Annual Wind Constraint and Curtailment Report 2013

Contents

Executive Summary

The EU Renewable Energy Directive (2009/28/EC) sets a target for Ireland to meet 16% of the country's total energy consumption from renewable energy sources by 2020. In order to achieve this target, the Government set a 10% renewable transport target, a 12% renewable heat target and a 40% renewable electricity target. Similarly in Northern Ireland, the Department of Enterprise, Trade and Investment (DETI) published the Strategic Energy Framework (SEF) in September 2010 that set out a 40% renewable electricity target to be reached by 2020. The Transmission System Operators for Ireland and Northern Ireland, EirGrid and SONI respectively, are actively working towards facilitating the governments' renewable electricity targets.

The Renewable Energy Directive requires Transmission System Operators (TSOs) to prioritise renewable energy generation, and where measures are taken to turn-off or dispatch-down renewable energy for system security reasons, the TSOs must report to the regulatory authorities on those measures and indicate which corrective measures they intend to take in order to prevent inappropriate dispatching-down.

Dispatch-down of wind energy refers to the amount of wind energy that is available but cannot be produced because of power system limitations, known as curtailment, or network limitations, known as constraints.

EirGrid and SONI have prepared this report on the dispatch-down of wind energy in 2013, as required under European and Member State legislation.

In 2013, the total wind energy generated in Ireland and Northern Ireland was 5,872 GWh, while an estimated 196 GWh of wind energy was dispatched-down. This represents 3.2% of the total available wind energy in 2013, and is an increase of about 86 GWh on the 2012 figure. However, it should be noted that the 2013 figure includes 12 GWh of dispatch-down of autonomous wind generation in Northern Ireland in 2013; this data was not recorded in previous years.

In Ireland, the dispatch-down energy from wind resources was 171 GWh: this is equivalent to 3.5% of the total available wind energy. The dispatch-down energy from variable price-taking generation (VPTG) was 118 GWh, and from autonomous generation was 53 GWh.

In Northern Ireland, the dispatch-down energy from wind resources was 24 GWh, up from 7.2 GWh in 2012: this is equivalent to 1.9% of the total available wind energy. The dispatch-down energy from variable price-taking generation (VPTG) was 12 GWh, and from autonomous generation was 12 GWh.

The level of dispatch-down is affected by a number of factors which vary from year to year. The amount of wind installed on the system and the capacity factor of the wind generation will have an impact on the levels of dispatch-down. The total capacity of wind generation rose by 200 MW in 2013 while the average capacity factor was 30.6%. In 2012 the average capacity factor was 28.5%.

The level of demand is another important factor which can vary from year to year. However, the year-on-year changes were relatively small, with average demand in Ireland in 2013 just 0.4% higher than in 2012 and in Northern Ireland it was 0.1% higher than in 2012.

While the principle benefits of the Moyle and East West interconnectors are in reducing the price of electricity in Single Electricity Market and in improving security of supply, they can also facilitate the reduction of wind curtailment through the use of System Operator trades directly with National Grid Electricity Transmission or through EirGrid's trading partner in Great Britain. This was largely evident in the case of the East West Interconnector which went into partial commercial operation in December 2012 and full commercial operation in May 2013. As a result of counter-trading, wind curtailment was reduced by 194 GWh in 2013[1]. To put this into context, the total wind dispatch-down volume on the island was 196 GWh in 2013, i.e. wind dispatch-down, which would otherwise have been 390 GWh, was reduced by almost 50% due to interconnector System Operator trading.

The fundamental issues which give rise to curtailment are being addressed by EirGrid's DS3 programme (Delivering a Secure, Sustainable Electricity System). This programme has been specifically designed to ensure that the power system can be operated securely and efficiently with the increased levels of renewable generation necessary to meet governments' targets and also address other system wide limitations. This programme of work is based on the published Facilitation of Renewables studies.

In order to address the network limitations which give rise to constraint of wind energy, the Grid25 programme was developed in Ireland and a similar programme is under development in Northern Ireland. The reinforcement of the network will increase the capacity of wind generation which can be accommodated. However, it should be noted that connections of new wind-farms to the network and general network improvement works necessary to provide priority dispatch can require temporary outages of transmission equipment which can lead to reduced network capacity and consequentially increased levels of dispatch-down in the short-term.

[1] 96% of this volume was traded on EWIC and 4% on the Moyle.

1. Introduction

1.1 Context

Under the 2009 European Renewables Directive (2009/28/EC) there is an onus on Member States to ensure that if significant measures are taken to curtail renewable energy sources in order to guarantee the security of the national electricity system and security of energy supply, the responsible System Operators report to the Regulatory Authorities, CER and URegNI, on those measures and indicate which corrective measures they intend to take in order to prevent inappropriate curtailments. This Directive was transposed into law in Ireland as S.I. No. 147 of 2011 and in Northern Ireland through the Electricity (Priority Dispatch) Regulations No. 385 of 2012. The Single Electricity Market (SEM) Committee, in its scheduling and dispatch decision paper SEM-11-062, requires that the TSOs (Transmission System Operators) report on this as appropriate to CER and URegNI, respectively. This report represents EirGrid and SONI's response to these obligations.

1.2 Reasons for Dispatch-Down

Renewable generation has priority dispatch. However, there will be times when it is not possible to accommodate all priority dispatch generation while maintaining the safe, secure operation of the power system. Security-based limits have to be imposed, due to both local network and system-wide security issues. It is therefore necessary to reduce the output of renewable generators below their maximum available level on occasions when these security limits are reached. This reduction is referred to in this report as "dispatch-down" of renewable generation and is consistent with the principle of priority dispatch.

There are two reasons for the dispatch-down of wind energy, curtailment and constraint. Curtailment refers to the dispatch-down of wind for system-wide reasons (where the reduction of any or all wind generators would alleviate the problem), whereas constraint refers to the dispatch-down of wind generation for more localised network reasons (where only a subset of wind generators can contribute to alleviating the problem).

1.3 Data Gathering

The SEM is the preferred source of data due to the reliability and accessibility of the data by all stakeholders. This adds to the transparency of the calculations as they can be readily verified. However, this source is only available for windfarms that are registered in the market as Variable Price Taking Generators (VPTGs).

Since there are no appropriate SEM data to calculate dispatch-down of autonomous generation, this had to be estimated manually using aggregate SCADA data (which is less accurate than the data for VPTGs). It was estimated that the dispatch-down energy from autonomous windfarms in Ireland and Northern Ireland was approximately 65 GWh for 2013.

Furthermore, due to the differences in the IT systems used in Ireland and Northern Ireland, it was not possible to log all of the categories for the reasons for constraint or curtailment of wind energy in both

jurisdictions. This capability has become available in the new All-Island Wind Dispatch Tool which went live in Quarter 2, 2014. It will take a few months to ensure the system is working correctly so it is expected that the first reports based on this will be available at the start of 2015 at the earliest. This will be the enduring solution going forward. In the meantime the TSOs intend to provide information based on estimates from the data available.

2. Level of Dispatch-Down Energy in 2013

The following provides a summary of the dispatch-down of wind energy in 2013 for Ireland and Northern Ireland. More details and figures are provided in Appendix A.

2.1 All Island

In the calendar year 2013, the share of centrally dispatched generation[2] from renewable sources in Ireland and Northern Ireland was 17.8%, with 16.1% provided by wind, 1.5% by hydro and 0.2% by renewable waste energy. The total wind energy generated was 5,872 GWh in Ireland and Northern Ireland. There was an estimated total of 196 GWh of dispatch-down energy of windfarms, which is an increase of approximately 86 GWh compared to 2012. The level of dispatch-down of wind represents just over 3.2% of total available energy from wind resources in Ireland and Northern Ireland. Details of the calculation methodology are provided in Appendix B.

