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Gate 3 Grid Connection Group

Processing Approach - An Analysis

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ABSTRACT

The aim of this project is to analyse the Group Processing Approach (the “GPA”) to renewable generator grid connections, and in particular the Gate 3 process which is the latest round of the GPA that is currently being implemented in the Republic of Ireland, to determine if it is the most effective approach for connecting new renewable generation. Gate 3 is the third series of the GPA for connecting renewable generation to the Irish Electricity grid where applications are processed in groups or batches. The size of the Gate 3 has been capped at 3,900MW with applicants being selected based on application date order and applicants will be granted firm access to the grid in order of the anticipated speed with which the required deep transmission reinforcement works can be completed.

The author firstly provides a high-level overview of the technical considerations for connecting vast amounts of dispersed wind energy to the national grid, the development of wind energy in Ireland and the developments of wind energy in other jurisdictions. Then the Gate 3 and GPA processes including the various options considered by the Commission for Energy Regulation (CER) are analysed along with submissions by various stakeholders such as wind farm developers, the Irish Wind Energy Association and consultants to determine if the GPA is the most effective approach.

The author then evaluates the findings against a set of defined criteria and discusses the results of the research while also making recommendations.

DECLARATION

I certify that this thesis which I now submit for examination for the award of an MSc in Energy Management is entirely my own work and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

This thesis was prepared according to the regulations for postgraduate study by research of the Dublin Institute of Technology and has not been submitted in whole or in part for an award in any other Institute or University.

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Signed: *JOHN LEAHY* *Date:*

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GLOSSARY OF TERMS

CER	Commission For Energy Regulation
CO₂	Carbon dioxide -
AER	Alternative Energy Requirement
AESO	Alberta Electric System Operator
AIES	Alberta Integrated Electrical System
AUC	Alberta Utilities Commission
BCTC	British Columbia Transmission Corporation
BETTA	British Electricity Trading Transmission Arrangements
CAP	Connection and Use of System Code Amendment Proposal
CIGRE	International Council on Large Electric Systems
CUSC	Connection and Use of System Code
DFIG	Double Fed Induction Generator
DFO	Distribution Facility Owner
DSO	Distribution System Operator
EPA	Electricity Purchase Agreement
ESB	Electricity Supply Bord
ESBNG	Electricity Supply Bord National Grid
EU	European Union
EWEA	European Wind Energy Association
FSL	Final Sums Liabilities
GB Queue	Great Britain Queue
GBSO	Great Britain System Operator
GBSQSS	Great Britain Security and Quality of Supply Standards
GDS	Grid Development Strategy
GPA	Group Processing Approach
IPP	Independent Power Producer
ITC Programme	Incremental Transfer Capability Programme
IWEA	Irish Wind Energy Association
LCTA	Least Cost Technically Acceptable Method

LMP	Locational Marginal Pricing
NFFO	UK Non Fossil Fuel Obligation
NGET	National Grid Electricity Transmission
NOW Ireland	National Offshore Wind Ireland
NO_x	Nitrogen Oxides
OATT	Open Access Transmission Tariff
Ofgem	Office of the Gas and Electricity Markets
Ofreg	Northern Ireland Authority for Utility Regulation
POI	Point of Interconnection
PPA	Power Purchase Agreement
RAS	Remedial Action Scheme
RO Order	Renewables Obligation Order
SAS	System Access Service Request
SCADA	Supervisory Control and Data Acquisition
SEI	Sustainable Energy Authority of Ireland
SGIP	Standard Generator Interconnection Procedures
SHETL	Scottish Hydro Electric Transmission Ltd
SO	System Operator
SONI	System Operator of Northern Ireland
SO_x	Sulphur Oxides
SPTL	Scottish Power Transmission Ltd
STAG	Short Term Access Governance Review
TAR	Transmission Access Review
TEC	Transmission Export Capacity
TFO	Transmission Facility Owner
TSO	Transmission System Operator
UCTE	Union for the Co-ordination of Electricity Transmission
UoS	Use of System
WTG	Wind Turbine Generator

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1. INTRODUCTION

1.1. Context

Renewable energy sources are indigenous, and can therefore contribute to reducing dependency on energy imports and increasing security of supply [1]. The European Parliament, for its part, has constantly underlined the role of renewable energy sources and in its White Paper, “An Energy Policy for the European Union”, the Commission has put forward its views as regards EU energy policy objectives and instruments to achieve them [2]. Three key energy policy objectives were identified:-

- a) Security of supply;
- b) Cost competitiveness; and
- c) Environmental responsibility.

Development of renewable energy sources can actively contribute to job creation, predominantly among the small and medium sized enterprises which are so central to the Community economic fabric and the deployment of renewables can be a key feature in regional development with the aim of achieving greater social and economic cohesion within the EU [1].

The expected growth in energy consumption in many third countries, in Asia, Latin America and Africa, which to a large extent can be satisfied using renewable energies, offers promising business opportunities for European Union industries, which in many areas are world leaders as regards renewable energy technologies [1].

A secure energy supply is a key requirement for building economic growth and social well being. Energy must be affordable as well as secure [5]. Any company that has to pay more for its energy than its competitors will be at a competitive disadvantage all other things being equal. The primary environmental impact of energy trends since the industrial revolution is the significant increase in gaseous emissions into the atmosphere such as CO₂, SO_x and NO_x [5].

Renewable energy is supported on the basis of its contribution principally to environmental responsibility and security of supply [6]. The general public favours development of renewables more than any other source of energy, very largely for environmental reasons [1]. Within the context of current energy economics, it has been recognised that there can be challenges associated with marrying renewable energy support (generally increasing the price of energy) with cost competitiveness (seeking to reduce the price of energy) [7] [8]. The modular character of most renewable technologies allows gradual implementation, which is easier to finance and allows rapid scale-up where required [1].

Renewable energy generally contributes positively to security of supply by increasing the indigenous share of energy supply and thereby reducing risks associated with imported fossil fuel delivery and price volatility [5].

The Irish Government White Paper on energy has set a target for 15% of electricity consumption (total electricity generated plus net imports) to come from renewable sources by 2010, rising to 33% by 2020 (increased to 40% in October 2008) [9]. The current peak demand in Ireland is roughly 5,100MW [4] and given the amount of generation currently available, the 2020 target represents an unprecedented technical challenge for the TSO and DSO operators to maintain a reliable and secure power system. The vast majority of this target is expected to come from the current 3,900MW of wind generation included in the Gate 3 ITC programme.

One major concern for industry and the Irish Government is the capacity of the grid to integrate new renewable generation, and the financing of any improvements required. When the Irish transmission and distribution system was developed they were designed to generate output from large power stations (mainly coal, oil and peat), transmit this to demand centres, and then distribute it to local users [11]. This flow of electricity was from a strong well interconnected network to a weaker periphery. Generally, the best wind resources tend to be in remote areas where strong grid connection points are not available and this can again lead to higher costs and greater technical challenges.

Large amounts of renewable and other types of low carbon generators will need to connect to our electricity networks if we are to meet renewable energy and climate change targets, reduce our dependency on imported fossil fuels and contribute to security of supply. The enduring grid access arrangements have acted as a barrier to connection of this essential new generation and, over the past 6 years since the introduction of the moratorium [12], industry has been working to identify a number of approaches to address the issue of grid access.

1.2. Research Objective

The process for connecting of large amounts of dispersed renewable generation to the electricity grid is an issue of very wide scope and there are numerous aspects which could be considered here including the technical challenges of connecting of large amounts of dispersed and variable wind generation to a network with low interconnectivity, pricing and UoS charging options, transmission reinforcements, constraints, funding of works, regulation, governance and licensing, political policy, market mechanisms and consenting.

It is important to note that the scope of this dissertation has evolved since the commencement of the research. The focus of this dissertation is solely to determine if Gate 3 and the group processing approach is the best method for Ireland when considering the following factors:-

- Fairness and transparency;
- Facilitate achievement of Irelands renewable energy targets;
- Optimum development and use of the transmission and distribution systems;
- Timely delivery;
- Development costs;
- Energy costs; and
- Security of supply.

The Research Question is:-

Is Gate 3 and the Group Processing Approach the best approach for connecting large amounts of renewable generation to the Irish power system?

1.3. Dissertation Structure

The dissertation is structured as follows:-

- Section 2 comprises of the Literature review which discusses the important documentation researched.
- Section 3 discusses the technical considerations when connecting large volumes of wind generation and the grid connection criteria.
- Section 4 details the development of wind energy in Ireland which includes the development of the Group Processing approach and the Gate 3 process.
- Section 5 details the current practice for processing wind applications in several other jurisdictions.
- Section 6 analyses and discusses the stakeholder views on Gate 3.
- Section 7 sets out the methodology for the primary research.
- Section 8 describes the findings from the primary research.
- Section 9 analyses the findings against a set of criteria.
- Section 10 comprises of the conclusions and recommendations.

1.4. Personal Position and Disciplinary Context

I am an employee of EirGrid plc (Transmission System Operator). I totally support and fully endorse the Gate 3 project. It should therefore be noted that I bring a degree of bias and subjectivity to the issues discussed in this thesis. Nevertheless, as noted above, I have endeavoured to distance my personal views from the process of data collection and interpretation.

2. LITERATURE REVIEW

The EU Directive (RES-E Directive) on the promotion of Electricity Generation from Renewable Energy Sources in the internal electricity market (2001/77/EC) states the following [13]:

“Without prejudice to the maintenance of the reliability and safety of the grid, Member States will take the necessary measures to ensure that the transmission system operators and distribution system operators in their territory guarantee the transmission and distribution of electricity produced from renewable sources.”

This means that grid access must be provided at a reasonable and transparent price in relation to the development of renewable electricity generation. It also means that Member States are required to put in place measures to facilitate grid access for renewable electricity.

The Commission for Energy Regulation and Ofreg commissioned a study in order to explore further the effects of increasing levels of wind energy generation on the combined electricity systems of the Republic of Ireland and Northern Ireland and this was completed in February 2003 [41]. This study raised many important points in relation to the development of wind energy in Ireland.

- Wind turbines can supply more than just energy and most of the likely requirements can be met by variable-speed wind turbine technology.
- Fixed-speed wind turbines, and in particular stall-regulated wind turbines, are likely to face higher costs to meet these requirements than variable-speed wind turbines.
- Requirements for provision of frequency response and reserve could be met by wind generation but at high cost.
- Less stringent requirements for small wind farms

This study found that the only limiting factors on the development of wind energy are transmission planning criteria and constraining due to running of conventional plant [41].

On 1st December 2003 the TSO wrote to the CER regarding their concerns around the increasing levels of wind generation connecting to the Irish grid [49]. This letter detailed ESBNG's concerns at the scale of proposed new wind generation and the resulting implications for the stability of both the transmission and distribution systems. This letter also included a report entitled 'Interim Policy on Wind Connections' which detailed the concerns of ESBNG in relation to the amount of wind seeking a grid connection [50]. This report acknowledges some of the findings in the Garrad Hassan study on the effects of increasing levels of wind energy generation on the combined electricity systems of the Republic of Ireland and Northern Ireland, however the ESBNG report states that the Garrad Hassan study did not consider the economic impacts of curtailment nor did it address transient or voltage stability issues in any detail [50].

Ó Gallachóir et al. discuss the moratorium in depth and the concerns of ESBNG due to the large number of applicants seeking a grid connection [5]. The paper discusses the technical characteristics of wind energy which underpinned the concerns of the TSO. The authors suggest that there may have been alternatives to the moratorium. It suggests that "The technical concerns underpinning the moratorium could have been addressed earlier as the challenges were foreseen in 2000" [5]. There should have been a more effective engagement between the TSO and turbine manufacturers as this would have resulted in the earlier development of dynamic models and a Wind Grid Code [5]. It is also suggested that the developers should have been allowed to proceed at their own risk and that wind farms could have been allowed to proceed in geographical areas where low-voltage ride-through and the other concerns are not anticipated to have a significant impact such as an unacceptable loss of wind generation when a transmission system fault occurs [5].

It is important to understand the technical characteristics of wind generation and the challenges that integrating large volumes of intermittent generation can present, in order to appreciate the concerns of ESBNG at the time of the moratorium. De Alegría et al. (2007)

investigates the technical requirements for wind farm connections and states that if wind farms were to be installed solely to maximise energy output they would have major limitations in terms of voltage and reactive power control, frequency control and fault-ride through limitations [38]. These were the concerns of ESBNG and all are addressed in the Grid and Distribution Codes. Singh et al. (2009) reviews the grid code requirements of multiple TSO's and concludes that the Grid Code requirements of active power control, frequency control, voltage control, and wind farm protection and states should be harmonised to meet the challenge of considerable wind power penetration [39].

The ESBNG report, 'Interim Policy on Wind Connections' stressed the need for a Wind Grid Code along with reliable forecasting and SCADA systems, and the need for dynamic models for wind turbine generators [50]. The CER approved the introduction of a moratorium on issuing wind connection offers on 3rd December 2003 [51]. The Wind Grid Code was approved on the 1st July 2004 and on 5th October 2004 the joint TSO/DSO proposal for Group Processing Approach for Renewable Generator Connection Applications was published [52]. This was the beginning of the introduction of the Group Processing Approach ("GPA") and involved dividing applications up into groups based geographical areas and sub-groups based on the assigned 110kV node. The TSO would then study the Groups from a load-flow impact and short circuit impact perspective and the appropriate transmission network reinforcements for each Group will be determined based on these studies [52]. The System Operators then identify the shallow connection method and associated deep reinforcements for each individual application within the Group/Subgroup [52]. The main idea behind the GPA was that it would remove "interactions". Formally written, "Interacting" in respect of a connection offer means that the studies performed and the basis for which an offer is made will change as a result of another offer being accepted. On 15th November 2004 the CER issued the Proposed Direction on Resuming Connection Offers to Wind Generators, incorporating elements of the earlier Group Processing Approach principles [53] and on 23rd December 2004 the CER issued a direction to the System Operators to resume issuing wind grid connection offers [18]. Gate 1 was the first round of the group processing approach and this began in December 2004.

In June 2006, the CER issued a direction entitled 'Criteria for Gate 2 Renewable Generator Connection Offer, Direction to The System Operators, CER/06/112' [19]. This direction detailed the criteria for inclusion in Gate 2 along with the application processing rules. The direction stated that the first 500MW of applicants in the queue on date order, along with other applicants who met particular “system optimisation” criteria, were eligible to be included in the Gate [19].

On 17th December 2007 the CER issued the consultation paper ‘Criteria for Gate 3 Renewable Generator Connection Offers (CER/07/223)’ [17]. This paper discussed the various criteria inclusion in Gate 3 along with the proposed size of the Gate and the proposed processing options. This paper also offered stakeholders an opportunity to respond to the criteria. On the 11th July 2008, the CER published the proposed direction for Gate 3 renewable generator connection offers (CER08/118) [27]. The size of Gate 3 was set at 3,000MW, with applicants being included based on application received date order and the Grid Development Strategy (GDS) approach, which allows Gate 3 applicants to be given a firm connection to the network in order of the expected date at which the necessary deep transmission reinforcements can be completed, being nominated as the best and most favoured approach. The CER also issued a ‘Comments and Responses Paper’, CER/08/119, detailing the views of the interested stakeholders [54]. On 13th November 2008 the CER issued the proposed direction ‘Criteria for Gate 3 Renewable Generator Offers & Related Matters’ (CER/08/226) [55]. The major change from the previous proposed direction was the increase in the Gate 3 size from 3,000MW to 3,900MW which took account of the increase to the Government’s renewable generation target for 2020 from 33% to 40% of electricity use. The final Gate 3 direction (CER/08/260) was issued on 17th of December 2008 and this document details the Gate 3 criteria and processing rules [20]. The most significant points in the Gate 3 direction are as follows:-

- Gate 3 size of 3,900MW to cater for 40% renewable penetration;
- Applicants to be selected on date order;
- CER to review the transmission capacity assumptions every second year from 2011 through to 2025 to cater for changes in demand or low uptake of offers;

- Firm access to be allocated using ITC programme;
- Projects can connect on a non-firm basis prior to getting firm access; and
- Planning permission is not a requirement for inclusion.

Great Britain has also experienced similar issues with a large number of applicants seeking a connection to the transmission network and hence the GB Queue is the term used to describe the queue of projects, largely in Scotland, that are waiting to be connected to the transmission system. The publication, 'Lost in transmission, The role of Ofgem in a changing climate' by the Sustainable Development Commission in 2007 describes the background to the GB Queue [56]. The queue arose as a result of an unprecedented number of applications seeking a connection to the transmission system submitted before the introduction of the British Electricity Trading and Transmission Arrangements (BETTA) in 2005. Projects in the GB queue are offered a grid connection by date order of application, as opposed to the status of the progression of the project. Consequently, some projects in Scotland now have connection offers despite not having applied for planning permission, whereas some projects may have planning permission but do not have a grid connection offer. Around this period there were 9.3 GW of wind energy applications awaiting connection to the transmission system and in June 2007 National Grid UK published the report entitled 'GB Queue Management - Final Conclusions Report' after an in-depth consultation [28]. This report detailed key queue management initiatives such as granting applicants who are "ready to connect" an earlier connection, provision of better information and a more active contract management [28].

In October 2007 Ofgem published a report entitled, 'Short Term Access Governance (STAG)' on the current status of the queue and the progress of initiatives aimed at addressing the issue with the increasing size of the GB Queue [57]. In addition to providing a report on the progress of the GB Queue, the STAG report also provided for a discussion on other avenues that could be explored to reduce the GB Queue. The Energy White Paper published in May 2007 announced a joint review by the Government and Ofgem of the electricity transmission connection arrangements in Great Britain and this was called the Transmission Access Review (TAR). In June 2008, the TAR process

concluded and a programme of reform intended to remove or significantly reduce the barriers to grid access was set out. On 15th July 2009, the Department of Energy & Climate Change issued a consultation paper on improving grid access [58]. The UK Government's initial view was that models based on a 'Connect and Manage' [81] approach were most likely to meet their objectives of accelerating grid access for new generation. Under these models, generators could connect to the transmission system prior to the required deep reinforcements being completed, which is similar to 'non-firm' transmission access in Ireland. Generators would have the option to connect to the transmission system once their shallow works were completed [58]. The UK Government hopes to implement initiatives from this consultation in June 2010.

3. WIND GRID CONNECTIONS

3.1 Technical Considerations

In 2008, more wind power was installed in the EU than any other electricity generating technology with 36% of all new electricity generating capacity built in the EU being wind energy, exceeding all other technologies including gas, coal and nuclear power [37]. For the first time, wind energy is the leading technology in Europe and the renewable share of new power installations was 57% in 2008. A total of 64,935 MW of installed wind energy capacity was operating in the EU by end 2008, 15% higher than in 2007 [37].

