2011 Curtailment Report

Contents

1 Overview

1.1 Context

Under the 2009 European Renewables Directive (2009/28/EC) there is an onus on the Transmission System Operators (TSOs) to report on the level of curtailment of renewable resources and mitigation strategies in place to minimise such curtailment. The requirements in the Directive have recently been transposed into law in Ireland (S.I. No. 147 of 2011) and are under consideration in Northern Ireland. The SEM Committee, in its scheduling and dispatch decision SEM-11-062, requested that the TSOs report on this as appropriate to CER and NIAUR respectively. This report represents EirGrid and SONI's response to these obligations.

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 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.

1.2 Summary

In the calendar year 2011, the share of centrally dispatched generation[1] from renewable sources in Ireland and Northern Ireland was 17%, with 15% provided by wind and 2% by hydro. The total wind energy generated was 5,212 GWh in Ireland and Northern Ireland. However, there was a total of 119 GWh of dispatch-down energy of windfarms. There has been no material dispatch-down of hydro resources. The level of dispatch-down of wind represents just over 2.2% of total available energy from wind resources in Ireland and Northern Ireland. However, this dispatch-down was concentrated in variable price taking generation (which generally are the units controllable by the TSOs and account for approximately 30% of the installed capacity) and represents over 7% of these units' total available energy. Details of the calculation methodology are provided in Appendix 1.

1.3 Ireland: Level of Dispatch-Down Energy from Wind Resources

In 2011 the dispatch-down energy from variable price taking wind generation (VPTG) was 106 GWh in Ireland. This represents 7.5% of the available energy from these generators in this period. When all other wind generation, including autonomous and non-market generation is considered, this is equivalent to 2.4% of total available wind energy.

This dispatch-down of energy occurred across 14 windfarms with a total registered capacity of almost 520 MW. 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 generally arises during the night time hours (between 11pm and 9am) when demand levels are lower.

[1] 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.

1.4 Northern Ireland: Level of Dispatch-Down Energy from Wind Resources

In 2011 the dispatch-down energy from variable price taking wind generation (VPTG) was 13.4 GWh in Northern Ireland. This represents 5.3% of the available energy from these generators in this period. When all other wind generation, including autonomous and non-market generation is considered, this is equivalent to 1.3% of total available wind energy.

This dispatched down energy occurred across three windfarms with a total registered capacity of approximately 80 MW.

2 Contributory Factors for Dispatch-Down of Renewables

2.1 Observed Network Limitations

From a network perspective it would appear that the north-west and south-west of the system have the greatest level of restrictions for the export of wind when compared to the other parts of the wider system. Figure 1 shows the percentage of total dispatch-down by region; it can be seen that the regions NW and SW experience the most significant levels of dispatch-down. There is also evidence that other areas on the system have at times seen congestion but, to date, these are generally maintenance related.

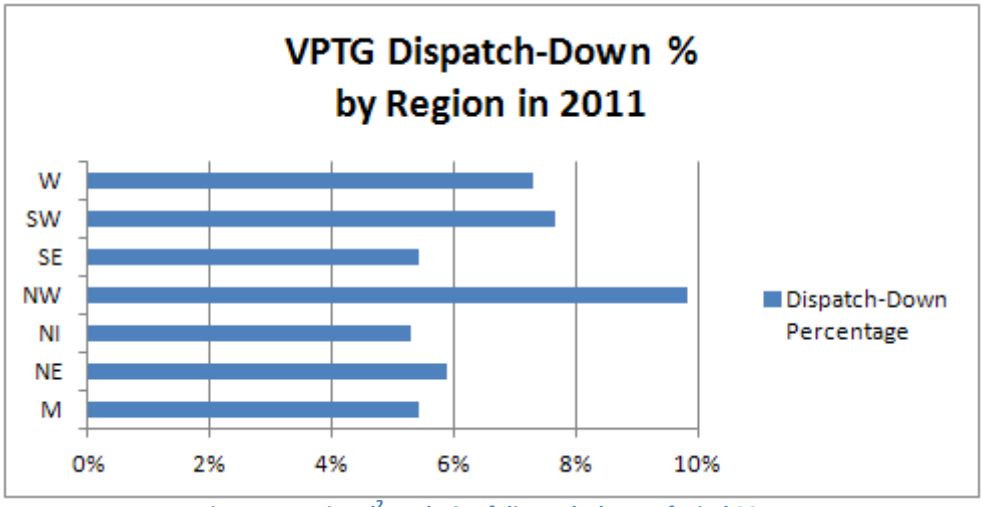

Figure 1 Regional[2] analysis of dispatch-down of wind 2011

2.2 Curtailment

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

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[3]) limit (currently 50%)