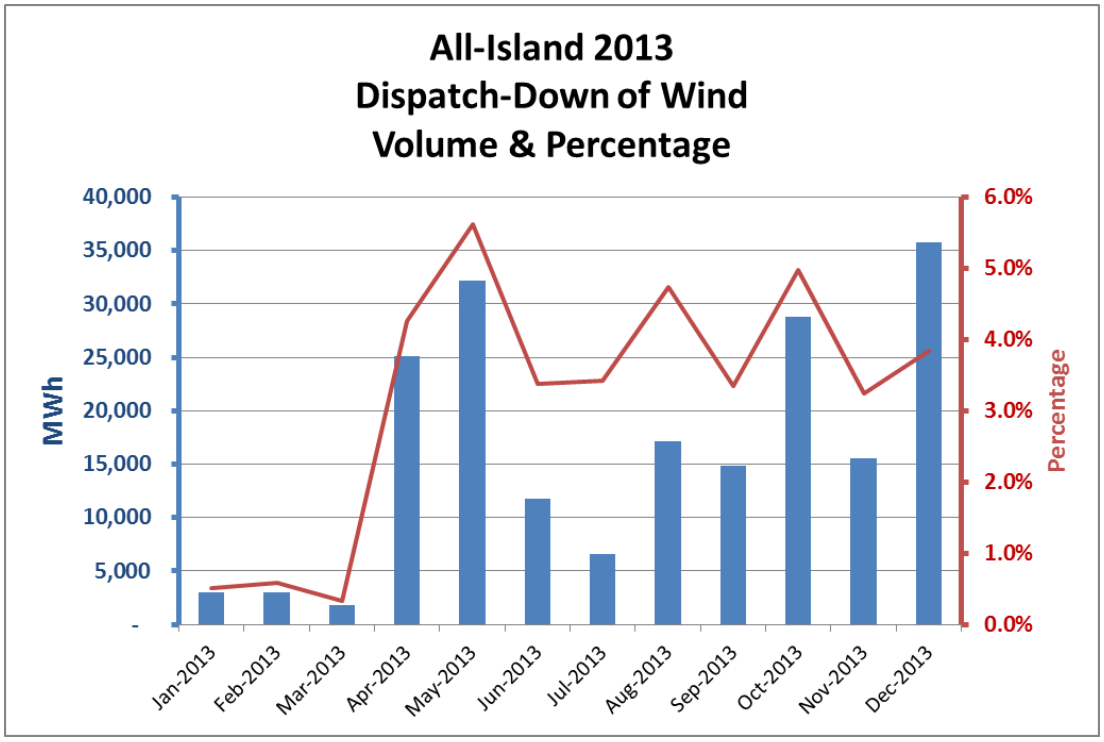

Figure 1: Monthly Variations in Wind Dispatch-Down Levels in 2013

[2] Note that since the percentage figures are presented for centrally dispatched generation (based on SCADA data), they do not account for non-dispatchable embedded renewable generation, which includes biomass, land-fill gas and small-scale hydro.

Figure 1 shows the monthly variation in dispatch-down levels on the island.

2.2 Northern Ireland

In 2013 the total dispatch-down energy from wind generation in Northern Ireland was 24 GWh; this is equivalent to 1.9% of total available wind energy in that jurisdiction. This is a total overall increase of approximately 17 GWh in dispatch-down energy from wind generation compared to 2012.

This dispatch-down was spread across variable price taking wind generation (VPTG) and autonomous generation. The dispatch-down energy from VPTG was 12 GWh in Northern Ireland. This represents 1.5% of the available energy from these generators in this period. In addition, there was an estimated 12 GWh of dispatch-down from other controllable wind generation. However, dispatch-down of autonomous generation in Northern Ireland was not recorded in 2012.

At end of 2013, VPTGs constituted 65% of all wind capacity in Northern Ireland. The dispatch-down of VPTGs occurred across 13 windfarms which had a total registered capacity of approximately 358 MW by the end of 2013.

2.3 Ireland

In 2013 the total dispatch-down energy from wind generation in Ireland was 171 GWh; this is equivalent to 3.5% of total available wind energy in Ireland. This is a total overall increase of approximately 68 GWh in dispatch-down energy from wind generation compared to 2012 and an increase of 65 GWh compared to 2011.

This dispatch-down was spread across variable price taking wind generation (VPTG) and autonomous generation. The dispatch-down energy from VPTG was 118 GWh in Ireland. This represents 4.3% of the available energy from these generators in this period. In addition, there was an estimated 53 GWh of dispatch-down from other controllable wind generation. At end of 2013, VPTGs constituted 53% of all wind capacity in Ireland.

The dispatch-down of VPTGs occurred across 33 windfarms which had a total registered capacity of approximately 1,002 MW by the end of 2013.

While it is difficult to assign dispatch-down to local network (“constraint”) and system-wide (“curtailment”) reasons distinctly and unequivocally, two major constraint areas are identifiable: the north-west and the south-west of Ireland. In addition, curtailment is seen to arise mainly during the night time hours (between 11pm and 9am).

3 Contributory Factors for Dispatch-Down of Wind

3.1 Changes to Operational Dispatch Policy

Prior to the SEM-11-062 decision paper, the operational policy in use was to dispatch-down variable price-taking generation before autonomous units. This policy was developed in 2008 to provide clarity on operational practice and reflect the more onerous commercial implications of dispatch-down that existed for autonomous units. Since the introduction of SEM-11-062, there is a requirement to dispatch wind generators down based on their controllability, as defined under Grid Code and as verified through performance monitoring and testing. The implementation of this is described in an operational policy document entitled "Policy for Implementing Scheduling and Dispatch Decisions SEM-11-062" and the associated addendum.

As a result of this SEM-11-062 decision paper, this report accounts for the dispatch-down of both variable price taking wind generation (VPTG) and autonomous wind generation. In the SEM, VPTG units have availability values that are distinct from dispatch quantities and actual output; this allows the dispatch-down of these units to be calculated. In contrast, autonomous units have their dispatch and availability quantities set to the metered outputs. There is no mechanism from SEM data to calculate the dispatch-down of these windfarms. Some estimation for Ireland generators has been provided in this report and this broad area is being examined.

3.2 Level of Wind

As explained in section 1.2, it is necessary, at times, to limit the maximum level of wind generation on the system for security or safety reasons. The impact of these limits on the level of dispatch-down will depend, ceteris paribus, on two factors: the amount of wind generation installed, and the capacity factor of the wind generation.

In January 2013 the total registered capacity of wind generation on the island was 2,208 MW. By year-end, the figure had risen to 2,564 MW (2,033 MW in Ireland and 531 MW in Northern Ireland). Figure 2 shows the increase in capacity throughout 2013. Of this total capacity, almost 1,360 MW was registered in the SEM as Variable Price Taker Generators (VPTG).

Over the year the capacity factor[3] of windfarms was 30.6%. For comparison the annual capacity factor in 2012 was 28.5% and in 2011 it was 31%. The seasonal variation in the capacity factor is evident in figure 3. The capacity factor for the six months between June and November was 22.7% while for the remaining six months (January to May and December) it was 38.6%.

[3] The capacity factor is the amount of energy produced (MW output) relative to the theoretical maximum that could have been produced if the wind generation operated at full capacity. It therefore represents the average output of the wind generation. This capacity factor is based on SCADA data.

