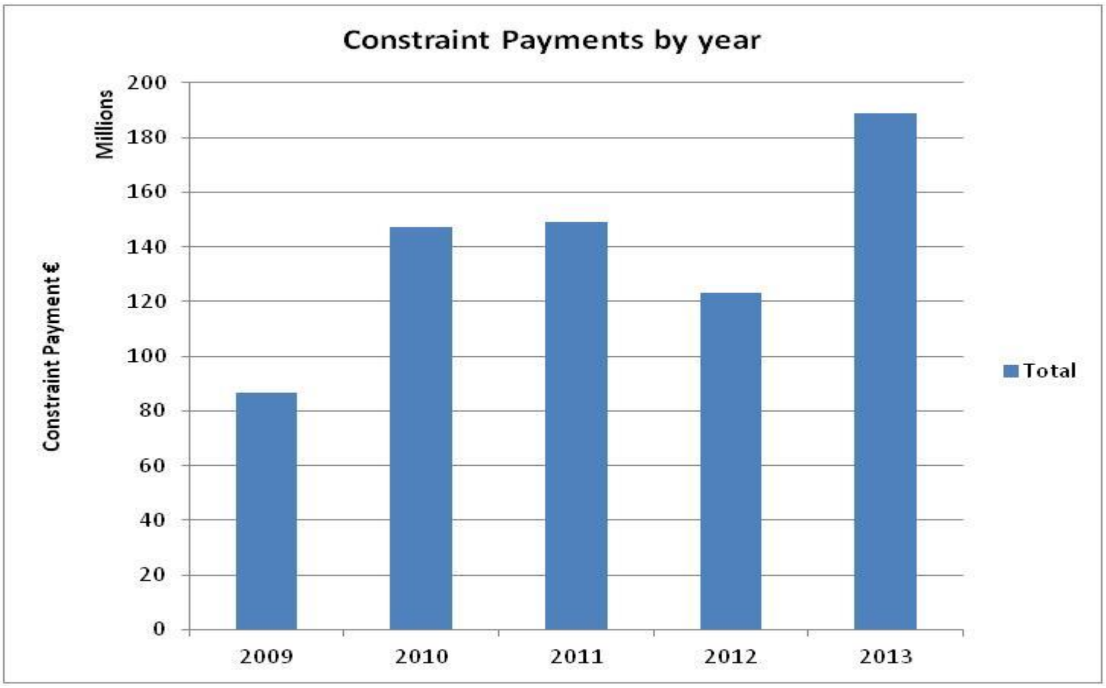


Figure 1: Metric 1 - Constraint payments 2009-2013

There are many variables that may affect the level of constraint payments including, fuel prices and the relative difference between different fuel prices of the marginal and infra-marginal generators. Other factors affecting constraint payments over the years include the level of demand, wind generation, availability of interconnectors and availability of flexible generation such as pumped storage. In the case of wind generation in 2013, December was a particularly high month for wind generation output, with nearly double the amount of wind generated in this period compared to 2012. High levels of wind can be correlated to the increase in constraint costs due to the notion of curtailment. When the synchronous non-synchronus penetration (SNSP) level reaches the maximum allowed 50%, the remaining "breached" level of wind is replaced by a generator plant being constrained on.

Figure 2 shows the monthly constraint payments in 2013. As can be seen, constraint payments in general were higher in 2013 than in 2012, notably during the months of March and December. Factors that have contributed to increased constraint payments throughout 2013 include:

- Transmission overruns in October and November contributed to higher levels of wind constraints being observed throughout these months.
- Outage of the north-South 275kV tie-line due to a suspected device contributed to higher constraint costs observed in November.
- Increasing bid costs for some generators due to the impact of gas capacity costs..
- Higher wholesale gas prices, in particular for March 2013.

