Single Electricity Market

Wind Generation in the SEM

Policy for Large-Scale, Intermittent Non-Diverse Generation

Discussion Paper

11th February 2008

SEM/08/002

Executive Summary

This discussion paper is put forward by the Regulatory Authorities (RAs), acting under the auspices of the Single Electricity Market Committee (the SEMC),[1] in order to promote discussion over key issues caused by increasing levels of wind generation on the island of Ireland and the potential solutions to those issues in the context of the Single Electricity Market (the SEM) and in anticipation of the All-Island Grid Study which has recently been published.

A number of wind related issues are considered in this paper and comments are invited both upon the scope of these issues and the potential ways in which they may be resolved. Following the receipt and consideration of the responses to this paper, the RAs intend to issue a further consultation paper in summer 2008 in which comment will be sought on more specific proposals for the way forward on specific wind related matters.

Different governmental support mechanisms exist in Ireland and Northern Ireland for renewable generation. These are provided for by Government and sit outside the core SEM market design and the remit of the RAs. However, they do have a significant influence on the level of wind entry. It is noted that the RAs' remit does not extend to provision of such explicit support for renewables. This paper deals primarily with the SEM and associated system operation issues. The RAs note that against the background of their statutory duties, the principles of equity, cost minimisation, reward for value, competitiveness, transparency and security of supply shall serve to guide decision making regarding the treatment of wind in the context of the above.

The increasing influx of wind generation poses substantial new challenges for the operation and management of the electrical system for a number of reasons. These challenges may impact the future operation of the SEM rules. Wind generation usually connects to the transmission or distribution system in electrically remote locations; the scale of new wind entry is potentially very significant and wind generation has a number of technical characteristics which differ from that of conventional generating plant – it is intermittent in nature, it tends to act together i.e. it is highly correlated, it cannot generally be dispatched upwards, and it is typically less able to provide reactive power and system inertia than conventional generation. In addition, wind has renewable status and in both Ireland and Northern Ireland the Commission, Authority and SEM Committee are required (amongst other things and subject to certain matters) to have regard to the need, where appropriate, to promote the use of energy from renewable energy sources[2].

From a system operation perspective, these new challenges include matters relating to the management of transmission constraints and "curtailments"; system operator incentives; more generally how wind generators should be scheduled and dispatched; and reserve issues.

From the perspective of the Trading and Settlement Code (the TSC), the issues raised are the treatment of wind in the unconstrained schedule and in the setting of System

[1] The SEM Committee is established in Ireland and 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 NIAUR (together the Regulatory Authorities) that, on behalf of the Regulatory Authorities, takes any decision as to the exercise of a relevant function of CER or NIAUR in relation to an SEM matter.

[2] See The Electricity (Single Wholesale Market)(Northern Ireland) Order 2007, Article 9(5) and The Electricity Regulation (Amendment) (Single Electricity Market) Act, Section 9(5).

Marginal Price; compensation for constraints and curtailment, treatment of firm access and the valuation of wind in the capacity payment mechanism.

Views are invited on both the scope and content of matters raised in the paper and will be used to inform more specific proposals in early summer 2008. In carrying out this consultation the RAs are mindful of the need to provide as much certainty as possible to investors regarding the regulatory framework governing the operation of wind generation in the context of the all island wholesale electricity market. To this end, the RAs consider that changes to existing rules and procedures arising from this process will be proportionate and limited to those which are necessary and appropriate. Given the wide ranging matters touched on the RAs consider that it will be necessary to afford priority to certain changes in the context of further, on-going work in other areas. This is discussed further in Section 1 below where matters that the RAs will be addressing as a priority are set out.

Contents

1 Introduction

The SEM, the new all-island arrangements for the trading of wholesale electricity went live on the 1st November 2007. The SEM wholesale energy market design incorporates a gross mandatory pool including a new marginal energy pricing mechanism, a capacity payment mechanism and a series of rules concerning constraint payments for generators.

The SEM encapsulates one element of the All-Island Energy Market Framework[3], including further co-ordination between the System Operators with regard to the management of the electrical system. This includes alignment of the scheduling, and dispatch of all-island generation by EirGrid and SONI, the System Operators in Ireland and Northern Ireland, respectively. The All-Island Energy Framework also covers, among other things, all-island initiatives in the energy sector, for example, an all-island market for gas.

The SEMC was established under legislation[4] in Ireland and Northern Ireland to oversee and direct policy in relation to the above matters.

In parallel with the development of the All-Island Energy Market Framework, the electricity industry is experiencing exceptional entry of intermittent generation, driven primarily by wind generation. This wind generation is at the forefront of the drive towards the achievement of the targets for renewable energy penetration in Ireland and Northern Ireland. Given wind generation's low cost of production, this increased wind penetration has yielded benefits to the Northern Irish and Irish electricity consumer in the SEM. Further wind generation has either received, or is in the application process to receive connection offers to commence construction and generation. Different governmental support mechanisms exist for renewable generation, including wind, outside of the core SEM market design and, indeed, the remit of the RAs.

Whilst currently yielding benefits, wind generation poses new operational challenges to the System Operators. Wind generation typically connects to the transmission or distribution system in locations that are more electrically remote than for conventional[5] generation. Furthermore, wind generation tends to act together as an intermittent infeed to the system, has different technical characteristics[6] and has a renewable status. The above impact on the management of the security and cost of operating the electrical system. These challenges increase with increasing wind penetration, whereas

[3] This framework was agreed between the Department of Enterprise Trade and Investment Northern Ireland (DETINI), the Department of Communications, Marine, and Natural Resource (DCNMR, now the Department of Communication, Energy and Natural Resources), the Northern Ireland Authority for Energy Regulation (NIAER, now the Northern Ireland Authority for Utility Regulation) and the Commission for Energy Regulation (CER) on November 2004.

[4] Electricity Regulation (Amendment) (Single Electricity Market Act) 2007, The Electricity (Single Wholesale Market) (Northern Ireland) Order 2007 SI No. 913(N.I. 7)

[5] "Conventional generation" in this paper at its broadest refers to dispatchable entities whose delivered power, or reduction in power, is not substantially reliant on meteorological conditions. Therefore, conventional generation includes SEM wholesale participants such as Interconnector Units trading on Moyle, and Demand Side Units.

[6] For example, it cannot be dispatched upwards, and has different reactive power and fault ride-through capabilities.

comparable challenges posed by conventional generation's characteristics tend to decrease with increasing conventional investment. While the focus is on wind generation in this paper, if other generation technologies or future generation technologies develop comparable characteristics to wind generation then the same challenges will be presented to the System Operators and similar principles as those arising from this consultation process should apply in their resolution[7].

Throughout the design process of the SEM, the RAs and industry participants have highlighted how the market rules reward and attribute risk to wind generation, given its characteristics, in response to consultations. Certain design elements of the SEM have been flagged in regulatory decision papers as requiring further review within the context of future increasing wind penetration. There also remains great industry interest in the methods that will be employed by the System Operators to operationally incorporate the increased levels of wind generation into the developing all-island dispatch processes, within the context of European and governmental targets for renewable generation.