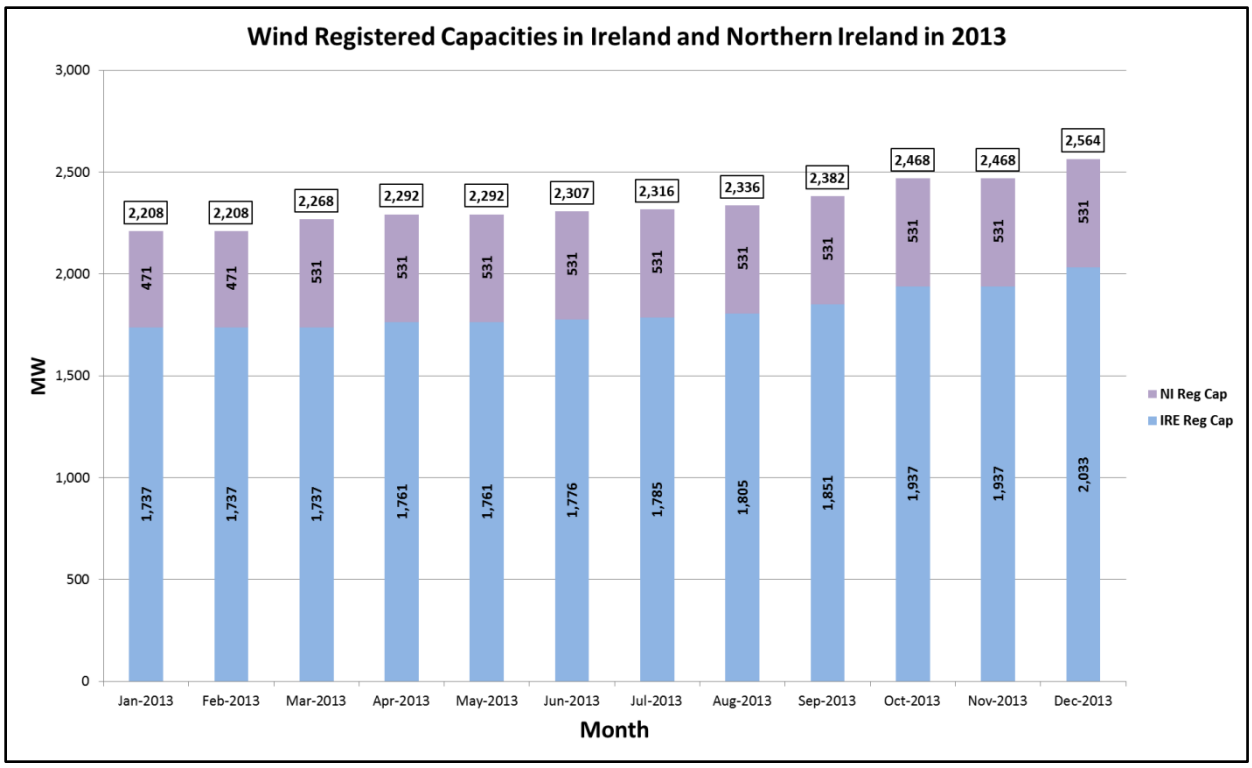

Figure 2: All-Island Monthly Wind Registered Capacities in 2013

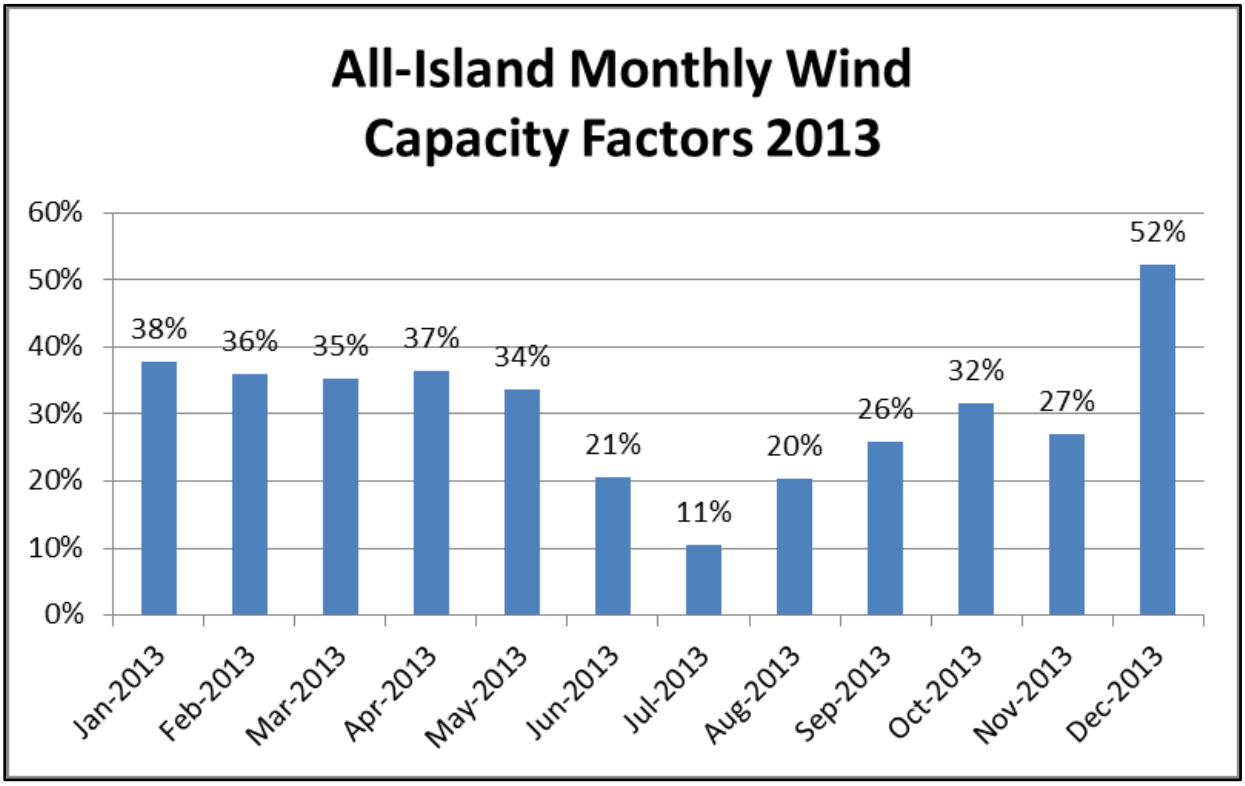

Figure 3: All-Island Monthly Wind Capacity Factors in 2013

3.3 Demand Level

The level of demand is another important factor which affects the dispatch-down of wind. Increased demand generally enables greater levels of wind to be accommodated on the system.

In 2013 the increase in wind installed capacities on the island coupled with higher capacity factors and a rise in imports by approximately 65%[4], coincided with almost no change in total demand. While total demand increased in 2013 by 0.3% (0.1% in Northern Ireland and 0.4% in Ireland) from 2012 levels, wind generation recorded a 14.1% increase in 2013 (23.4% in Northern Ireland and 11.7% in Ireland) from 2012 levels. In fact, the month of December 2013 recorded a 51% wind capacity factor where wind contributed an average of approximately 28% of total demand on the island. This however only resulted in a 1.1% increase in wind dispatch-down on the previous year. This increase is likely to be overestimated due to the non-recording autonomous wind dispatch-down in Northern Ireland prior to 2013.

3.4 Breakdown of Wind Dispatch-down – Curtailment vs. Constraint

In Northern Ireland, the breakdown of wind dispatch-down volumes in 2013 between constraints and curtailments is estimated to be 24% to 76% respectively.

In Ireland, due to the interaction and overlap of curtailment and constraint and the limitations of the systems used in 2013 to dispatch wind generation, it is not possible to categorically distinguish between constraint and curtailment. As a result, the breakdown of dispatch-down energy between constraint and curtailment can only be estimated using the available VPTG wind dispatch-down figures. As a rule of thumb, for any given half-hour, if dispatch-down occurred in five or more regions (of seven in total), this was attributed to curtailment. Conversely, if there was dispatch-down in four or less regions, this was attributed to constraint. Using that methodology, it is estimated that curtailment accounts for approximately 44% of the dispatch-down, while constraint accounts for 56%. For comparison, in 2012, using the same estimation methodology, approximately 62% of dispatch-down was attributed to curtailment, while constraints accounted for 38%.

All-Island: The following table shows the aggregate estimated breakdown of wind dispatch-down on the island in the last 3 years.

Estimated Breakdown of Dispatch-down of Wind on the Island	2011	2012	2013
Constraints	20%	38%	28%
Curtailments	80%	62%	72%

Table 1: Yearly Breakdown of Dispatch-down Energy into Constraints and Curtailments

3.5 Curtailment

Curtailment refers to the dispatch-down of wind for system-wide reasons. There are five types of system security limits that necessitate curtailment:

[4] This was mainly due to the commissioning of the new East West Interconnector (EWIC) with Great Britain.

i) System stability requirements (synchronous inertia, dynamic and transient stability)
ii) Operating reserve requirements, including negative reserve
iii) Voltage control requirements
iv) Morning load rise requirements
v) System Non-Synchronous Penetration (SNSP[5]) limit (currently 50%)

The first four of these limits tend to impose minimum generation requirements on the conventional (synchronous) generation portfolio, which in turn can limit the "room" for wind generation, particularly overnight during the lower demand hours. The current implementation of these security limits are described in the Operational Constraints Update paper, which superseded the Transmission Constraint Groups document. Both of these are published[6] on the EirGrid website.

SNSP is a system security metric that has been established from the results of the Facilitation of Renewables studies. These studies identified 50% as the current maximum permissible level. In 2013 there were some instances of curtailment to ensure this level was not breached. However, the SNSP limit is often superseded by the other minimum generation limits described above, particularly during low demand periods with high wind.

The impact of curtailment can be seen in figure 4, which shows the total annual all-island dispatch-down energy by hour of day. The predominance of curtailment in the night hours 23:00 – 09:00 over local constraints (which arise throughout the day) is evident.

[5] SNSP is the ratio of non-synchronous generation (wind and HVDC imports) to demand plus HVDC exports
[6] http://www.eirgrid.com/aboutus/publications/