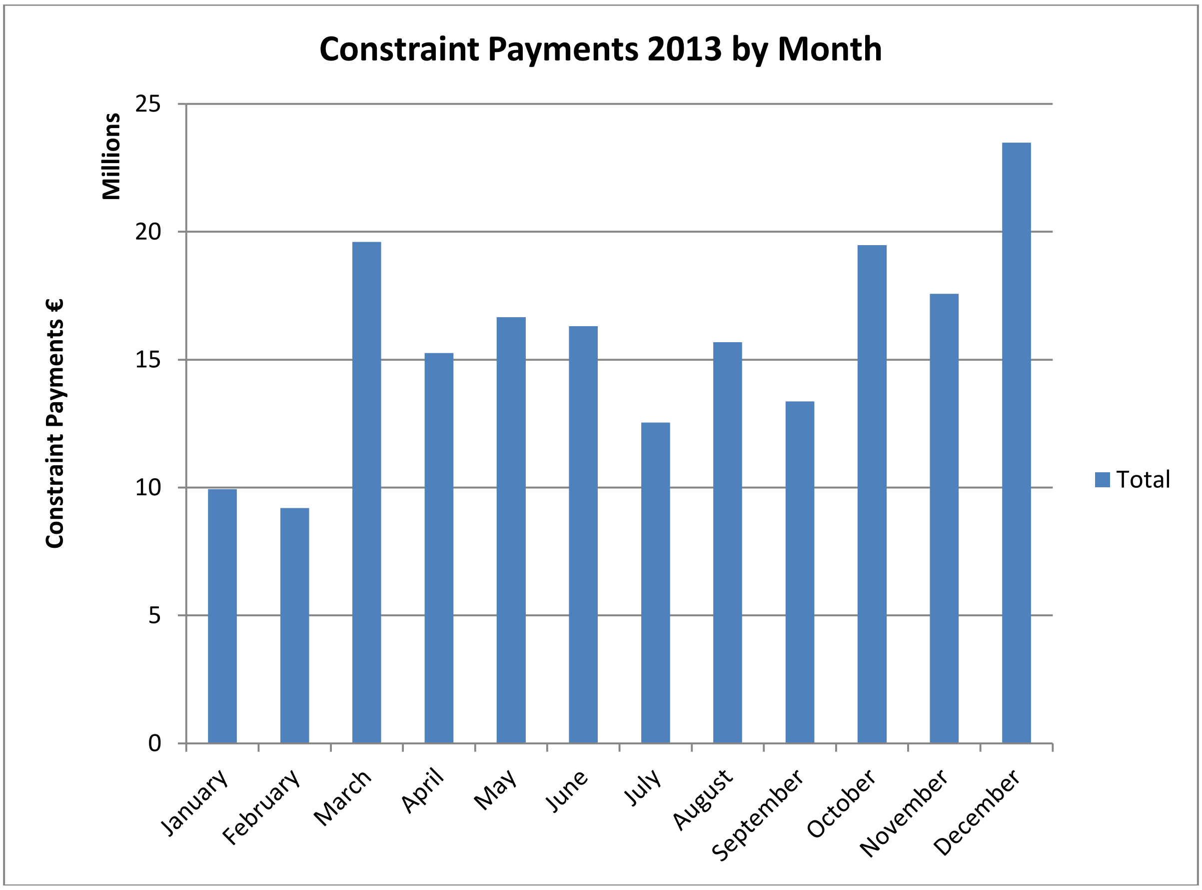


Figure 2: Metric 1 - Constraint payments 2012-2013

3. Metric 2 Proportion of Energy Payments attributable to Constraints

This metric measures constraints as a percentage of overall wholesale energy payments. Total suppliers costs are the cost to all suppliers of purchasing electricity at the trading point, which is subsequently passed on customers in NI and ROI i.e. it is the total energy cost (market schedule only) which will have to be paid for by end users.

The Proportion of Energy Payment Attributable to Constraints (PEPAC) is determined by the following formula:

$$PEPAC_y = \frac{\sum_{uh} CONP_{uh}}{\sum_{uh}(MSQ_u.SMP)_h}$$

Where

- $CONP_{uh}$ is the Constraint Payment payable to Generator Unit u for Trading Period h;
- MSQ_{uh} is the Market Schedule Quantity for Generator Unit u in Trading Period h;
- SMP_h is the System Marginal Price in Trading Period h; and

  $\sum_{uh}^{y}$ is the sum of all Generating Unities, u, in all trading periods in the year y.