In this context, and in light of the recent publication of the results of the All Island Grid Study, the RAs now commence a review of the SEM rules for wind guided by their legal remit and that of the SEMC and under the guiding principles set out in Section 2 of this paper, while being cognisant of wider targets for renewables. This discussion paper seeks initial comment from industry on these matters, in particular within the context of market design and system operator practices. The RAs particularly welcome comments related to the appropriateness and cost-reflectiveness of the existing treatment of wind in comparison to conventional generation.

The next Section of this paper gives further background to this topic including more detail as to why wind in particular is the focus of this review, and why this review is pertinent at this time. In Section 3 certain areas in relation to wind that the RAs consider should now be addressed as a priority are highlighted. These specific areas relate to the impact of large penetration of wind generation on:

I. the processes by which the System Operators create a secure economic dispatch, including the definition of the term 'curtailment' in this context;
II. the compensation of wind generation, with and without firm-access, when constrained down[8] in comparison to conventional generation;
III. the calculation of the market System Marginal Price, and
IV. the remuneration of wind generation within the capacity payment mechanism.

Item I. above is examined in Section 4.2. Items II. to III. are dealt with in Sections 4.3.1 to 4.3.3 of this paper. Item IV. is examined in Section 4.3.4. .

In addition to the above, with regard to the on going development of market rules, readers should note that the RAs intend to undertake a review of the TSC market rules in relation to the treatment of firm-access for Price Taking Generator Units in order to align this with previous policy directions regarding firm and non firm access both jurisdictionally under the group connection process in Ireland, and on an all-island basis (the SEM High Level Design). This is discussed further in Section 4.3.1 of this paper.

[7] For example, if wave generation produces significant levels of power.
[8] The term "curtailment" is sometimes used in industry, specifically in relation to wind, for constraining down wind arising from the challenges presented by wind. This is discussed further in Section 3 of this paper.

Readers should note that renewables targets and associated support for renewables are matters for government and, as such, outside of the direct remit of the RAs and the scope of this review.

Informed by comments received regarding the matters raised in this paper, and by the guiding principles set out in Section 2, the RAs will formally consult on the enduring policy governing wind generation and, by extension, any other forms of generation which present the same challenges to secure, economic all-island dispatch. This consultation will occur in early summer of 2008. In carrying out this review the RAs are mindful of their statutory duties in relation to renewables and of the wider legislative requirements in relation to the all-island market. To this end, the RAs consider that changes to existing rules and procedures arising from this process will be proportionate and limited to those which are necessary and appropriate, with priority afforded to certain matters as set out above. Furthermore, the consultation that will occur in early summer 2008 will take a practical approach to progress the treatment of wind in the SEM; there are in train other bodies of work which are managing aspects of the areas discussed within this paper. Consequentially, readers should be aware that the development of particular aspects of the treatment of wind in the SEM, for example the interaction of wind and ancillary services, may be brought forward in parallel under different processes.

Comments on any of the issues raised in this document should be returned, preferably in electronic format, by 1700hrs on Monday, March 10th to:

Aoife Crowe	Juliet Corbett
acrowe@cer.ie	juliet.corbett@niaur.gov.uk
Commission for Energy Regulation	Northern Ireland Authority for Utility Regulation
The Exchange	Queens House
Belgard Square North	14 Queens Street
Tallaght	Belfast
Dublin 24	BT1 6ER

All comments received will be published unless marked confidential. Bilateral and multilateral meetings will be held on request with interested parties to discuss the matters raised in this paper and in responses to it in advance of the further consultation in early summer 2008. Should you wish to arrange a bilateral meeting to discuss these matters, please either contact one of the individuals identified above or indicate your desire/willingness to meet in your response to this paper.

Respondents may wish to refer to the following decision papers which the SEMC considers may be of relevance to this review of wind policy within the SEM:

- SEM High Level Design AIP/SEM/42/05, setting out connection policy principles
- High Level Design of the Capacity Payment and Reserves AIP/SEM/53/05
- Transmission Use of System Charging AIP/SEM07/50
- The Value of Lost Load, the Market Price Cap and the Market Price Floor, AIP/SEM/07/484
- Consultation on Ancillary Services AIP/SEM/07/447, decision pending

- Revisions to the Criteria for Approval of Intermediary Applications under the Trading and Settlement Code SEM/07/11

These papers and further information regarding the development of the SEM can all be found on the All Island Project website at www.allislandproject.org. In addition, readers are directed to the All Island Market for Electricity website at www.allislandmarket.com where the TSC and associated market documentation can be viewed.

2 Guiding Principles

In reaching decisions regarding the matters consulted upon under this process, the RAs, acting within their legal remit, will be guided by their legal duties and functions and by the following principles:

- Equity
- Cost minimisation
- Value reflective pricing
- Competitiveness
- Transparency
- Security of supply

It is in this context that the RAs will determine, inter alia, how wind is rewarded in the market via the SMP, constraint payments, ancillary services payments and capacity payments. Decisions regarding provision of support outside of the SEM mechanism to wind in addition to market revenues earned rest with government.

3 Background

3.1 The Single Electricity Market

The SEM, the new all-island arrangements for the trading of wholesale electricity, went live on the 1st November 2007. Its design includes wholesale trading arrangements for electricity which incorporate the following key features:

- a gross mandatory pool incorporating a new non-regulated energy pricing mechanism;
- a capacity payment mechanism; and
- a series of rules concerning constraint payments for generators.

The introduction of the SEM was underpinned by new legislation[9] in both Ireland and Northern Ireland each of which includes provision for joint regulation of the wholesale electricity market arrangements through the SEM Committee as well as movement towards harmonisation of many electricity transmission related matters. Areas in which steps towards all-island harmonisation have already been taken include generation scheduling and dispatch, the processing of new connection applications, transmission access pricing, connection and use of system arrangements and transmission investment planning. In some areas these matters are now jointly carried out on a harmonised all-island basis by the two System Operators (EirGrid and SONI[10]) and in other areas, certain steps have been taken towards this broad objective.

It is noted that the Single Electricity Market is one element of the All-Island Energy Market Framework[11]. This framework covers, among other things, all-island initiatives in the energy sector and all-island harmonisation of the operation of the electrical system.

In parallel with the introduction of the SEM and the further development of the All-Island Energy Market Framework, the electricity industry is experiencing exceptional entry of intermittent generation, driven primarily by wind generation. This wind generation is at the forefront of the drive towards the achievement of the targets for renewable energy penetration in Ireland and Northern Ireland. A substantial amount of wind generation has either received, or is in the application process to receive connection offers to connect to the transmission and distribution systems on the island. Different governmental support mechanisms exist in Ireland and Northern Ireland for renewable generation. These are provided for by Government and sit outside the core SEM market design, the remit of the RAs and the SEMC and, hence, this consultation process.

3.2 SEM Issues arising from Increased Levels of Wind Penetration

During the design phase of the SEM a number of issues were flagged in regulatory decision papers as requiring further subsequent review within the context of increasing wind penetration. There also remains great industry interest in the methods that will be

[9] Electricity Regulation (Amendment) (Single Electricity Market Act) 2007, The Electricity (Single Wholesale Market) (Northern Ireland) Order 2007 SI No. 913(N.I. 7)

[10] Including, in the case of investment planning in Northern Ireland, NIE T&D.