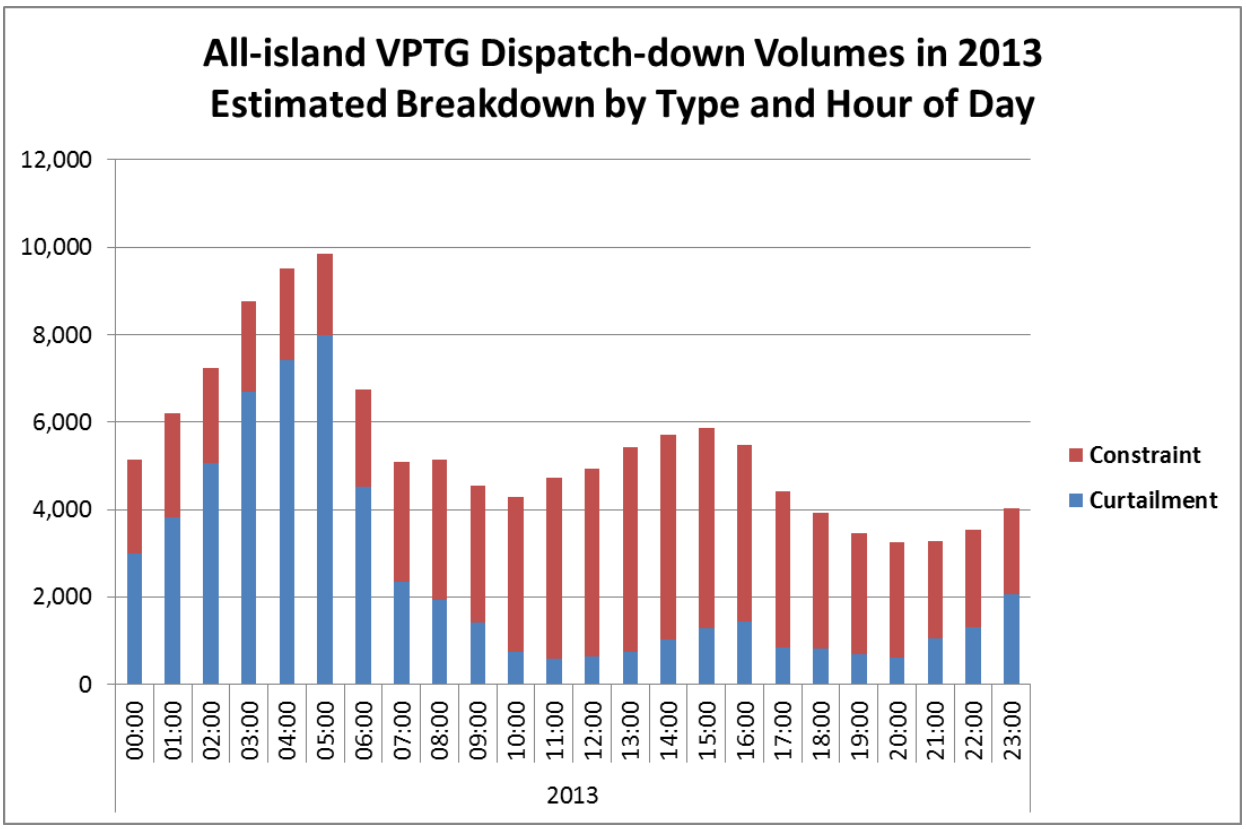

Figure 4: Estimated Breakdown of VPTG Dispatch-down Volumes on the Island in 2013

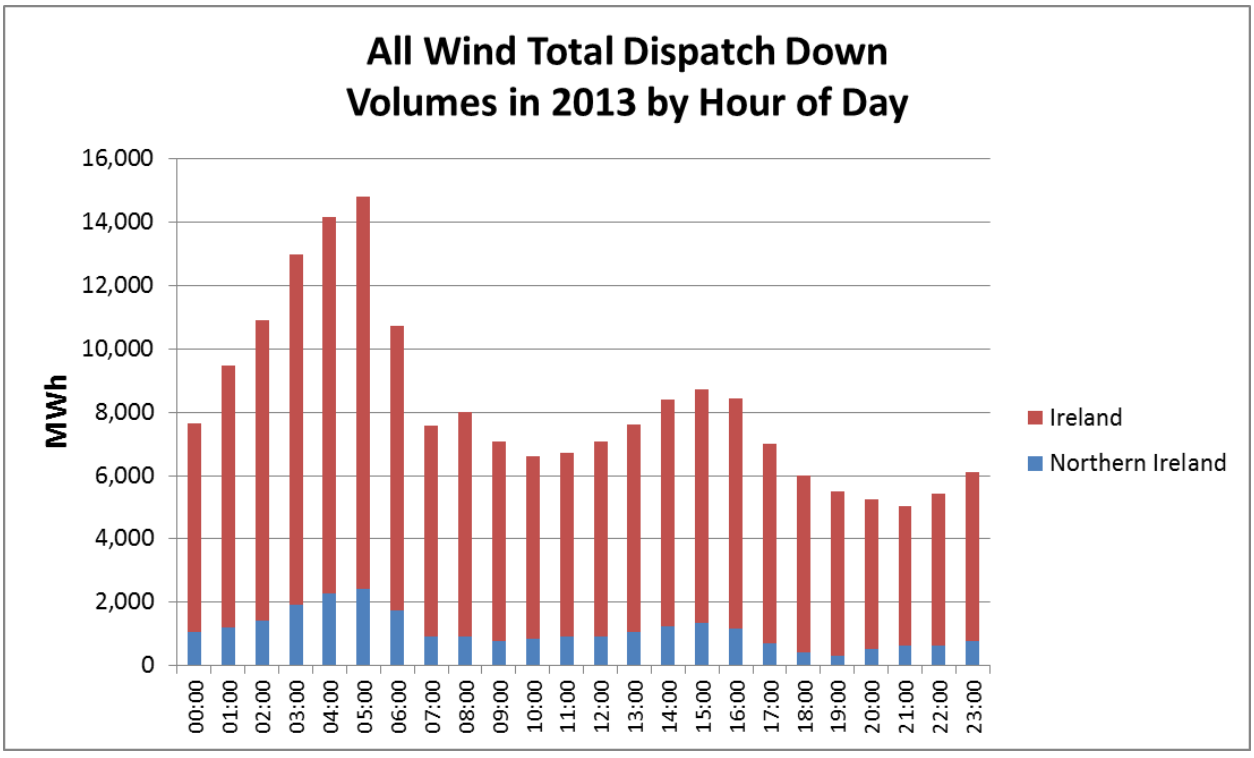

Figure 5: Total Wind Dispatch-down Volumes in 2013 by Jurisdiction and Hour of Day

3.6 Constraints

The dispatch-down of wind for network reasons is referred to as constraint. Constraint of wind can occur for intact network conditions (due to more wind generation than the localised carrying capacity of the network) or during outages (which can be for maintenance, upgrade works or due to faults). The Grid25 strategy and associated programmes are in place to directly address these issues in Ireland by strengthening the network in critical/constrained areas. Similar programmes are being envisioned in Northern Ireland which will address these limitations in that jurisdiction. The major capital works associated with these types of projects may reduce the capacity of the network for the duration of the work. In the short term, this leads to a rise in the levels of constraint in these areas. However, in the long term, this reinforcement of the network increases its capacity, enabling the accommodation of more generation in that area.

From a network perspective it would appear that the west, north-west and south-west of the Irish system have the greatest level of restrictions for the export of wind when compared to the other parts of the wider system (See "VPTG Wind Dispatch-Down by Region in 2013" Chart in Appendix A). In Donegal, even when there is a fully intact network, there are often restrictions, resulting in high levels of constraint of wind in this area. There is also evidence that other areas on the system have at times seen restrictions but these are generally associated with transmission outages.

The proportion of dispatch-down attributable to constraint (rather than curtailment) is estimated to be 28% in 2013. This is due partly to an increase in installed wind generation but more significantly to the transmission outages in 2013, many of which are to facilitate the upgrading and uprating of the transmission system. To illustrate, some of the transmission outages that resulted in significant constraint of wind generation are described below.

North West: High constraints on wind farms north of Srananagh can largely be attributed to outages that were required to facilitate the uprate of Cathaleen's Fall 110 kV busbars, most notably the outage of Cathaleen's Fall-Srananagh 1 110 kV line from April to October 2013, which resulted in high loading of the parallel Cathaleen's Fall-Srananagh 2 110 kV line during high wind conditions.

South West: The Clonkeen 110 kV station re-configuration works resulted in high wind constraint in the South West region. The main purpose of these works was to increase Firm Access Quantities. The works included a lengthy outage of the Clonkeen-Coomagearlahy 110 kV line from 17th July to 3rd August 2013, off-loading Coomagearlahy and Glanlee wind farms. Clonkeen 110 kV substation was also split from April to June necessitating constraints on wind farms in the Cork/Kerry region to alleviate the risk of high line loadings.

An outage of the Boggeragh-Clashavoon 110 kV line from 11th to 13th Sept 2013 resulted in a complete off-loading of the Boggeragh wind farm; the outage was required to facilitate maintenance of transmission plant and Blackstart Shutdown testing of Booltiagh wind farm.

West: Works on upgrading the Ennis 110 kV substation required numerous outages of the Booltiagh-Ennis 110 kV line in July and Sept 2013, which led to constraints on the Booltiagh wind

farm. This wind farm was also constrained off by works in Booltiagh 110 kV substation (19 July to 3 Aug 2013) required for an extension of the wind farm.

South East: Ballywater-Crane 110 kV line was switched out to facilitate maintenance works from 18th to 21st June. This resulted in the disconnection of Ballywater wind farm.

Northern Ireland: An outage at Aghyoule 110 kV substation for transformer maintenance from 29th July to 2nd Aug 2013 resulted in some constraints of Slieve Rushen Wind Farm (VPTG, capacity 54 MW).