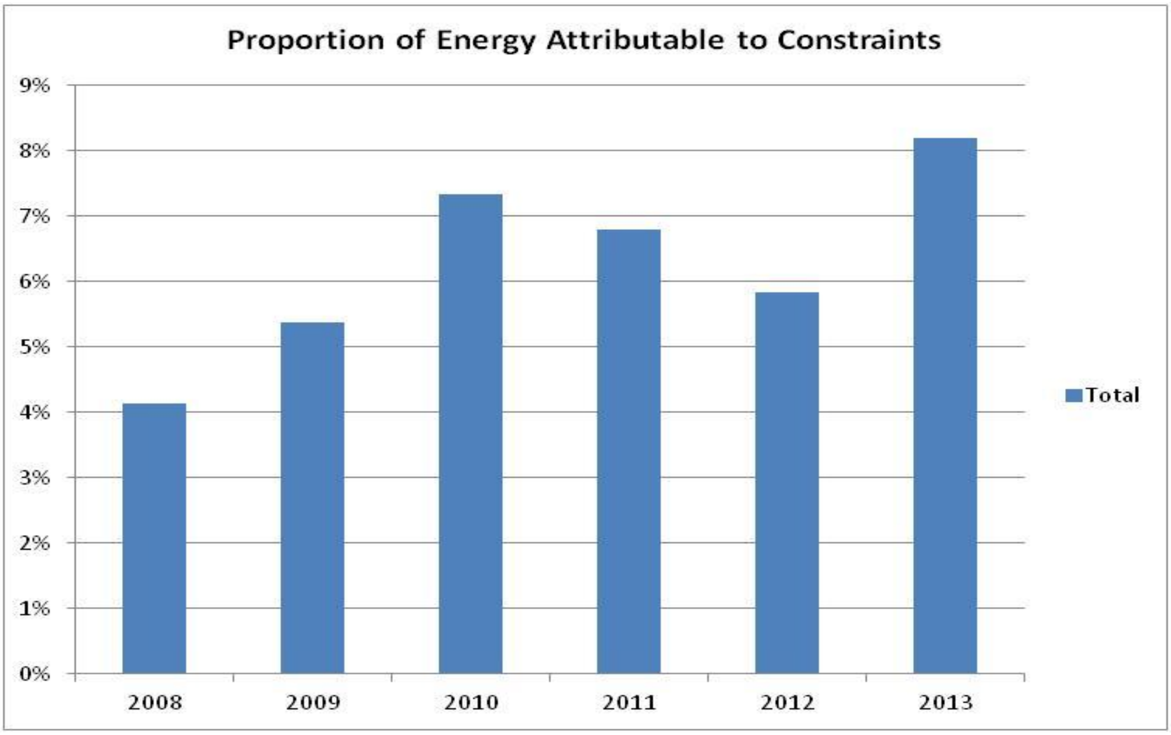


Figure 3: Metric 2 - Proportion of energy payments attributable to constraints 2008-2013

Figure 3 highlights a general increasing trend in the proportion of energy payments attributable to constraints between 2008 and 2010, with a decreasing trend from 2010 to 2012. An increase was then observed in 2013. This was due factors which are highlighted in the previous section.