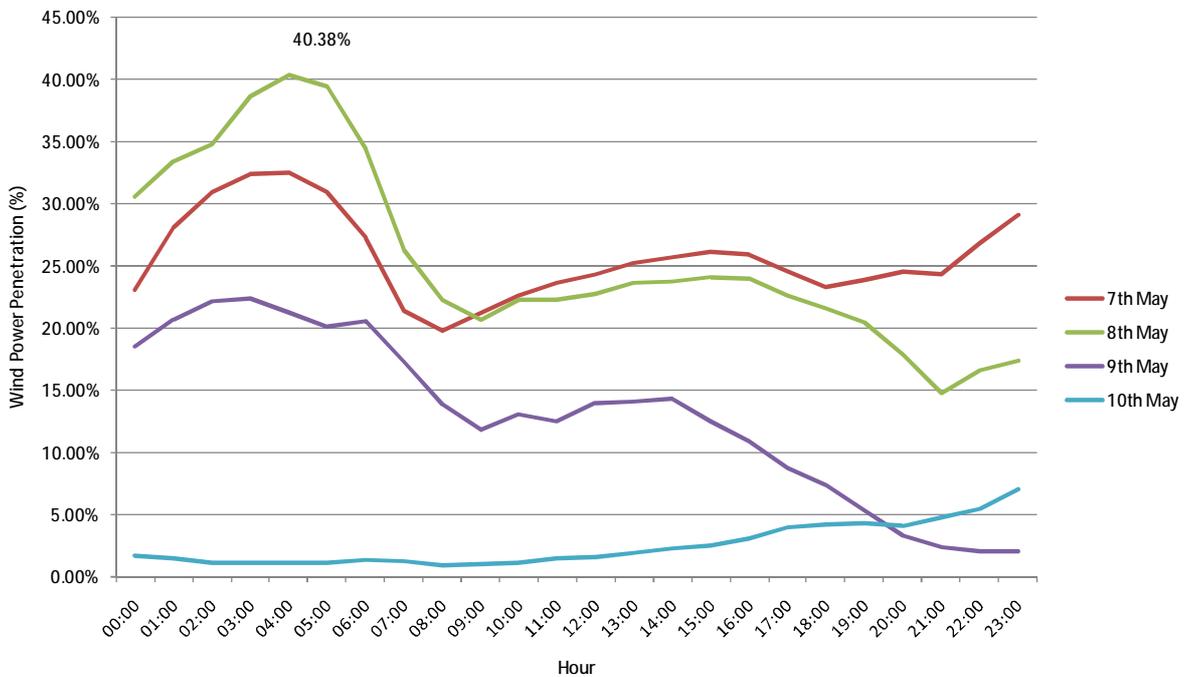


Figure 1 – Wind Generation Profile May 2009 [4]

It is important to understand the technical characteristics of wind generation, in order to appreciate the issues in comparison to conventional generation. Firstly, wind generation is clearly variable which makes it much less reliable and predictable than conventional generation, as can be seen from Figure 1. However this is less of a problem than previously imagined with development of forecasting techniques and understanding of the way in

which variability is smoothed across large areas [5]. Secondly, wind generation does not use directly-connected synchronous generators. Conventional power plants employ synchronous machines, which are well understood by Network Operators. Synchronous machines assist in maintaining transient stability, good voltage control, reactive power support, frequency control and fault ride-through capabilities, thus being able to meet the connection requirements defined by the system operators [38]. The counterpart to synchronous machines in wind farms are mainly fixed speed asynchronous generators, doubly fed induction generators and full power converter generators (which could be induction or synchronous) [5]. Their technical characteristics are very different to those of synchronous machines. The first generation of commercial grid connected wind turbines in the 1980s used the fixed-speed concept using an asynchronous induction generator, which was soon supplemented with a capacitor bank for reactive power compensation [39]. During the 1990s, different types of variable speed concepts became more popular and the DFIG generator was the most successful variable-speed concept with more than 45% market share in 2002 [39]. The Technical characteristics of DFIG can be made very close to those of a synchronous generator by using power electronic converters and control mechanisms to enhance the performance required to meet the connection requirements defined by various TSO's [39].

When analysing the increase in wind power penetration into electric power grids, it is also important to consider the size of the synchronous power system to which the wind capacity is integrated rather than the amount of generating capacity within a national border [5]. Consider the four main synchronous power systems in Western Europe as shown in Figure 2 [40]. The challenge facing Ireland becomes clear when this is the manner within which wind power penetration is considered. The power systems in the Republic of Ireland and Northern Ireland act as a single power system due to the AC interconnector. The British power system is more than nine times larger than that in Ireland. The Nordel power system in Scandinavia is over 23% larger than the Great Britain power system. The UCTE system has an installed capacity of roughly 666GW, stretching from the Adriatic to the Atlantic and from the Baltic to the Mediterranean, and covers the bulk of the remainder of continental Europe. Although Germany and Spain have each a large installed wind

capacity, it is small compared with the size of the UCTE power system accommodating it. It must be noted also that the wind power penetration on the Irish synchronous power system is greater than either UCTE or Nordel, in particular as these systems include the countries with the highest levels of wind capacity. UCTE includes Germany with 23.9GW of wind capacity at the end of 2008 and Spain with 16.7GW (EWEA, 2009).

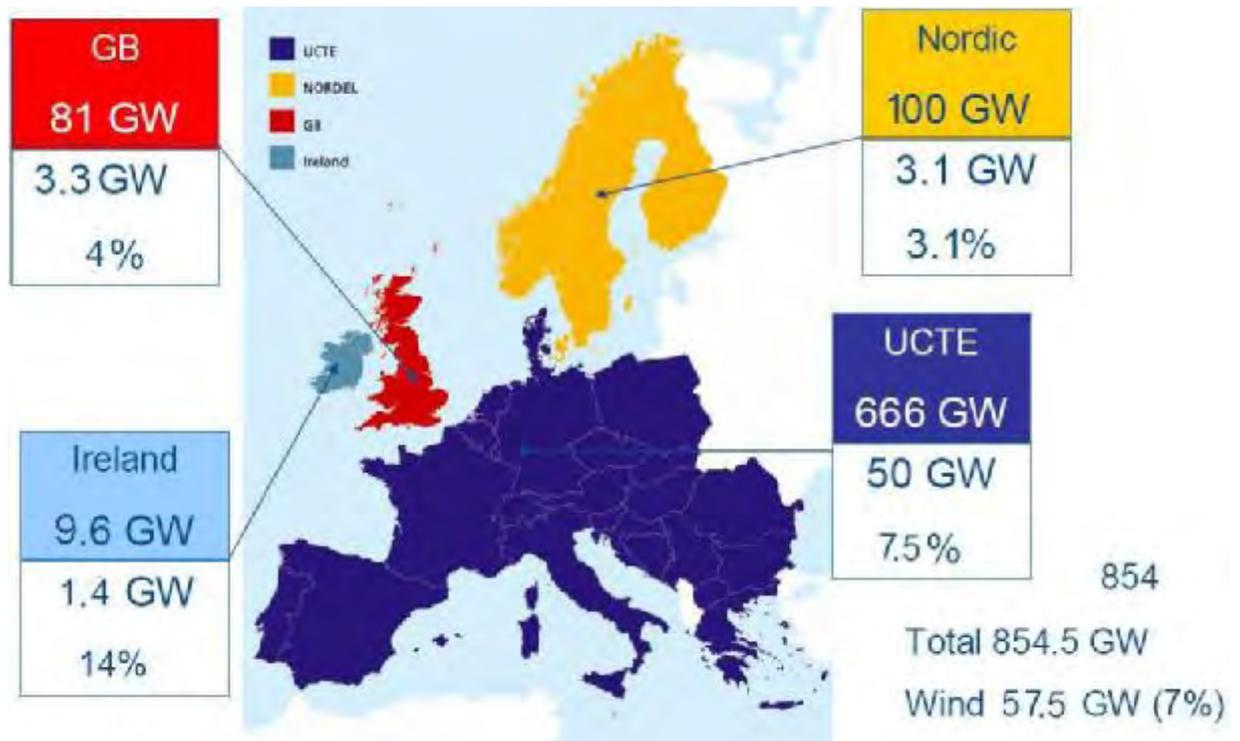


Figure 2 - European Synchronous Power Systems (based on [40])

The technical and operational characteristics of a power system are determined by the network, by the technical characteristics of the generation, and to a lesser extent by the loads connected to it [39]. Wind farm developers, turbine manufacturers and system operators have been working together to define a set of minimum technical performance requirements in order to accommodate significantly larger volumes of wind generation without compromising the stability and security of the networks. In a system with well matched loads, large load following capacity generators, high power reserve and strong interconnections with neighbour grids wind penetration can be in the range of 30–40% without compromising the reliability of the power system and in isolated or weak systems the percentage may be as low as 10% [39]. A report by Garrad Hassan on the impacts of

increased wind penetration in Ireland for the CER concluded that no technical limit to wind penetration could be found up to approximately 4000MW on the Irish power system [41].

Country	TSO	Author	Title	Year
Denmark	Eltra/Elkraft	Eltra/Elkraft	Regulation TF 3.2.5, Wind turbines connected to grids with voltages below 100 kV	2004
Germany	E.On	E.On	Grid Code High and Extra High Voltage 2	2006
UK	NGET	NGET	Grid Code	2008
Sweden	Svenska Kraftnät (SvK)	Svenska Kraftnät (SvK)	Affärsverket svenska kraftnäts föreskrifter och allmänna radom driftsäkerhetsteknisk utformning avproduktionsanläggningar	2005
Ireland	EirGrid	EirGrid	EirGrid Grid Code: WFPS1 – Wind Farm Power Station Grid Code v3.4	2009
Scotland	Scottish Hydro Electric	Scottish Hydro Electric	Guidance note for the connection of wind farm	2002
China	All	CEPRI	Technical Rules for Connecting Wind Farm to Power System	2005
USA		FERC	FERC Order No. 661-A, Interconnection for Wind Energy	2005
Poland	PSE	PSE	INSTRUKCJA RUCHU I EKSPLOATACJI SIECI PRZESYŁOWEJ	2006

Table 1 - Grid Codes from Different TSOs [39]

Unsurprisingly due to the high penetration of wind power in their respective countries both Denmark and Germany have been the first countries adapting their grid codes for wind

power integration in high voltage networks. Different system operators in the USA and Canada have also set their own standards based on the Danish and German grid codes and Spain, Holland, Sweden, Great Britain and Ireland also redefining their grid codes.

The main areas that SO's have had to adapt in their respective Grid Codes are:-

- Active power control
- Frequency control
- Voltage control
- Fault ride-through

The Garrad Hassan study on the impacts of increased wind penetration in Ireland pointed to the absence of [41]:

- Grid Code specific to wind generators.
- Wind turbine Dynamic Models to facilitate the assessment of wind power on dynamic performance of the system.
- Reliable wind power forecasting and SCADA data from the wind farms.

The wind Grid Code was developed in 9 months in consultation with industry (IWEA, SONI, CER, WTG Manufacturers, DSO, SEI) and was approved by CER on 1st July 2004 [42]. The Wind Generation Distribution Code was subsequently approved by CER on 6th October 2004. Both codes outlined the requirements that must be met by wind generators with regard to [5]:

- Fault ride through capability – requiring wind farms to remain connected to the system for voltage dips (down to 15% of nominal voltage for 625ms) on all phases, to provide active power and maximise reactive current.
- Frequency requirements – specifying acceptable limits for generator performance over a range of system frequencies (including remaining synchronised with the system at system frequencies within the range 47.5–52.0 Hz for 60 min), frequency control (including the capability of operating each generator within the wind farm at a reduced level and following specific power-frequency requirements) and controlling ramp rates of active power.

- Voltage requirements – requiring wind farms to remain connected at maximum power output for step changes in transmission voltage of up to 10% and to have a continuously active voltage regulation system that will modulate the wind farm’s reactive power output to change voltage set point at the connection point.
- Signals communications and controls including meteorological data, availability data, MW curtailment data and frequency response system settings. The ability to receive signals from the TSO and act accordingly.

Significant progress has also been made regarding the provision, testing and validation of dynamic models for wind turbines with 18 models successfully validated by July 2008, due to the requirement for accurate representative models as a pre-condition for the acceptance of a grid connection application [5] [43].

3.2 Grid Connection Criteria

The most significant factors that contribute to the efficient development of wind energy are:-

- Determination of the Connection Point
- Connection Charges
- Firm Access Allocation

Formerly, the investment in the grid was done by the vertically integrated power industry, as it mostly having a monopoly on generation, transmission and distribution. Afterwards this investment was “socialized” among the consumers. With the liberalization of the electricity market, and the consequent system unbundling, the question arises who has to pay for the investments in the grid: the generator, the grid owner or the customer [75]. This question is especially important when considering wind energy. The investment costs for these energy sources are often relatively high per unit of energy supplied compared to other conventional sources as they are often located at a distance from the load centres and less concentrated. Regardless of how grid connection applications are selected for processing, a Country’s transmission access rules may impede the optimum development of its power system by way of their connection rules and this can mainly relate to

connection costs. Grid connection and extension costs are significant factors for integrating wind generation technologies into an existing electricity network. The costs of grid connection are especially relevant if, for example, offshore wind is considered, for which the next suitable grid connection point may be several tens of kilometres away. Hence, additional grid connection costs occur that are generally not required for integrating conventional generation technologies (this is mainly due to the fact that those networks already exist and have been paid for in the past) [46].

The determination of the connection point is closely linked to the connection charges. In Ireland the System Operators are obliged to offer and charge the applicant for the Least Cost Technically Acceptable Method (LCTA) of connection, even though this may not be the connection that is actually built. Currently, there are several approaches used within the European community for connection charging and these can be classified as ‘shallow’, ‘deep’, or a combination of both and these are described below [46] [76]:-

- *Shallow costs* are charged if the wind developer pays for only the costs of connecting the plant to the grid, and not for grid reinforcement. The major advantage of this approach is that it induces relatively cheap grid integration costs, since any grid reinforcements are paid by the system operator (and ultimately by the consumers).
- *Deep costs* are charged if the wind developer pays for all costs associated with the connection, including all network reinforcement costs. The main benefit of this approach is that it includes the actual costs of integrating a new wind farm into the existing network within the generation costs of the wind developer.
- *Hybrid approach*, whereby the generator has to pay only a fraction of any additional grid extension and reinforcement costs.

Firm access is allocated once the required system reinforcements are in place. Generally reinforcements are identified and progressed only as a result of commitments from developers, such as when a connection contract is signed.

4. WIND DEVELOPMENTS IN IRELAND

Ireland's onshore wind resource is among the best in Europe, particularly along the western seaboard and its potential for development has been appreciated for some years within the European wind energy community. Growth in wind farm deployment was slow during the 1990s but has accelerated since 2000 [7] and by November 2009 there were 97 wind farms operating in Ireland with a combined installed generating capacity of 1,161MW along with a further 1,415MW that are contracted to be built [8]. The first wind farm was located at Bellacorrick in County Mayo comprising of 21 Nordtank wind turbines and came into operation in 1992 with an installed capacity of 6.45MW. Bellacorrick wind farm has performed well with an average load factor of 30% [85].

In 1996 Ireland launched a programme to promote electricity from renewable energy sources entitled "Renewable Energy - A Strategy for the Future" which set wind connection targets of 30MW per year between 2000 and 2010 [47]. The policy also introduced the Alternative Energy Requirement (AER) Programme which was administered by the Renewable Energy Division, Department of Communications Marine and Natural Resources. It was originally modelled on the UK Non Fossil Fuel Obligation (NFFO) [48]. The underlying principle of the AER Programme was that prospective generators were invited to make formal applications to build, own and operate newly installed renewable energy based electricity generating plant, and to supply electricity from these to the Electricity Supply Board (ESB) under a Power Purchase Agreement (PPA) of up to 15 years duration. The Programme was an open competitive process conducted in accordance with European Union procurement rules and state aid guidelines with the lowest bids in each category being offered contracts up to the available capacity. Since the Programme was launched in 1995, six AER competitions have been held with a target capacity of 718MW. Five of the six AER competitions failed (except AER I) to reach the targets set and the AER scheme was abandoned after the last round occurred in 2005 as many of those who won contracts tendered bids that were too low and consequently, a considerable number of wind farms never were built [48].

Ireland's existing grid infrastructure was mostly built prior to the opening up of the electricity market to competition and when the electricity sector was publicly owned. As a result the network was designed to allow access for large power plants [11]. Renewable sources of electricity, however, tend to be smaller scale, more dispersed and the greatest wind resources tend to exist in areas where the network is weak with low levels of interconnectivity. As a result it is generally uneconomical and potentially destabilizing to connect them directly to the existing transmission system [11].

In 2003 the growth in wind penetration caused the TSO operator to raise concerns relating to the security and stability of electricity supply. As a result the Commission for Energy Regulation (CER) issued a moratorium on grid connections for wind generators in 2003. The CER established working groups to address some of the technical concerns raised by the ESB and to develop new grid codes at transmission and distribution level. The number of applicants wishing to connect wind generation increased from 422MW to 2,059MW from the time the moratorium began in December 2003 to October 2004 [14]. The uncertainty associated with the timeframe had a significant effect on the viability certain projects, and in some cases planning permissions expired. Recent moratoriums for wind connections have also occurred in other recently in other countries, such as Alberta in Canada. In mid 2004 the number of individual wind farm applications grew further and amounted to nearly twice the total number of contracted wind farms and, in terms of megawatt capacity, represented a more than three-fold increase in the amount of wind generation operational on the Irish grid at that time [15]. The moratorium was lifted in December 2004 and the "group processing approach" for dealing with grid connection applications, which was proposed by the ESB and EirGrid, was put in place in order to deal with the large number of wind farm applications seeking a connection to the Irish grid [16].

2.1. Conventional Grid Application Process

The conventional method of processing generator applications involved simply using a single application processing process where applications are processed independent of all other applicants and offers usually issued sequentially. This system performs well for large conventional plant where there are a limited number of applicants. However, due to

the large number of renewable generation applications this can cause problems due to interactions between applications. For example, if an applicant received a connection offer but delays in signing, and then subsequently a different applicant also receives a connection offer and accepts the offer, the initial offer may have to be withdrawn and re-issued due to possible interactions. One of the features of this conventional approach is that grid applicants in the same or similar geographical region compete with each other for the same capacity on the network [15]. This means when a connection offer was accepted, all the other interacting applications must be processed again and new connection offers issued to individual applicants and if there was a large volume of applicants with interactions, this could invariably lead to long delays.

2.2. Group Processing

The TSO and DSO jointly proposed the concept of Group Processing of renewable applications in September 2004 and this was introduced by the CER in December 2004 [16]. Group processing simply involves the System Operators processing renewable generators connection applications under defined criteria simultaneously in batches or Gates, rather than on an individual basis [18]. The eligibility criteria and Gate/batch size is decided by the CER and the eligible applications are then broken into geographic groups depending on their level of interaction [18]. Load flow studies are then carried out for each group and the infrastructure or reinforcements are based on the group requirement. The shallow connection charge is shared between applicants in the group on a per MW basis [15].

Gate 1 was the first version of the group processing approach and this began in December 2004 when the CER issued a direction (CER/04/381) to the TSO and DSO which provided for connection offers to be issued to completed renewable applications received by 3rd of December 2003. The CER stated that priority was to be given to those applicants longest in the queue and this included thirty four (34) applications with a combined capacity of 381MW [18]. As part of Gate 1, thirty-three (33) Connection Offers were issued and this amounted to a further 373 MW of new wind power for the Irelands Electricity Supply [15].

In June 2006, the CER issued a direction for the criteria for applications to be included in Gate 2, CER/06/112. At that time there was roughly 3,200MW of renewable applications seeking a connection to both the transmission and distribution systems [15]. The direction stated that the first 500MW of applicants in the queue on date order, along with other applicants who met particular “system optimisation” criteria, were eligible to be included in the Gate [19]. The final number of renewable generator projects eligible to receive an offer in Gate 2 was over 120, totalling over 1,300 MW in terms of capacity, almost all of which is in the form of wind generation [19].

2.3. Gate 3

On 17th December 2007 the CER issued the consultation paper Criteria for Gate 3 Renewable Generator Connection Offers (CER/07/223). It was announced in this consultation paper that 17th December 2007 was the Gate 3 closure date and any renewable generator application received after this date would not be included in Gate 3 [17]. It was also stated in this paper that it was highly likely that some “cut-off” would be applied to Gate 3, given the size of the queue and combining this with the amount of offers that would be issued as part of Gate 2, this would exceed the government target of 33% [17]. This consultation paper set out three options for the criteria to be used in deciding which renewable projects were to be included in Gate 3 and when connection offers are issued to these projects. Consideration was also given to inter-related issues such as planning permission, the application processing fee/data, the offer acceptance and dispute timeline, and interaction with conventional/other renewable generation [17]. The Gate 3 criteria and options were developed in line with the following (often conflicting) objectives [17]:

- Be fair and reasonable to individual generator applicants;
- Be as simple and transparent as possible;
- Be practical and timely for the system operators to implement;
- Be in keeping with the philosophy of group processing, in particular by allowing for the network to be developed as efficiently and optimally as possible;
- Assist the growth of renewable generation in Ireland and facilitate the achievement of the Government’s renewable targets; and

- Ensure that security of Ireland’s electricity supply is maintained, having regard for plant that promote competition and/or bring wider system benefits.

There were three options proposed and these were as follows:

- Date Order
- Date Order and System Optimisation
- GDS Approach

The “Date Order” option just involved issuing a connection offer to applicants in the order that a complete application was received. This approach was adopted for Gate 1 and partially for Gate 2 and has the particular advantages of being simple, transparent, quick and fair with those longest in the queue getting an offer first and being easily identifiable. This received little support as it did not provide for optimal development of the network in that offers would be issued in an “electrically random manner” so that the network would not be developed as efficiently and cost-effectively as it could be with options 2 or 3 [17].