These limits impose minimum generation levels on the conventional generation portfolio, which in turn can limit the "room" for wind generation, particularly overnight during the lower demand hours. The implementation of these security limits are described in the "Transmission Constraint Groups" operational policy and the "Operating Security Standards" document, which are published[4] 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. There were some instances of curtailment to ensure this level was not breached. However, the SNSP limit

[2] The allocation of windfarms to the regions listed is described in Table 4 in section 4.
[3] SNSP is the ratio of non-synchronous generation (wind and HVDC imports) to demand plus HVDC exports
[4] http://www.eirgrid.com/media/Transmission%20Constraint%20Groups%20Version%201.2.pdf
http://www.eirgrid.com/media/Operating%20Security%20Standards%20December%202011.pdf

has tended to be superseded by the other minimum generation limits described above as the demand falls during nights with high wind.

The impact of curtailment can be seen in Figure 2 below, which shows the total all-island dispatch-down by half-hour. The predominance of curtailment (which tends to be confined to the night hours 23:00 – 09:00) over local constraints (which arise throughout the day) is evident. It is estimated that curtailment accounts for approximately 80% of the dispatch-down.

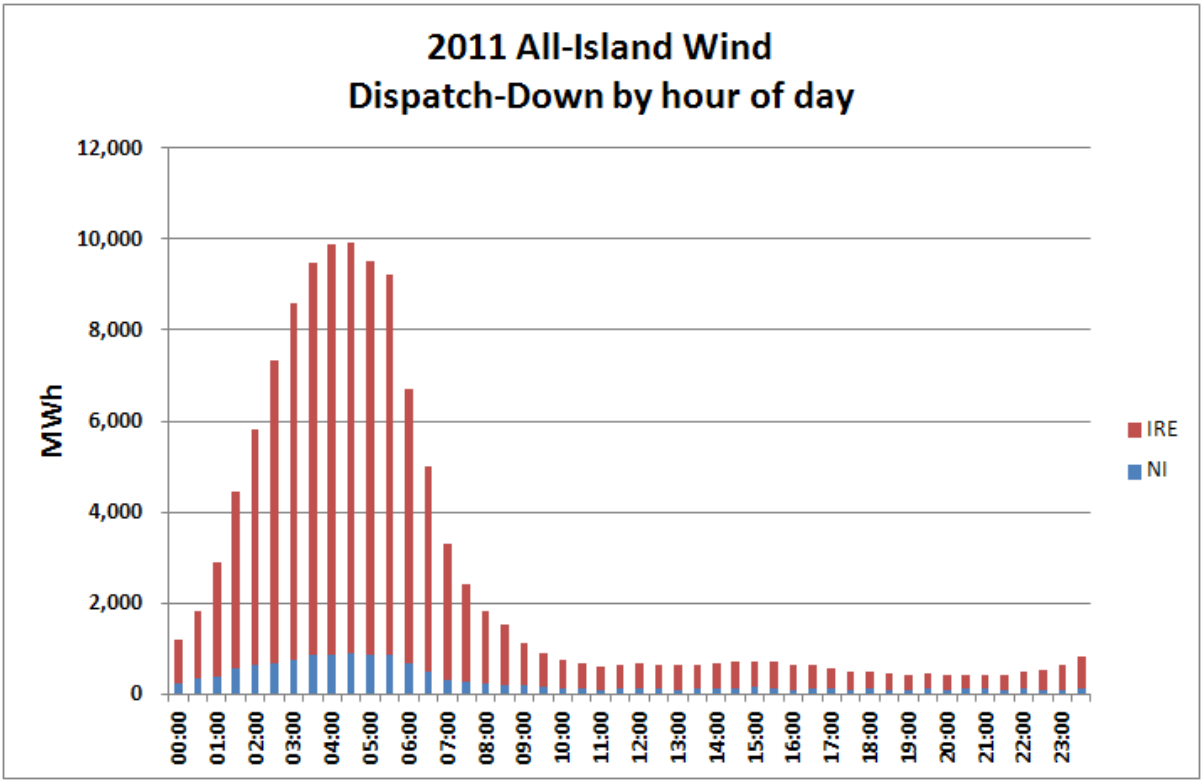

Figure 2 Ireland and Northern Ireland 24 hour clock of dispatch-down of wind 2011

2.3 Level of Wind

As explained above, it is necessary, at times, to limit the maximum level of wind generation on the system. 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 2011 the registered capacity[5] of windfarms was 1,771 MW. By the end of the year the figure had risen to 2,012 MW, split 1,615 MW in Ireland and 397 MW in Northern Ireland. Of this almost 600 MW was registered in the SEM as Variable Price Taker Generators (VPTG). Further testing and commissioning during 2011 resulted in approximately 250 MW additional wind generation being certified as controllable; this generation is now required to register as VPTG.