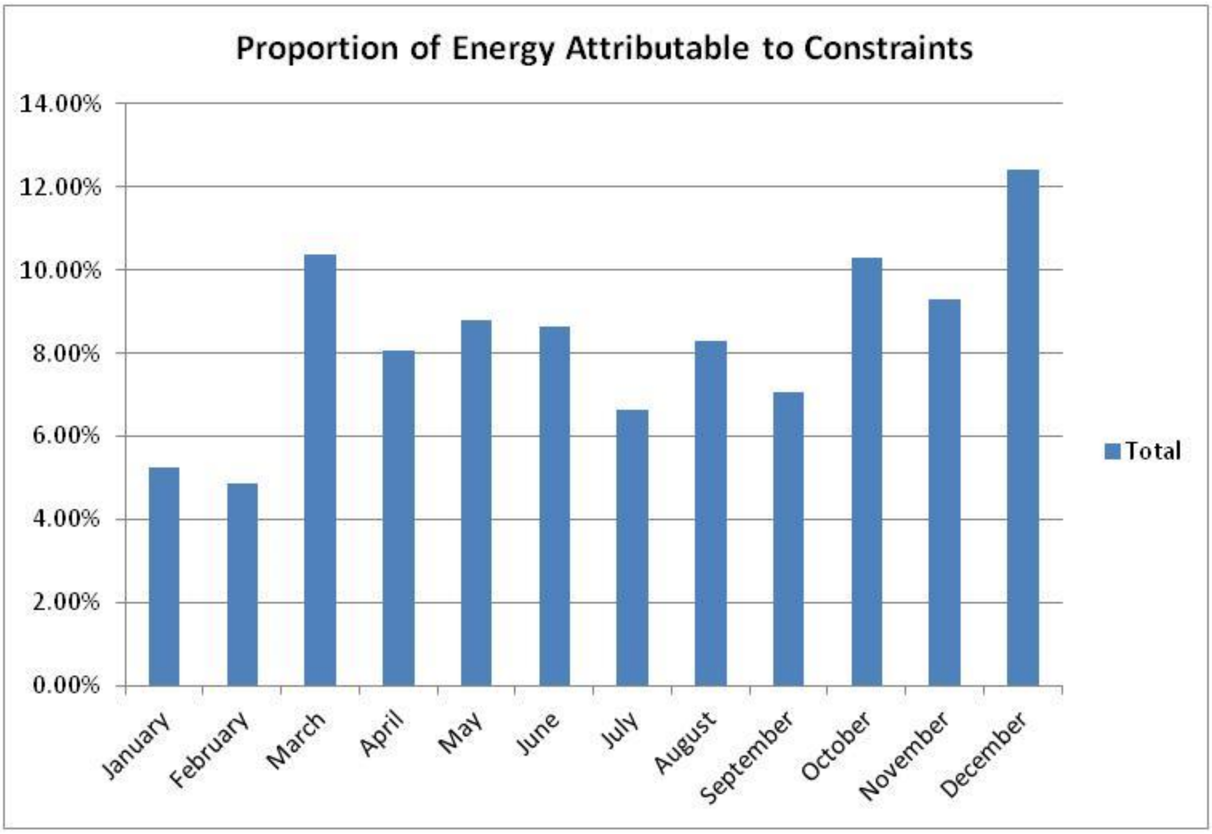


Figure 4: Metric 2 – Proportion of energy payments attributable to constraints 2013

Figure 4 also shows that the results for Metric 2 follow a similar pattern to those for Metric 1 (Figure 2). Although there are some differences, such as a decreasing trend from September onwards as energy payments are increased due to the rise in demand (while constraint payments remain more stable over this time period). Overall the drivers for Metric 2 are similar to those for Metric 1.

In March 2013 a high proportion of energy attributable to constraints was observed. This appears to have been driven by exceptionally high gas prices during this month, which were driven by pipeline issues in Britain.

4. Metric 3 Infra Marginal Rent as a result of being Constrained Off

When a generator is constrained off it will pay back to the market operator the savings in cost between the dispatch quantity and the market schedule quantity. In this case, it retains any difference between the SMP and the costs which would have been incurred to deliver its Market Schedule (referred to as Infra-marginal rent).