The “Date Order and System Optimisation” approach was similar to the system used in Gate 2. Applicants longest in the queue would be selected and studies would be carried out to identify which other applicants’ drive the least transmission/distribution deep reinforcement works and these would also be included [17]. This option of being fair and making more efficient use of the system than the “Date Order” option, however this method has been accused of being much less transparent.

The final option was the Grid Development Strategy (GDS) approach and this approach allowed for the Gate 3 applicants to be given a firm connection to the network in order of the expected date at which the necessary deep transmission reinforcements can be completed. It involves examining the required development of the transmission system to 2025 to meet current and future generation, Government renewable targets, interconnection and demand growth and thus it marks a significant shift from current practice in that the transmission system would no longer be developed largely on a reactive basis in response to connection applications, but instead there would be more emphasis on planning and

developing the system in advance to meet anticipated generation (including renewable generation) and demand requirements for the longer-term [17].

On the 11th July 2008, the CER published the proposed direction for Gate 3 renewable generator connection offers (CER08/118). The size of Gate 3 was set at 3,000MW, with applicants being included based on application received date order and the GDS approach being nominated as the best and most favoured approach. Assumptions for demand and generation up to 2025 which would drive the transmission system were based on the All-Island grid study, with the peak demand for the Republic of Ireland assumed to be 8,000MW and Northern Ireland 2,150MW [27]. The assumed conventional generation capacity for 2005 is shown in Table 2. The total installed renewable capacity and its breakdown for the 33% renewable penetration level assumed in 2025 is provided in Table 3. It was estimated that around 4,700MW of installed renewable capacity would be required to meet the government's target of 33% of consumption coming from renewables by 2020 [27]. Using a 31% load factor and assuming that 2,800MW of renewable generation will be connected after Gate 2 it is assumed that further 2,000MW would be required and as a result the Gate 3 size was set at 3,000 in order to meet the government's target with a reasonable degree of certainty while also taking into account projects that may not be build due to planning, financial or other reasons.

Applicants will be allowed to connect to the Transmission/Distribution systems on a non-firm basis and as part of the GDS approach EirGrid will run the ITC Programme to identify the scheduled firm transmission capacity to be provided to the each of the eligible Gate 3 projects for each year from 2010 to 2025 the scheduled firm capacity provided (within the ITC Programme) to applicants for each year will be rationed on the basis of the application received date (See Appendix A). Planning permission was not set as a condition for inclusion in Gate 3, mainly due to the fact that a planning consent expires after five years.

TYPE	SIZE (MW)	Number	TOTAL (MW)
Base	500	8	4,000
Mid Merit	350	8	2,800
Peaking	100	16	1,600
CHP	100	4	400
Interconnectors	500	3	1,500

Table 2 - Total capacity of conventional generation assumed for 2025 [27]

Technology	Republic Of Ireland 2025 Renewable Penetration
Wind	4,414
Wave	500
Tidal	0
LS Hydro	222
LFG/Biomass	200
TOTAL	5,336

Table 3 - Total assumed installed renewable capacity for 2025 [27]

On 13th November 2008 the CER published the proposed direction for the treatment of renewable generators in Gate 3 (CER/08/226). The major change from the previous proposed direction was the increase in the Gate 3 size from 3,000MW to 3,900MW which took account of the increase to the Government's renewable generation target for 2020 from 33% to 40% of electricity use. It was proposed again that selection for Gate 3 be based on application receipt date with completed applications received by the relevant system operator up to and including 15th November 2007 being included in Gate 3.

Then on 17th of December 2008 the CER issued its final direction to the TSO and DSO for the treatment of renewable generators in Gate 3. This direction provided for the new 40% renewable target by increasing the planned size of Gate 3 to circa 3,900 MW and

Renewable Applications received by the relevant System Operator up to and including 16th November 2007 were to be included in Gate 3 [20].

The CER decided that EirGrid's Grid Development Strategy (GDS) should be applied in Gate 3. The GDS is a forward-looking transmission development strategy which proposes the collective grouping of wind power connection applications and the simultaneous study of related possible new conventional plant connection to cater for anticipated demand and generation requirements up to 2025, as requested in the Government's White paper on energy [17]. As part of this, the Incremental Transfer Capacity (ITC) Programme identifies the level of deep transmission reinforcements required for firm access and their completion dates.

The following is the total list of applications included in Gate 3:

- Renewable Applications
 - 151 Wind applications - Totalling approximately 3,200MW
 - 4 Offshore Wind applications - Totalling approximately 795MW
- Conventional Applications (incl. Interconnectors)
 - 56 Conventional Applications - Totalling approximately 6,593MW. However only 2,000MW of offers will be issued as part of Gate 3 [83].

On 29th January 2010 the CER published EirGrid's audited scheduled firm quantities for all renewable and conventional applicants eligible for a connection offer as part of Gate 3, as well as for non-GPA applicants [84].

It is important to put into context the scale of the ambitious renewable energy targets that have been set by the Irish government and the scale of the challenge presented to both SO's and the CER. If one compares Ireland's 2010 targets and Ireland's relative position with respect to the renewables share of overall electricity production in Figure 3 with Ireland's 2020 targets and Ireland's relative position with respect to wind as a percentage of total electricity in Figure 4, it is easy to see that this is an enormous challenge, particularly for an Island nation with little or no interconnectivity.

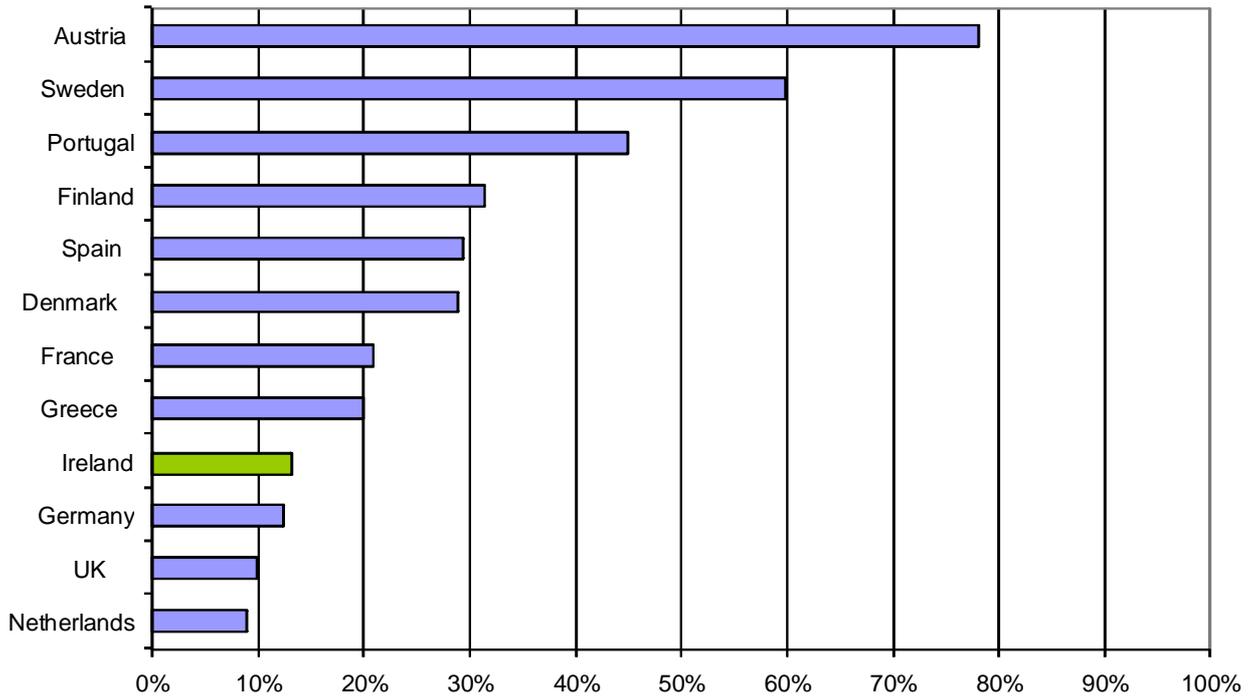


Figure 3 - Renewables Share of Overall Electricity Production 2010 Target (Select EU Countries) [10]

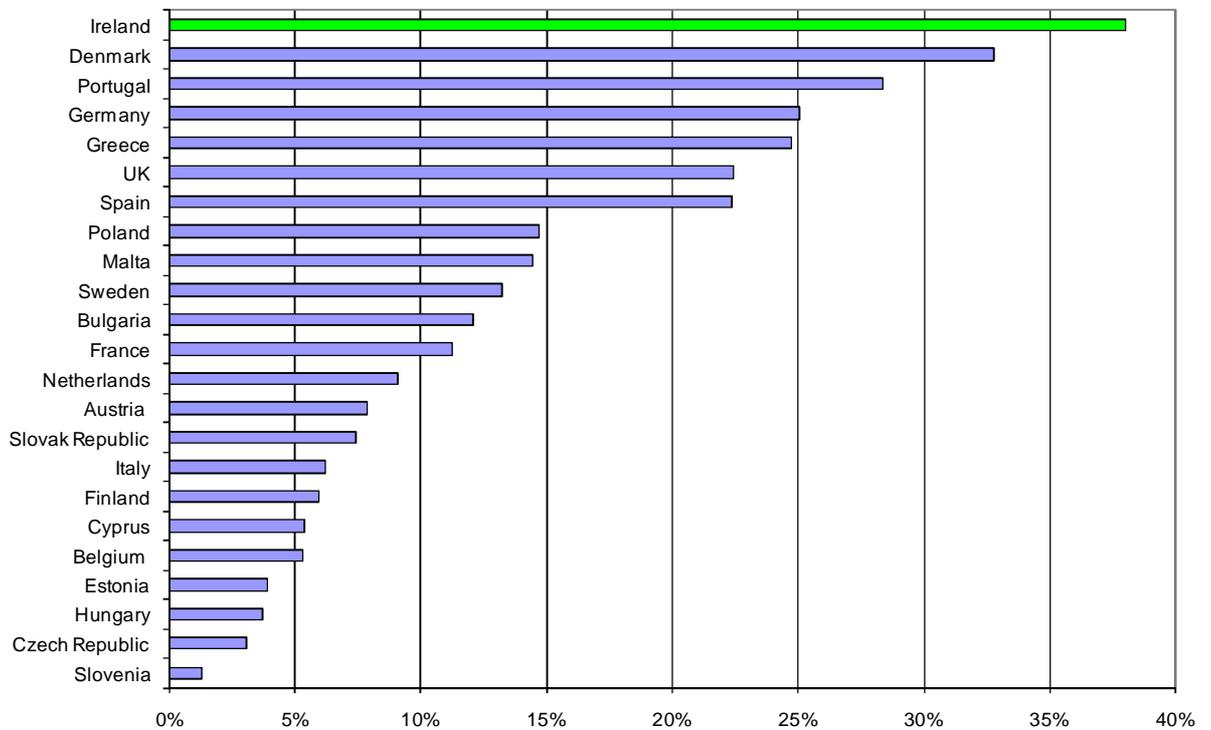


Figure 4 - Wind as a Percentage of Total Electricity 2020 Target (Select EU Countries) [10]

5. WIND DEVELOPMENTS ABROAD

5.1 Great Britain

As part of the EU's target of 20% of electricity to be generated from renewable resources, the UK government has been set a target of 15% [21]. The UK enjoys one of the best wind energy resources in Europe with 50m wind speeds over most of the country averaging above 5.5m/s and much of the North and West over 7.5m/s. It also benefits from large areas of accessible offshore locations, many with equally good or better wind speeds.

The transmission system in Great Britain is divided into three transmission licence areas which are England and Wales, South of Scotland and North of Scotland [24]. The England and Wales transmission system is owned by NGET, Scottish Power Transmission Ltd (SPTL) owns the transmission system in the South of Scotland and Scottish Hydro Electric Transmission Ltd (SHETL) owns the transmission system in the north of Scotland. All three of these transmission owners (TOs) are responsible for building and maintaining the transmission networks and this is regulated by Ofgem [24]. NGET is the GB system operator (GBSO) and as a result has the responsibility of overseeing and managing the flow of electricity and providing the commercial interfaces with users across the whole GB transmission system, including the network elements owned and operated the TOs [24].

The Renewables Obligation Order (RO Order) was introduced in the UK in 2002 and is the current main mechanism for supporting large scale generation of renewable electricity. It requires energy suppliers to source an annually increasing percentage of their requirements from renewable sources or make a payment to the buy-out fund. Due to the financial incentives there was a large increase in the development of renewable energy projects, and in particular wind farms. In 2005 the British Electricity Trading and Transmission Arrangements (BETTA) were introduced and this provided for even greater market opportunities for selling electricity [24]. This led to a huge surge in grid applications in Scotland where around 12GW of wind generation applied for a connection to the transmission system [24]. There is an oversupply of generation in Scotland and as a result

it exports a large proportion of this surplus electricity into England and Wales. This has led to an overall geographical disposition of generation and demand, with an ever increasing volume of generation being developed in the north and the demand heavily concentrated in the south of Britain and the flow of electricity is largely north to south. This 'generation demand' profile means that new generator connections in Scotland may give rise to deep transmission reinforcements being required not only within Scotland but all the way down to the major supply hubs in southern England [24]. Large volumes of renewable generation are under development or under consideration in England & Wales and the tendering process for offshore for generation and transmission is expected to contribute substantially to the development of renewable generation capacity in offshore waters. There is also substantial interest in building new conventional generation to replace older, 'slow acting' plant, to meet rising demand and support higher levels of wind penetration. Taking into consideration the 12GW of generation waiting to connect in Scotland, plus around 9GW in Wales, plus an anticipated further wave of gas, nuclear and offshore wind connections, around 45GW of new generation is expected to connect in Great Britain before 2020, with around 83.6GW of installed capacity at present [24].

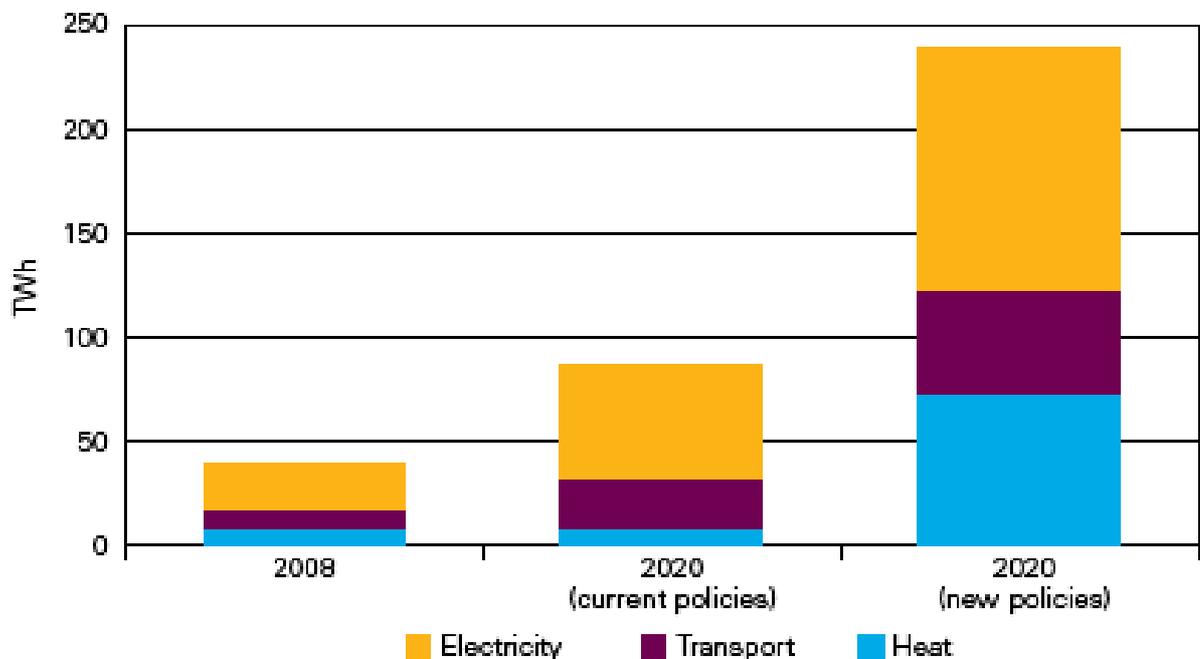


Figure 5 - The UK challenge to reach 15% renewable energy by 2020 [23]

The UK has signed up to the EU Renewable Energy Directive, which includes a UK target of 15 percent of energy from renewables by 2020 [23]. This target is equivalent to a seven-fold increase in UK renewable energy consumption from 2008 levels [23]. In 2008, renewables provided 5.5% of UK electricity generation with 2.25% of UK energy (electricity, heat and transport) coming from renewable sources with wind energy being the biggest contributor, passing the 3GW mark in October 2008 [22]. The current installed capacity of the UK is 4,491MW which includes 1,041MW offshore wind [82]. Furthermore there are 26 wind farms under construction expected to have a total installed capacity of 1,676.55MW including 1,119MW offshore [82]. This still represents a comparatively modest penetration into the viable potential, with the renewable energy strategy estimating that the 2020 capacity should be of the order of 28GW (of which 14GW could be offshore) [23].

These developments placed an unprecedented demand on the transmission system, which needs to be extended and strengthened to cope. However, planning delays, both for renewable projects themselves and for transmission investment, combined with the scale of the physical work required has led to substantial delays in connection of new projects, and what has become known as the “GB Queue” [24]. Projects in the GB queue are offered connection to the grid by date of application rather than project status. Consequently, some projects in Scotland now have connection offers despite not having applied for planning consent, whereas other projects have consent but do not have a connection offer [25].

Traditionally, the transmission system has been planned and developed using a methodology of “invest then connect”, which means that if the connection of a new generator drives the need for further deep reinforcements, such as the building of a new overhead line, the generator is not allowed to export power onto the transmission system until all associated reinforcements are complete [24]. As a result, there can be a situation where a generator is physically able to export power onto the system, but delays to their associated deep reinforcements can prevent them from doing so. In such situations it is important to ensure that the maximum use is being made of the existing network capacity

while the deep reinforcements are being completed as this will enable faster connections of renewable generators while also ensuring that the arrangements for access to scarce capacity are fair [24].

The Energy White Paper in May 2007 identified the following challenges [26]:

- The need to manage more efficiently the queue of developers waiting for grid connection;
- The need for reform to the arrangements for access of renewable generation to the grid, and
- Ensuring the technical standards do not disproportionately burden renewable generators.

Ofgem and BERR were requested to assess the arrangements for transmission access and identify potential improvements to the process, both in the short term and long term. This led to two major work streams: the Short Term Access Governance (STAG) Review which involved examining the steps being taken to optimise access to the network in the short term, and the Transmission Access Review (TAR) which considered more substantial reforms of the access arrangements required in the longer term [24] [26]. The STAG review was completed in October 2007 focussed on the following initiatives [24]:-

- GB Queue management initiatives;
- Commercial framework development, relating primarily moving projects forward;
- Review of system operation with a view to potentially freeing up scarce capacity; and
- Review of the GB Security and Quality of Supply Standards (GBSQSS), particularly the existing planning and operational criteria.

National Grid Electricity Transmission (NGET) has published two consultation documents in an attempt to resolve the issues that led to the GB Queue [28]. The key proposal is a move to a more “interventionist approach to contract management” which would see NGET enforcing clauses within contracts which give it the right to terminate projects that were failing to deliver. NGET has also developed a mechanism which allows the most viable projects, irrespective of their place in the queue, to move into any gaps which

become available [24]. The goal is to optimise the utilisation of the limited capacity available prior to reinforcements being completed [24] and thus NGET concluded that where opportunities for an earlier connection date arise then these should be allocated based on ability to use the system soonest [28]. Also as part of the GB Queue management initiatives was the introduction of a more robust “User Commitment” regime via CAP131 which incentivises projects that remain highly uncertain or speculative to reduce capacity or withdraw from the queue until such time as their project is more certain [28].

NGET will take a more active approach to contract management which includes improved and regular communications from both sides including quarterly reporting and milestone management especially in the area of planning, equipment procurement and construction. For those projects that do not meet their contractual commitments, including failing to obtain the appropriate planning consent or necessary finance, NGET will now take a more robust approach than previously and this may lead to the slipping of connection dates for some projects or even termination [28]. Developers can also request that their connection dates be delayed or their export capacity (TEC) be reduced.