[5] Registered Capacity is the maximum capacity, expressed in whole MW, that a generation unit can deliver on a sustained basis

The year 2011 was characterised by low wind levels in the first six months and substantially increased wind levels in the latter half of the year. Over the year the capacity factor[6] of windfarms was 31% with 34.5% being achieved in the latter half.

These two factors contributed to the higher levels of dispatch-down that were evident in the second half of the year (Figure 3). The correlation between higher wind generation and higher dispatch-down levels can also be seen.

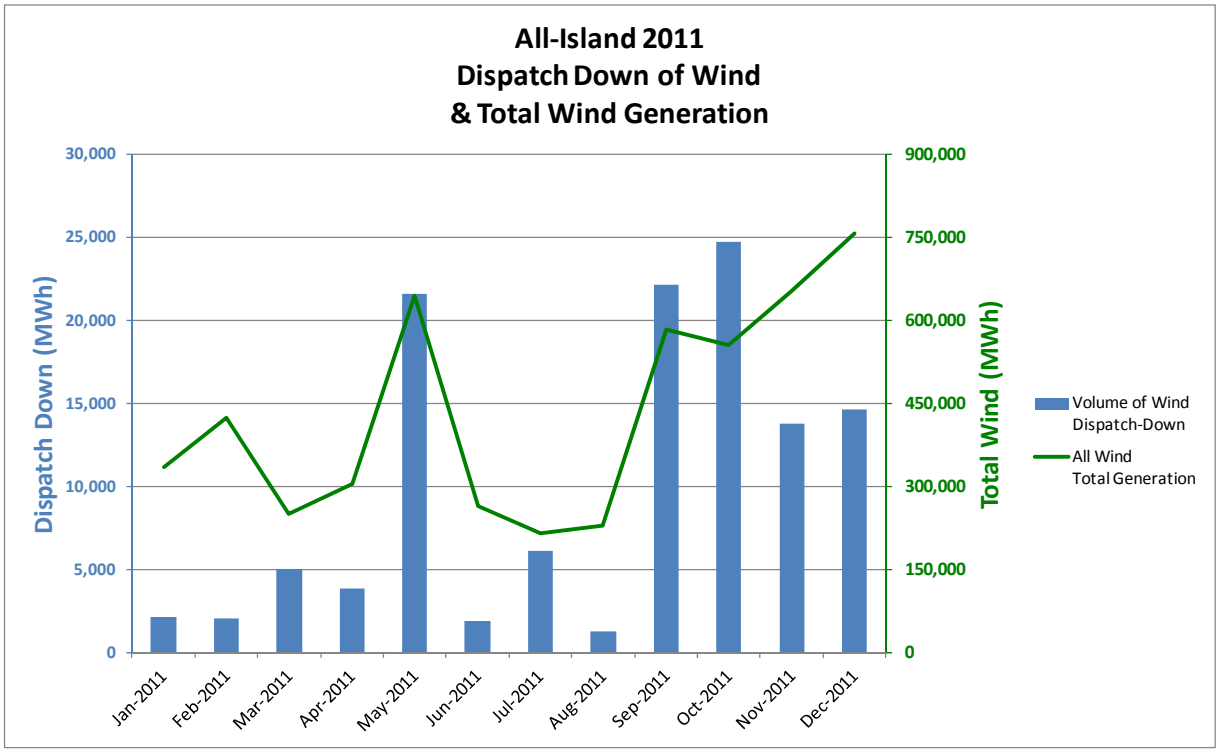

Figure 3 Ireland and Northern Ireland dispatch-down of wind 2011

2.4 Notable plant outages - Moyle Interconnector and Turlough Hill plant outages

The Moyle DC interconnector was reduced to half capacity[7] due to a cable fault from 26th June 2011 until 24th August 2011. On 24th August 2011, the second pole developed a fault so the interconnector was fully unavailable for the remainder of the year. When the Moyle HVDC interconnector is out of service the static primary reserve that it normally provides needs to be made up from other resources. This, at times, resulted in open cycle gas turbines being dispatched on at night or larger units being run at levels higher than their minimum stable generation to maintain adequate reserves.

