Chapter 10
Ireland

10.1 INTRODUCTION

For several reasons, 2003 was a year of high wind-energy activity in Ireland. The year set a record for new wind-power capacity addition in Ireland, with complete construction of new wind farms totaling more than 70 MW of capacity. However, while the capacity constructed in the previous record year was exceeded, this still falls short of the construction rate required to meet the national renewable energy deployment target of 500 MW of additional renewable generating capacity by 2005.

Other high points for the year include a continuing increase in wind farm size, with the 25-MW Kings Mountain wind farm, commissioned in 2003, being the largest completed to date, and construction starting on the 60-MW Derrybrien wind farm. Construction of the first 25-MW phase of the Arklow Bank project – Ireland's first offshore wind farm – was also completed in 2003.

A report titled, *The Impacts of Increased Levels of Wind Penetration on the Electricity Systems of the Republic of Ireland and Northern Ireland* – commissioned by the island of Ireland's two energy regulators, on the possible limits to penetration of wind power in the Irish electricity grid – gave a generally positive outlook. In June 2003, the results of the last tender round in the current government price support scheme for renewable electricity were announced. Support for two offshore wind farms of 25 MW each was included for the first time.

An initiative to develop a special section of the electricity transmission system code for wind turbine generators commenced in late 2003. A consultation group was set up to provide the wind power industry with opportunity to influence the code requirements. The new grid code section will be completed early in 2004.

The year 2004 ended with two notable events for the wind industry. At the end of November, the transmission system operator for the Republic of Ireland, ESBNG, wrote to the energy regulator requesting that a moratorium be placed on pending wind farm connections. The reasons given mainly concerned the unknown possible effects of a rapid near-term growth in wind power penetration on grid stability and security. The need for the new grid code section for wind turbines to be implemented, and a poor response from manufacturers in providing dynamic models for turbines, were cited as key factors. The regulator acceded to extending the moratorium until April 2004.

The government also published a consultation document, *Options for Future Renewable Energy Policy and Programmes* in December 2003. Need for a replacement scheme exists because the current price support scheme for renewable energy has allocated all the capacity for which state aid approval has been received.

10.2 NATIONAL POLICY

Strategy

The key national policies relating to wind power in the Republic of Ireland are: (1) a target, detailed in the *Green Paper on Sustainable Energy 1999*, to install 500 MW of additional renewable electricity generating capacity between 1999 and

2005; (2) an indicative target, committed to in *EU Directive 2001/77/EC*, to increase national renewable electricity consumption to 13.2% of total demand by 2010. While neither of these targets relates specifically to wind power, it is anticipated that, in each case, wind power will ultimately contribute in excess of 90% toward achieving these targets.

In December 2003, the government published a consultation document titled, *Options for Future Renewable Energy Policy, Targets and Programmes*. As a result of this consultation, plans exist for a new renewable support mechanism to be decided upon and implemented. This is required to replace the current Alternative Energy Requirement (AER) competitive tendering scheme, which has run its course. Renewable energy targets will also be set for the period between 2010 and 2020, which is not covered by any current renewable energy policy.

Progress Towards National Targets

Progress towards achieving the national renewable energy capacity target for 2005 has, to date, been below the rate required. This has been due to extremely slow progress in the early years when unanticipated difficulties were encountered in implementing the renewable energy support schemes. The rate of deployment increased significantly in 2003 but is still below the rate required to achieve targets.

The 2010 target should not pose a similar challenge, as its achievement does involve an increase in the rate of deployment beyond 2005. The government has indicated a commitment to exceed the target of 13.2% national renewable energy consumption by 2010, committed to under the EU RES-E directive.

10.3 COMMERCIAL IMPLEMENTATION

Installed Capacity

The installed and commissioned wind generating capacity at the end of 2003 was 190 MW. This is an increase of 52 MW in the year 2003 and marginally exceeds the previous record in 2000. Construction has been completed on several other projects, including the 25-MW Phase 1 of the Arklow Bank offshore wind farm, but these await commissioning.

Rates and Trends in Deployment

Grid connection agreements committed to by wind farm developers, if acted upon, will result in 326 MW of wind generation capacity being connected in 2004. It is to be expected that a majority of connection agreements will be taken up because they include financial penalties for non-performance.

Onshore wind farms totaling 75 MW in capacity are currently under construction. As previously mentioned, the largest wind farm to date, the 60-MW Derrybrien project, is among these. This project received a setback late in 2003 when a significant peat-slide occurred on the site, infiltrating a local watercourse and giving rise to serious local disquiet. As a significant number of wind projects in Ireland are being developed on upland blanket bog sites, this incident may have repercussions for future permitting of wind farms within the planning system.