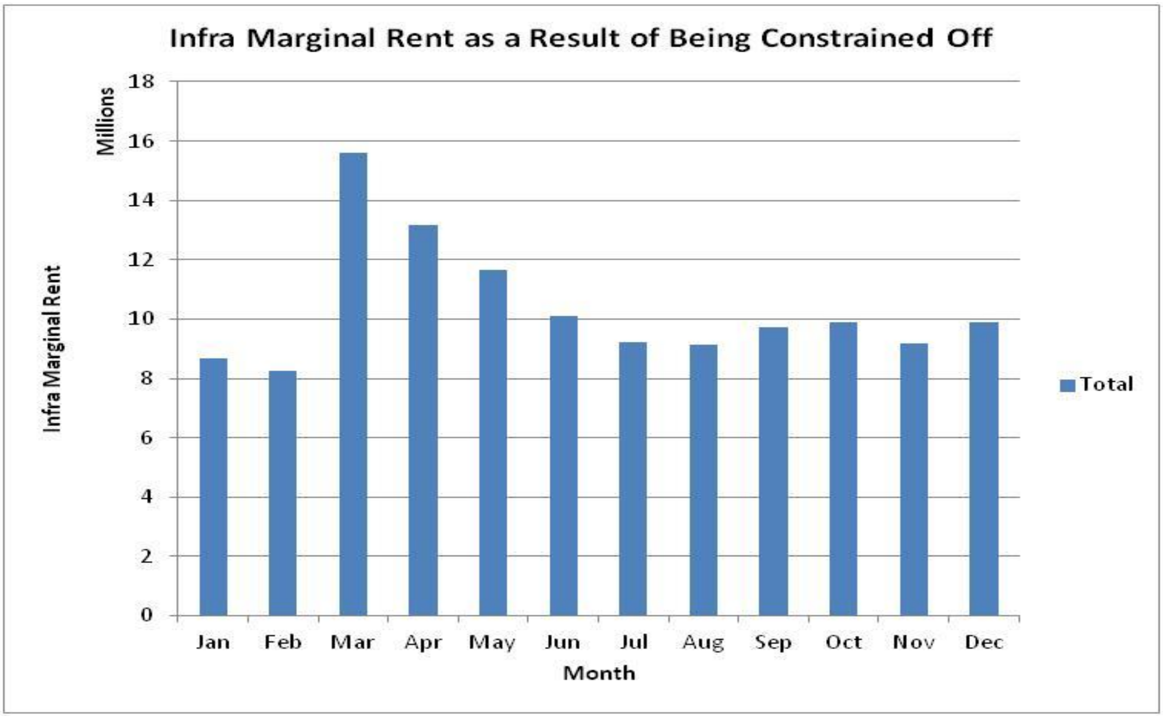
This performance indicator therefore represents an indication of how the market rewards generation that is not run as well as showing the effect of divergence from the market schedule.

Infra-marginal rent as a result of being constrained off is calculated using the following formula:

$$\mathrm{IMR}_y = \sum_{uh-CTO}^{y} [(\mathrm{MSQ}_{uh} * \mathrm{SMP}_h) - (\mathrm{GenCosts}_{uh} + \mathrm{StartupCosts})]$$

Where

- MSQ_{uh} is the Market Schedule Quantity for Generator Unit u in Trading Period h;
- SMP_h is the System Marginal Price in Trading Period h;
- Generation and Start up costs cannot be easily defined by an equation. These variables are derived from the Generators Commercial and Technical offers which are published on SEMO website as all the other variables used in this paper (http://www.sem-o.com/marketdata);
- $\sum_{uh-CTO}^{y}$ Is the sum of all Generating Unities, u, in all trading periods in the year y which are constrained off in the period h.



Infra-marginal rent as a result of being constraint off 2013

Figure 5 shows infra marginal rent as a result of being constrained off in 2013. Between January and June there is no clear trend, with relatively significant month on month variations occurring during this period. In March, infra-marginal rent as a result of being constrained off is particularly high. This was primarily due to the impact of high gas prices during this period.

From July through to December less volatility has been observed. A slight increase was exhibited, but overall the remainder of the year displayed a constant trend-line. In comparison to 2012's figures, the highest month in terms of cost was June (€13m), in 2013 this figure dropped to €10m. Incidentally, June 2012 was a peak value; whereas in 2013 this is clearly March's figure of just under €16m.

5. Metric 4 Constrained Running by Volume (Divergence)

This metric shows how energy volumes differ as a result of deviation from the market schedule. The performance indicator would represent the proportion of energy in the market that has been constrained on-or-off to meet demand at the market level. All data required to calculate this information is publicly available from SEMO.

The divergence between the market schedule and dispatch schedule reflects the volume of constrained running in the market. The Constrained Running by Volume (CRV) variable was determined in accordance with the following formula.

$$\mathrm{CRV}_y = \frac{\sum_{uh-CTO}^{y}\left[\max(\mathrm{MSQ}_{uh} - \mathrm{DQ}_{uh}, 0) + \max(\mathrm{DQ}_{uh} - \mathrm{MSQ}_{uh}, 0)\right]}{\sum_{uh}^{y}\mathrm{DQ}_{uh}}$$

Where

- MSQ_{uh} is the Market Schedule Quantity for Generator Unit u in Trading Period h;
- DQ_{uh} is the Dispatched Quantity for Generator Unit u in Trading Period h;
- $\sum_{uh}^{y}$ is the sum of all Generating Unities, u, in all trading periods in the year y