The Turlough Hill pumped storage facility is a key reserve provider, particularly when pumping at night. In addition, the pumping demand at night can help reduce the impact of the system security limits by providing more "room" for wind generation. The entire Turlough Hill station was

[6] The capacity factor is the amount of energy produced 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.

[7] The Moyle interconnector has two poles (and two sub-sea cables), and in the event of a fault on one pole, can operate at half capacity on the remaining pole.

unavailable for all of 2011 due to a major station refurbishment project. Without Turlough Hill not only was there an increased requirement to commit units on at night to maintain reserves, the loss of the pumps (which normally provide additional demand overnight) reduced the ability of the system to accommodate wind.

These two outages have resulted in higher levels of curtailment than would otherwise have been expected.

2.5 Operational Dispatch Policy

Up until the SEM-11-062 decision paper, the operational policy 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 operational testing as appropriate. The implementation of this is described in an operational policy document, which is published on the EirGrid website in November 2011, entitled *Policy for Implementing Scheduling and Dispatch Decisions SEM-11-062*[8] and the associated *addendum*.

2.6 Commissioning Units

The commissioning of new generators, particularly where sustained periods of running at high outputs (i.e. a "reliability run"), can result in increased levels of curtailment. There was no significant or material commissioning of conventional plant in 2011 that had a material impact on the level of dispatch-down of renewable generation.

8 http://www.eirgrid.com/media/Implementing%20SEM%20Decision%20SEM%2011%20062%20in%20Real%20Time%20Operations.pdf

3 Migitation Measures

3.1 Observed Network Limitations:

Appropriate investment in the network is required to minimise the levels of constraints on wind generation output. The Grid25[9], RIDP (Renewable Integration Development Project[10]) and Network25 programmes are the primary methods of addressing network issues in the coming years.

3.2 Notable Outages and Operational Policy

A future long term outage of the HVDC Moyle will be mitigated with the completion of the East West interconnector project, scheduled for autumn 2012, as it too can provide static reserve.

Both Moyle and part of Turlough Hill returned to service in early 2012, though at the time of writing Turlough Hill is still being recommissioned and is not expected to be fully available until June 2012.

In order to provide the ability for priority dispatch counter-trading on interconnectors a pricing framework has been submitted to the Regulatory Authorities. This measure has the potential to significantly reduce levels of dispatch-down of wind, particularly if the interconnector is importing energy into the SEM at night.

To ensure increasing and appropriate levels of controllability EirGrid and SONI have sought, where possible, to standardise testing procedures and rigorously enforce them on all windfarms. To this end all non-compliant windfarms have been given until 1st December 2012 to demonstrate controllability. Furthermore, a comprehensive operational policy to implement the decisions in SEM-11-62 was published on the EirGrid website in November 2011. These combined measures will result in greater portfolio control and an enhanced portfolio performance as they better align the commercial and regulatory incentives.

3.3 DS3 Programme

The fundamental issues that give rise to curtailment have been identified in section 2.2 above, and these issues will be addressed by EirGrid and SONI's Delivering a Secure Sustainable Electricity System (DS3) programme[11]. 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 2.2. Based on published modelling (Facilitation of Renewables studies[12]) 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 the 2020 government policy targets.

The DS3 programme was formally launched in August 2011 and is designed to deliver material operational benefit to curtailment issues. 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 and both Transmission and Distribution System Operators.

[9] Grid25 newsletters are available online: http://www.eirgridprojects.com/grid25/what-is-grid25/
[10] http://www.ridp2020.com/
[11] www.eirgrid.com/operations/ds3
[12] www.eirgrid.com/renewables/facilitationofrenewables

4 Summary of Results

In addition to the graphs presented above, 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.