[11] This framework was agreed between the Department of Enterprise Trade and Investment Northern Ireland (DETINI), the Department of Communications, Marine, and Natural Resource (DCNMR, now the Department of Communication, Marine and Natural Resources), the Northern Ireland Authority for Energy Regulation (NIAER, now the Northern Ireland Authority for Utility Regulation) and the Commission for Energy Regulation (CER) on November 2004.

employed by the transmission System Operators (SOs[12]) to incorporate operationally the increased levels of wind generation into the developing all-island dispatch processes, within the context of European and governmental targets for renewable generation.

The increasing penetration of wind generation poses substantial new challenges for the SEM for a number of reasons. First, wind generation usually connects to the transmission or distribution system in electrically remote locations; this means that additional network infrastructure is required to transport the energy from where it is generated to where the electricity is consumed. Second, the scale of new entry wind is potentially very significant. For example, the Irish Government's White Paper on Energy sets out the Irish Government's energy policy framework for the period 2007-2020 and includes a target of 33% of electricity consumption from renewable sources by 2020. In the UK, the Energy White Paper also contains a target to see renewables grow as a proportion of energy supplied to 10% by 2010, with an aspiration that this level double by 2020. Differing support mechanisms for renewable generation exist in Ireland and Northern Ireland to facilitate achievement of these targets. In addition to the above the All Island Grid Study published recently examines the technical feasibility of and assesses defined costs and benefits in relation to increasing penetrations of renewables on the island.[13]

Third, wind generation has a number of technical characteristics which differ from that of conventional generating plant. Wind generation projects are typically smaller than existing power stations, but are very numerous. In addition, wind generation, by its nature, is intermittent (with a degree of unpredictability), and non-diverse. By "intermittent" it is meant that wind generation's availability to generate electricity varies with meteorological conditions. "Non-diverse" is defined in this context as meaning that there is a degree of correlation between the behaviour of wind power stations across the all-island electricity system, i.e. if wind is light in the south-west of the island, there is a strong chance that wind will also be light in the north-east. This intermittent non-diverse nature, combined with the number and scale of the wind stations connected or seeking to connect to the all-island system, means that together wind generation constitutes the largest single correlated in-feed loss to the all island system[14]. Furthermore, with wind's low short run marginal cost of production, it is likely that conventional generation will be increasingly utilised in a reserve capacity to support wind intermittency.

Because of the intermittent nature of wind generation, and in order to maintain security of supply, it is necessary to ensure that there exists back-up conventional plant which is able to generate to meet demand in the event that wind generation is not available. The reliance on conventional generation to support wind generation reduces the economic and environmental benefit of wind. Studies have shown that the greater the level of wind generation, the greater the aggregate amount of installed generation capacity required to maintain a given security of supply and the lesser the benefits that accrue from additional wind. Finally, wind generators are typically less effective in their ability to provide reactive power and system inertia than conventional generation. These factors have additional consequences for system operation.

[12] EirGrid in Ireland and SONI in Northern Ireland.

[13] http://www.dcmnr.gov.ie/Energy/North-South+Co-operation+in+the+Energy+Sector/All+Island+Grid+Study.htm

[14] If other generation technologies or future generation technologies develop comparable characteristics to wind generation then the same challenges will be presented to the System Operators and similar principles as those arising from this consultation process should apply in their resolution.

Overall, wind generation has a low short run marginal cost which, despite the cost of supporting conventional generation, aids the reduction in the cost of the production of electricity at existing levels of penetration. With increasing penetration, the cost incurred by wind production with regard to the constraints paid to supporting conventional generation, an increasingly inefficient schedule and dispatch of conventional generation[15] and the level of any constraint compensation to wind when constrained down, will erode the marginal benefits of wind power. With very high levels of wind penetration, the question arises as to whether all wind should be taken in all circumstances where technically feasible, irrespective of the ultimate cost to the consumer. Such trade-offs are not yet binding, but the questions posed above in relation to such situations will become increasingly pertinent as wind penetration increases.

3.3 Renewables Targets

Policy in the renewables sector has largely been driven by developments on a European level. In September of 2001 Directive 2001/77/EC[16] was adopted by the European Parliament and the Council of the European Union. This Directive aims to promote an increase in the contribution of renewable energy sources to electricity production and to create a basis for a future Community framework thereof. It sets out national indicative targets for electricity produced from renewable energy sources by 2010. The indicative target for Ireland for energy under this Directive is 13.2% by 2010**.** The UK has an electricity target of 10% from renewable generation. The Department of Enterprise Trade and Investment's Strategic Energy Framework for the proportion of electricity that is generated from indigenous renewable sources by 2012 contains a current target of 12%.

Overall, increasing focus has been placed on sustainable, competitive and renewable energy within the European context. It is has been proposed[17] that the EU achieves a contribution of 20% of its energy mix from renewable energy sources by 2020, and to support this target by building on the existing legislative framework.

The increasing focus on renewables at EU level has been mirrored in Ireland and Northern Ireland, both jurisdictionally and on an all-island basis. The Irish Government's White Paper on Energy sets out the Irish Government's energy policy framework for the period 2007-2020[18] sets a target of 33% of electricity consumption from renewable sources by 2020 and states that an all-island target for renewable energy will be set with Northern Ireland Authorities in 2007, informed by an the All-Island Grid Study discussed below.

In the UK, the Energy White Paper also contains a target to see renewables grow as a proportion of energy supplied to 10% by 2010, with an aspiration that this level double by

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[15] As the magnitude of wind generation's variability increases with increased installed capacity, more mid-merit plant will be required to displace the cheaper generation, or base-load plant may be cycled incurring start-up and no-load costs. In parallel, depending on the treatment of wind within the market schedule (see Section 4), and the accuracy of wind forecasts, the System Operators may find that their dispatch diverges from the market schedule, leading to increased constraint payment compensation to conventional generation.

[16] The promotion of electricity produced from renewable energy sources in the internal electricity Market, the "RES-E directive".

[17] See the Renewable Energy Roadmap at http://europa.eu/scadplus/leg/en/lvb/l27065.htm

[18] Government White Paper: Delivering a Sustainable Energy Future for Ireland, The Energy Policy Framework 2007-2020, Department of Communications, Marine and Natural Resources , March 2007

2020. The Department of Enterprise Trade and Investment's (DETI) Renewables target is 12% by 2012, of which 15% should be from non-wind renewable sources, as stated in DETI's Strategic Energy Framework for Northern Ireland, published in June 2004. Finally, the Renewables Obligation Order (Northern Ireland) 2007 contains a target of 6.3% of total energy supplies to come from renewable sources by 2012.

While the Regulatory Authorities are not specifically tasked to deliver these targets, it is appropriate to be cognisant of these European, governmental, and departmental commitments to ensure that the SEM does not hinder their achievement, and continues to operate appropriately with such levels of renewable generation. A further description of the RAs' duties in the context of renewable generation is set out in Section 3.5.

Practically speaking, it is expected that the drive towards the renewable targets set out above will be facilitated primarily by wind. Indeed, a significant amount of wind generation is connected or is in the process of connecting to the transmission or distribution systems on the island of Ireland. Over 8000MW of wind is currently in the connection queue in Ireland and Northern Ireland. This is being facilitated by the group connection process in Ireland; a similar "cluster" approach is under consideration in Northern Ireland.