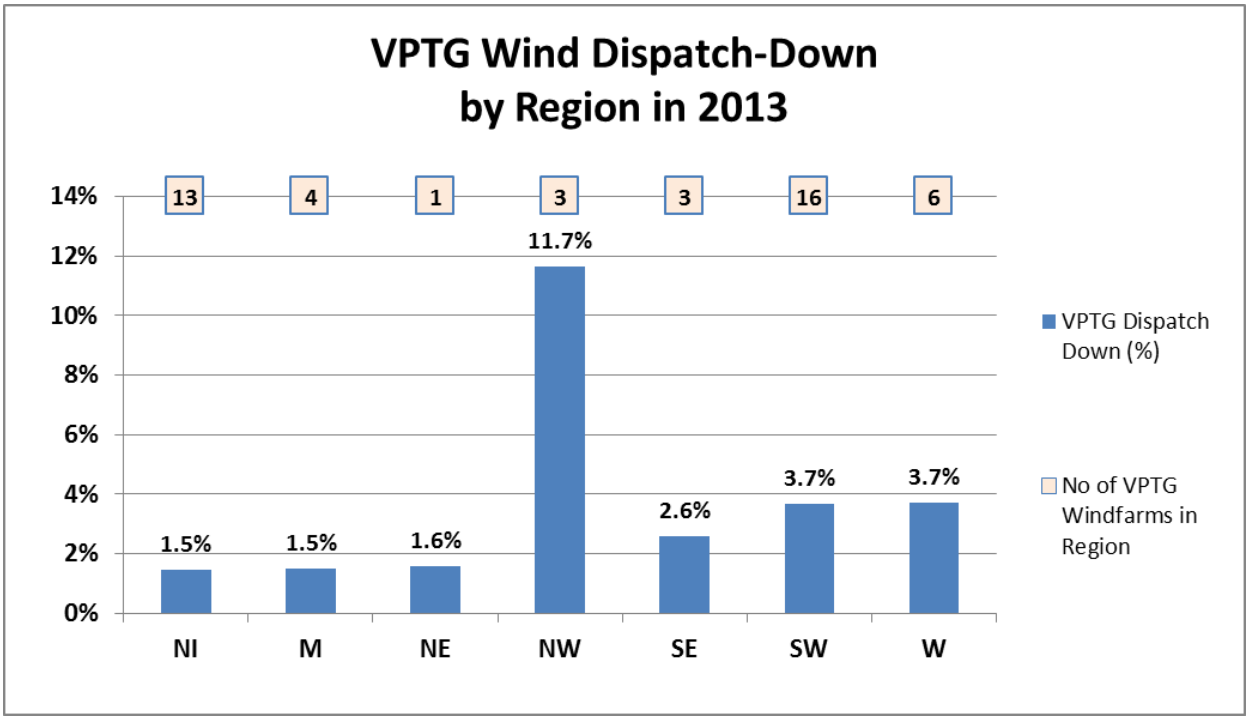

Figure 6: VPTG Wind Dispatch-Down by Region in 2013

4 Mitigation Measures

4.1 Network Reinforcements:

Grid25 as well as the programmes being developed in Northern Ireland are the primary methods of addressing network capacity issues in the coming years. The outages necessary to deliver the network upgrades may result in additional constraints in the short term but will reduce constraints on wind generation in the long run. In addition, consideration will be given to the use and deployment of new technologies including dynamic line rating and special protection schemes.

4.2 Operational Policy and the DS3 Programme

The fundamental issues that give rise to curtailment have been identified in section 2.5 above, and these issues will be addressed by EirGrid and SONI's Delivering a Secure Sustainable Electricity System (DS3) programme[7]. This is a multi-stakeholder, multi-year programme of work designed specifically to securely and efficiently increase the capability of the power system from operating at a maximum of 50% System Non-Synchronous Penetration (SNSP) level to a maximum of 75% and also address the other limits identified in section 2.5. Based on published modelling (Facilitation of Renewables studies[8]), this has the capability of ensuring that curtailment issues will lead to low levels of dispatch-down (circa 6% total) when there is sufficient installed windfarms to meet both governments' policy targets for 2020.

The DS3 programme was formally launched in August 2011 and is designed to reduce curtailment. However, the success of the programme is dependent on appropriate and positive engagement from all industry stakeholders including conventional and renewable generators, the Regulatory Authorities, Transmission System Operators and Distribution System Operators.

As part of the DS3 programme of work there are studies underway to investigate the optimisation of operational policy and to minimise curtailment.

4.3 Operational Policy – Interconnection

Interconnector Status Updates

The East West Interconnector (EWIC) went into partial commercial operation in December 2012 and full commercial operation in May 2013.

Since September 2010, Moyle has experienced four cable faults, three of which have been repaired. The fourth has been precisely located and identified. As a result, Moyle is currently operating at 250 MW of its 500 MW capacity.

[7] http://www.eirgrid.com/operations/ds3/
[8] http://www.eirgrid.com/renewables/facilitationofrenewables/

System Operator Interconnector Countertrading[9]

Following gate closure in the SEM, the System Operators (SOs) may seek to initiate changes to the interconnector flows - via countertrading between SOs or through a third party in the wholesale electricity market in Great Britain - for reasons of system security or to facilitate priority dispatch generation (as directed in SEM Committee Decision paper SEM-11-062). Countertrading is carried out in accordance with commercial parameters approved by the Regulatory Authorities; any relevant system limitations; and the availability of a counter party to give effect to any potential trade.

2013 Arrangements

Countertrading arrangements were used on a regular basis throughout the year to alleviate curtailment of priority dispatch generation. Initially this was achieved using SO-SO trading with National Grid Electricity Transmission. This mechanism was recently enhanced by using the services of a third party trading partner. It should be noted that this change was made for both operational and economic reasons.

As a result of priority dispatch counter trades, wind dispatch-down was reduced by almost 50% in 2013. Figure 7 shows that these trades occurred largely at night which coincides with periods of high curtailment.

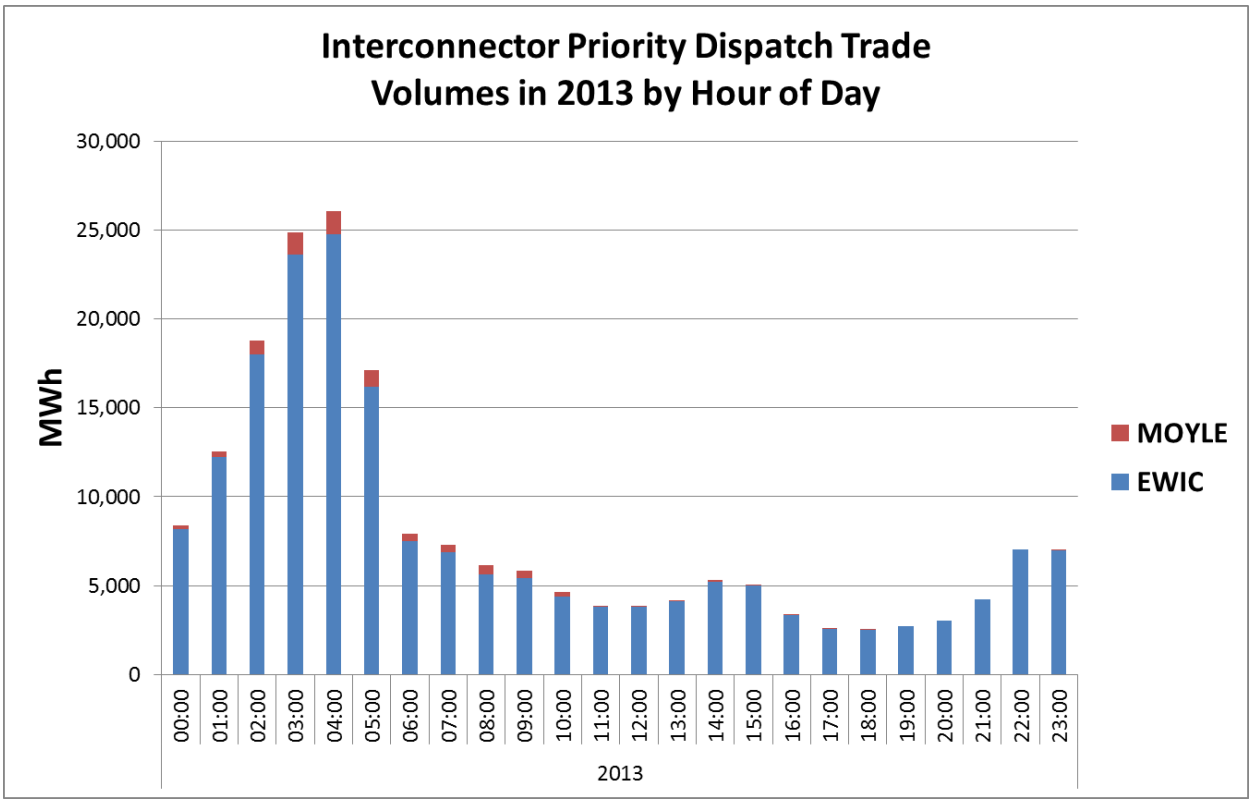

Figure 7: Interconnector Priority Dispatch Trade Volumes in 2013 by Hour of Day

[9] http://www.eirgrid.com/media/Information%20Note%20on%20SOInterconnectorCountertrading12July2013.pdf

Extension of System Operator Counter-Trading Facilities for DBC Management[10]

Following a request from both CER and UREGNI, EirGrid examined the possibility of extending the counter-trading facility to assist in the management of Dispatch Balancing Costs (DBC). It was concluded that significant DBC savings could be made without impacting the counter-trading of priority dispatch generation, the market position of participants in the SEM or security of supply. In addition it should result in a reduced volume of constrained-on running for generators in Ireland, thus allowing the physical generation schedule to more closely match the unconstrained market schedule.