Table 1 Northern Ireland monthly, quarterly and yearly dispatch-down of wind 2011

Monthly

NI

Month	Volume of Wind Dispatch-Down	All Wind Total Generation	All Wind Possible Generation	Dispatchable Wind Total Generation	Dispatchable Wind Possible Generation	All Wind Dispatch-Down (%)	Dispatchable Wind Dispatch-Down (%)
Jan-2011	-	67,676	67,680	21,106	21,110	0.0%	0.0%
Feb-2011	-	78,479	78,483	20,012	20,016	0.0%	0.0%
Mar-2011	1,346	48,971	50,597	12,413	14,039	2.7%	9.6%
Apr-2011	819	62,714	63,574	14,882	15,742	1.3%	5.2%
May-2011	2,691	122,021	124,927	23,560	26,466	2.2%	10.2%
Jun-2011	143	38,144	38,295	8,383	8,534	0.4%	1.7%
Jul-2011	86	39,750	39,844	10,282	10,376	0.2%	0.8%
Aug-2011	-	41,952	41,955	12,061	12,065	0.0%	0.0%
Sep-2011	2,768	111,526	114,352	25,305	28,130	2.4%	9.8%
Oct-2011	2,826	114,249	117,158	27,351	30,260	2.4%	9.3%
Nov-2011	1,687	135,704	137,445	28,279	30,020	1.2%	5.6%
Dec-2011	1,050	142,566	143,638	35,543	36,615	0.7%	2.9%
Quarterly							
2011 - Q1	1,346	195,127	196,761	53,531	55,165	0.7%	2.4%
2011 - Q2	3,653	222,879	226,796	46,825	50,742	1.6%	7.2%
2011 - Q3	2,854	193,228	196,151	47,648	50,571	1.5%	5.6%
2011 - Q4	5,563	392,519	398,242	91,173	96,895	1.4%	5.7%
Total 2011							
2011	13,415	1,003,753	1,017,950	239,176	253,373	1.3%	5.3%