3.4 The All Island Grid Study

In July of 2005, the Governments of Ireland and Northern Ireland jointly issued a preliminary consultation paper on an all-island '2020 Vision' for renewable energy. The paper sought views on the development of a joint strategy for the provision of renewable energy sourced electricity within the All-island Energy Market leading up to 2020 and beyond, so that consumers, North and South, could continue to benefit from access to sustainable energy supplies provided at a competitive cost. Within the context of the All-island Energy Market Development Framework agreed by Ministers in November 2004 and the undertaking to develop a Single Electricity Market, views were sought on how the electricity infrastructure on the island might best develop to allow the maximum penetration of renewable energy.

The July 2005 consultation paper identified that further information was required on the resource potential for different renewable technologies on the island of Ireland in 2020, the extent to which partially dispatchable and non-dispatchable generation can be accommodated, network development options and the economic implications of the policy options outlined within the paper.

A working group was established to specify and oversee the completion of studies that would provide more detailed information on the above issues. The working group recommended an "All Island Grid Study" comprising four work-streams.

The conclusions of this All Island Grid Study are now published and may have a significant bearing on the future development of renewables, including wind, on the island of Ireland. It is expected that responses to this consultation will be advised by analysis of and debate regarding the results of the All Island Grid Study.

3.5 Summary of Regulatory Authority Duties in the Context of Renewables

The duties of the CER and NIAUR and of the SEM Committee in relation to SEM matters are set out in the SEM related legislation in Ireland and Northern Ireland. In the case of

Ireland, this is the Electricity Regulation (Amendment) (Single Electricity Market) Act 2007 and in Northern Ireland the 2007 Electricity Order[9]. Both the CER and NIAUR have similar duties in relation to SEM matters which principally include the protection of consumers in both Ireland and Northern Ireland wherever appropriate by promoting effective competition. In each case, when carrying out their functions the RAs must also have regard to, *inter alia,* the effect on the environment in Ireland and Northern Ireland and the need, where appropriate, to promote the use of energy from renewable sources. In carrying out the relevant duties pertaining to renewables as set out in SEM legislation and referred to above, the RAs are cognisant of the EU Directive pertaining to renewables.

It is noted here that Section 6 of the Electricity Regulation (Amendment) (Single Electricity Market) Act 2007 amends Section 9 of the Electricity Regulation Act 1999 and in doing so provides that, where the SEM is in operation, subsections (3), (4) and (5) of that Section shall not apply in relation to an SEM matter. These subsections pertain to various matters to which the Commission must have regard and certain duties, including that to require that the System Operator gives priority to generating stations using renewable, sustainable or alternative sources when selecting generating stations.

In November 2004 the Development Framework (the Framework) for an All-Island Energy Market was published by the DCMNR, DETINI and the Regulatory Authorities. This gave rise to the establishment of harmonised working arrangements for the System Operators, the all-island Single Electricity Market Operator and the Single Electricity Market (SEM).

The Framework states "*the All-island Energy Market should be capable of meeting the increasing energy requirements of the island in ways that are compatible with national and EU sustainable energy policies and targets".* The RAs are tasked within the Framework with responsibility for wind energy market policy in the context of the SEM. Under the Memorandum of Understanding issued by the RAs in 2004 regarding the all island electricity market, a commitment was made to co-operate in developing a consistent market approach to the development of renewable energy sources and to the treatment of greenhouse gases.[19]

It is reiterated that any support mechanisms and targets for renewables are a matter for Government and not the responsibility of the RAs.

[19] Memorandum of Understanding between CER and Ofreg/NAIER in relation to an All Island Electricity Market, 23 August 2004.

4 Wind Related Issues in the SEM

4.1 Introduction

This Section sets out a discussion of some of the issues that increasing levels of wind penetration give rise to in the context of the SEM. For convenience, the analysis of the issues is split into a number of categories including: the treatment of wind in system operation and the procurement of ancillary services and the treatment of wind in the TSC from an energy and capacity perspective.

In considering the potential issues that may arise from increasing levels of wind penetration, it may be possible to identify specific solutions to address particular issues. In doing so, it is important to keep in mind the overall context in which these solutions are being developed. The RAs, as indicated in Section 1 above, deem it appropriate to prioritise decision making on and implementation of certain issues in order to maintain the efficiency of the SEM wholesale market with increasing levels of wind penetration. The relevant matters, namely system operator practices and treatment of wind in the TSC, are set out in this Section 4. Issues that should be noted when addressing the above, such as the rules and processes regarding the processing of connection applications on the island and associated pricing are set out in Section 4 of this document.

A consultation will occur in early summer 2008 drawing from the discussion raised in this paper. Note that this future consultation will take a practical approach to progress the treatment of wind in the SEM as there are already in train other bodies of work which are managing aspects of the areas discussed within this paper. Consequentially, readers should be aware that the development of particular aspects of the treatment of wind in the SEM, for example the interaction of wind and ancillary services, may be brought forward in parallel under different processes.

4.2 System Operation and Ancillary Services

This Section considers a number of the system operation and ancillary services issues which arise from increasing levels of wind. The market unconstrained schedule and the associated setting of wholesale market prices are discussed below.

4.2.1 Dispatch and Scheduling

To the extent that substantial numbers of new wind generators are granted access to the SEM market prior to the construction of adequate levels of new transmission and distribution infrastructure, it is likely that transmission operation will become increasingly constrained. This issue is likely to initiate further debate in a number of areas.

First, there is the question of whether more innovative means of managing transmission constraint issues can be adopted. For example it may be appropriate to consider how the System Operators[20] are incentivised to manage constraints costs on all timescales on an all-island basis. This would include incentives to invest to minimise constraint costs, to optimise operational planning arrangements, for the efficient purchasing of

[20] And possibly also NIE T&D in Northern Ireland

ancillary services and for cost optimisation in the real-time scheduling and dispatch of generation. The design and implementation of any incentivisation package for the System Operators around the treatment of transmission constraints would need to form part of a wider review of regulatory revenue/price control for the System Operators which would include other applicable incentives.

As intermittent non-diverse wind generation penetration increases greater amounts of total installed capacity is needed are to meet a given security of supply. The System Operators schedule all conventional generation in the SEM, including Interconnector Units and Demand Side Units, and wind generation, to meet demand day ahead based on 48-hour ahead forecasts of wind generation and conventional generator and transmission line outage information. EirGrid and SONI then currently dispatch the generation within each individual jurisdiction around these all-island schedules. When this all-island schedule (which is recalculated by the System Operators throughout the day) materially changes due to, for example, the receipt of improved wind forecast information[21] or an unexpected generator outage, the System Operators communicate the new updated generation schedule to generators. In this way the System Operators seek to schedule the appropriate conventional generation to meet the wind-load balance at any given time.

As wind penetration increases, errors in the wind forecasts are more likely to lead to an increased number of updated schedules being issued to generators throughout the day. Better long-term wind forecasts would be likely to facilitate firmer schedules of conventional generation more appropriate to accommodating wind generation. An alternative would be a formalised rolling scheduling methodology, or one that is produced and communicated on a set timetable, as is more common in ex-ante markets with short rolling gate closures. This could help to ensure that more appropriate conventional plant is scheduled to meet the likely output and change in output of wind generation. Such a formalised rolling schedule may have operational impacts on both the System Operators and on conventional generation, for example in the area of fuel procurement.