4.4 Controllability of Wind Generators

Windfarm controllability is the ability of the TSO control centres to dispatch a windfarm's output to a specific level. Uncontrollable windfarms are dispatched directly by opening circuit breakers which results in full disconnection rather than a gradual dispatch-down. Controllability enables fairness of dispatch-down between windfarms on a pro-rata basis. To ensure increasing and appropriate levels of controllability, EirGrid and SONI have sought, where possible, to standardise testing procedures and rigorously enforce controllability requirements on all windfarms. To this end all non-compliant windfarms were given until 1st December 2012 to demonstrate controllability. Furthermore, a comprehensive operational policy to implement the decisions in SEM-11-62 was published on both SONI's and EirGrid's websites in November 2011.

[10] http://www.eirgrid.com/media/InformationNoteExtensionofTSOcounter-tradingfacilitiesforDBCmanagement.pdf

Appendix A – Detailed Results

The following tables provide a detailed summary of the dispatch-down of wind (in MWh and in terms of percentage of available energy). The data is provided for Northern Ireland and Ireland individually and in aggregate.

All-Island:

Month	All Wind Generation (MWh)	All Wind Dispatch-down Vol (MWh)	All Wind Dispatch-down (%)	VPTG Dispatch-down Vol (MWh)	Non-VPTG Dispatch-down Vol (MWh)
Jan-2013	586,406	2,991	0.5%	1,378	1,613
Feb-2013	501,560	2,987	0.6%	1,502	1,485
Mar-2013	553,583	1,824	0.3%	874	950
Apr-2013	553,624	25,133	4.3%	16,499	8,634
May-2013	523,918	32,140	5.6%	20,023	12,117
Jun-2013	324,689	11,784	3.4%	10,214	1,571
Jul-2013	176,716	6,584	3.4%	6,021	563
Aug-2013	344,981	17,180	4.7%	13,218	3,961
Sep-2013	424,010	14,842	3.3%	11,127	3,715
Oct-2013	545,514	28,788	5.0%	19,564	9,224
Nov-2013	456,854	15,505	3.2%	9,568	5,936
Dec-2013	880,245	35,778	3.8%	20,507	15,271
2013 Total	**5,872,102**	**195,534**	**3.2%**	**130,496**	**65,038**

Table 2: Details of Monthly Dispatch-down Energy on the Island

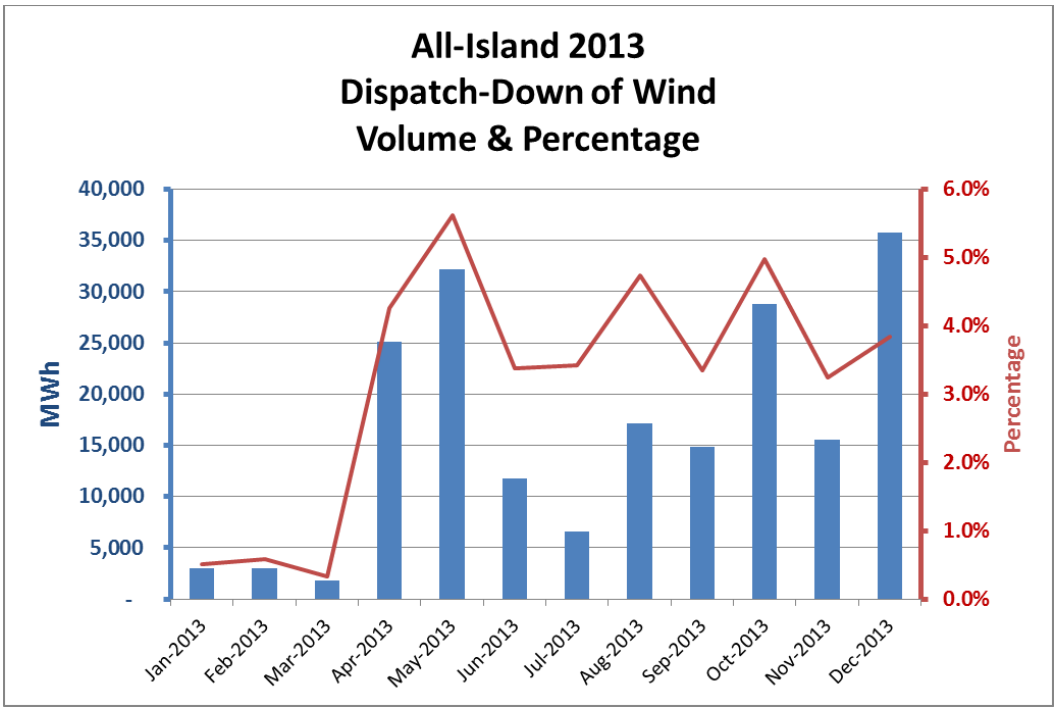

Figure 8: All-Island Wind Dispatch-Down Monthly Volumes and Percentages in 2013

Ireland:

Month	All Wind Generation (MWh)	All Wind Dispatch-down Energy (MWh)	All Wind Dispatch-down (%)	VPTG Dispatch-down Energy (MWh)	Non-VPTG Dispatch-down Energy (MWh)
Jan-2013	468,170	2,103	0.4%	1,169	934
Feb-2013	410,976	2,755	0.7%	1,495	1,260
Mar-2013	445,373	1,144	0.3%	650	494
Apr-2013	444,675	22,034	4.7%	15,692	6,342
May-2013	419,708	27,563	6.1%	18,884	8,678
Jun-2013	266,886	10,447	3.7%	9,451	996
Jul-2013	140,513	6,225	4.2%	5,829	396
Aug-2013	266,569	15,302	5.4%	11,502	3,800
Sep-2013	327,169	14,301	4.2%	10,819	3,481
Oct-2013	424,569	26,780	5.9%	18,741	8,039
Nov-2013	351,087	10,982	3.0%	6,848	4,133
Dec-2013	676,564	31,433	4.4%	16,986	14,447
2013 Total	**4,642,260**	**171,068**	**3.5%**	**118,067**	**53,000**

Table 3: Details of Monthly Dispatch-down Energy in Ireland

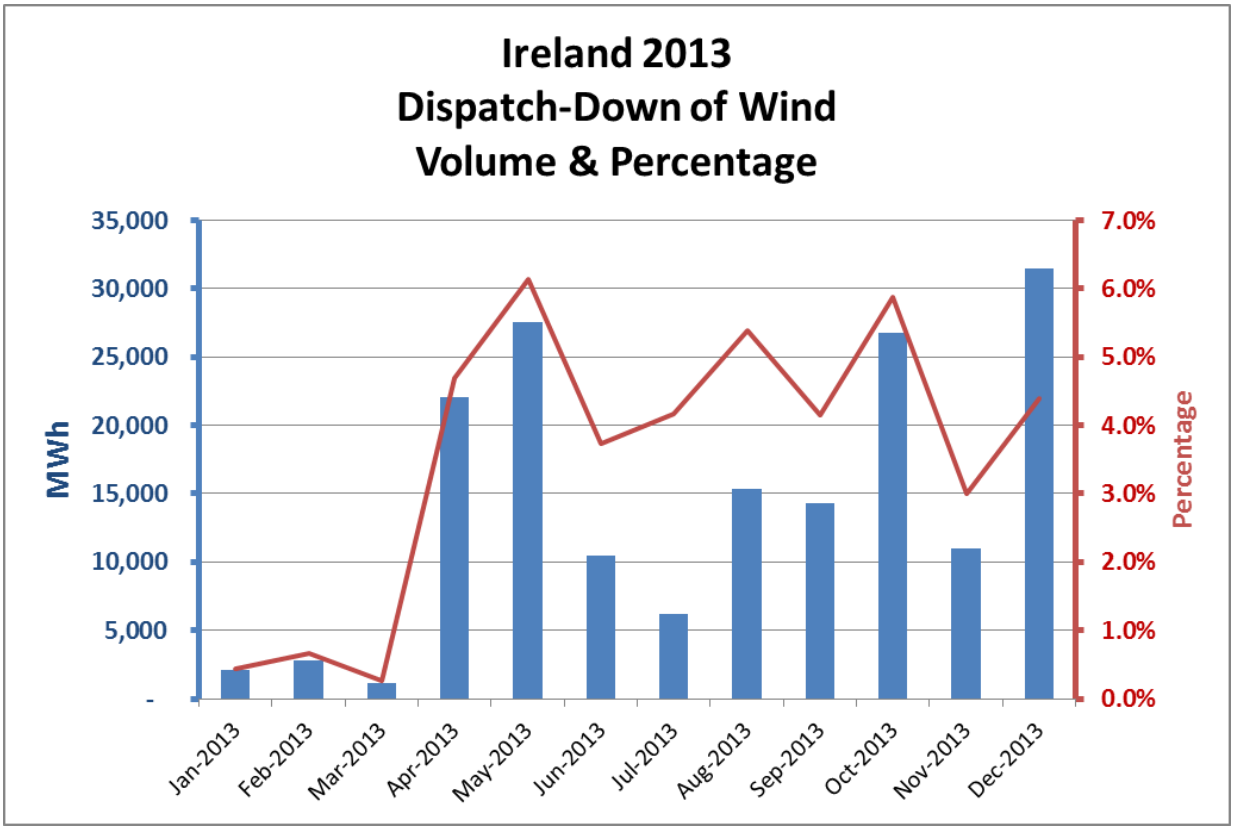

Figure 9: Ireland Wind Dispatch-Down Monthly Volumes and Percentages in 2013

Northern Ireland:

Month	All Wind Generation (MWh)	All Wind Dispatch-down Energy (MWh)	All Wind Dispatch-down (%)	VPTG Dispatch-down Energy (MWh)	Non-VPTG Dispatch-down Energy (MWh)
Jan-2013	118,236	888	0.7%	209	679
Feb-2013	90,584	231	0.3%	7	225
Mar-2013	108,210	679	0.6%	223	456
Apr-2013	108,949	3,099	2.6%	807	2,292
May-2013	104,210	4,577	3.7%	1,139	3,438
Jun-2013	57,803	1,337	1.9%	763	575
Jul-2013	36,203	359	0.8%	192	167
Aug-2013	78,412	1,878	2.4%	1,716	161
Sep-2013	96,841	542	0.5%	308	234
Oct-2013	120,945	2,008	1.6%	823	1,185
Nov-2013	105,767	4,523	4.0%	2,720	1,803
Dec-2013	203,680	4,345	2.0%	3,521	824
2013 Total	**1,229,842**	**24,466**	**1.9%**	**12,429**	**12,038**

Table 4: Details of Monthly Dispatch-down Energy in Northern Ireland

Month	Estimated Breakdown of Dispatch-Down		Estimated Breakdown of Constraints		Wind Capacity Factor
	Constraints	Curtailment	Transmission	Distribution	
Jan-2013	62%	38%	37%	63%	36%
Feb-2013	89%	11%	38%	62%	30%
Mar-2013	100%	0%	34%	66%	28%
Apr-2013	27%	73%	0%	100%	31%
May-2013	23%	77%	11%	89%	31%
Jun-2013	8%	92%	0%	100%	18%
Jul-2013	100%	0%	65%	35%	11%
Aug-2013	22%	78%	1%	99%	20%
Sep-2013	100%	0%	0%	100%	26%
Oct-2013	28%	72%	0%	100%	32%
Nov-2013	3%	97%	0%	100%	28%
Dec-2013	13%	87%	0%	100%	55%
2013 Total	**24%**	**76%**	**14%**	**86%**	**29%**

Table 5: Detailed Monthly Breakdown of Dispatch-down Energy in Northern Ireland

A breakdown of wind dispatch-down figures is provided in this section for Northern Ireland.
Due to the differences in the systems used to record the data, it was not possible to log all of the categories for the reasons for constraint or curtailment of wind energy in Ireland. This capability has become available in the new All-Island Wind Dispatch Tool which went live in quarter 2, 2014.

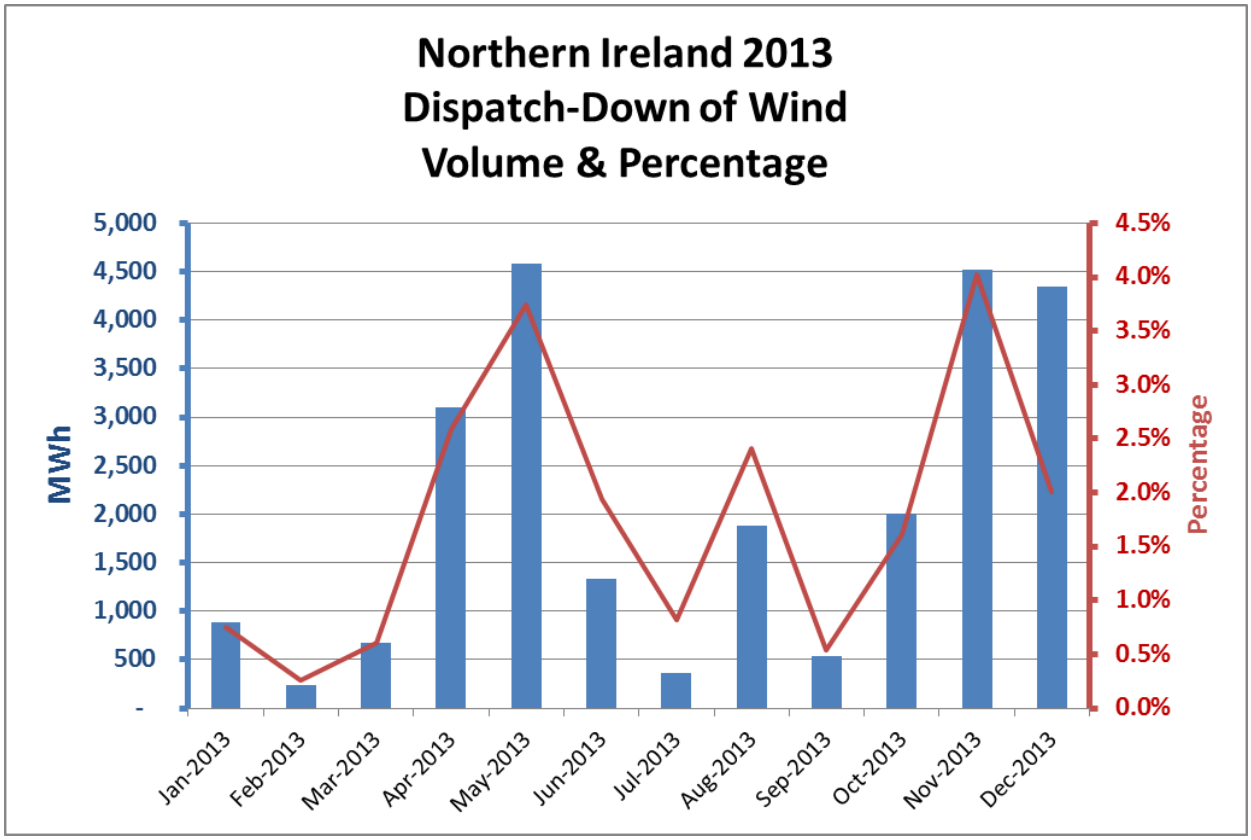

Figure 10: Northern Ireland Wind Dispatch-Down Monthly Volumes and Percentages in 2013

Individual dispatch-down of VPTG windfarms 2013:

Jurisdiction	Region	Unit ID	Unit Name	Capacity (MW)	Available Energy (MWh)	Dispatch Down Vol (MWh)	Dispatch Down %	VPTG Start Date
NI	NI	ALT2	Altahullion 2	11.7	30,619	422	1.4%	
NI	NI	CarnHill	CarnHill	13.8	22,131	223	1.0%	25/07/2013
NI	NI	Carrickatane	Carrickatane	20.7	50,581	394	0.8%	27/06/2013
NI	NI	Churchill	Churchill	18.4	42,802	256	0.6%	12/09/2013
NI	NI	Crighshane	Crighshane	32.2	68,655	1,085	1.6%	06/06/2013
NI	NI	Curryfree	Curryfree	15	48,988	835	1.7%	
NI	NI	GAR	Garves	15	42,300	454	1.1%	
NI	NI	GRU	Gruig	25	63,126	449	0.7%	19/09/2013
NI	NI	Screggagh	Screggagh	20	51,241	964	1.9%	
NI	NI	SD1	Slieve Divena 1	30	66,670	784	1.2%	06/06/2013
NI	NI	SLI2	Slieve Rushen 2	54	152,991	2,810	1.8%	
NI	NI	Slieve Kirk	Slieve Kirk	74	130,086	2,837	2.2%	
NI	NI	TAP	Tappaghan	28.5	75,476	916	1.2%	
Northern Ireland				**358.3**	**845,665**	**12,429**	**1.5%**	
IRE	M	GE1	Gortahile	20	65,362	794	1.2%	
IRE	M	GU1	Glenough	32.5	117,387	1,368	1.2%	
IRE	M	LS1	Lisheen 1	36	104,644	2,193	2.1%	
IRE	M	LS2	Lisheen 1a	19	42,164	576	1.4%	19/09/2013
IRE	NE	BD1	Bindoo	48	118,740	1,888	1.6%	
IRE	NW	BM1	Beamhill	14	39,559	4,371	11.0%	
IRE	NW	MCT	Meentycat	84.96	219,860	27,410	12.5%	
IRE	NW	SN1	Sornehill	38.9	98,117	9,896	10.1%	
IRE	SE	BW1	Ballywater	42	96,002	5,289	5.5%	
IRE	SE	CK1	Castledockrell	41.4	105,836	1,054	1.0%	
IRE	SE	RF1	Richfield	27	69,300	705	1.0%	
IRE	SW	BA1	Ballybane	29.9	71,734	174	0.2%	11/12/2013
IRE	SW	BCw	Ballincollig Hill	13.3	37,055	552	1.5%	
IRE	SW	BG1	Boggeragh	57	181,058	8,685	4.8%	26/02/2013
IRE	SW	BR1	Bawnmore	24	74,024	2,343	3.2%	22/01/2013
IRE	SW	CG1	Coomagearlahy 1	42.5	113,631	7,845	6.9%	
IRE	SW	CG2	Coomagearlahy 2	8.5	24,544	1,032	4.2%	
IRE	SW	CG3	Coomagearlahy 3	32.5	83,809	2,144	2.6%	12/06/2013
IRE	SW	CJ1	Clahane	37.8	108,056	1,247	1.2%	
IRE	SW	CZ1	Coomacheo	59.225	183,645	12,090	6.6%	
IRE	SW	DR1	Dromada	28.5	74,844	1,432	1.9%	08/01/2013
IRE	SW	DV1	Dromdeeveen	27	90,778	1,254	1.4%	
IRE	SW	GLC	Glanlee	29.8	83,808	7,267	8.7%	
IRE	SW	GW1	Grouse Lodge	15	46,959	702	1.5%	
IRE	SW	KW1	Knockawarriga	22.5	64,910	649	1.0%	17/07/2013
IRE	SW	RC1	Rathcahill West	12.5	46,091	647	1.4%	
IRE	SW	TN2	Tournafulla	17.2	50,678	1,033	2.0%	
IRE	W	BT1	Booltiagh 1	19.45	37,626	775	2.1%	
IRE	W	BT2	Booltiagh 2	3	10,664	411	3.9%	18/09/2013
IRE	W	DY1	Derrybrien	59.5	130,756	9,849	7.5%	
IRE	W	GH1	Garvagh 1	26	90,754	1,133	1.2%	
IRE	W	GH2	Garvagh 2	22	60,710	842	1.4%	
IRE	W	KG2	Kingsmountain 2	11.05	29,312	416	1.4%	
Ireland				**1,002.0**	**2,772,417**	**118,067**	**4.3%**	
All Island				**1,360.3**	**3,618,083**	**130,496**	**3.6%**	

Table 6: Dispatch-down Figures for Each VPTG Windfarm in 2013

Note: VPTG start dates are displayed only for windfarms that became VPTG during 2013.

Appendix B – Calculation Methodologies

This appendix outlines the methodologies used to calculate wind dispatch-down in Ireland and Northern Ireland. The methodologies are different due to the different systems used in both jurisdictions in 2013. The new wind dispatch tool went live in quarter 2 of 2014. This will allow the use of the same calculation methodologies in both jurisdictions in the future.

Ireland

Data Used

The following figures were obtained (for VPTG windfarms) from the Single Energy Market settlement system:

DQ (Dispatch Quantities in MW)

AO (Actual Output in MW)

AP (Profiled Availabilities in MW)

TPD (Market Trading Period Duration = 0.5 hr)

Data from other sources (for all windfarms):

Total wind generation: EirGrid & SONI Operations

Total half hourly wind availabilities and generation from SCADA (Ireland only)

Calculation Methodology

Dispatch-down of wind energy is calculated individually for generators that are registered in the SEM as VPTGs. Prior to the SEM-11-062 decision the majority of units dispatched down were VPTGs. Since SEM-11-062 this has changed to the dispatch-down of controllable windfarms, which includes some autonomous generation. Due to the market rules for autonomous generators (APTGs) it is not possible to use validated SEM data to calculate the dispatch-down of APTGs; instead, this is estimated on an aggregate basis using SCADA data.

The calculation steps for dispatch-down of wind are as follows:

Step 1: Dispatch-Down Calculation for VPTG Wind using SEM Data

a) Dispatch-down volume V (MWh) in each trading period:

IF AP = DQ

THEN V = 0

ELSE V = TPD * Max[0, AP-Max(AO,DQ)]

Total dispatch-down volume R = $\sum_{rp} V$

Where ***rp*** is the reporting period – the year 2013 in this case.

b) Dispatch-down level (%):

The dispatch-down levels for a VPTG wind generator are calculated based on the dispatch-down volume R from part (a) above and the wind generator's maximum possible energy generation PE (MWh):

$PE = \sum_{rp}[Max(AO,AP)] * TPD$

(Only during those trading periods where the wind generator is registered as VPTG in SEM)

VPTG dispatch-down level (%) = 100 * R / PE

Step 2: Dispatch-Down Calculation for Autonomous (Non-VPTG) Wind

SCADA data is used to estimate autonomous wind dispatch-down in Ireland only.

a) Estimating all wind dispatch-down in Ireland from SCADA:

The difference between total wind availabilities (Avail) and total wind output (WO) is used as an indicator of the dispatch-down volume of all wind in Ireland. However, the accuracy of SCADA data is not high.

To improve the accuracy, this difference (Avail – WO) is used only during the trading periods where there was a dispatch-down in the market in Ireland (VI ≠ 0). Market dispatch-down volumes in Ireland (VI) can give us a better indication of when there was active dispatching down of wind taking place in Ireland.

Total Dispatch-Down Volume in Ireland DD (MWh) = $\Sigma Max[VI, (Avail-WO)*TPD]$

(Note: DD will be zero when VI is zero, i.e. during periods where there was no dispatching down of VPTG wind in Ireland.)

All wind Dispatch-Down % in Ireland = $100 * DD / (DD + \Sigma(WO_I*TPD))$

All wind Dispatch-Down % in Northern Ireland = $100 * R_{NI} / (R_{NI} + \Sigma(WO_{NI}*TPD))$

Where R is the dispatch-down volume calculated for Northern Ireland in Step 1.

Actual total wind output is used for Northern Ireland (WO).

b) Estimating autonomous dispatch-down of wind in Ireland:

It is calculated by getting the difference between the estimated total wind dispatch-down volume in Ireland and the VPTG dispatch-down in Ireland = DD – RI

Northern Ireland

Data Used

The figures used in these calculations are obtained from the SONI Energy Management System (EMS) in conjunction with dispatch data recorded in EDIL, the control centre tool for dispatching generating plant.

- DIs (Dispatch Instructions in MW from EDIL)
- MW Availability (Minute SCADA MW Availability Data from EMS)
- MW Generation (Minute SCADA MW Generation data from EMS)
- Wind Farm Capacity (MW)
- TP (Time Period, 1 minute)

Calculation Methodology

Dispatch-down of wind energy is calculated individually for each wind farm in Northern Ireland. This is calculated based on Dispatch Instructions logged by SONI Control Engineers in EDIL (date in dd-mm-yy and time in hh:mm) and MW Generation / MW Availability data in the SONI EMS. The resolution of the data used from the EMS is 1 minute.

Where a wind farm's output is reduced by SONI, instructions are logged as a way of determining why a wind farms output has been reduced and as a way of sending instructions to SEMO for market settlement.

Wind Farm Dispatch Instructions recorded in EDIL are classified using the following EDIL reason codes:

LOCL	Local Transmission Constraint
CURL	All Island Curtailment
LOCL T	Local Distribution Constraint
MWOF	MW of Fuel

Step 1: Dispatch-Down Calculation for VPTG Wind using SEM Data

See Ireland calculation methodology section above.

Step 2: Dispatch-down Calculation

1-minute MW Availability and MW Generation SCADA data is downloaded daily from the EMS. This is downloaded for each wind farm installed in Northern Ireland.

Where a wind farm has been dispatched down, the time logged in EDIL is used to calculate the dispatch-down volume for each 1-minute time period. A value in MWhrs and time (hrs) is recorded.

Total Dispatch-down Volume (V) in MWhrs is calculated, using minute SCADA data, in the following way;

IF DI < Wind Farm Capacity

THEN V = (MAX(MW Availability, MW Generation) – DI), 0

Where V >= 0 MW

Total Dispatch-down time (t) in hrs is calculated, using minute SCADA data, in the following way;

IF DI < Wind Farm Capacity

THEN t = COUNT(TP(DI < Wind Farm Capacity))

Notes

These calculations are applied daily to all wind farms in Northern Ireland. The accuracy of the Dispatch-down Volumes (V) is dependent on the accuracy of MW Availability and MW Generation SCADA data.

The accuracy of the Dispatch-down time (t) is dependent on the accuracy of the instructions entered into EDIL. These are checked daily by SONI staff.