Construction of 25-MW Phase 1 of the Airtricity Arklow Bank wind farm was completed in 2003 and is in the final stages of commissioning at the time of writing. This is the first such development in Ireland, and it is also the first offshore deployment of the GE Wind 3.6-MW wind turbine. The ultimate capacity for this wind farm is 520

MW under the terms of its foreshore lease. The 60-MW Phase 2 has a scheduled grid connection date of 2005.

Two other offshore wind farms, the Kish Bank and the Bray Bank, both being developed on the east coast of Ireland by the Kish consortium, each won price support contracts, at a tendered price of 0.08 euro/kWh, for 25 MW of capacity apiece under the AER VI competitive tendering round in July 2003. These will have to be commissioned by 2006 in order to avail of the AER VI power purchase agreement.

All of this points to a significant increase in the rate of deployment of wind power in Ireland in the immediate future. However, the possible effects of the moratorium, detailed in Section 10.1, on wind farm connections, cannot yet be quantified. This moratorium is based solely on signing new connection agreements and so should not seriously affect the wind farms totaling 575 MW capacity with existing connection agreements. This will give some room for development to continue while the issues that led to the moratorium being imposed are resolved.

However, the moratorium does create an uncertain environment for investors because its effects on the cost of implementing current and future wind connections are not quantifiable until possible new technical requirements are defined. Uncertainty regarding ultimate wind penetration level also contributes to an uncertain environment for growth.

Contribution to National Energy Demand

The estimated contribution from wind power to national electricity demand in the year 2003 was 465 GWh. This represents a 20% increase on 2002 production. A preliminary estimate for the total electricity demand in Ireland in 2003 is 25,270 GWh, an increase of 1% on 2002. The percentage contribution of grid-connected wind power to gross national electricity demand was therefore 1.84%.

10.4 MARKET DEVELOPMENT AND STIMULATION

Main Support Initiatives and Market Stimulation Incentives

The primary market support mechanism remains the AER scheme, through which price support contracts with a 15-year term are awarded to renewable electricity generators in regular competitive tender rounds. The scheme has been in place since 1996 and contracts for wind generation capacity totaling 334 MW, which were announced for the AER VI tender round in July 2003, may be the last in the scheme.

This tender round was the first to include a category for offshore wind power for which two projects, of 25 MW each, were approved for award of contracts. A reserve list of projects was included for allocation of any remaining generating capacity for which EU state aids approval has been obtained in the event that some contracts in the scheme are not acted upon.

A high-level indication of the effectiveness of the AER scheme can be obtained from its performance in delivery of generating capacity. Of a total of 807 MW wind power capacity announced in the tender rounds to date, only 110 MW has been delivered. The competitive process tended to favor over-optimistic, uninformed tenders. It could be concluded that, while competitive tendering is an appropriate mechanism for obtaining generating capacity in a mature market sector, it is not as appropriate to a nascent market sector where there is

little operational experience and market participants have varying levels of sophistication.

In recognition of the necessity to review Ireland's policies on renewable energy and the associated support mechanisms, the responsible government minister published a consultation document in December 2003. This document was titled, *Options for Future Energy Policy, Targets and Programmes*, and outlines the possible practical choices for Ireland in renewable energy technologies, support mechanisms, and targets up to the year 2020. Responses to the consultation document are invited from all relevant stakeholders, and the decision on the design of the future support mechanism and setting of future targets will take account of the responses.

In the liberalization of the electricity market in Ireland, in accordance with the requirements of the *EU Directives 96/92/EC* and *EU Directive 98/30/EC*, special consideration was given to renewable electricity suppliers in granting them access to all consumers in advance of full-market opening. Renewable electricity generators and suppliers are also advantaged in that they only have to balance aggregated annual renewable electricity supply and demand to qualify as "green" electricity suppliers, rather than that for each half-hour metering and trading period.

Approximately 30% of the wind generation capacity installed to date in Ireland trades electricity within these trading arrangements without the benefit of government price support or green credits. The majority of companies, which have developed projects in this manner to date, have been integrated generation-and-supply businesses that gain access to a significant portion of the electricity supply market prior to it being fully deregulated for "brown" electricity suppliers. As the deregulated portion of the market increased from 40% to 56% at the beginning of 2004, the sector in which green generation does not compete with other new market entrants decreased by 16%.

This advantage for green electricity suppliers will end when the market is fully deregulated in 2005. However, it is planned that, upon full-market opening, new trading arrangements – involving a single-pool market with marginal pricing for generators based on location – will replace the current interim, bilateral market. In general, these arrangements will be more favorable to wind generation because generators can obtain the pool price for any electricity they generate, without entering into a power purchase agreement with a supplier. However, wind power operating will therefore be exposed to the volatility of market prices and larger wind farms will be subjected to pricing based on location.