Another issue is that of which generating stations should be constrained down to alleviate the export constraints likely to arise from greater levels of wind generation. Under the existing scheduling and dispatch processes wind generation is generally treated as a price taker[22] and specific prices are not submitted for individual wind generators. This poses a potential problem for System Operators when required to choose between two wind-stations. If there are no prices (or equivalent, effective prices of zero) which the System Operators can use to aid in the decision as to which wind generator to constrain down, then an alternative means of selection will be needed. There are a number of potential solutions ranging from adopting a first-come-first served (in the connections process) approach and pro-rating, through to requiring wind generators to submit prices for scheduling and dispatch purposes. Alternatively it would be possible to permit the System Operators to choose purely on technical grounds when possible, for example depending on the specific ability of a wind generator to alleviate the transmission constraint, its relative impact on transmission losses, and/or its other technical characteristics.

[21] Wind forecasts are updated every six hours.
[22] The plant is given priority in meeting demand in the unconstrained schedule but does not set price.

The discussion above assumes that the generators in question have the same degree of firm access. Where this is not the case, then this must also be considered along with costs in the decision making process when constraining. The latter may be a deciding factor when there is a choice between constraining down wind generators and other price taking generation or between wind and conventional plant.

It is noted that in conjunction with the concept of being constrained for system security reasons the use of the term "curtailment" has become increasingly used in relation to wind generation. The possibility of the need to constrain down wind for system security, and potentially economic (where appropriate to the definition of curtailment), reasons and the level of compensation that is attracted in such instances has been raised. Nationally and internationally, curtailment has been used to describe a variety of concepts, from the constraining down of wind for wind-only related issues, and more widely for any form of constraint, including transmission constraints[23]. To facilitate discussion the System Operators have provided the RAs with their agreed definition of 'curtailment', as distinct from 'constraint'. This is included in Appendix A of this document for review and comment. [24] Comment on the matter of compensation for curtailment is sought in Section 4.3.2*.*

The RAs invite comment on the matters raised above, including comments regarding the following:

- ***incentivisation of the System Operators regarding the management of constraints on an all island basis including suggested high level approaches to such incentivisation;***
- ***should the introduction of rolling dispatch scheduling and wind forecasting be considered in the context of increasing wind penetration;***
- ***guiding principles for decision making by the System Operators and factors to be taken account of in relation to constraining down of wind and other generation, specifically in the situations outlined above, and***
- ***the definition of 'curtailment' as provided by the System Operators.***

4.2.2 Contingency Operational Reserve

Contingency operational reserves are held by the System Operators to deal with large unexpected reductions in generation. That is, if a plant trips unexpectedly, other fast-ramping generation is kept available to quickly restore the generation-demand balance. Generators receive payment for such operational contingency reserves, which are

[23] http://www.sd-commission.org.uk/publications/downloads/Wind_Energy-NovRev2005.pdf; the utilisation of the term curtailment throughout the All-Island Grid Study work-stream reports; and "*System Operation with High Wind Penetration. The Transmission Challenges of Denmark, Germany, Spain and Ireland*", Eriksen, P.B., Ackermann, T., Abildgaard, H., Smith, P., Winter, W., and Rodriguez Garcia, J.M. Vol. 3, Issue 6, pp. 65-74, Power and Energy Magazine, IEEE, 2005.

[24] The commercial arrangements regarding constraints under the TSC are dealt with in Section 3.3.2.

procured by the System Operators under the terms of system support/ancillary services contracts. In the event that wind generation is constrained down and can quickly increase output, consideration should be given to wind generation's ability to access operational reserve payments. Such payments to wind would need to be cognisant of the degree of predictability of wind generators to return to previous levels over the operational reserve timescales.

In the context of increasing amounts of wind generation on the system, one option is to continue to use existing reserve products to manage the unexpected variability of wind. This may result in reduced transparency in relation to the reserve required for wind and may not serve to best incentivise the provision of the required reserve. A reserve product to manage the unexpected variability of wind could also be considered, giving transparency to the operational strategies employed by the System Operators in utilising wind forecasts to securely incorporate wind into the scheduling and dispatch process.

Such a reserve product would provide a degree of incentivisation to generation to provide such a service, and would mitigate the possibility that conventional operational reserves may be utilised to manage unexpected falls in wind production.

Note that a wind reserve product would need to facilitate a response to unexpected decreases or increases in wind generation output. An entity that accesses such a reserve product would need to be able respond by increasing or decreasing generation (or vice versa for responsive demand) in response to unexpected decreases or increases in wind generation.

The cost of reserves in general is currently recovered through a socialised charge. A previous AIP decision paper (AIP/SEM/53/05) rejected the principle of causer-pays for reserves, but does raise the potential of recognising the impact of a new plant which affects the total reserve requirement at the time of its connection. A further decision paper addressing reserves is due imminently following a detailed consultation on ancillary services (AIP/SEM/07/447). This high level decision paper will deal with procurement and payment methods for defined classes of reserves and ancillary services and the mechanism for cost recovery. While this discussion paper on the treatment of intermittent generation in the SEM seeks respondents to comments on the interaction of wind generation and reserves within the broader context of scheduling and dispatch, it is noted here that development and implementation of all-island reserves will form a parallel piece of work, and interested readers are directed to the imminent decision paper on ancillary services on how this shall be taken forward.

The RAs invite comment on the matters raised above, including comments regarding the following:

- ***the ability of wind generators to provide reserve***
- ***the possibility of alternative reserve products to manage the variability of wind generation***

4.2.3 Other Ancillary Services

In addition to increased levels of contingency operational reserve, it is likely that a greater reliance on wind generation will give rise to increased requirements for voltage support. The reasons for this are that it may be needed to support additional power flows on the electrical networks as a consequence of wind generation connecting in areas more remote from electrical demand and that wind generation technology is itself typically a less flexible provider of reactive power than conventional generation. Reactive power capability and delivery is procured by the System Operator through ancillary services/system support contracts. Wind generators that can demonstrate the ability to provide reactive power under the terms of the Grid Codes can also access these reactive power reserve payments.

Because investment in the transmission and distribution systems can also have a significant bearing on the need for voltage support, the interaction between procuring voltage support as an ancillary service or through additional transmission/distribution investments also needs to be considered. In this case, the charging and payment arrangements as well as the incentive mechanisms will need to be considered in conjunction with equivalent arrangements for funding and incentivising transmission investments (as well as for managing transmission constraints in general). Readers should note the imminent decision paper on the procurement of Ancillary Services mentioned above.

4.2.4 Grid Code Requirements and Compliance of Conventional and Wind Generation

The wind provisions of the Grid Codes set out various requirements for wind generation, such as the ability to be controlled down.

EirGrid and SONI are monitoring ongoing Grid Code compliance of all generators. The collation of this information will further allow the consideration of appropriate and necessary steps to resolve any areas of non-compliance. Furthermore, as compliance information becomes available from these reviews, consideration could be given to extending the requirements on conventional generation, e.g. in particular with regard to minimum generation capabilities, where practical and appropriate to accommodate minimisation of constraining down wind generation within the all-island dispatch. The

compliance of conventional generators with the Grid Codes, in particular relation to 'wind friendly' attributes such as low minimum generation levels, fast ramp rates, could be examined in the context of this review.