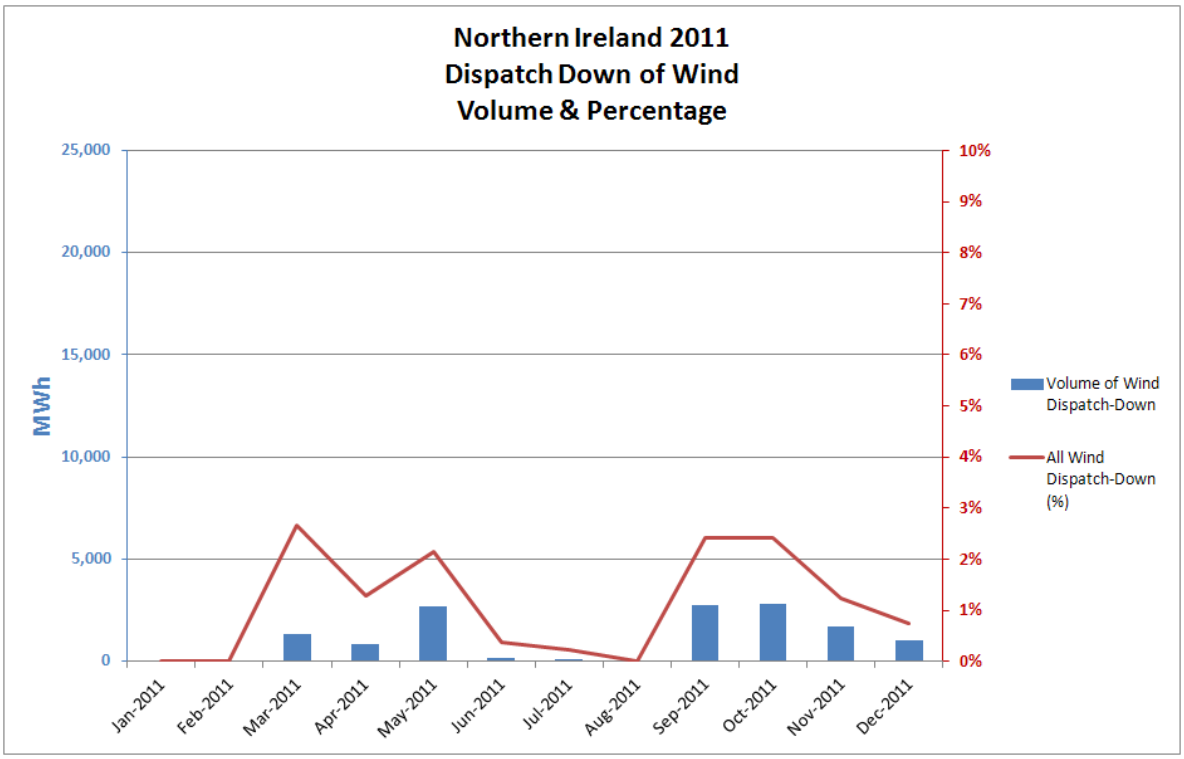

Figure 4 Northern Ireland dispatch-down of wind 2011

Table 2 Ireland monthly, quarterly and yearly dispatch-down of wind 2011

Monthly

IRE

Month	Volume of Wind Dispatch-Down	All Wind Total Generation	All Wind Possible Generation	Dispatchable Wind Total Generation	Dispatchable Wind Possible Generation	All Wind Dispatch-Down (%)	Dispatchable Wind Dispatch-Down (%)
Jan-2011	2,112	266,962	269,161	94,682	96,881	0.8%	2.2%
Feb-2011	2,075	344,915	347,091	118,576	120,752	0.6%	1.7%
Mar-2011	3,649	200,260	204,033	67,884	71,657	1.8%	5.1%
Apr-2011	3,052	241,228	244,420	79,559	82,751	1.2%	3.7%
May-2011	18,857	521,019	540,516	166,453	185,949	3.5%	10.1%
Jun-2011	1,769	226,806	228,681	72,297	74,171	0.8%	2.4%
Jul-2011	6,027	174,703	180,850	51,101	57,247	3.3%	10.5%
Aug-2011	1,263	187,766	189,083	56,197	57,514	0.7%	2.2%
Sep-2011	19,372	470,577	490,493	136,028	155,943	3.9%	12.4%
Oct-2011	21,906	440,279	462,611	125,277	147,610	4.7%	14.8%
Nov-2011	12,077	518,553	531,051	153,678	166,176	2.3%	7.3%
Dec-2011	13,582	614,939	628,823	181,694	195,577	2.2%	6.9%
Quarterly							
2011 - Q1	7,837	812,137	820,284	281,142	289,290	1.0%	2.7%
2011 - Q2	23,677	989,054	1,013,617	318,309	342,871	2.3%	6.9%
2011 - Q3	26,662	833,045	860,425	243,325	270,704	3.1%	9.8%
2011 - Q4	47,565	1,573,771	1,622,484	460,649	509,363	2.9%	9.3%
Total 2011							
2011	105,741	4,208,007	4,316,810	1,303,425	1,412,229	2.4%	7.5%