The Commercial Framework Development sought to improve contractual developments by introducing five industry code amendment proposals with the objective of improving the GB Queue and aspects of the transmission access arrangements. Two of these, CAP131 and CAP143, were rejected [29] [30]. CAP131 required parties waiting to connect to provide Final Sums Liabilities (FSL), similar to a connection works bond in Ireland, for security while construction is underway for their connection and the purpose of this was to protect against connection assets becoming stranded [24]. CAP143 sought to provide an opportunity for applicants to use the transmission network prior to the completion of reinforcement works. A generator would purchase a product (Interim TEC) allows them to use the transmission network for all but certain periods of the year and during these periods the System Operator would be able to constrain the applicant off the system without paying compensation [24]. CAP149 has been accepted [31] and aims to increase the transparency of SQSS design variation connections and the associated access restrictions by allowing a lower (or higher) standard of connection based on a customer request, providing this meets

the conditions described in the SQSS [24]. CAP142 allows existing users to trade their capacity on a temporary, within year basis, subject to an appropriate exchange rate being determined by NGET. This capacity leasing may allow any unused or underused capacity to be transferred between existing users and maximise the use of the transmission system [32]. CAP148 is a significant amendment proposal, which requests priority transmission access for renewable generation. Renewable generators would receive transmission access rights following a fixed period (e.g. 3 years) after the later of the project gaining consent or accepting a connection offer from NGET [33]. CAP148 is still under consideration.

The final report of the Transmission Access Review (TAR) was published on 26th June 2008 includes actions that will allow faster connection of renewable generation to the grid, ensure enduring grid access arrangements will allow faster connection and expansion of grid capacity, measures to identify the new transmission infrastructure necessary to meet growing demand and new financial incentives for the transmission companies to deliver that capacity. The TAR sets out the key characteristics of an “Efficient Access Regime” [36]:-

- New generation projects should be offered firm connection dates, reasonably consistent with the development time of their project;
- Generators requesting a long term financially firm connection to the transmission system must be prepared to make a long term financial commitment;
- TSO's need to be incentivised to respond to the long term demand for grid access required by new generators. They require the freedom and incentives to expand and develop the network prior to any commitments from potential generators. Furthermore TSO's must have the appropriate incentives to deliver new connections on time and to innovate so that they can deliver as much capacity as possible from existing transmission assets;
- Transmission access rights need to be more clearly defined and all generators must be offered a choice about how they access the system, such as long term fixed price access rights that guarantee long term access in return for a commitment to pay for capacity or shorter term access rights that offer more flexibility; and

- Transmission capacity should be ‘shared’, particularly as the amount of connected generating capacity increases in relation to transmission network capacity. This will invariably lead to a more efficient use of both existing and future transmission assets.

Three Access Models were identified and included in the TAR analytical discussion document, known as the Strawmen Models [35]:-

- **Model A** - adopts a ‘connect and manage’ approach to transmission access in which the right to access the system is driven by the requirements of a connecting party. This reflects the model’s primary focus of facilitating increased generation deployment.
- **Model B** - uses market-based mechanisms to deliver access to the party that values it most at any given time. This is done through the initial allocation and secondary trading of a range of access products. This includes firm access rights of different duration and the provision of a facility for generators to access the system through overrun arrangements.
- **Model C** - is based on a Locational Marginal Pricing (LMP) approach, which exposes all participants to the short run costs of transmission access in each half hour. The model maintains the separation of energy and capacity markets.

Under Model A, a new generator receives a guarantee of being connected to the transmission system no more than three years after the submission of their application. This is subject to their application satisfying specified project development criteria. The new generator will be allocated firm access rights upon connection to the system. These rights can only be used to access the system at the node to which the generator is connected. Connection of new generation is further facilitated by a pre-connection user commitment that only relates to the cost of local connection assets. Once it has connected to the system, the generator has a commitment to pay annual access charges for a de minimis period, with an extended notice period of at least 3 years to broader cover the wider reinforcement costs. Model A does not require the system to be fully secure before new generation is granted access, so generators can connect on a non-firm basis as In

Ireland. The advantage of this is that it facilitates new connections quickly, which will help to deliver greater renewable generation deployment and leads to increased competition. This model could potentially have security of supply benefits, if it results in a substantial increase in new generation, then the pool of available generation on the system should increase, thereby resulting in more free headroom, and potentially a higher capacity margin. However, if the majority of this new generation is intermittent, the security of supply benefit of the additional capacity will be relatively low - output depends on available wind, and cannot easily be predicted by the SO. Where large deployment of wind generation occurs, additional reserves of responsive (largely conventional) generation will need to be procured to cover unpredictable loss of output. However, if Model A applies to all types of generation, the impact of intermittency on system reliability would be diminished. The further risk of Model A is that it could allocate more transmission access rights than the system can accommodate, which could lead to additional constraint costs which would ultimately pass on to the consumer.

Model B uses market-based mechanisms to deliver access to the party that values it most at any given time. This can be achieved through a combination of the initial allocation and secondary trading of a range of access products. This includes firm access rights of different duration and the provision of a facility for generators to generate and gain access the system through “overrun arrangements” i.e. generate when they do not hold access rights and pay an overrun charge. This may encourage connection of greater levels of renewable generation either because they will find it significantly easier to gain transmission capacity. A new generator is able to be connected to the transmission system upon submission of an application that satisfies specified project development criteria. These criteria may relate to completion of shallow works, planning consent of financing. However, connection to the system does not confer any firm access rights on the generator. There are a number of different ways in which the generator is able to export its output onto the transmission system (up to their level of MEC). These include:

- Obtaining firm access rights from the SO (initial allocation); making successful bids for long-term firm access rights; making successful bids for short-term firm (or interruptible) access rights;

- Obtaining firm access rights from other generators ('secondary trading'); and
- Using the overrun facility.

In making its network investment decisions, the network operator will take into account the values placed on long-term firm access rights in the bids that it receives in the initial allocation process. These will be supported by the evidence from the prices seen in secondary trading mechanisms. If the system operator receives bids for access rights for a sufficiently long period (rather than a snapshot) that are significantly above the long run marginal cost of providing access, then firm access rights will be provided to the successful bidders within three years of the auction. In order to facilitate secondary trading of rights up to real time, a firm access right provides a generator with firm access within a trading zone (which is a collection of different nodes). The boundaries of trading zones may or may not coincide with the boundaries of pricing zones. As it is assumed that trading of rights within a zone can be done on a one-to-one basis, the definition of rights as zonal allows for the easy and quick trading of rights within a larger area than a single node.

Model C is based on a locational marginal pricing approach, which exposes all participants to the short run costs of transmission access in each half hour. Again a new generator is able to be connected to the transmission system upon submission of an application that satisfies specified project development criteria. The Transmission Export Capacity (TEC) is replaced by a purely financial product called FTEC, Financial Transmission Entry Capacity. These products are defined on a zonal basis and new generators are only able to export through an overrun mechanism. All parties are exposed to the Short Run Marginal Cost of generation, which is equivalent to the difference between the unconstrained national electricity price and the constrained zonal energy price, and this could be hedged by purchasing a FTEC product. As with Model B, this model is complicated and would require a considerable amount of development time, including creation of a new financial instrument, FTEC. Model C would therefore not be a particularly timely way of bringing on new generation.

In May 2009, Ofgem approved a new interim regime that allows National Grid to offer earlier grid access to a significant number of new generation projects. Based on this regime, circa 1GW of renewable energy projects in Scotland have been offered the opportunity of an earlier connection to the transmission system [58]. The new regime means that projects are able to advance connection to the grid by a number of years. However, this decision is only an interim arrangement and to ensure that there are necessary enduring arrangements in place for the long term DECC began a consultation on improving grid access by issuing a consultation paper on 25th August 2009. The industry process identified a number of options that broadly fell into two categories:

- ‘Connect & Manage’ options, whereby generators would receive a fixed connection date, and would be entitled to use the system from that date.
- Auctions, whereby any existing grid access arrangements would cease, in favour of reallocating all capacity by auction to all generators (both existing and new).

The UK Government decided that models based on ‘Connect and Manage’ were most likely to best meet their objectives and as a result this was the basis of the Improving Grid Access consultation [58]. Under these models, generators do not have to wait for network reinforcements to be completed before they connect to the transmission network. Users would be able to connect to the transmission system as soon as their shallow works were ready, should they choose to do so [58]. Where the combination of new and existing generation exceeds the capacity of the transmission network, the system operator actively balances the network to ensure that it is not overloaded. Generators may be constrained (told that they cannot generate as much electricity as they would like to at a certain point in time). This results in ‘incremental constraint costs’ as payments are made to them to compensate for this. There are different options for Connect and Manage are listed below:

- **Connect and Manage (Socialised):** A model that fully socialises any additional constraint costs. Under these arrangements costs will be shared between all users of the network and ultimately borne by consumers [58].
- **Connect and Manage (Hybrid):** A model that targets some, but not all, of the additional constraint costs on new entrant power stations. These costs may be

limited because of the incentive for new entrants to reduce their impact on overall costs through their choice of location and operation profile [58].

- **Connect and Manage (Shared Cost and Commitment):** A model that offers the choice to new and existing power stations to commit to the network in return for greater certainty over charges, or to opt out and be exposed to additional constraint costs [58].

All three options are intended to give new generation projects options that will provide firm connection dates reasonably consistent with project development timescales. The essential difference between the models is how any costs are shared between new entrants and existing generators with grid access.

5.2 Alberta

Alberta has adopted a leadership position in wind power development in Canada, being the first jurisdiction to develop wind interconnection standards and currently leading in wind penetration with 563MW of wind generation connected to the grid (600MW including wind connected by distribution) and much more in development in a jurisdiction with a total installed capacity of 12,427MW. Large-scale integration of wind power, however, is still relatively new and presents new operational opportunities and challenges. The AESO recognized that it was important, both to system reliability and to the successful development of renewable resources in Alberta, that the impact on power system operations was understood as Alberta reached new levels of wind penetration [44]. As a power source, wind power holds great potential for Alberta as it is clean, renewable and Alberta contains a range of suitable wind generation sites. However, the nature of wind power makes managing the reliability of the system significantly more challenging than managing the existing, predominately thermal generation.

In 2004, the AESO began working with stakeholders, wind developers and other jurisdictions to better understand the impact of integrating wind power into Alberta's electric power system and subsequently two studies on assessing the impacts of increased wind power on AIES operations and mitigating measures were conducted in November

2005 and April 2006 [45]. The studies indicated that wind power posed system reliability concerns as wind penetration increases in the absence of corresponding mitigation measures such as increased regulating reserves, wind forecasting and power management of wind resources. In addition, it was noted that the scope, scale and potential cost of mitigating measures escalated rapidly as wind penetration increased beyond about 900 MW. Facing substantial wind additions in the near term, the AESO established a temporary 900MW threshold to ensure continued system reliability until appropriate mitigation measures could be defined and associated cost allocations determined. The AESO continues to work with Alberta industry stakeholders and system/market operators in other jurisdictions to implement the Market and Operational Framework including further defining the rules, tools and procedures the AESO will employ to integrate increasing volumes of wind power into the Alberta system without compromising system reliability or the fair, efficient and openly competitive operation of the market.

The generator connection process in Alberta has just completed an extensive review and consultation process and on April 1st 2010, the AESO implemented a new generator connection process [79]. Under the current system applicants are placed in an interconnection queue and transmission capacity is allocated based on date of application. Presently, there is approximately 21,812MW of generation in the interconnection queue including 12,922MW of wind generation seeking a connection to the Alberta Interconnected Electric System (AIES). Currently, the queue is a public document that provides stakeholders with general information regarding those projects that have applied for a connection or a change to an existing contract or service [72]. The queue is used to assign planning capacity, to track forecasted in-service dates, and as a guide to resource and prioritize work accordingly. The assignment of planning capacity is used to distinguish which projects are given priority for remedial action scheme (RAS) sequencing based on application date [72]. Notwithstanding the queue, some projects can advance ahead of others depending on whether there is need for transmission reinforcement (Alberta is a transmission-constrained market) and how quickly the project proponent advances through the process. In addition, project proponents must adhere to Project Milestone Obligations to ensure the project is progressing and not holding up other projects that may follow in the

queue. A set of key project milestones and associated obligations dictate how and when a customer interconnection project progresses through the AESO's Interconnection Process. The milestone obligations are based upon the following principles [77]:

1. Preliminary Assessment Applications (PAA) will be used to establish queue position and to allocate transmission capacity and work priority to projects on a first come first serve basis.
2. The AESO will work with the Transmission Facility Owners (TFO) in order to provide the customer with an Interconnection Proposal in a timely manner.
3. The AESO will work collaboratively with the customer and other industry participants (TFO, Distribution Facility Owners (DFO), Alberta Utilities Commission (AUC)), in an effort to achieve customer requested in-service dates.
4. Milestones are put in place in order to ensure projects progress at a reasonable rate. Customers are required to meet the Milestones in order to maintain queue position, work priority and allocated transmission capacity.
5. Milestone obligations may be adjusted in the event that system transmission reinforcement is required which could delay the customer interconnection project's in-service date.

The new Connection Process implemented in April 2010 involves 6 Stages and follows a gated approach [78] [79]. Key activities take place in each Stage and projects must meet all of the requirements within each Stage to complete the corresponding Gate for that Stage. Each IPP is accountable to drive their connection project while the AESO appoints a project coordinator to facilitate the process and be the AESO point of contact for the TFO and IPP. The six stages are outlined below [78]:-

STAGE 0: Identify Project (2 weeks)
1. Customer submits System Access Service Request (SAS) to AESO and AESO reviews SAS Request for completeness
STAGE 1: Connection Study Scope (8 weeks)
1. Complete Connection Plan and Connection Study Scope
2. Customer submits Stage 1 Project Data Update Package
STAGE 2: Connection Proposal (14 weeks)
1. Connection studies completed and Customer completes or accepts Connection Proposal.
2. Customer submits Stage 2 Project Data, includes specific machine data for dynamic studies
3. Customer enters into an agreement for Stage 3 costs.
STAGE 3: Need Identification Document & Facility Application (32 weeks)
1. Confirm Connection Proposal is still valid
2. AESO completes Functional Specification
3. Generators file Application with Alberta Utilities Commission (AUC)
4. Customer submits Stage 3 Project Data Update Package
5. Customer enters into an agreement for Stage 4 costs
STAGE 4: File Applications & AUC Approval (24 weeks)
1. AUC decision
2. Customer enters into an agreement for Stage 5 costs
3. AESO issues invoice for Generator System Contribution
STAGE 5: Construct & Prepare to Energize (16 weeks)
1. Construction of transmission facilities
2. Customer and AESO sign the System Access Service (SAS) Agreement
STAGE 6: Energize, Commission & Close
1. Energize transmission facilities
2. Commissioning Certificate issued by AESO for generators

A key component of the stage connection process is governance, which simply means that each requirement of the process is checked in a formal way by the AESO and this is

intended to ensure that the connection model is efficient and that involved parties deliver on their requirements and do not hold up other applicants that may be behind them in the connection queue. Projects are only entered in the connection queue once Stage 0 has been passed and project must pass each stage within a certain timeframe or projects will be cancelled. The timeframes are listed below [79]:-

- Stage 1 - 4 months
- Stage 2 - 9 months
- Stage 3 - 1 month
- Stage 4 - Within 90 days of AUC issuing TFO Permit & Licence may be cancelled
- Stage 5 - Projects that do not pass Stage 5 cannot be energized

5.3 British Columbia

British Columbia's electricity supply is predominantly a hydroelectric generation system, and currently over 90 per cent of electricity generation is renewable, low or no carbon electricity. Hydro plants range in size from large in scale, such as the BC Hydro GM Shrum Generating Station at 2730MW and 1310 average GWh per year, to small in scale operations, such as the Hupacasath First Nation's China Creek small hydro operation at 5.6MW and 25 GWh per year. British Columbia's first wind farm began commercial operation in August 2009. The Bear Mountain Wind Farm, which is located near Dawson Creek, comprises of 34 wind turbines and has an installed capacity of 102MW. BC Transmission Corporation (BCTC) was established to plan, operate and maintain British Columbia's publicly owned transmission system. BCTC's generator interconnection procedures are governed by their Open Access Transmission Tariff (OATT), which sets out the terms and conditions by which BCTC conducts business with customers. There are two generator interconnection procedures:-

1. Standard Generator Interconnection Procedures (SGIP)

Designed for IPPs interested in:

- Connecting to the transmission system outside of a BC Hydro power call;
- Modifying generation and associated interconnection facilities; or
- Responding to BC Hydro's Standing Offer program.

2. BC Hydro's Calls for Power: Interconnection Procedures

These are interconnection procedures designed for BC Hydro's Competitive Electricity Acquisition Process.

The Generator Interconnection Queue ensures that valid interconnection requests are processed in the order they are received and as a result applicants that are in a higher position in the queue will have the impact of their study included in the base case of those lower in the queue. In order to maintain their queue position and progress through the interconnection process, the applicant must meet the milestones set out in BCTC's Interconnection Procedures within the stated deadlines. If deadlines are not met, the applicant is withdrawn from the queue. There is one Generator Interconnection Queue for both the Standard Generator Interconnection Procedures (SGIP) and the Interconnection Procedures for BC Hydro's Competitive Electricity Acquisition Process (CEAP). However, queue positions are issued differently according to the interconnection process being followed. Customers following the SGIP are treated individually and are given their own time and date stamp upon entering the queue. These interconnection requests move through the interconnection process individually. Customers participating in the CEAP enter the queue as a group. A time and date stamp is given to the entire group and CEAP participants move through the interconnection process as a group. This enables the combined impact of all of the interconnection customers to be studied and evaluated collectively. This helps inform BC Hydro's evaluation and selection process.

Potential IPPs submit an application to BC Hydro and an Interconnection Request to BCTC. Once a project submits an Interconnection Request, they receive a place in the interconnection queue. All projects participating in a 'Call for Power' receive the same queue position and are studied on a stand-alone basis. BCTC perform a Feasibility Study, consisting of a load-flow and short circuit analysis, for each project. The result is a report indicating the required method of connection and an estimated time and cost to construct the interconnection facilities and associated local upgrades. BC Hydro uses this data and other criteria to determine which projects they will select to continue the process and undergo further study.

Once the planning studies are complete, an IPP selected by BC Hydro will sign a Standard Generator Interconnection Agreement with BCTC and an Electricity Purchase Agreement with BC Hydro. The SGIA allows for the IPP to connect to the grid and the EPA with Hydro enables the power to be transmitted to load. BC Hydro is responsible for nominating the IPP as a network resource and BCTC will perform studies to determine whether any system network upgrades are required. If the IPP is not planning to sell to BC Hydro, they must submit a Point-to-Point Transmission application in order to determine the upgrades required to bring their power to a customer outside of the BC Hydro service area.

All interconnected generators are granted equal access to the grid, i.e. there is no distinction between firm and non-firm. The customer is responsible for all costs to bring their project to the Point of Interconnection (POI) on BTC's existing system (transmission line or a substation). The interconnection facility is built and paid for by BCTC but the customer must provide a security deposit for the total estimated cost. This security is reduced over time using a formula incorporating our transmission rates and the project capacity. BC Hydro pays for the transmission re-enforcement costs if the customer is selling to BC Hydro, however the customer must pay if selling to another company.

The application processing and project development timelines are much shorter than in Ireland. Each project's interconnection construction schedule is dependent upon a number of factors including, but not limited to:-

- Complexity of interconnection facilities (simple line tap, three-breaker ring substation, etc.)
- Procurement of equipment
- Land acquisition
- Environmental and First nations consultation
- Construction windows (especially in colder or environmentally sensitive regions)

As an example, the Bear Mountain wind farm submitted an Interconnection Request in January 2006 and was energized in July 2009.

6. STAKEHOLDER VIEWS ON GATE 3

6.1 Gate 3 Consultation Responses

On 17th December 2007 the Commission for Energy Regulation published a consultation paper on Gate 3 entitled “Criteria for Gate 3 Renewable Generator Connection Offers - A Consultation Paper” (CER/07/223). This consultation paper discussed potential options for the inclusion of renewable generator projects in Gate 3 and three broad options for the processing of these renewable generator projects. The consultation paper also invited comment from interested stakeholders and asked them to put forward their preferred options. The options and proposals in the consultation paper were explained at a special workshop with all interested stakeholders held by the Commission in Dublin on 22nd January 2008 and the deadline for receipt of comments to the consultation paper was the 22nd February 2008. The CER received 26 responses to the Gate 3 consultation paper, with a wide range of views expressed and these are discussed below.