The RAs invite comment on the matters raised above, including comments regarding the following:

- ***is there benefit to examining the current requirements on conventional generators under the Grid Codes with a view to extending those requirements in light of increasing wind penetration on the all island system?***
- ***what specific attributes could be examined in this context?***

4.2.5 Utilisation of Interconnection with BETTA

A number of the operational issues associated with wind generation identified above may, to a certain extent, be mitigated through existing or increased interconnection with Great Britain. The correlation of unavailability of wind generation across both BETTA and the SEM is likely to be less than that in either of the two markets on their own. Furthermore, there may be time delays between unavailability of wind in the SEM and unavailability of wind in Great Britain. In either case, there may be opportunities for reserve and/or capacity sharing and a consequent reduction in the overall costs of accommodating additional wind generation.

Under the SEM, commercial trading with the British Electricity Trading and Transmission Arrangements (BETTA) occurs based on day-ahead offers by Gate Closure which are made firm for the subsequent Trading Day. The Northern Ireland System Operator is the only entity which can utilise more up-to-date wind generation information to access inter-day power trades from BETTA through the mechanism of System Operator to System Operator trades. These up to real-time trades are utilised to procure or provide operational reserves, and the trades have a resulting impact on generator dispatch and consequentially on the total constraint payments within the SEM. It is recognised that to provide commercial access to the Interconnector to market participants in real-time within the SEM would require a substantial impact analysis against the market principles of simple offers, long gate closure and central commitment.

4.3 Trading and Settlement Code Arrangements

This Section sets out a number of TSC issues associated with wind generation.

4.3.1 Wind in the Unconstrained Schedule

Wind's Input into the Unconstrained Schedule: Within the TSC, wind generation that registers as a Price Taker, is granted the commercial benefits of fully firm commercial access, irrespective of the status of their connection agreement, dispatch, or load to be met. Price Making generation receives firm commercial access to the unconstrained

schedule based on the level of its availability submitted by the System Operator, limited by its level of firm access where it has registered as a non-firm generator in the SEM and subject to the market demand target. Therefore, wind generation that chooses to register as a Price Taker is currently paid for what they could generate, even in scenarios where the wind generation has been constrained down, for example, even during an excessive generation event. During an excessive generation event, the SMP is set to the negative price floor. Therefore under such circumstances, wind would pay for the greater of what it generated and what it could have generated if it chooses to register as a Price Taker.

The RAs consider that the current TSC rules in relation to the treatment of firm-access, irrespective of the form of registration of a generator, need to be aligned with the overall previously stated policies in this area, such as the SEM High Level Design and decisions regarding the Group Connection Process in Ireland[25]. The SEM High Level Design Decision Paper (AIP/SEM/42/05) states the following regarding firm access:

Where deep reinforcements are not complete it is expected that a plant will be granted Firm Physical Capacity for a portion of Maximum Export Capacity (MEC). The plant will then receive Firm Physical Access and constraint off payments for the portion of their plant with Firm Physical Access. The plant will receive non-firm physical access for the remainder of the MEC and no off constraint payments until deep reinforcements are complete and the plant is then given firm physical access. It should be noted that the level of firm physical capacity may change as and when deep reinforcements come on stream.

The SEM High Level Design is reflected in the TSC for Price Makers as they may only receive a market schedule, impact on price and receive constraint payments to the level of their firm access. This has not been reflected yet in the TSC with regard to Price Takers. The RAs intend to amend the Trading and Settlement Code to reflect this policy decision as soon as practical and to ensure that Price Taker generators will only receive constraint payments to the extent that they are constrained down below the level of their firm access.

Wind's Incorporation within the Unconstrained Schedule: More generally, the fact that wind generation (in the event it opts to be a Price Taker) is not scheduled in price order in the unconstrained schedule and that it is not permitted to set prices, means that there may be certain instances in which it is (implicitly) scheduled to run even though system marginal prices are below its avoidable cost. Given the relatively low avoidable costs of wind (and possibly negative avoidable costs where revenues from renewable subsidies are linked to actual output) the circumstances where this might arise are currently relatively rare. However as more wind generation joins the market the likelihood of excessive generation events occurring and default negative prices being adopted increases. Furthermore, there is an increasing likelihood that the total unconstrained generation requirement may be met by price taking generation.

Another feature of the treatment of wind in the unconstrained schedule is that in principle, under the existing trading and settlement rules, there is no limitation on the quantity of price taking generation that is deemed to be scheduled, even if the quantity exceeds actual demand. Whilst the current treatment of price taking generation and

[25] For example, CER/06/112

default negative pricing in the event of an excessive generation event may be an acceptably pragmatic solution with relatively low levels of wind penetration, it is less clear that these arrangements will be appropriate with increasing levels of wind penetration. By their nature, default prices of this kind are unlikely to be truly value or cost reflective at all times, and the implicit scheduling assumption that wind generation cannot be dispatched down to generate less output is not reflective of the true operating characteristics of all wind generators.

Finally, related to the questions raised in Section 4.2.2 relating to tie-breaking rules between generators, some mechanism for choosing between different Price-Taking wind generators is likely to become necessary in the event that the schedule has the option of constraining wind downwards, e.g. in an excessive generation event. Such tie-breaking rules will be necessary as part of any more robust treatment of wind within the price setting arrangements.

The RAs invite comment on the matters raised above, including comments regarding the following:

- ***the appropriateness of the inclusion of unlimited price taking generation in the unconstrained schedule beyond demand requirements;***
- ***the application of the market price floor in the context of increasing wind penetration going forward;***
- ***tie-breaking rules for Price Takers as required within the unconstrained schedule.***

4.3.2 Compensation for Constraints and Curtailment

Under the TSC conventional generation is compensated (up to the level of its firm access if economic within the market schedule) irrespective of the reason for its constraint. This includes being constrained down to provide operational reserves, i.e. in some cases to resolve an issue that conventional generation on the system has caused. Wind generation may be constrained down for transmission reasons, or for wind-only reasons. These wind-only reasons have been briefly enumerated earlier in this document and the System Operators definition of 'curtailment' as distinct from 'constraint' in this context has been set out in Appendix A for comment (see Section 3.2.1). Currently, the SEM makes no distinction regarding the reason for constraints. Therefore, at present wind generation is compensated for transmission constraints or being constrained down for wind-only reasons under the TSC.

As noted earlier, the issue of whether or not compensation should accrue to wind generators in the case of curtailment as distinct from constraint has been raised previously. The RAs note that if a clear case emerges from the overall consultation process for wind (detailed in the next steps in Section 6) for not compensating large scale, correlated, intermittent generators including wind for curtailment, and if this is

deemed appropriate in the context of the guiding principles set out in Section 2 and governing legislation, the decision that emerges will reflect this.

The RAs invite comment on the matters raised above, including comments regarding the following:

- ***the payment of constraint payments to wind generators for curtailment reasons as defined in Appendix A .***

4.3.3 Reflection of Cost of Wind within the Market SMP

Another consideration for the unconstrained schedule is under what circumstances wind generation will continue to be (implicitly) scheduled to meet demand even if in practice there are limitations on the quantity of wind that can be accommodated from a system security perspective. Increasing levels of wind generation will give rise to additional system operational issues. In some cases, these issues may be resolved as additional transmission infrastructure is built, whereas in others the issues may prevail into the longer term.