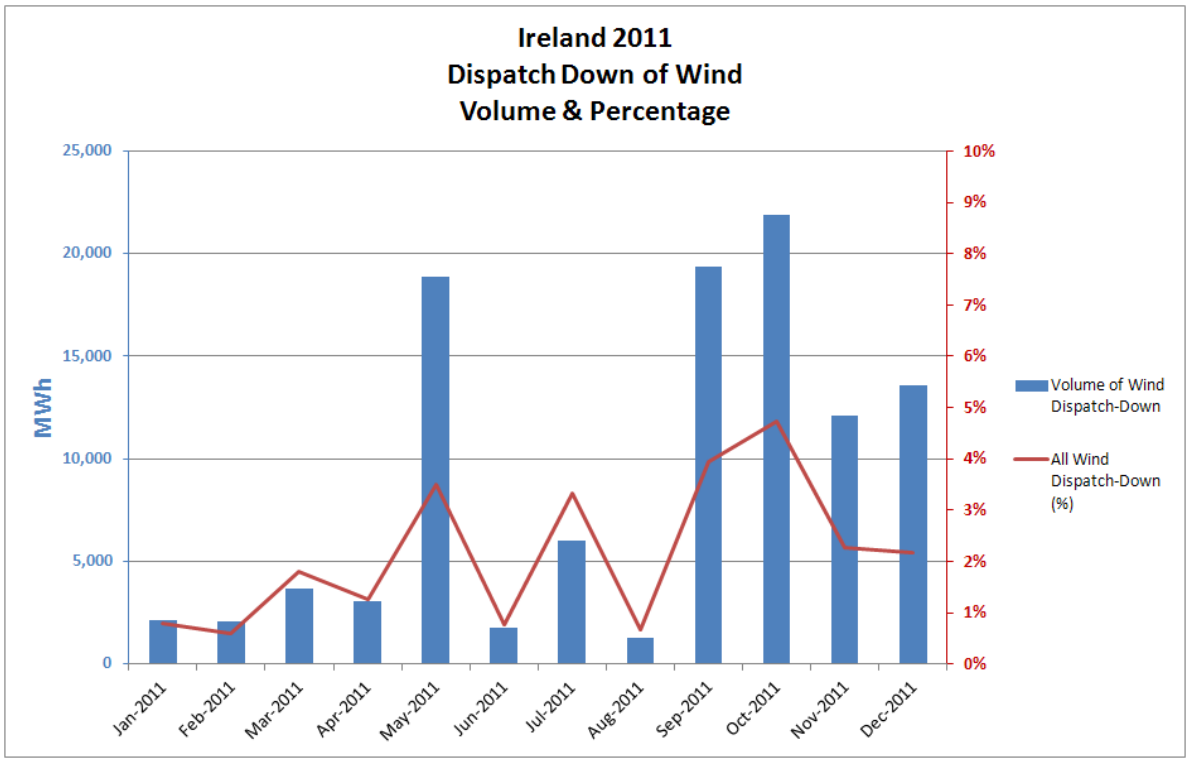

Figure 5 Ireland dispatch-down of wind 2011

Table 3 Ireland and Northern Ireland monthly, quarterly and yearly dispatch-down of wind 2011

Monthly

All-Island

Month	Volume of Wind Dispatch-Down	All Wind Total Generation	All Wind Possible Generation	Dispatchable Wind Total Generation	Dispatchable Wind Possible Generation	All Wind Dispatch-Down (%)	Dispatchable Wind Dispatch-Down (%)
Jan-2011	2,112	334,638	336,841	115,787	117,990	0.6%	1.8%
Feb-2011	2,075	423,394	425,574	138,588	140,768	0.5%	1.5%
Mar-2011	4,995	249,231	254,630	80,297	85,696	2.0%	5.8%
Apr-2011	3,871	303,942	307,994	94,441	98,493	1.3%	3.9%
May-2011	21,548	643,040	665,443	190,012	212,415	3.2%	10.1%
Jun-2011	1,911	264,951	266,976	80,680	82,705	0.7%	2.3%
Jul-2011	6,113	214,452	220,693	61,382	67,623	2.8%	9.0%
Aug-2011	1,263	229,717	231,038	68,258	69,579	0.5%	1.8%
Sep-2011	22,140	582,104	604,845	161,333	184,074	3.7%	12.0%
Oct-2011	24,732	554,528	579,769	152,628	177,870	4.3%	13.9%
Nov-2011	13,764	654,257	668,496	181,957	196,196	2.1%	7.0%
Dec-2011	14,631	757,505	772,461	217,237	232,193	1.9%	6.3%
Quarterly							
2011 - Q1	9,182	1,007,263	1,017,045	334,673	344,455	0.9%	2.7%
2011 - Q2	27,330	1,211,933	1,240,413	365,133	393,613	2.2%	6.9%
2011 - Q3	29,516	1,026,274	1,056,576	290,973	321,275	2.8%	9.2%
2011 - Q4	53,128	1,966,290	2,020,726	551,822	606,259	2.6%	8.8%
Total 2011							
2011	119,156	5,211,759	5,334,760	1,542,601	1,665,602	2.2%	7.2%