Gate 3 Size: The CER initially decided that the Gate 3 closure date was 17th December 2007 and that any applicants received after this date would not be included in Gate 3 [17]. The vast majority of applicants believe that there should be no cap on the size of Gate 3 as certain offers may not be accepted and there may be a high attrition rate due to planning permission or financial constraints and this could ultimately affect our renewable energy targets. The following is a list of responses from interested parties in relation to the proposed Gate 3 size:-

- A significant number of respondents believe there is no need for a cut-off date and there should not be a limit on the Gate 3 size as it is not necessary for the GDS Option;
- It appears that Irelands renewable energy targets are being viewed as a ceiling to renewable potential and this should not be the case, our targets should be viewed as just a stepping stone to even greater targets;
- The GDS approach has the potential to deliver large volumes of renewable energy, however it is more effective with a larger pool of applicants, as planning/building for a larger group now (instead of a smaller group first and returning to build

transmission for new applicants) will lead to a more efficient network being developed;

- An installed renewable target of 4,400 MW does not equate to 33% of electricity consumption in 2020, pointing out that the All-island Grid Study referred to 4,253 MW equating to 27% of demand being met from renewables;
- A 35% capacity factor should not be used when assessing the Gate size against renewable energy targets, according to Airtricity, because less windy sites could become more prominent as penetration increases; and
- It was suggested by one stakeholder that the CER should initially start with a smaller Gate, such as the 1,650 MW as this equated to the amount of applicants that were eligible but not successful for Gate 2 and this would also give priority to those longest in the queue.

Eligibility: It was initially suggested that applicants should be included in Gate 3 based on application date order up to a certain cut-off size, i.e. 3,000MW. The following is a list of responses from interested parties in relation to the proposed Gate 3 eligibility:-

- the inclusion of applicants in Gate 3 should relate to when applications were initially received by the SO's, rather than when deemed complete, as both SO's have different procedures for deeming applications complete;
- Applications lodged subsequent to 17th December should be included in Gate 3 on account of being located in areas with excellent wind speeds and/or close to the transmission system;

Gate 3 Processing Options: The GDS was broadly welcomed by all respondents as their preferred option for Gate 3 [17]. It is seen as the preferred model by which to integrate large volumes of renewable generation into a long-term plan for the optimal development of the transmission system [17]. However there were many conflicting views on how the GDS should be implemented and these are detailed below:-

- No respondents expressed a view that there should be a 'purely date order' approach to Gate 3.

- Priority to applicants waiting longest in the connection queue, i.e. by date order, though there were some who believed that a system optimisation approach should also be used.
- A request was made by many respondents to allow applicants avail of any spare firm capacity at a node in a given year, even if this was less than the capacity they applied for.
- Inclusion of the distribution (along with the transmission) system in the GDS to facilitate a more optimal network development and the connection of distributed generation.
- Support for a continuous and regular update of the GDS feeding through to a roughly annual cycle of connection offers being issued, rather than one large discrete Gate. This would lead to a regular pattern of offers being issued based on available capacity and this would invariably provide for predictability and fairness and could help reduce the “rush to apply” situation that currently exists.
- Some respondents believe that a minimum target volume of firm capacity should be offered each year.
- All of the stakeholders believe that the time lines for issuing offers in Gate 3 are far too long.
- One respondent recommended that all Gate 3 projects should be given a date by which they receive an offer.
- A significant number of stakeholders believe that applicants which were unsuccessful in Gate 2 and/or are longest in the queue should be prioritised as regards receiving a connection offer.
- Capacity should be allocated in queue order.
- Allocation of firm capacity should not be issued by date order but by some reference to their contribution to system optimisation.
- Priority for firm connections should be given to sub-groups which have a Least Cost Technically Acceptable (LCTA) connection method.
- Other respondents believe priority should be based on the following type of order criteria:

- Extensions to existing projects where both the existing shallow and deep infrastructure can accommodate new development.
 - Existing developments requiring reinforcements and/or extensions to new projects in an area where the deep reinforcements are minimal.
 - Areas where the wind resource is good and a node/zone can support a high capacity and/or potentially also the ease with which planning is likely to be granted - this could include off-shore wind.
- Airtricity supports “fast-tracking” the connection of large-scale renewable generators due to their security of supply and “dispatchability” benefits.
 - Similarly two others support off-shore wind projects due the benefits that they can bring such as ease in securing consents, scale and consistency of output for system operation purposes.
 - In contrast one respondent recommends that an offer is made immediately to all small projects (< 5 MW) for which planning permission is about to expire (<18 months).
 - Another also recommends that a “ready-to-go” criterion be applied.

6.2 Gate 3 Proposed Direction (08/118) Responses

On 11th July 2008 the CER issued a proposed direction to the system operators in relation to the criteria for inclusion, treatment and processing rules for Gate 3. This set out in detail, and for a second round of public consultation, a particular approach for the inclusion of renewable generators in Gate 3, along with other inter-related issues such as the treatment of other non-renewable generator applications [55]. A workshop was held by the CER on 26th August 2008 to explain the proposed direction, and interested stakeholders were invited to comment by 5th September 2008. Subsequently 21 comments of a diverse nature were received by the consultation closing date and these are discussed as follows:-

Gate 3 Options: The options put forward by the CER were “Date Order”, “Date Order & System Optimisation” and the “GDS approach”. The following is a list of responses from interested stakeholders in relation to the GDS approach being the preferred option:

- All of the stakeholders agreed that the GDS approach, allowing for the integration of renewable generation into a plan for the long-term and optimal development of the grid, should be the approach used in Gate 3.
- One respondent suggested that distribution system should be included in the in the GDS along with the transmission system, with an emphasis on connecting small projects to the distribution rather than to the transmission system, citing that this would be a more sustainable and efficient approach.

Gate 3 Size: The size of Gate 3 was proposed to be 3,000MW which took into account the Governments target of 33% renewable penetration by 2020. This was controversial as the connection queue size was greater than 3,000MW. The following is a list of responses from interested stakeholders in relation to the proposed Gate 3 size of 3,000MW:

- The 3,000MW Gate 3 size strikes a balance between the need to have applications processed in a timely manner and the desire to have the largest number of applicants included in Gate 3.
- There would be concern at any proposals to increase the size of Gate 3 as this would severely extend the timelines associated with issuing offers which would affect those longest in the queue.
- More renewable generation is needed to meet the then 33% Government renewables target for 2020, due to decreasing capacity factors, constraints limiting output, potential demand increases and project attrition and as a result more than 3,000 MW is needed in Gate 3 to meet this target.
- The Government target for renewables should not be applied as a “de facto” limit or ceiling on renewable energy integration to the network and the target should be viewed as a minimum to be achieved for renewables rather than the limit.
- Airtricity views the imposition of a ceiling on the level of wind capacity to be in conflict with the intent of EU legislation.

Gate 3 selection method: The Direction proposed that applicants should be included in Gate 3 based on application date order based on a Gate size of 3,000MW. The following is

a list of responses from interested parties in relation to the proposed Gate 3 selection method:-

- SWS, Airtricity, Coillte and Viridian advocated that Gate 3 applicants should not be selected on application date order (as was proposed) but on the basis of whether they would optimise the development of the transmission system. A report by TNEI, which was commissioned by SWS, Airtricity, Coillte and Viridian, claimed that the CER's proposed criterion for selecting Gate 3 projects took no account of efficiency or optimisation and that to select Gate 3 applicants by transmission system optimisation would result in significantly fewer transmission reinforcements being required. The report claimed that this would result in significant savings in transmission investment costs, an increase in the likelihood of meeting the Government renewable targets in a timely fashion and a reduction in the environmental impact. It further claimed that, based on an initial analysis on the optimisation of 3,000 MW for Gate 3 from a connection queue of circa 7,500 MW, transmission investment costs (financed by the end customer) could be reduced by up to €390 million, with the amount of 110 kV lines reduced by up to 250 km [59].
- Coillte went further and proposed that, on the grounds of fairness to those longest in the queue (the first circa 1,500 MW of applicants) should be included in Gate 3 based on application date order with the remaining applicants, up to and including the application cut-off date of 17th December 2007, eligible for inclusion on an optimised basis. These applicants could then be chosen on the basis of the following broader system optimisation criteria: the likely unit generation cost of a wind farm, the level of capital investment required in the connection infrastructure and the speed with which the project can be brought into operation [60].
- Airtricity argued that large-scale renewable applicants, including off-shore, should be able to avail of a "complementary" and faster connections process in view of their benefits, including security of supply, dispatchability, higher utilisation of transmission infrastructure, reduced planning delays and the requirement to speedily meet renewables targets [62].
- In contrast, a greater number of stakeholders rejected the idea of selecting applicants on the basis of optimisation, scale or other criteria and expressed a

strong view that applicants be selected in application date-order. This was on the basis of fairness (to those longest in the queue), speed of implementation and transparency [55].

Extensions to Existing Projects: Gate 2 allowed for extensions to existing wind farms where these could be accommodated by their existing shallow connections, i.e. no physical shallow line works required to accommodate the requested additional MEC [19].

- Two respondents, Keohane Geological & Environmental Consultancy and Declan Rouse requested that provisions should be made within Gate 3 to allow extensions to an existing wind farm development with full planning permission to receive capacity, in the event of a project within its group not being built as this would make for more efficient use of grid infrastructure and help achievement of renewable targets more quickly [63] [65].
- However, a lot of other parties came out strongly against the inclusion of extensions in Gate 3 with Meitheal na Gaoithe stating that they were “abused” in Gate 2 [64].

Planning Permission: The proposed direction on Gate 3 (CER/08/118) proposed that planning permission would not be a criterion for inclusion of wind generators in Gate 3, but would be for subsequent Gates of the GPA [27].

- Coillte responded that the current timeframes for processing offers do not allow for planning permission to be used as a criterion for subsequent Gates, stating that obtaining planning permission in advance will impose very significant extra costs on developers who are already faced with the uncertainty, not only as to whether their projects will receive a connection offer within the next 10 years, but more fundamentally as to whether they will receive a connection offer at all [60].
- SWS Energy and Bord na Mona agree that planning permission should not be a criterion for Gate 3. It also believes that, while it could be applied in future Gates to decrease the uncertainty associated with projects being processed by the system operators, a number of issues would need to be considered first. Planning permission generally is only granted for five years which means that current

permissions could expire by the time of offer issuance/firm network connection. In addition wind farm layouts are fixed at the time of planning permission application and flexibility is needed in this area for as long as possible so an applicant can take advantage of turbine technology changes [66] [67].

Land Access: In Gate 1 and Gate 2 proof of land access was not required by EirGrid, however it was required by ESB networks. The CER proposed that the System Operators should require that applicants submit proof that the landowner has consented for the applicant to develop the wind farm on the land specified in the application [17].

- Most respondents welcomed the requirement for evidence of land access on which a development is to be sited in order to mitigate the potential for land access disputes with some believing that a signed letter of consent from the landowner, without witness from a solicitor, should suffice [55].
- For offshore developments, Fuinneamh Sceirde Teoranta believe that land access should be based on holding or having held a Foreshore Licence as to seek a Foreshore Lease would cause large delays [68].

Access Arrangements: Consistent with Gate 1 and Gate 2, the CER proposed that wind projects in Gate 3 could connect prior to the completion of associated deep transmission works on a non-firm basis, once the transmission/distribution shallow works, transmission short circuit driven deep works, control systems and all deep distribution assets were complete [27].

- The general consensus was that the access rules, including constraint rules for non-firm generators, needed a clear definition [55].

6.3 Gate 3 Proposed Direction (08/226) Responses

On 13th November 2008 the CER issued a second proposed direction to the system operators in relation to the criteria for inclusion, treatment and processing of applications for Gate 3 [55]. The CER received 25 responses to the second Gate 3 proposed direction, with once again varying views being expressed and these are discussed as follow [20]:-

Gate 3 Size: The proposed size of Gate 3 was increased to 3,900MW to take into account the Government's new target of 40% renewable penetration by 2020. The following is a list of responses from interested stakeholders in relation to the proposed Gate 3 size of 3,900MW [55]:

- The vast majority of respondents welcomed the CER's decision to increase the size of Gate 3 from circa 3,000 MW to 3,900 MW in light of the new Government 40% renewable target for 2020 [20].
- Other respondents argued that the Gate 3 size should be even larger to compensate for a possible high attrition rate [20].
- However Airtricity commented that increasing the size by 900MW serves only to compound the cost impact of selecting applicants for Gate 3 on a received date order basis rather than a "transmission optimisation" basis [69].

Order of Offers: The proposed direction CER/08/226 proposed that offers would issue in the order of those areas which can be processed most easily, i.e. those which are least complex. However, it also provided that within this approach and where feasible, connection offers will issue to areas with an applicant with the earliest application date [55].

- Bord na Mona submitted that those longest in the application queue should not have their offer delayed simply because they are more complex, but should have their application expedited regardless of complexity [70].
- Meitheal na Gaoithe similarly argued that any unsuccessful Gate 2 project should be the first to receive an offer [71].

6.4 Summary of Gate 3 Consultation Responses

A wide range of comments were received in respect of the Gate 3 consultation paper and the two subsequent proposed directions, however the most common comment sentiments from all stakeholders are listed below:

- No ceiling or at least a larger Gate size than 3,900MW should be applied to Gate 3.

- The GDS approach is the most popular, as opposed to processing on date order or the date order/system optimisation approach.
- Planning permission should not be a prerequisite.
- Priority should be given to those longest in the queue.
- The timelines for delivering connection offers are too long.
- Most agreed that applicants should be selected for inclusion in the Gate on date order.

7. METHODOLOGY

The primary research undertaken as part of this dissertation is set out in Table 4 below, defined as “Key Research Events” and listed in chronological order.

No.	Key Research Events	Date
1	Interview with Dermot Byrne, CEO EirGrid plc	20 th August 2009
2	Interview with Michael Walsh, CEO IWEA	1 st September 2009
3	Interview with Margaret Riordan, SWS Group	25 th October 2009
4	Interview with Dave McNamara, Renewable Power Generation & IWEA Council Member	26 th October 2009
5	IWEA Conference	1 st October 2009
6	NOW Ireland Conference	12 th October 2009
7	Interview with Graeme Cooper, FredOlsen Renewables	19 th October 2009
8	Interview with Jane McArdle, SSE Renewables	4 th May 2010

Table 4 – Primary Research Undertaken

Hereafter, a brief narrative on each research event is provided in date order, in an effort to frame the evolution of the research question and the researcher’s findings. With regard to the semi-structured interviews, copies of the pre-prepared questions and the recordings, where taken, are available on request.

7.1 Interview with Dermot Byrne, Chief Executive EirGrid plc

Dermot Byrne was appointed Chief Executive of EirGrid in July 2005. A graduate of University College Dublin he holds a Masters in Electrical Engineering and a Masters in Business Administration. Prior to joining EirGrid, he worked at senior management level in the electricity industry in Ireland and abroad; this included serving in a variety of engineering and management roles in the operation of transmission systems and working

on consultancy assignments in Bahrain. From 1993 to 1997 he held the post of Manager of Power System Operation at ESB National Grid. In the late 1990's he worked in senior roles within the ESB's customer services and power generation areas. In 2000, he was appointed to the newly created post of Head of ESB Networks. While in this post, he oversaw the major ramp-up of the ESB's investment in transmission and distribution infrastructure. He is a Fellow of Engineers Ireland and he is also a distinguished member of the international electricity body CIGRE.

This interview was carried out on a semi-structured basis, with pre-prepared questions and Dictaphone recording throughout. The researcher's intention was primarily to gather more detailed background information the Gate 3 process and the evolution of group processing in Ireland. Additionally, it was pre-agreed that the interview would take no longer than thirty minutes.

7.2 Interview with Michael Walsh, CEO IWEA

Michael joined the IWEA as CEO in November 2007. Prior to joining he was manager of market readiness at EirGrid where he supported the introduction of the Single Electricity Market on the island of Ireland. Michael has a B.E. and a Ph.D. in Engineering from University College Dublin and is active in several professional associations.

This interview was carried out on an informal basis and no recording was taken. The researcher's intention was to gather background information and to establish the current position of the IWEA with regard to Gate 3 and the processing of wind generation applications in Ireland.

7.3 Interview with Margaret Riordan, SWS Energy

Margaret Riordan graduated from University College Cork in 2001 with a BE (Elec). Margaret worked with EirGrid as a Transmission Planning Engineer from October 2001 to June 2008. Margaret currently works with SWS Energy as an Electrical Engineer.

This interview was carried out on a semi-structured basis, with pre-prepared questions and Dictaphone recording throughout. The researcher's intention was primarily to gather more detailed background information the Gate 3 process and the evolution of group processing in Ireland. Additionally, it was pre-agreed that the interview would take no longer than thirty minutes.

7.4 Interview with Dave McNamara, Renewable Power Generation

Dave McNamara is the Managing Director of Renewable Power Generation Limited. This interview was carried out on a semi-structured basis, with pre-prepared questions and Dictaphone recording throughout. The researcher's intention was primarily to gather more detailed background information the Gate 3 process and the evolution of group processing in Ireland. Additionally, it was pre-agreed that the interview would take no longer than one hour.

7.5 IWEA Conference

IWEA comprises two separate entities, the Irish Wind Energy Association which is committed to the promotion and education of wind energy issues and IWEA which is the legal entity charged with conference organisation, lobbying and policy development. IWEA is committed to promoting the use of wind energy in Ireland and beyond as an economically viable and environmentally sound alternative to thermal or nuclear generation.

7.6 NOW Ireland Conference

The National Offshore Wind Energy Association of Ireland was established to promote the development of Ireland's substantial offshore wind resource and to ensure that our island leads the way in building a sustainable, green economy. The founding companies of NOW Ireland have the potential to generate over 2,000MW of energy from existing resources, that's 40% of Ireland's total energy requirement from green energy sources.

At this conference the vast potential of opportunities that offshore wind could bring to Ireland along with the three main barriers to development, which include grid access, consenting and the pricing system in Ireland, were discussed.

7.7 Interview with Graeme Cooper, FredOlsen Renewables

Graeme Cooper is employed by Fred.Olsen Renewables. He is the current Policy, Regulatory & Compliance Manager for the UK and Ireland, having previously been Head of Grid, Health & Safety and Technical Affairs at BWEA, and National Power Group Manager at National Grid Wireless. Graeme was educated at Oxford Brookes University and Reading College of Technology.

This interview was carried out on an informal basis with a Dictaphone recording throughout. The researcher's intention was primarily to gather the interviewee's thoughts and experiences on the processing of grid connection applications in both Ireland and Great Britain and compare both jurisdictions. Additionally, it was pre-agreed that the interview would take no longer than one hour. Whilst a number of questions were pre-prepared for this interview, the interview deviated substantially from these. Recording of the full interview was carried out.

7.8 Interview with Jane McArdle, SSE Renewables

Jane McArdle is the Ireland Grid Manager at SSE Renewables. Jane graduated from University College Dublin in 2001 with a B.E. in Mechanical Engineering and shortly afterwards joined ESB National Grid where she worked as a Transmission Planning Engineer. Jane joined Airtricity (Now SSE Renewables) in August 2008.

This interview was carried out on a semi-structured basis, with pre-prepared questions and Dictaphone recording throughout. The researcher's intention was primarily to gather more detailed background information the Gate 3 process and the evolution of group processing in Ireland. Additionally, it was pre-agreed that the interview would take no longer than one hour.

8. FINDINGS

The following sections detail the findings from the primary research that was detailed in Chapter 7. The objective of this was to gather the thoughts and views of a wide range of stakeholders who are heavily involved in Gate 3, previous Gates of the GPA, processing of applications prior to the GPA and those with experiences in other jurisdictions.