If a situation is reached where substantial additional levels of wind generation results in increasing differences between the unconstrained schedule and actual dispatch, the value of system marginal prices in sending an appropriate price signal may become diluted. In such circumstances an increasing quantity of (conventional) plant that is actually dispatched will be treated as though it were being "constrained on" and consequently paid at bid price, and, all other things being equal, system marginal prices may become depressed as plant lower down the merit order sets prices. Wind generators and conventional plant alike may receive lower system marginal prices in the market, infra-marginal rents will be lower and, as identified above, greater quantities of conventional generation will be treated as being constrained on and therefore be paid constrained on payments rather than SMP. This has the potential to impact on the ability of certain plant to recover its fixed costs. The extent to which they actually do result in market distortions is a matter of degree which is influenced by the level of renewables entering the market.

Whether or not the level of divergence between the unconstrained and actual schedules is such that the former becomes effectively undermined as a reasonable basis on which to set prices depends on a number of factors. These include:

- the likely level and rate of wind penetration;
- the rate at which associated wires infrastructure required to accommodate new generation can be constructed;
- the arrangements for granting access rights to new wind (for example even if the necessary associated wires infrastructure has not been fully built);
- the level to which the wind can technically be accommodated irrespective of the levels of new wires infrastructure;

- the extent to which the System Operators can implement arrangements to minimise production costs in real-time, and
- the extent to which wind is afforded firm access in the determination of the unconstrained market schedule.

It is noted in relation to the above that the dispatching of generation away from the unconstrained schedule in order to manage the intermittency of wind and the limitations in the accuracy of wind forecasts is distinguishable from dispatching away from the unconstrained schedule due to transmission constraints as this can be resolved in the longer term through appropriate reinforcement of the transmission network.

The RAs invite comment on the matters raised above, including comments regarding the following:

- ***the appropriateness of the continued treatment of wind generation in the unconstrained schedule as per the current TSC rules in the context of increasing wind penetration, and***
- ***alternative approaches to the current treatment of wind generation in the unconstrained schedule.***

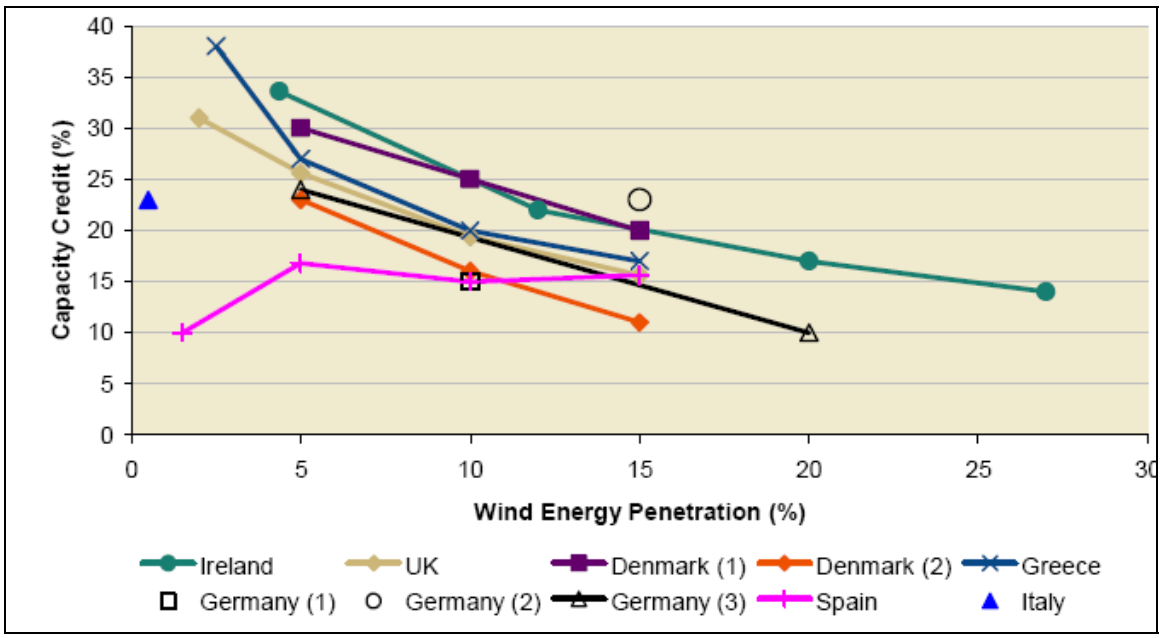
4.3.4 Value of Wind within the Capacity Payment Mechanism

The capacity payment mechanism in the SEM rewards capacity based on both actual system conditions and ex-ante valuations of availability based on forecasts of load, wind, and generator availability. Wind generation also contributes to the calculation of the required fixed pot of yearly capacity payments. The need for a review of the treatment of wind generation in the context of the capacity payment mechanism was flagged in a previous decision paper, AIP/SEM/07/13.

As wind generation penetration increases, the real capacity value (i.e. the true contribution to reducing loss of load) of each megawatt of installed capacity decreases. Several studies[26] have demonstrated the fall in the value of wind generation's marginal capacity value with increased installed wind capacity. As wind generation penetration increases, studies have indicated that the true capacity value falls from roughly 40% of installed capacity (depending on load factor of the wind generator) down to potentially as low as 10% within the ranges of wind penetration studied. The rate of fall off depends on a series of factors, including flexibility of other scheduled conventional plant on the system, the accuracy of wind forecasts used to schedule plant for later dispatch, and the assumed variability and constraining down of the wind time-series used in the study. The fall off occurs as wind generation requires conventional generation to support it; the greater the level of wind generation, the more conventional generation falls into a wind

[26] See for example EirGrid's "Wind Power Generation. An analytical study to assess generation cost implications", June 2007, "Establishing the Role That Wind Generation May Have in Future Generation Portfolios", R. Doherty, H. Outhred, and M. O'Malley, IEEE Transactions on Power Systems, Vol. 21, No. 3, August 2006, and the discussion of capacity value of wind on page 129 of "Wind Power in the UK" from the UK's Sustainable Development Commission, available at: http://www.sd-commission.org.uk/publications/downloads/Wind_Energy-NovRev2005.pdf

supporting role, rather than providing towards the capacity requirement itself. The positive correlation in the unavailability of wind also contributes to the fact that the marginal benefit of additional wind capacity decreases as total wind capacity increases[27].



Source: Wind Powered Generation: An Analytical Framework to Assess Generation Cost Implications, EirGrid June 2007

The capacity remuneration mechanism does not operate in such a manner as to reduce the pro-rata payments to wind as the levels of wind penetration increases in all instances. Given that this is the case, it is possible that as wind capacity increases, wind generation may become over-remunerated by the capacity payment mechanism and conventional plant under-remunerated. As all generation competes for a fixed yearly capacity pot, it is important that wind and conventional generation compete on an equal footing within the capacity payment mechanism, given the context of the phenomenon of wind generation's reducing capacity credit.