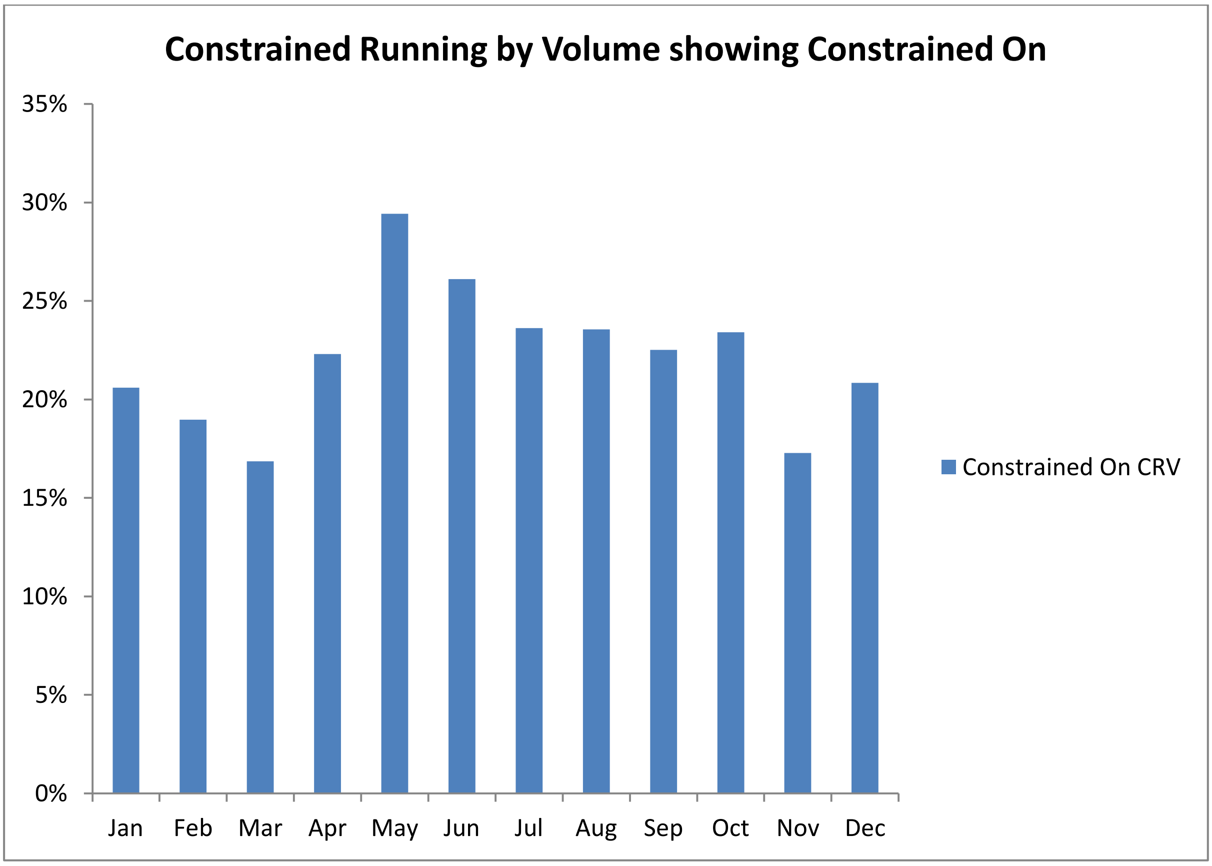


Figure 8: Metric 4 – Constrained running by volume (Divergence)

Figure 8 shows the constrained on values by month. A consequential action is that there are corresponding amounts constrained off. On average for the year 2013, the dispatch quantity deviates from the market schedule by roughly +20%. In comparison to 2012, the average for the year was similar but the graph shows much more volatility in and around the mean value. In 2013, the maximum (minimum) are greater (smaller) but the mean divergence is roughly the same overall (40%).

Although overall there is no strong trend, the divergence is in general higher during the summer months when demand is lower and the number of generator scheduled outages is greater.

6. Conclusion

The variation in these metrics is driven by changes to a number of drivers. Overall there does not appear to be any strong or consistent trend. However the general rise in constraint payments in 2013 compared to 2012 is noted and will be closely monitored in the lead up to the 2014 assessment.

A further high level assessment will be published for subsequent years.