8.1 Interview with Dermot Byrne, CEO EirGrid plc

The following relevant points were made by Dermot Byrne during the interview:–

- Prior to the Group Processing Approach applications were studied, processed and issued on a ‘one by one’ basis and this led to a ‘snakes and ladders’ effect whereby each applicant would need to be re-studied before being issued an offer. This method was not suitable for dealing with a large volume of applications and this led to a backlog in the processing of applications. As a result there was a temporary ‘moratorium’ on the processing of wind applications. Subsequent to this the wind grid code was developed and the ‘innovative’ Group Processing Approach was launched. Gate 1 (390MW) was developed after a consultation process and applicants were processed on date order. Gate 2 (1,300MW) was again developed after a consultation process and applications were processed using a mix of date order and a system optimisation approach. Gate 2 sought to learn from the mistakes of Gate 1. Gate 3 was again developed after an extensive consultation process and this again sought to learn from the mistakes of Gate 1 and Gate 2. The GPA is a very fair and transparent system that is decided by the regulator. A judicial review would have occurred in the process was not fair and transparent
- Optimisation is not the most important factor as the best wind resource may be in a very remote location where the network is weak.
- The proper approach has been to integrate Gate 3 with Grid 25
- The size of Gate 3 has been determined from the Government target of 40% of renewable by 2020. It is also very important to first consider those longest in the application queue.

- Date order selection is the fairest approach as many applicants submitted their applications in 2004.
- Fast tracking of applications on a “ready to connect” basis is a decision for the regulator. This might impact on the overall process and be unfair to those longest in the queue.
- Having planning permission as a prerequisite may help the overall process as a lot of time could be spent on studying applications that might not get the necessary planning permission. On the contrary an applicant’s planning permission might expire due to the length of time in the queue. Does not have a strong view on this matter.
- The biggest risks to Gate 3 are:-
 - Grid development;
 - The credit crunch; and
 - Equipment availability.

8.2 Interview with Dr. Michael Walsh, CEO IWEA

The following relevant points were made by Dr. Michael Walsh during the interview:-

- IWEA considers the Gate 3 process to be of fundamental importance to the Irish energy industry for the next decade. Even though Gate 3 has many flaws, it is essential that it proceeds in an efficient and timely fashion and delivers offers that enable developers to proceed with their project.
- The Gate 3 size is one concern. It might be a better solution to run smaller and more frequent Gates on an annual basis.
- The ITC program should be re-run on an annual basis as this would open up the possibility of additional offers being made to renewable generators where capacity has become available due to changes in previously proposed developments or new innovative grid management strategies. The suggestion that the ITC programme should not be re-run unless a very low take-up on Gate 3 offers was experienced is an unnecessary limitation, and could result in delaying offer opportunities which would have been identified earlier with an annual re-run.

- Some of the applications in Gate 3 were submitted as early as 2004. According to the Gate 3 project plan some of these applicants may not receive their connection offer until 2010 or 2011. A timeframe of six or seven years for processing a connection application is totally unacceptable. It is essential that preparations for Gate 4 begin soon or applicants who were not included in Gate 3 will face similar delays.
- Deemed Firm Dates should be introduced for all GPA offers, whereby the generators would become financially firm even if the deep reinforcements are not complete. Furthermore, the degree to which a non-firm wind farm will be constrained should also be financially capped at the constraint level indicated in the constraint report that accompanies the connection offer.
- The issue of trading and/or relocating valuable capacity was discussed. While Michael Walsh did not give a view on whether or not this should be permitted he did make the point that there was a feeling that some applicants may only have submitted a connection application with the intention of selling the capacity and not really intending to build the project. This may result in money being taken out of the industry.

8.3 Interview with Margaret Riordan, SWS Group

The following relevant points were made by Margaret Riordan during the interview:–

- The GPA, though not without its flaws, is far superior to the previous iterative approach where applications were processed on an individual basis.
- Processing applications in date order is not the most optimal approach to developing a ‘renewable’ network.
- Processing applications in groups is the fairest and most optimum approach when considering the resources available.
- Since this is the third ‘Gate’ of the GPA and applications have been selected for each gate based on application date order, a precedence has been set and date order must remain as the key criteria for selection in any future Gates.
- Fast-tracking of applications that are ready to connect should be used on a case-by-case basis.

- Development of the grid is the biggest stumbling block.
- SWS has concerns over firm access dates, particularly as target firm access dates from Gate 2 are now being optimised.
- There is a risk that many projects in Gate 3 may not proceed due to financial or planning constraints and this may ultimately delay projects that were not included in Gate 3 but might have been had a different selection criteria been used.

8.4 Interview with Dave McNamara, Renewable Power Generation

The following relevant points were made by Dave McNamara during the interview:–

- Date order is now the fairest method for selecting applicants for processing. Processing applications on date order is a sub-optimal approach. A system optimisation approach would have been a better approach but this should have used much earlier, even before the moratorium.
- Gate 2 was a better approach which utilized date order and a system optimisation approach. Gate 2 also had a provision for ‘outliers’ where projects/extensions could connect if there was spare capacity available.
- Gate 3 is too big and this problem has been created by years of not developing the network and sub-optimal processing.
- The underlying problem with processing of wind applications is not due to the processing method but due the weak grid.
- Gate 3 is a fair and transparent system, although there is an issue with the transparency of shallow connection costs.
- Applicants should not be “fast tracked” outside of the GPA.

8.5 IWEA Conference

The IWEA conference was held in Galway on 1st October 2009. As part of my primary research I attended this event in an attempt to gather thoughts and updates from the many interested stakeholders and presenters that attended this event. During this event I chatted with many stakeholders, listened to all the presenters and gathered notes. Below is a summary of the findings from some of the presentations that I felt are relevant to renewable grid connection processing.

The following relevant points were made by Pierre Loing, Vice President of Product Strategy and Planning at Nissan.

- As part of Nissan's Green Program, Nissan is beginning to mass produce Electric Vehicles with sales beginning in 2011.
- These electric vehicles use an advanced Lithium-Ion battery, which can be charged at night, utilizing the extra wind capacity during low demand at night.

The following relevant points were made by Dr. Michael Walsh, CEO IWEA.

- Ireland has the fourth highest dependence on imported energy in Europe. It's important to note that the vast majority of this energy comes from countries that could be considered politically unstable.
- Ireland has the third highest household electricity prices in Europe.
- Based on the estimates of MW to be installed to 2020, the Irish wind energy sector is capable of supporting more than 10,760 jobs through direct and indirect involvement in the sector. The construction and development of wind energy projects across the island will involve circa. €14.75 billion of investment and circa €5.1 billion of which will be retained in the local Irish economy to 2020.
- Wind is reducing our fossil fuel bill.

The following relevant points were made by Paul Dowling Chief Executive Officer of SSE Renewables:-

- Energy Demand has grown by 23% in last 10 years
- Ireland is 91% dependant on imported energy
- Ireland has 2nd highest Greenhouse gas emissions in EU 27
- In Ireland we have to deliver large scale wind
- We can do land based wind energy more cost effectively than Great Britain.
- We have more Offshore, Wave and tidal resources than we need.
- We should actively trade our renewable energy capability with Great Britain.

The following relevant points were made by Christian Kjaer, Chief executive European Wind Energy Association:-

- EWEA's 20 year offshore network development plan.
- Recommends building a transnational offshore grid infrastructure to connect 40GW by 2020 and 150GW by 2030.

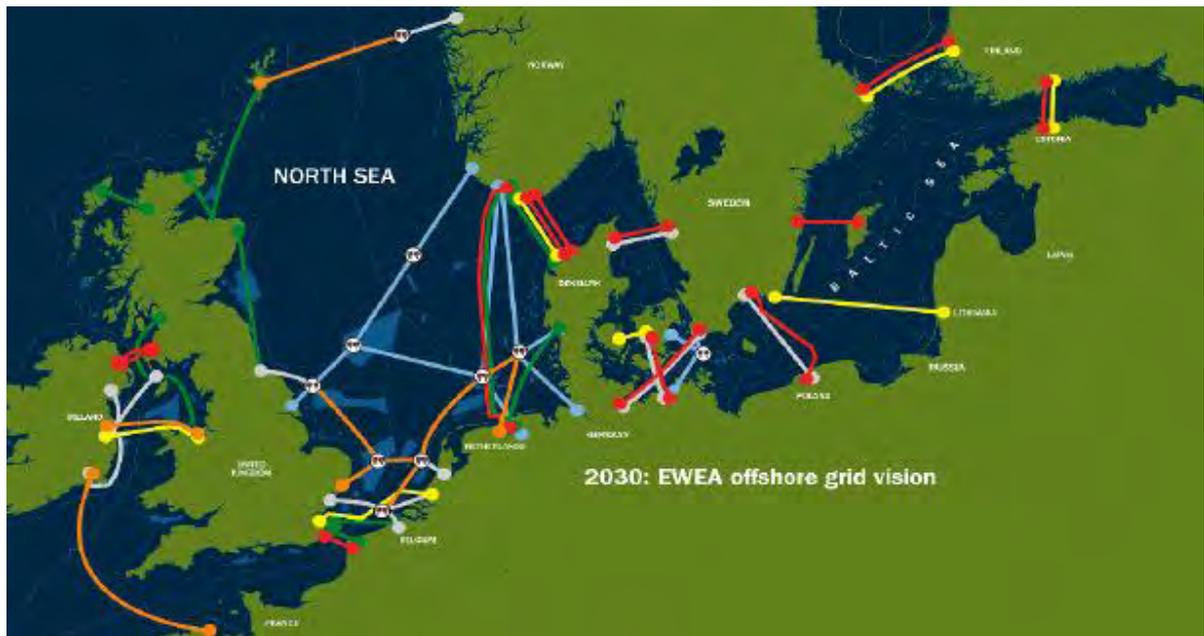


Figure 6 - EWEA's 20 year offshore network development plan [80]

8.6 NOW Ireland Conference

The following relevant points were made by Brian Britton, Secretary, during the NOW Ireland

conference welcoming address:-

- A cost benefit analysis was published at the NOW Ireland conference in 2008. This report found that Ireland could reap an economic reward of up to €3.8 billion as a result of developing a 1,000MW offshore wind farm in Irish waters. This was based on the potential employment opportunities, reduced requirement of imported fossil fuels, reducing our exposure to oil and gas price fluctuations, avoidance of possible carbon fines and the long term reduction in energy prices.

- A study by the EWEA has estimated that 14 jobs could be created for every MW of wind power installed.
- Ireland is not reaping the rewards of the vast potential that lies within our waters. Ireland now lies fourth in the world in terms of the percentage electricity generated from wind power. We must remember that Ireland has ten times more ocean area than it has land area and our waters offer higher and more consistent wind speeds which leads to much more efficient electricity generation load factors.
- Ireland developed one of the first offshore wind farms in 2001 and was the first to use turbines greater than 3MW, and this shows that Ireland can be a world leader. Since those achievements the wind industry in Ireland seems to have stalled.
- There are three barriers which are preventing offshore wind from achieving its goals. These can be summarised as grid connecting, consenting or planning and the pricing system currently in operation.
- There are five offshore wind farms currently being developed in Ireland, two have consenting and no grid connection and three are due to receive a grid connection as part of Gate 3 but do not have consenting. This means that none of these developments are in a position to be developed until they achieve both consenting and a grid connection.

The following relevant points were made by Ian Marchant, Chief Executive Officer of Scottish and Southern Energy, during his presentation entitled “Offshore Ireland: Making the transition from project plans to power output” at the NOW Ireland conference:-

- In the UK there is a real focus on delivering multiple GW’s of offshore wind by 2020 where the Crown Estate is issuing licenses for the use of its seabed. Those licences have specific development targets as a condition of acceptance that developers will have to meet. Ireland is seriously lagging behind the UK. Unfortunately, Ireland is not just behind the UK. Ireland is behind the Netherlands, Germany and most of Scandinavia.
- If one looks at an example of two Scottish and Southern Energy offshore wind development projects, the Greater Gabbard project, off the Suffolk Coast, will go from initial award of licence to fully operational in nine years. If one compares that

with the Arklow Banks offshore wind development, which was installed in 2003, at that time it was about 5% of the world's installed offshore wind energy. At the rate of progress nothing else will happen there until beyond 2020, by which time it will be less than 0.1% of the installed capacity of wind.

- Scottish and Southern Energy want to build Arklow Banks. Arklow Banks is consented at 200 bases and could have a capacity of 700MW. Scottish and Southern Energy's preferred option would be to service that for the Irish market. However, at the current rate of development, a more likely solution is that Scottish and Southern Energy wind ultimately export some of that capacity to the UK.

8.7 Interview with Graeme Cooper, FredOlsen Renewables

The following relevant points were made by Graeme Cooper during the interview:–

- Processing by date order alone is sub-optimal because it assumes that all projects have the same thought process, methodologies and lead times.
- The 'Gate' process has resulted in grid applications being submitted by those who might want a connection in the future. Such applicants may not achieve the necessary milestones required to develop a project.
- If grid access managed the development timescale then there would not be a queue and hence no need for a 'Gate' process.
- If there was a process where applicants were encouraged/incentivised to ask for a date of grid connection that was reasonably consistent with development timelines (acquiring land, wind measurements, planning, design & construction), then this would drive applicants to make reasonable requests for a grid connection date if they knew they could "what they wanted when they wanted".
- In Great Britain, National Grid realised that there was a serious issue where some projects at the back of the GB queue that had all necessary consents and design work completed were being held up by projects ahead of them in the GB queue because they had applied earlier but were no closer to being developed.
- In Great Britain the CAP150 Amendment Proposal issued by Ofgem has been a great success. This is a "use it or lose it" GB queue management initiative. Projects that are taking longer to develop or those that are having difficulties with

consenting can have their connection dates revised and this allows the System Operator to concentrate their efforts on projects that may be further back in the queue to move forward. Transmission capacity is a scarce resource and this allows the System Operator to reschedule or only upgrade the transmission network for those who are ready to connect.

- Instead of an “Invest – Then Connect” methodology in Great Britain they are using an “Interim Connect & Manage” methodology which allows generator connection dates ahead of the need to complete wider transmission reinforcement works provided shallow works required to connect the project can be completed in advance of the wider deep works. Applicants receive a connection data that is reasonably consistent with their development timeframes.
- The System Operators in Ireland should do a test of “Ready Winning & Able” in order to determine which projects are likely to be developed.
- There is likely to be a high attrition rate in Gate 3 due to projects not getting the relevant finance or necessary consents and this may ultimately affect Ireland’s 2020 targets.
- Currently there is a plan to “re-wire” the Irish transmission system to accommodate Gate 3 however it is likely that a portion of applicants may not connect and this is sub-optimal.
- If the System Operators knew with some certainty which projects were going to connect then they could plan upgrades accordingly.
- The CER seems more concerned with being open to legal challenge regarding date order, rather than meeting and exceeding Ireland’s targets.

8.8 Interview with Jane McArdle, SSE Renewables

The following relevant points were made by Jane McArdle during the interview:–

- The GPA has advantages, such as processing in groups allows the SO’s to optimise the system which allows for the building of less infrastructure.
- However using a date order selection method is of major concern.
- Planning permission should be a requirement to receive a grid connection offer.

- Not having planning permission can result in a situation where applicants are holding scarce capacity while they try to secure planning and this may be prolonged if the developer is having difficulties securing planning.
- The rules of Gate 3 in relation to capacity relocations are too strict. Applicants must submit an application early to be accepted into a Gate, however the project may have evolved due to environmental restrictions, wind analysis, etc, from the time the application was submitted to the time an offer will be issued which could a period of five to ten years. To restrict an applicant from relocating the capacity could severely affect the uptake of Gate 3 offers.
- Along with the date order approach, the CER should have looked at the most suitable sites from a wind perspective and also the sites that are closer to the grid and sites that have planning permission, i.e. a more optimal solution.
- SSE Renewables have projects that are very close to the grid with full consent, however these projects may never receive a connection offer.
- The size of the Gate at 3,900MW is very ambitious and the CER could have considered smaller (more manageable) Gates on a more regular basis.
- The issue of people submitting speculative applications, with no real project planning or analysis undertaken, just so they can sell the connection offer is a concern and does remove money from the industry. However, the developers who buy these connection offers or capacity are forced down this road as their projects may not be included in the Gate. Buying up these speculative applications may be a company's only route to building a wind farm.
- The CER should seek more commitment from applicants earlier in the process. The connection bond and 10% down payment which is paid on signing the offer is a method of showing commitment, however more could be done.
- Connection costs have increased due to the fact that the grid was underdeveloped for years. The increase in connection costs cannot be blamed on the GPA.
- Gate 3 can be described as fair and transparent, suboptimal and anything but timely. It is important for the CER to create a fair process, however from an "Ireland Inc" perspective Gate 3 may not be the best solution.

8.9 Primary Research Summary

All of the interviews were semi-structured so as to gain the interviewee’s thoughts with respect to the eight evaluation criteria, which are listed in Table 5 below. What is clear from Table 5 is that all of the interviewees believe the process is fair and transparent, but not timely, obviously due to the length of time that many of the applicants have been in the connection queue. It was also felt that Gate 3 did not allow for optimal development of the transmission system.

Criteria	Agree	Neutral	Disagree
Fairness	●●●●●●		
Transparent	●●●●●	●	
Timely	●	●	●●●●●
Optimum TS Development	●		●●●●●
RES-E Targets	●●	●●	●●
Development Costs	●●●	●●	●
Energy Costs	●●	●●	●●
Security of Supply	●●	●●	●●
Total	22	10	17

Table 5 – Primary Research Summary

However there was a wide range feedback with respect to the other four criteria as Table 5. The difficulty with the analysis is in relation to the weighting of each of the criteria, i.e. is it better to have a fair system at the expense of optimum development of the transmission system. For the purpose of this report, the author has evaluated each of the criteria on an even basis.

9. ANALYSIS

9.1 Evaluation Criteria

As discussed earlier the Gate 3 direction and group processing approach was developed against a set of often conflicting objectives which are relevant here and it is evident from the primary research gathered that the following considerations are paramount:-

- Fair and reasonable to all applicants
- Transparent
- Timely delivery
- Facilitate achievement of renewable energy targets
- Optimum development and use of the transmission and distribution systems
- Project Development costs
- Energy costs
- Security of supply

Each of these considerations is elaborated upon further in the context of the evaluation of the group processing approach.

9.2 Fairness

The Group Processing Approach and Gate 3 can be considered to be fair and reasonable to all applicants for the following reasons:-

- Applications are selected on date order, irrespective of size or location.
- In each of the three rounds or “Gates” thus far, applications longest in the queue have been given consideration and included in each Gate, irrespective of size or location.
- All applications in a specific Gate are bound by the rules of the Gate as decided by the CER.
- All applicants and stakeholders have the opportunity to be involved in the relevant Gate direction consultation process and all applicants and stakeholders have the opportunity to make submissions.

- Applications are processed in groups, which include sub-groups which are equivalent to transmission nodes and all applicants pay a per MW share of the cost to connect to that node.

The Group Processing Approach and Gate 3 could be considered to be unfair and unreasonable to some applicants for the following reasons:-

- The application processing fees are much larger on a per MW basis for small projects. For example in Gate 3, the Oriel 330MW wind farm will pay an application fee equivalent to €271/MW, however the Cooly 4MW wind farm will pay an application fee equivalent to €7,053/MW.

Verdict: The Group Processing Approach and Gate 3 is a process that is fair and reasonable to all applicants, with an equal opportunity being afforded to anyone who wishes to apply for a grid connection.

9.3 Transparent

The Group Processing Approach and Gate 3 can be considered to be a transparent process for all applicants for the following reasons:-

- The Gate 3 direction followed an extensive public consultation. Firstly, on 17th December 2007 the Commission published “Criteria for Gate 3 Renewable Generator Connection Offers - A Consultation Paper” (CER/07/223), which included three broad potential options on the inclusion of renewable generator applicants for connection in Gate 3. The options and proposals provided in this consultation paper were explained by the CER and System Operators at a public workshop. Taking account of the comments received to this consultation, and given the complex and important nature of Gate 3, the CER then published a proposed direction on 11th July (CER/08/118) for a second round of public consultation. A detailed summary of comments received to the previous consultation, along with the CER’s responses, was also published (CER/08/119). The July proposed direction was the subject of a second public workshop, and the CER again received numerous responses to this paper, of a diverse nature with conflicting opinions expressed. Taking account of, and responding to, these comments, the CER then

published a second proposed direction (CER/08/226) on 13th November 2008 for a short period of final consultation.