[27] Reference is also made in this context to Eirgrid, Wind Powered Generation, An analytical framework to assess generation cost implications. June 2007. http://www.eirgrid.com/EirgridPortal/uploads/Announcements/Windreportv.16.pdf

The RAs invite comment on the matters raised above, including comments regarding the following:

- ***Does the capacity payment mechanism accurately reflect the value of wind capacity and will it continue to do so as wind penetration increases?***
- ***How could the capacity payment be best revised to accurately value wind capacity going forward?***

5 Associated Areas

This Section sets out a number of underlying areas that should be noted when considering the matters raised in Section 3 above.

5.1.1 Processing of Connection Applications and Associated Pricing Arrangements

Under existing arrangements for managing new connections, generators applying to participate in the SEM (through being granted access rights to connect to and use the transmission and/or distribution networks) are required to apply for connection/use of system to the relevant TSO or DSO which operates the system to which they wish to connect. Offers for firm use of system will be granted contingent upon the completion of necessary deep infrastructure works required to facilitate the full output of the new connection. Under the SEM High Level Design, all generators are granted access rights in advance of completion of the necessary contingent infrastructure works to the extent that this is possible, as reflected in non-firm values. Under the associated charging regime, generators pay shallow connection charges and locational TUoS. [28]

In Ireland, a group processing approach is used for the processing of applications from renewable generators, including wind. Further details regarding the operation of this approach can be found in various papers on this matter on the CER's website[29] and the details of the associated connection charging arrangements are set out in the Joint TSO/DSO Group Processing Approach Pricing Principles Guidelines.[30]

It is understood that consideration is being given to a similar "cluster" process in Northern Ireland and that the examination of the requirement to have obtained planning permission is being reviewed in this context. Information relating to this can be found on the SONI website[31].

5.1.2 Planning Standards and Assumptions

EirGrid and SONI maintain separate planning standards for the transmission system in Ireland and Northern Ireland respectively. Northern Ireland's system security and planning standards currently incorporate both the transmission and distribution system. In Ireland the standards for the distribution system are maintained by ESB Networks. These standards[32] set out the reliability criteria of the transmission and distribution systems as a whole and underlie the long term design of the systems in relation to infrastructure investment and generation connection. The standards also describe a set of contingencies, e.g. the combined trip of a transmission line and a generator, to which the system must be robust. The All-Island Energy Market Framework refers to the future harmonisation of the Transmission Planning Criteria. The System Operator Licences set out the required coordination between the System Operators and the Ireland Distribution

[28] Section 3.7, SEM High Level Design Decision, June 10th 2005, AIP/SEM/42/05
[29] http://www.cer.ie/en/renewables-decision-documents.aspx#RenewableConnections
[30] http://www.cer.ie/GetAttachment.aspx?id=43ee462b-5a5c-42e4-a796-d2b483e96253
[31] http://www.soni.ltd.uk/wind.asp
[32] See http://www.eirgrid.com/EirgridPortal/uploads/Library/Transmission%20Planning%20Criteria.pdf; http://www.soni.ltd.uk/allislandmarket.asp; and http://www.esb.ie/esbnetworks/downloads/220903_publication_distribution_system_security_and_planning.pdf

System Operator to inform the development, but not as yet the harmonisation, of these planning standards through a joint planning committee.

Therefore the planning standards are at this time different for Ireland and Northern Ireland. This may impact the relative speed of shallow connection and deep reinforcements between jurisdictions. It also may impact the relative costs of providing these system facilities. These standards apply within a jurisdiction (noting different planning standards between the transmission and distribution system in Ireland) to all forms of generation[33]. This means that the network is developed using the same reliability criteria based on the full capacity of windfarms as it is for conventional generation.

5.1.3 The Changing Role of Distribution

The majority of the wind generation, including controllable wind generation, which is progressively connecting in Ireland and Northern Ireland is at distribution level. Coordination between the Transmission System Operators and the Distribution System Operators is ongoing in relation to the connection processes. The SEM High Level Design makes no distinction between transmission connected generation or distribution connected generation with regard to use of system charging or the treatment of firm access so no economic distortions or undue technical differences should apply to a wind generator connecting to either the transmission or distribution system. Nonetheless the distribution systems have intrinsic differences in purpose, design and operation to the transmission system.

As regards use of system charging, the regulatory decision on use of system charging in the SEM[34] stated that a reverse MW-mile methodology, as used by Eirgrid, is to be employed. This methodology provides for the levying of transmission use-of-system charges on distribution connected generation, meaning that distribution generators will[35] incur the socialised impact of their connection on the distribution system.

[33] Wind generation is specifically mentioned within the Ireland Transmission Planning Criteria, but the references do not overwrite the general planning standards on the network.

[34] AIP/SEM/07/433

[35] See SEM-07-16 "TUoS Tariff Industry Update" which has left existing pre-SEM tariffs in place until September 30th, 2008.

6 Next Steps

The RAs seek written submissions on the scope and content of this paper. Bilateral and/or multilateral meetings with industry representatives will be held on request to discuss the issues raised in this paper and respondents' views on them. Any organisation or individual wishing to participate in such a meeting should contact the Regulatory Authorities through the individuals identified in Section 2.

Unless marked as confidential, the RAs intend to publish any written responses received.

Following the receipt of written and verbal responses, the RAs propose to develop and consult further on more specific proposals for the treatment of intermittent generation in the SEM. This subsequent consultation is planned for early summer 2008 and will cover, inter alia, the following:

- the processes by which the System Operators create a secure economic dispatch, including the definition of the term 'curtailment' in this context;
- the compensation of wind generation when constrained down[36] in comparison to conventional generation;
- the calculation of the market System Marginal Price, and
- the remuneration of wind generation within the capacity payment mechanism.

In due course, the Regulatory Authorities will be raising a modification proposal to the TSC to transpose the stated policy regarding the treatment of firm access within the SEM High Level Design and decisions regarding the Group Connection Process in Ireland.

It is intended that the decision arising from this consultation will provide a set of principles to guide ongoing development of the SEM market rules in this area and further development of transmission/distribution arrangements by the relevant licence holders in each of the two jurisdictions with respect to intermittent generation. High level decisions will then be subject to implementation which will include, as appropriate, revisions to market documentation and systems and follow on work in the area of system operation. The RAs recognise that any proposed changes emerging from this process will need to be proportionate and limited to only those which are necessary to ensure that the SEM arrangements remain robust against the background of increasing levels of wind generation

[36] The term "curtailment" is sometimes used in industry, specifically in relation to wind, for constraining down wind arising from the challenges presented by wind. This is discussed further in Section 3 of this paper.

Appendix A

System Operators' Definition of Curtailment

Curtailment refers to restricting a generator's output due to system security issues – in the case of wind generators related to the inherent technical characteristics, uncertainty of actual outturn and limited controllability of wind generators. Curtailment can be defined as any reduction in output which is necessary to ensure:

- that there is the ability to regulate system frequency, control interconnector and system tie line flow for a given level of reserve;
- that there is sufficient ramping capability on the system to meet the expected variances in system demand given potential variability in generation whose output is less predictable;
- to ensure that the system remains stable for all normal operational scenarios including ensuring there is sufficient plant on the system to meet operating reserve requirements.

By contrast, constraining refers to the alteration of the output of a particular generator because of limitations of the transmission network and for the provision of operating reserve. Constraining will/may result from:

- The provision of reserve
- A shortage of network capacity – to include periods pending deep reinforcement work
- Transmission forced outages
- Transmission scheduled outages