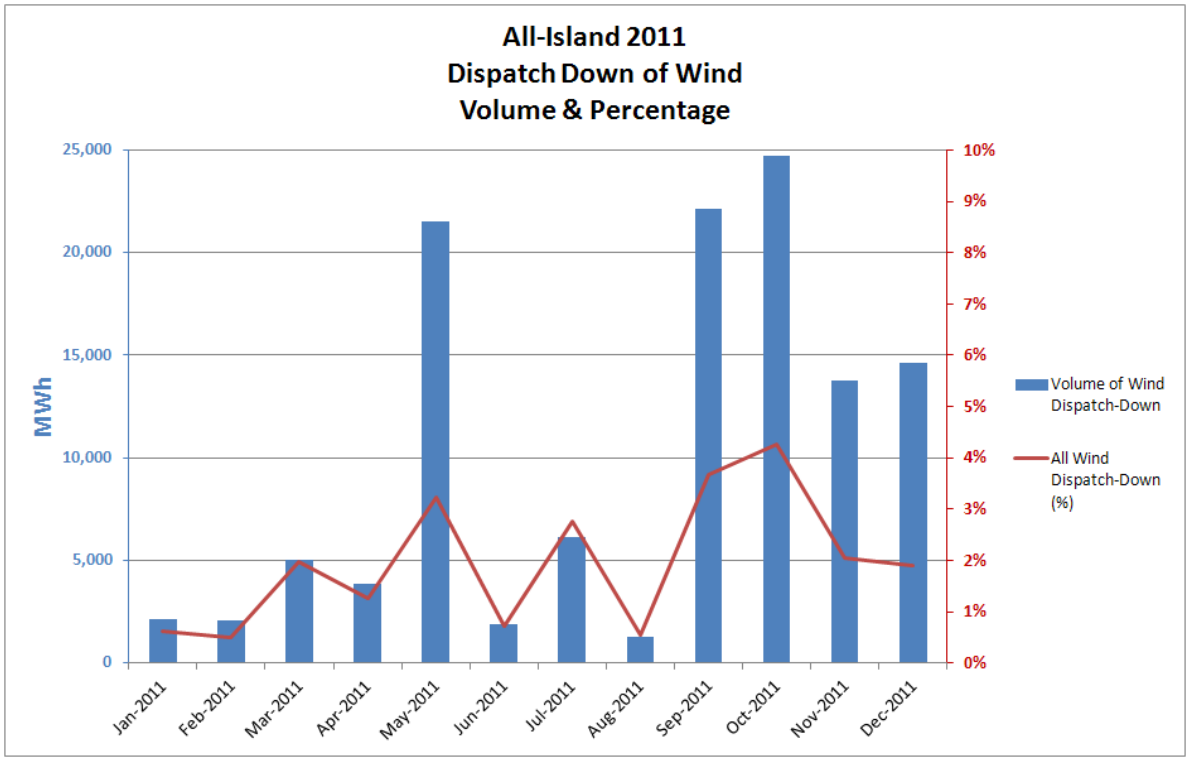

Figure 6 Ireland and Northern Ireland dispatch-down of wind 2011

Table 4 Individual dispatch-down of windfarms 2011[13]

2011 VPTG Reductions				
Jurisdiction	Region	unit ID	Unit_Name	Dispatch-Down Percentage
NI	NI	ALT2	Altahullion 2	3.2%
NI	NI	SLI2	Slieve Rushen 2	6.2%
NI	NI	GAR	Garves	3.0%
NI Average				5.3%
IRE	M	LS1	Lisheen	6.7%
IRE	M	GE1	Gortahile	3.4%
IRE	NE	BD1	Bindoo	5.9%
IRE	NW	MCT	Meentycat	9.5%
IRE	NW	BM1	Beamhill	7.4%
IRE	NW	SN1	Sornehill	11.6%
IRE	SE	RF1	Richfield	5.5%
IRE	SE	BW1	Ballywater	5.4%
IRE	SW	GLC	Glanlee	9.7%
IRE	SW	CG1	Coomagearlahy 1	9.9%
IRE	SW	CJ1	Clahane	3.5%
IRE	SW	CG2	Coomagearlahy 2	8.6%
IRE	W	BT1	Booltiagh	6.1%
IRE	W	DY1	Derrybrien	7.7%
IRE Average				7.5%
			All-Island Average	7.2%

[13] Note that the data provided here is based on publicly available SEM data

Appendix 1 - Methodology

Data Used

The following figures were obtained from the Single Energy Market settlement system:

- DQ (Dispatch Quantities) [MW]
- MG (Metered Generation) [MWh]
- AP [or Avail] (Profiled Availabilities) [MW]
- TPD (Trading Period Duration = 0.5) [hours]

Data from other sources:

- Total wind generation: EirGrid & SONI Operations
- Wind availability signal quality metrics from DAR, EirGrid's Performance Monitoring System

Calculation Methodology

Dispatch-down of wind energy is calculated 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. As a result, the figures presented in this report somewhat under-represent the total level of dispatch down of wind. However, due to the mitigation factors described under operational policy in Section 3.2, it is EirGrid and SONI's view that VPTGs will represent the majority of the dispatch-down of wind going forward and, therefore, this calculation methodology is valid.

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

1. Calculate Dispatched down volume, R [MWh]

   IF Avail = DQ
   THEN R = 0
   ELSE R = Σ[Max(0, Avail*TPD - Max(MG, DQ*TPD))]

2. Calculate Potential Energy Generation, PE [MWh]

   PE = Σ[Max(MG, Avail*TPD)]

3. Calculate Dispatched down level (%)

   Dispatched down levels are calculated in terms of a percentage of both VPTG wind and overall wind potential energy generation:

$$\% \text{ Dispatch down level (VPTG)} = 100 * \frac{R}{PE} = 100 * \frac{\sum R}{\sum_{D} PE}$$

$$\% \text{ Dispatch down level (All Wind)} = 100 * \frac{R}{PE} = 100 * \frac{\sum R}{\sum_{All} MG - \sum_{D} MG + \sum_{D} PE}$$

   Where:

   All: All wind

   D: Dispatchable wind only