- All applicants have the opportunity to submit a proposal for their preferred connection method, including stating their preferred connection node and this is taken into consideration by the system operators then determining the LCTA. This information is requested 30 days after the node assignments have been made public.
- A Gate 3 Liaison Group was established to provide a forum to communicate and discuss ongoing Gate 3 issues of interest to the industry and it will also work to ensure that the Gate 3 offer programme is being adhered to. It meets on a monthly basis throughout the Gate 3 process and is convened by the CER and consists of the system operators and representatives of the renewable and non-renewable generation sectors including IWEA, Meitheal na Gaoithe and NOW Ireland.
- As part of the Gate 3 process, the System Operators will have a connection method meeting with the applicants in all subgroups to discuss the shallow connection method. The applicants will have the opportunity to discuss the connection options and state whether they wish to use cable or overhead line and if they wish to build any of the shallow connection contestably.
- All applicants know the date that they will receive their connection offer as per the Gate 3 project plan, and all applicants know the date that they will receive their firm access quantities as per the ITC results issued on 29th January 2009.
- Perez et al. describes Ireland's transparency as high with connection charging published and well defined [75].

The Group Processing Approach and Gate 3 could be considered to lack transparency for the following reasons:-

- Many applicants believe there is an issue with the transparency of shallow connection costs.
- Some applicants believe that there is an issue with the transparency of the allocation of firm access in the ITC programme.
- Some applicants believe that there is a lack of transparency with regard to application received dates and application deemed complete dates. This is a

particularly sensitive issue as some applicants missed inclusion in Gate 3 by only a single day and there is a debate as to whether the application may actually have been received before the deadline, but may have been processed after the deadline.

Verdict: The Group Processing Approach and Gate 3 have been shown to be an extremely transparent process. Potential applicants and stakeholders have the opportunity to be involved in consultations and workshops and the CER ultimately decides on the rules of the Gate.

9.4 Timely Delivery

Due to the nature of the GPA, those that applied towards the end of the Gate 3 deadline will receive their connection offers in a reasonably timely manner, however those applicants who missed Gate 2 and applied at the beginning of Gate 3 may have had to wait for an unreasonably long period of time before receiving a connection offer. An example of this is the Oweninney wind farm application which was received by the System Operator on 15th April 2004 and will not receive a connection offer until October 2010.

Verdict: The GPA does not provide for the timely delivery of connection offers.

9.5 Optimum Development of the Transmission System

The Group Processing Approach and Gate 3 can be considered to be an optimal development of the transmission system for the following reasons:-

- Processing applications in groups can provide for optimal development of the transmission system as it allows a certain amount of forward planning and is a far superior method than the previous iterative processing method.
- Prior to accepting a connection offer, the applicant is provided with the shallow connection costs, the expected level of constraint (if any), the firm access date and the level of reinforcements required to enable the connection to become firm. This provides the applicants with more certainty and thus allows for a more optimal development of the network.

The Group Processing Approach and Gate 3 can be considered to be sub-optimal development of the transmission system for the following reasons:-

- Selecting applicants on date order does not provide for optimal development of the transmission system.
- The TNEI report supported the claim that Gate 3 was sub-optimal development of the transmission system and that transmission investment costs be reduced by up to €90 million, with the amount of 110 kV lines reduced by up to 250km.
- The system operators must plan to develop the network without any certainty that all applications will proceed as many applications may be speculative because of the fact that applications are selected on date order and some applicants may submit an application without first having carried out any feasibility study, just to reserve a place in the queue. In Ireland, the first step in developing a wind farm seems to be to submit an application, whereas in other jurisdictions the proper process is to undertake a feasibility study.
- Gate 2 employed a system optimisation approach and some stakeholders believe that this was a better approach.

Verdict: The Gate 3 process of selecting applications on date order alone does not provide for optimal development of the transmission system and this view is supported by the vast majority of stakeholders. Gate 2 used a hybrid approach which employed a selection method of both those longest in the queue and a system optimisation approach. Gate 2 was a better approach. It must however be realised that the concept of processing applications in groups is a more optimal method of developing the transmission system than processing applications on an individual basis.

9.6 Facilitate Achievement of Renewable Energy Targets

There is currently 1,263MW of wind generation installed on the Irish grid and a further 1,267 MW of Gate 1 and Gate 2 projects are currently contracted and expected to connect over the coming years [75]. It is assumed that all Gate 1 and Gate 2 projects will connect which means that there should be 2,530MW of wind generation on the Irish grid before

any Gate 3 projects connect. EirGrid’s Generation Adequacy Report 2010 to 2026 estimates that the demand in 2016 will be 32,600GWh, with a peak demand of 5,700MW [74]. Based on a conservative estimate of demand growth beyond 2016 of 2% per annum, it is estimated that the annual demand by 2020 will be roughly 35,300GWh and the peak demand will be roughly 6,200MW. If one was to consider a load factor of 30% and an annual demand of 35,300GWh, Ireland would need to have an installed capacity of 5,370MW to meet the target of 40% of electricity to come from renewable resources by 2020. Gate 3 has included 3,900MW of wind so at least 73% of this total must connect to assist Ireland to reach its 2020 targets. This figure also assumes that the primary source of electricity from renewable resources will be from wind generated electricity. Also, the level of total demand does not also take into account the increase that will be driven by the proposed plan to electrify up to 10% of the national car fleet by 2020.

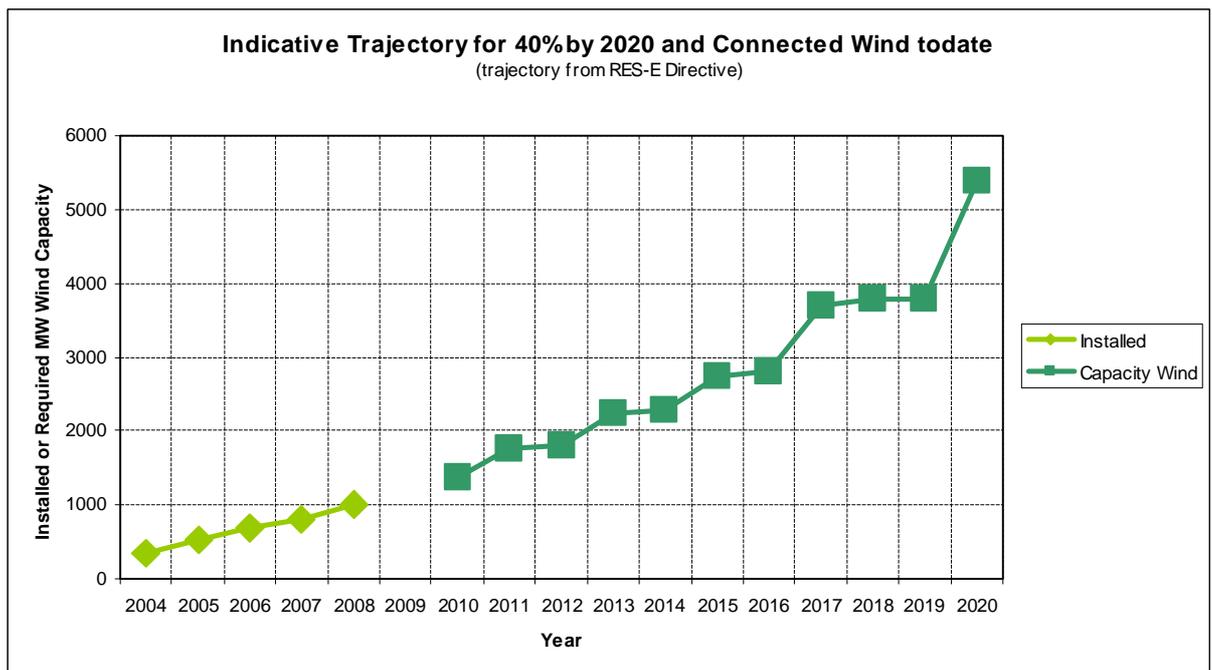


Figure 7 – Expected Levels of Wind Penetration to 2020 [73]

On the contrary, if the uptake in Gate 3 is less than 73% and if the demand rises further due to electrifying 10% of the national car fleet, then there is a serious risk that Ireland might not meet its 2020 targets.

Verdict: There are mixed feeling from stakeholders as to whether uptake in Gate 3 will be sufficient or not for Ireland to meet its 2020 target. The significant factors are availability of finance and consenting. A low uptake may be offset my moving capacity within the subgroup (Transmission Node).

9.7 Project Development costs

The Group Processing Approach and Gate 3 can be considered to reduce project development costs for the following reasons:

- Processing of a large volume of applications in groups allows the System Operators to plan the development of the network with a forward thinking approach. The fact that applicants who are in the same subgroup can share shallow connection costs on a per MW basis provides for a connection cost reduction. This is as opposed to the traditional method where shallow connections were designed on a single application basis and applicants would not have the opportunity to share assets in the same manner.
- There is no ‘race to sign’ a connection offer as there is no possibility of an interaction with another applicant who has received an offer.
- The System Operators can better plan for the required system reinforcements when processing applications in groups, as opposed to processing individual applications where it is much more difficult to associate individual generators with network reinforcements.
- Application processing fees are reduced when processing applications in groups.

Verdict: The overall feeling from stakeholders and applicants is that the Group Processing Approach and Gate 3 have reduced shallow connection costs and thus reduced project development costs.

9.8 Energy Costs

The Group Processing Approach and Gate 3 can be considered to have a positive impact on energy costs for the following reasons:-

- The Group Processing Approach has resulted in a large volume of wind generation connecting to the Irish grid over the past five years. If a high percentage of Gate 3 applications connect then this will reduce Ireland's dependency on imported fossil fuels and thus reduce Ireland's exposure to fluctuations in oil and gas prices.
- Furthermore, there is a large volume of wind generation applications that are currently sitting in the connection queue awaiting a direction from the CER, likely to be Gate 4, and these should further contribute to stabilizing Ireland's energy costs.

The Group Processing Approach and Gate 3 can be considered to have a negative impact on energy costs for the following reasons:-

- Selecting applications on date order criteria alone and not taking into account any efficiency or optimisation criteria will lead to greater transmission reinforcement costs which will ultimately be paid by the TUoS customer and this obviously leads to greater energy costs.
- Selecting better projects which have the potential to generate more renewable energy, i.e. in a rounds system, could contribute to cheaper energy costs.

Verdict: Adding more wind generation capacity to the Irish grid is likely to have the effect of stabilizing energy costs in the long term, however taking into account that the GPA does not provide for efficient development of the transmission system one could derive that the GPA has a neutral effect on energy costs. It must however, also be recognised that the GPA has added a lot of renewable generation to the Irish grid and this has invariably increased competition in the electricity market and this could be seen as having a positive effect on energy prices.

9.9 Security of Supply

The Group Processing Approach and Gate 3 can be considered to contribute to the security of supply of energy in Ireland for the following reasons:-

- 362MW of wind generation accepted offers as part of Gate 1, with 234MW connected the remaining 128MW expected to connect by 2010. 1,334MW of wind generation accepted offers as part of Gate 2, with 281MW connected the remaining 1,053MW expected to connect by 2013 [74]. 3,900MW of wind generation will receive connection offers as part of Gate 3 by the end of May 2011, with a target connection date or roughly 2015 for all offers to connect. The Group Processing Approach and Gate 3 have the potential to add almost 5,600 of wind generation onto the Irish grid in 10 years.
- The first step of the group processing approach was to introduce the Wind Grid Code, which has allowed for a greater penetration of wind energy development and has provided a platform for the integration of even more wind onto the Irish electricity system.

On the contrary, there is a feeling that the Group Processing Approach and Gate 3 in particular has hindered and stalled wind development in Ireland and that better targets could have been achieved if a different processing scheme had been in place. The following points would support this view:-

- Projects should complete a “ready, willing & able” test to ensure that they are viable and are not holding up better projects that are behind them in the connection queue. There are some large projects with consent, finance and all feasibility completed that are potentially being held up by projects that may not proceed.
- By not employing a system optimisation approach in selecting applicants will ultimately mean that it will take longer for Gate 3 applicants to connect, as more transmission reinforcements and 110kV lines are required. Employing a system optimisation approach in selecting applicants would invariably connect more projects, faster.

Verdict: Adding more wind generation capacity to the Irish grid will likely have the effect of improving Irelands security of energy supply, however taking into account that the GPA does not provide for efficient development of the transmission system and the fact that uptake is unlikely to be 100% one could derive that the GPA has a limited effect on improving security of supply. On balance and given

the size of the Irish grid and the aggressive government targets for 2020, it must also be recognised that a lot of renewable generators have been and will continue to be connected to the Irish grid and thus improve security of supply.

9.10 Evaluation Summary

The above criteria are summarised in the evaluation graph in Figure 8 below. If we compare this graph with the results in Table 5 we can see many similarities, particularly with respect to the first three criteria, Fairness, Transparency and Timely.

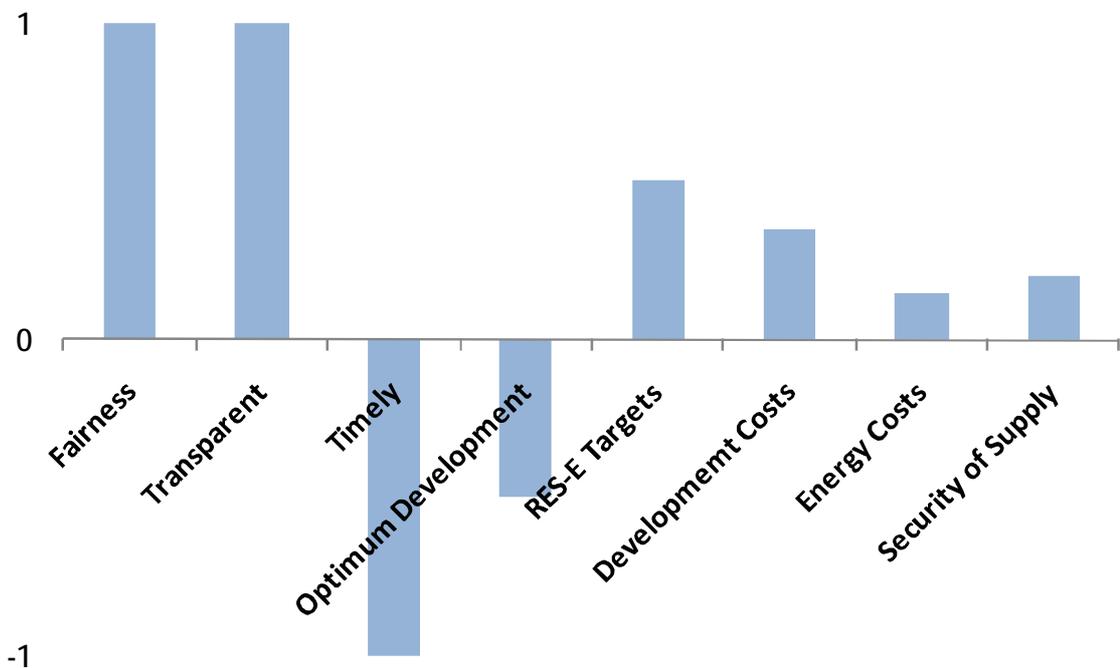


Figure 8 – Evaluation Graph

The author has also concluded that the Gate 3 does not provide for optimal development of the transmission system, however the author notes that the current system provides for a more optimal development as opposed to processing applications on an individual basis, particularly in a subgroup where there are many applicants. I believe it is fair to say that Gate 3 may not be the most optimal solution, however I do not believe that it is completely ‘sub-optimal’, as described by some stakeholders. The final four criteria are quite similar to the results in Table 5. Here the author has derived that the GPA and Gate 3 have had a

limited, but positive effect on development costs, energy costs and Ireland's security of energy supply. It must be noted that Ireland's 2010 renewable targets of 15% has already been reached this year, however reaching 40% by 2020 will be a much more challenging task.

10. CONCLUSION

On balance the author concludes that the GPA is a fair and transparent system that will have a positive effect on energy costs and Ireland's security of energy supply. However, the author recommends that the GPA incorporates changes to the process similar to what is currently being implemented in Great Britain and recently introduced to Alberta, where developers should be asked to meet certain project milestones before being included in any Gate as opposed to being included on application date order, which is the current process. Both Alberta and Great Britain employ a more dynamic approach to queue management, where developers must meet certain milestones and this prevents projects holding up other projects that have a lower queue position by allowing them to move ahead if milestones are not being met. The author believes that the most likely reason for not employing a more dynamic approach to queue management is that SO's carry out studies and shallow connection designs on that basis that all of Gate 3 will proceed. Employing a more dynamic approach might result in changes to shallow connection designs or impact the results of deep reinforcement studies or even constraint studies. It seems that employing a dynamic queue management system might lead the same issues that were experienced by the system operators prior to beginning of the GPA, where interactions may cause the relevant SO to change the connection method of a signed offer due to another interacting applicant. It may also be difficult to assess if milestones are being actually being met and furthermore there is also an administrative overhead consideration. If monitoring of milestones is not properly implemented then it may ultimately lead to further delays in the process.

Another talking point is the transferring of, or trading of capacity rights. It has become widely known that successful applicants in the GPA process are potentially in possession of an extremely valuable commodity, a grid connection offer. It has been expressed that some applicants have only submitted applications with a view to selling the connection offer or capacity and have never had any intention of developing the project. This can have the effect of taking money out of the industry and could potentially make some projects unviable or indirectly increase energy costs. It could also lead to a situation

whereby some projects could be included in a gate without any proper wind analysis, planning or financial analysis being completed, and such projects may ultimately not be developed and this could result in a ‘well planned’ project not being included in a Gate, due to the developer maybe not submitting an application until a feasibility analysis has been undertaken. As mentioned earlier in one of the stakeholder responses, this rewards those who submit applications early, but maybe disadvantages those who undertake a detailed analysis prior to submitting an application. It is also important to note that some developers have stated that they feel they are forced down the route of buying connection contracts or capacity, as sites that they may have already secure planning permission for may never receive a connection offer so they feel they are forced into buying capacity.

It must also be remembered that the idea of processing a large volume of connection applications in groups or batches can be described as extremely innovative. As discussed earlier, Ireland has a small grid with little or no interconnectivity (as opposed to mainland Europe) and the same time the CER and both SO’s are working extremely hard to turn Ireland’s grid into a renewable power system and they must be commended for doing this.

In summary the author recommends the following changes to the GPA:-

- Introduce a set of criteria that must be met before being included in a respective gate. The criteria should include but not limited to the following:-
 - Land option
 - Planning permission
 - Sufficient wind data reporting
 - Finance available
 - Options on turbines/equipment
- Smaller and more regular Gates should be run, as opposed to larger and less often;
- The CER should not the abandon ‘fairness’ objective, however a provision should also be made for a more optimal selection method, possibly along with a date order approach.

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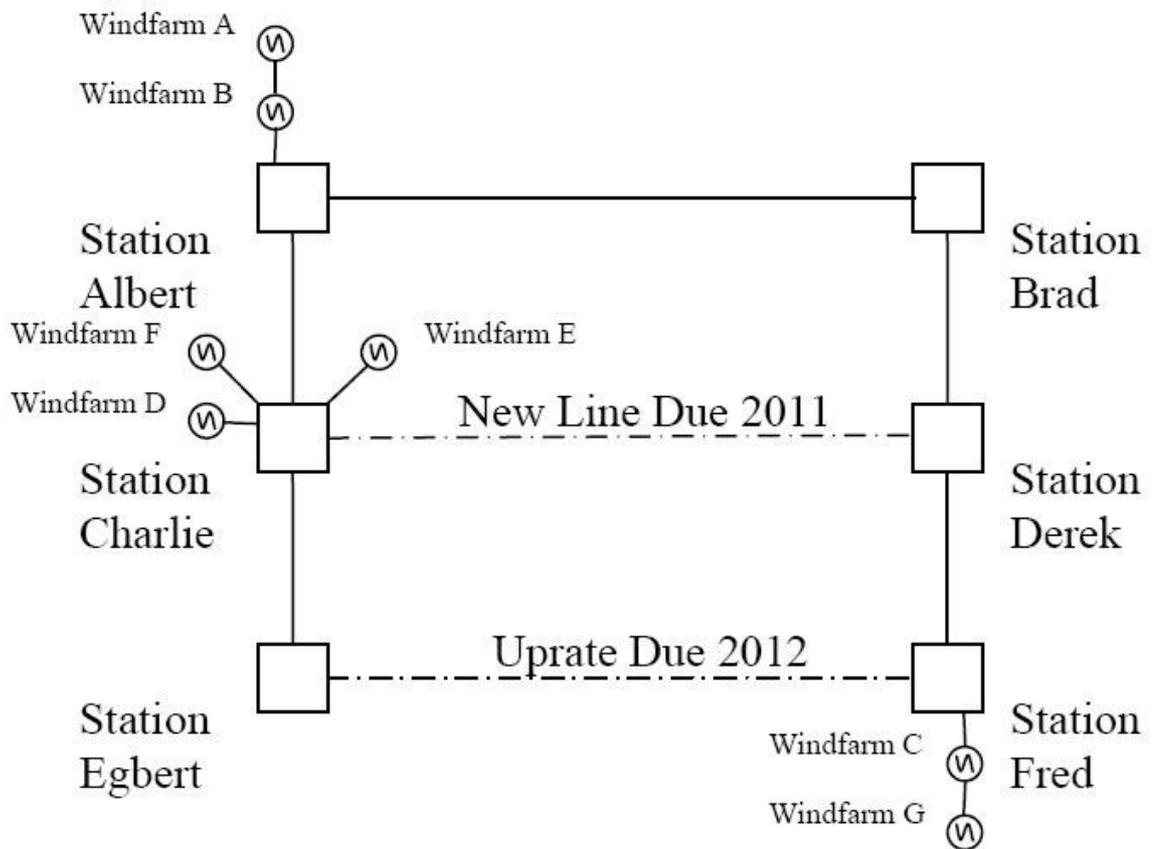
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Appendix A – Firm Access Allocation Example

The table below shows a list of wind farm applications that will be tested for firm access in the small scale example network below for the years 2011-2013. The ITC Programme uses the generators’ application received date to prioritise the order in which the applicants should be offered firm capacity.

Name	MEC (MW)	Date of application	Shallow connection point
Wind Farm A	10	01/01/2004	Station Albert
Wind Farm D	20	01/04/2004	Station Charlie
Wind Farm E	15	01/05/2004	Station Charlie
Wind Farm B	5	01/01/2005	Station Albert
Wind Farm F	5	01/06/2005	Station Charlie
Wind Farm G	2	01/07/2005	Station Fred
Wind Farm C	7	01/03/2006	Station Fred

This six 110 kV station network is connected in a ring prior to 2011, when a new 110 kV line linking Station Charlie to Station Derek is built (shown with a dotted line). The following year (2012) one of the lines between Station Egbert and Station Fred is updated. The ITC Programme operates by adding in the complete list of generators sequentially, accepting or rejecting each in turn based on whether network problems arise, until the list is completed. Although the Programme does not determine actual “spare” capacity levels, its methodology determines whether the capacity is available in the network for a particular generator(s).



Study results for 2011:

In 2011 the network has “spare” capacity which in this example equates to:

- Station Albert 15 MW
- Station Charlie 25 MW
- Station Fred 25 MW

As the first generator in date order is Wind Farm A (10 MW), it is added in by the programme to Station Albert. The revised ‘spare’ capacity in 2011 now becomes:

- Station Albert 5 MW
- Station Charlie 15 MW
- Station Fred 15 MW

As there is still capacity on the network the next generator in date order, Wind Farm D (20 MW), is added to Station Charlie in the programme. This however cannot be fully

accommodated and therefore only 15 MW of the 20MW can be offered firm capacity. There is no longer any “spare” capacity in the network and studies for 2011 are completed.

Study results for 2012:

As the new 110 kV line between Stations Charlie and Derek is completed in 2011, the ‘spare’ capacity in the area has increased. The ‘spare’ capacity now equates to:

- Station Albert 15 MW
- Station Charlie 27 MW
- Station Fred 27 MW

As both Wind Farm A and part of Wind Farm D (15 MW) were already given a 2011 connection date they are already in the model for this year. Of the remaining generation, the first generator in date order is the remaining 5MW of Wind Farm D (20 MW). It is successfully added, to Station Charlie, by the programme. The revised “spare” capacity in 2012 now becomes:

- Station Albert 10 MW
- Station Charlie 22 MW
- Station Fred 22 MW

As there is still “spare” capacity on the network the next generator in date order, Wind Farm E (15 MW) is added. This can be accommodated and is therefore connected. The revised capacity now becomes:

- Station Albert 0 MW
- Station Charlie 7 MW
- Station Fred 7 MW

As there is still “spare” capacity on the network the next generator in date order, WindFarm B (5 MW), is added (to Station Albert) into the Programme. This however cannot be accommodated and therefore is omitted. The next on the list is checked, Wind Farm F (5 MW). This can be accommodated at Station Charlie and is therefore connected by the programme. The revised “spare” capacity in 2012 now becomes:

- Station Albert 0 MW
- Station Charlie 2 MW
- Station Fred 2 MW

As there is still “spare” capacity on the network the next generator in date order, Wind Farm G (2 MW), is added (to Station Fred) in the programme. There is no longer any spare firm capacity in the network and therefore studies for 2012 are completed.

Study results for 2013:

As the uprate of the 110 kV line between Stations Egbert and Fred is completed in 2012 the ‘spare’ capacity in the area has increased. The “spare” capacity now equates to:

- Station Albert 22 MW
- Station Charlie 35MW
- Station Fred 35 MW

As Wind Farms A, B, D and E were already given a 2011/12 connection date they are already in the model for this year. Of the remaining generation, the first generator in date order for is Wind Farm B (5 MW). It is successfully added to Station Albert by the programme. The revised “spare” capacity in 2012 now becomes:

- Station Albert 17 MW
- Station Charlie 30 MW
- Station Fred 30 MW

As there is still “spare” capacity on the network the next generator in date order, Wind Farm C (7 MW), is added to Station Fred in the programme. This can be accommodated and is therefore connected by the programme and the programme terminates as all applicants have been connected.

Appendix B – List of Gate 3 Wind Projects

Received Date	Ref	Project Name	Type	TSO / DSO	MEC (MW)	Cumulative MEC (MW)
19-Feb-04	TG33	Ederglen (1)	Wind	DSO	16.8	16.8
15-Apr-04	TG25	Oweninney (1)	Wind	TSO	34	50.8
15-Apr-04	TG26	Oweninney (2)	Wind	TSO	48	98.8
15-Apr-04	TG27	Oweninney (3)	Wind	TSO	56	154.8
15-Apr-04	TG28	Oweninney (4)	Wind	TSO	34	188.8
19-Apr-04	TG30	Boolynagleragh (1)	Wind	DSO	36.98	225.78
07-May-04	TG31	Castlepook (1)	Wind	DSO	33.1	258.88
31-May-04	DG87	Carrickeeney (1)	Wind	DSO	7.65	266.53
08-Jul-04	DG91	Bunkimalta (1)	Wind	DSO	46.5	313.03
16-Jul-04	DG92	Ugool (1)	Wind	TSO	64	377.03
28-Jul-04	DG93	Kilmeedy (1)	Wind	DSO	5	382.03
28-Jul-04	DG94	Leitir Guingaid & Doire Chrith1 & 2	Wind	DSO	18.4	400.43
29-Jul-04	DG95	Crohaun (1)	Wind	DSO	34	434.43
30-Jul-04	DG115	Rathnacally (1)	Wind	DSO	2.5	436.93
30-Jul-04	DG96	Cureeny (1)	Wind	DSO	94	530.93
03-Aug-04	DG101	Faughary (1)	Wind	DSO	6	536.93
03-Aug-04	DG104	Springfarm (1)	Wind	DSO	6	542.93
06-Aug-04	DG107	Askeaton (1)	Wind	DSO	20	562.93
13-Aug-04	DG109	Kish 1 & 2 & 3 and 4	Offshore	TSO	208	770.93
25-Aug-04	DG108	Lealetter (1)	Wind	DSO	22.5	793.43
26-Aug-04	TG34	Kilgarvan (1)	Wind	TSO	62.2	855.63
27-Aug-04	DG120	Lissycasey (1)	Wind	DSO	6	861.63
14-Sep-04	TG36	Boolynagleragh (2)	Wind	DSO	11.64	873.27
15-Sep-04	DG145	Boolabrien Upper (1)	Wind	DSO	25	898.27
16-Sep-04	DG128	Carrownawelaun (1)	Wind	DSO	4.6	902.87

20-Sep-04	DG131	Tullaroan (1)	Wind	DSO	11.7	914.57
22-Sep-04	DG119	Charleville (1)	Wind	DSO	5	919.57
27-Sep-04	TG37	Croaghbrack (1)	Wind	DSO	33.1	952.67
28-Sep-04	DG121	Barrboy (1)	Wind	DSO	7.8	960.47
28-Sep-04	DG224	Ballyhoura (1)	Wind	DSO	18.3	978.77
04-Oct-04	DG123	Coolrus (1)	Wind	DSO	3	981.77
04-Oct-04	DG134	Barranafaddock (1)	Wind	DSO	39.9	1021.67
19-Oct-04	TG44	Barnadivane (1)	Wind	TSO	60	1081.67
08-Nov-04	TG45	Raheenleagh (1)	Wind	DSO	36.5	1118.17
11-Nov-04	DG135	Woodhouse (1)	Wind	TSO	23.28	1141.45
11-Nov-04	DG144	Bragan (1)	Wind	DSO	33.1	1174.55
15-Nov-04	DG136	Monaincha Bog (1)	Wind	DSO	30	1204.55
24-Nov-04	DG213	An Cnoc (Bawnlea Newpark Grangehill)	Wind	DSO	11.5	1216.05
25-Nov-04	DG154	Glengoole (1)	Wind	DSO	4.6	1220.65
29-Nov-04	DG137	Farrannahineeny (1)	Wind	DSO	4.25	1224.9
14-Dec-04	DG140	Barnastooka (1)	Wind	DSO	34	1258.9
16-Dec-04	DG143	Bunnahowen (1)	Wind	DSO	2.55	1261.45
30-Dec-04	DG147	Sillahertane (1)	Wind	DSO	10	1271.45
30-Dec-04	DG148	Cahermurphy (1)	Wind	DSO	6	1277.45
08-Feb-05	DG153	Lettercannon (1)	Wind	DSO	21.6	1299.05
27-Feb-05	DG222	Dromgarriff (1)	Wind	DSO	11.5	1310.55
04-Mar-05	DG157	Holmes Hill (1)	Wind	DSO	11.7	1322.25
11-Mar-05	DG158	Gurteen (1)	Wind	DSO	2.3	1324.55
13-Apr-05	DG202	Bunaveala (1)	Wind	DSO	9.2	1333.75
19-Apr-05	DG165	Tarbert (1)	Wind	DSO	18	1351.75
05-May-05	DG168	Doolbeg More (1)	Wind	DSO	2	1353.75
05-May-05	DG171	Rathnaveoge (1)	Wind	DSO	2.55	1356.3
13-Jun-05	DG175	Kingscourt (1)	Wind	DSO	18	1374.3
05-Sep-05	DG191	Clochar na Lara (1)	Wind	DSO	24	1398.3

06-Sep-05	DG186	Tawnaghmore 1, 2 & 3	Wind	DSO	16.1	1414.4
09-Sep-05	TG57	Dooghbeg (1)	Wind	TSO	45	1459.4
19-Sep-05	DG182	Ballyshonog (1)	Wind	DSO	5	1464.4
19-Sep-05	TG58	Seecon (1)	Wind	TSO	105	1569.4
27-Sep-05	DG181	Glencarby (1)	Wind	DSO	37	1606.4
05-Oct-05	TG59	Killala (1)	Wind	DSO	30	1636.4
28-Oct-05	DG190	Ballycurreen (1)	Wind	DSO	5	1641.4
24-Nov-05	DG195	Cooly (1)	Wind	DSO	4	1645.4
24-Nov-05	DG196	Newtownfore (1)	Wind	DSO	14.4	1659.8
09-Dec-05	TG62	Doolick (1)	Offshore	DSO	100.8	1760.6
19-Dec-05	DG204	Lettergull (1)	Wind	DSO	20	1780.6
09-Jan-06	TG66	Mountlucas (1)	Wind	TSO	79.2	1859.8
19-Jan-06	DG209	Ballycumber (1)	Wind	DSO	18	1877.8
27-Jan-06	DG223	Anarget (3)	Wind	DSO	0.5	1878.3
16-Feb-06	DG217	Cloghboola (2)	Wind	TSO	10	1888.3
15-Mar-06	DG219	Curraghderrig (1)	Wind	DSO	4.5	1892.8
02-May-06	DG250	Gneevies (2)	Wind	DSO	5.4	1898.2
05-May-06	DG252	Nafferty Hill (1)	Wind	DSO	2.04	1900.24
07-May-06	DG243	Meenkeeragh (2)	Wind	DSO	0.4	1900.64
10-May-06	DG238	Derryknockeran (1)	Wind	DSO	4.25	1904.89
17-May-06	DG248	Curraheen (1)	Wind	DSO	24	1928.89
17-May-06	DG261	Scartaglen (2)	Wind	DSO	2.4	1931.29
17-May-06	TG69	Kill Hill (1)	Wind	TSO	62.5	1993.79
22-May-06	DG231	Lisbealad (1)	Wind	DSO	6	1999.79
22-May-06	DG232	Slievenaglogh (1)	Wind	DSO	15	2014.79
22-May-06	DG233	Ballagh (1)	Wind	DSO	9	2023.79
22-May-06	DG249	Coomleagh (1)	Wind	DSO	5.95	2029.74
22-May-06	DG260	Cronalaght (2)	Wind	DSO	8.16	2037.9
30-May-06	DG212	Sonnagh Old (2)	Wind	DSO	0.85	2038.75
30-May-06	DG247	Gortnahurra (1)	Wind	DSO	33.9	2072.65

31-May-06	DG251	Carrigans (2)	Wind	DSO	1.4	2074.05
02-Jun-06	TG74	Athea (4)	Wind	TSO	25	2099.05
09-Jun-06	DG240	Tullynamalra (1)	Wind	DSO	8	2099.6488
14-Jun-06	DG244	Meenachullalan (2)	Wind	DSO	1.9	2101.5488
14-Jun-06	TG78	Athea (3)	Wind	TSO	1	2102.5488
19-Jun-06	DG236	Knockraha (1)	Wind	DSO	21.6	2124.1488
19-Jun-06	DG254	Carrowleagh (2)	Wind	DSO	2.65	2126.7988
21-Jun-06	DG241	Dunmore (3)	Wind	DSO	2.3	2129.0988
06-Jul-06	TG73	Glenmore	Wind	DSO	30	2159.0988
11-Oct-06	DG258	Ashford (1)	Wind	DSO	13.8	2172.8988
16-Oct-06	DG257	Clifden (1)	Wind	DSO	3	2175.8988
26-Oct-06	TG71	Oweninney (5)	Wind	TSO	198.9	2374.7988
27-Oct-06	DG259	Knockawarriga (2)	Wind	DSO	12	2386.7988
02-Jan-07	DG262	Stack's Mountain	Wind	DSO	13.8	2400.5988
02-Jan-07	DG263	Muingatlaunlush	Wind	DSO	11.5	2412.0988
02-Jan-07	DG264	Knockathea	Wind	DSO	33.9	2445.9988
17-Jan-07	DG265	Teevurcher	Wind	DSO	9	2454.9988
22-Jan-07	DG266	Garvohill	Wind	DSO	6	2460.9988
25-Jan-07	DG267	Kiltumper	Wind	DSO	5	2465.9988
11-Feb-07	DG269	Clogheravaddy (1)	Wind	DSO	9.2	2475.1988
20-Feb-07	DG268	Loughderryduff	Wind	DSO	9.4	2484.5988
01-Mar-07	DG271	Muingnaminnane (2)	Wind	DSO	13.5	2498.0988
01-Mar-07	DG272	Cordal (2)	Wind	DSO	34	2532.0988
01-Mar-07	DG273	Cordal (3)	Wind	DSO	31	2563.0988
04-Mar-07	DG290	Cleanrath (1)	Wind	DSO	16.56	2579.6588
05-Mar-07	DG277	Kish 5 & 6 and 7 Merge	Offshore	TSO	156	2735.6588
23-Mar-07	DG282	Kilvinane (2)	Wind	DSO	5.82	2741.4788
23-Mar-07	DG283	Muingnatee (3)	Wind	DSO	1.8	2743.2788
31-Mar-07	DG284	Beam Hill (2)	Wind	DSO	9	2752.2788

18-Apr-07	DG285	Lisdowney (1)	Wind	DSO	9.2	2761.4788
23-Apr-07	TG83	Clahane (2)	Wind	TSO	13.8	2775.2788
24-Apr-07	DG286	Garrymore (1)	Wind	DSO	10.8	2786.0788
03-May-07	DG289	Cloontooa (1)	Wind	DSO	13.8	2799.8788
03-May-07	DG291	Magheramore (1)	Wind	DSO	27	2826.8788
03-May-07	DG292	Carrignadoura (1)	Wind	DSO	22.08	2848.9588
08-May-07	DG294	Raragh (2)	Wind	DSO	16.56	2865.5188
13-Jun-07	DG303	Kilberehert (1)	Wind	DSO	4.5	2870.0188
19-Jun-07	DG302	Knocknagornagh	Wind	DSO	43.7	2913.7188
28-Jun-07	DG306	Ballycaddan	Wind	DSO	11.5	2925.2188
28-Jun-07	DG307	Knocknalour	Wind	DSO	3.95	2929.1688
28-Jun-07	DG308	Meenadreen South (2)	Wind	DSO	5.4	2934.5688
09-Jul-07	DG311	Tullabrack (1)	Wind	DSO	13.8	2948.3688
11-Jul-07	DG324	Garracummer (3)	Wind	DSO	1	2949.3688
20-Jul-07	DG312	Black Lough (1)	Wind	DSO	12.5	2961.8688
02-Aug-07	TG84	Bruckana	Wind	DSO	39.6	3001.4688
07-Aug-07	DG316	Toonagh (1)	Wind	DSO	0.9	3002.3688
09-Aug-07	DG317	Toonagh 499kW	Wind	DSO	0.499	3002.8678
30-Aug-07	DG323	Ballyduff WF (1)	Wind	DSO	0.6	3003.4678
03-Sep-07	DG321	Dromadda More (2)	Wind	DSO	12	3015.4678
13-Sep-07	TG102	Boggeragh (2)	Wind	TSO	47.7	3063.1678
17-Sep-07	DG400	Sonnagh Old (3)	Wind	DSO	11.04	3074.2078
03-Oct-07	DG402	Altnagapple (1)	Wind	DSO	27	3101.2078
03-Oct-07	TG86	Oriel (1)	Offshore	TSO	330	3431.2078
17-Oct-07	DG404	Tullynagee (1)	Wind	DSO	16.1	3447.3078
17-Oct-07	DG405	Cappagh White 2 and 4 Merge	Wind	DSO	27.48 7	3474.7948
26-Oct-07	DG407	Corkermore (2)	Wind	DSO	3	3477.7948
30-Oct-07	DG406	Geevagh (2)	Wind	DSO	11.98	3489.7748
30-Oct-07	DG408	Smithstown (1)	Wind	DSO	8.28	3498.0548

02-Nov-07	DG410	Cappagh White (3)	Wind	DSO	21.6	3519.6548
02-Nov-07	DG412	Glentanemacelligot (2)	Wind	DSO	34	3553.6548
05-Nov-07	DG413	Kilmacow (1)	Wind	DSO	0.401	3554.0558
15-Nov-07	DG425	Knockawarriga (3)	Wind	DSO	26.5	3580.5558
15-Nov-07	TG90	Cluddaun (1)	Wind	TSO	52	3632.5558
15-Nov-07	TG91	Cluddaun (2)	Wind	TSO	64	3696.5558
15-Nov-07	TG92	Cluddaun (3)	Wind	TSO	34	3730.5558
15-Nov-07	TG93	Killinaparson (1)	Wind	TSO	55	3785.5558
15-Nov-07	TG94	Sliabh Bawn (1)	Wind	TSO	58	3843.5558
16-Nov-07	DG418	Cappaboy Beg (1)	Wind	DSO	6	3849.5558
16-Nov-07	DG419	Cappaboy Beg (2)	Wind	DSO	6	3855.5558
16-Nov-07	DG420	Kilronan (2)	Wind	DSO	34	3889.5558
21-Nov-07	TG103	Cronacarkfree (1)	Wind	TSO	105	3994.5558

Appendix C – Gate 3 Group Areas