It therefore remains to be seen whether financing of wind farms based on merchant operation will become commonplace. Those companies involved with both generation and supply are likely to remain the most active in this area. It is noteworthy that, due to the wind regime in some areas of Ireland, wind generation can profitably supply electricity to certain mid-tariff customers with no external support other than fiscal measures that are available to conventional generation.

The main fiscal incentives, from which investors in wind farm projects can benefit, are: (1) the Business Expansion Scheme (BES) and (2) tax relief under Section 486b of the *1998 Finance Act* on capital directly invested in wind farm assets. Under the first incentive, those investing in approved qualifying businesses can claim a tax refund on income invested. Electricity generation

is a qualifying business activity. The scheme has an investment cap of 750,000.00 euro and is therefore of limited value to larger wind energy projects. Under the second incentive, corporate investors in renewable energy projects can claim tax relief on equity investment in capital assets. This fiscal incentive will have limited future attraction because the corporate tax rate has been reduced to 12.5%.

A 2002 amendment to the finance act also restricted eligibility for tax relief on capital assets to active participants in projects. This measure effectively eliminated a commonly used investment vehicle for private investment in wind farms.

Unit Cost Reduction

Does not apply.

10.5 DEPLOYMENT AND CONSTRAINTS

Wind Turbines Deployed

The number of operational, grid-connected wind turbines in Ireland at the end of 2003 was 269. The size of operational wind turbines ranges from 225 kW to 2.5 MW onshore, and the single offshore wind farm uses 3.6-MW turbines. The largest wind farm currently operational is 25 MW.

The average size of grid-connected wind turbines deployed in Ireland in 2003 was 1.23 MW. This average size lags worldwide averages; possible reasons are: (1) turbine size is generally fixed at the planning stage, but project development periods are protracted; and (2) road access limits turbine size on many sites. A wind farm with 71 Vestas 850-kW wind turbines, currently under construction and to be commissioned early in 2004, will be the largest wind farm upon completion. The largest wind turbines deployed in Ireland to date have been 2.5-MW Nordex turbines onshore and 3.6-MW GE Wind turbines offshore.

Operational Experience

Capacity factors for wind turbines installed in Ireland to date generally exceed 35%, and capacity factors exceeding 40% are not uncommon. While turbine availability will typically exceed 97%, there has been mixed experience on the reliability of turbines supplied into the Irish market.

A wind turbine users group was formed in Ireland in 2003 to provide a forum where experiences on turbine performance could be exchanged and concerted representations could be made to manufacturers. Sustainable Energy Ireland has funded a monitoring program to establish performance levels that are being obtained from wind turbines installed to date in Ireland. The results of this study should inform project developers when negotiating future contracts for wind turbine supply in Ireland.

Main Constraints on Market Development

As indicated in the 2002 report, permitting of wind farm sites has diminished as a near-term constraint on market development, and electricity system issues are likely to emerge as the primary constraint on growth. This perception has been reinforced by the moratorium that has been imposed by the energy regulator, at the request of the TSO, ESBNG, on issuing new wind farm grid-connection offers.

Prior to this, the availability of generation connection capacity in the electricity system had constrained growth. However, the moratorium has been imposed on the grounds of the unknown effects of a large increase in the number of wind farm

connections on the stability and security of the electricity system. In discussions subsequent to the imposition of the moratorium, it emerged that the concerns of the TSO revolve around two key issues: (1) Most wind farms installed to date are not grid code compliant, and (2) dynamic models of wind turbines were not provided by turbine suppliers as required as a connection condition.

The pre-existing grid code took no account of wind generator characteristics, and connecting wind farms regularly required derogations to its requirements. This deficiency had been highlighted previously, and in September 2003 the TSO initiated a process to develop specific grid-code sections for wind generators in consultation with the industry. However, in November 2003, the TSO became concerned about the growth in the number of wind farm connection applications, which might lead to a significant portion of generators not being subject to the new grid code requirements. As a result, the TSO called for the moratorium to be imposed.

The lack of wind turbine dynamic models for power system simulation studies precluded the TSO modeling the effects of wind farm connections on system stability and carrying out remedial action where necessary. There are limited resources available to offset the effects of a growth in intermittent generation penetration because the electricity system in Ireland is a small, isolated island system with only weak interconnection with the United Kingdom.

The projected total – in excess of 1,200 MW of additional capacity from current connection offers and connection applications – would bring wind penetration in the electricity system to a level equaling or exceeding the highest penetration in any electricity system internationally. The TSO recommended against proceeding with connecting this wind generation capacity in the absence of measures to control it and predict its effects on system stability.

While the issues at the root of the moratorium are likely to be addressed in the near term, the capacity of the electricity system to accept wind generation is likely to remain as the limiting constraint on the growth of the wind generation sector in Ireland. Grid issues may not substantially hinder the achievement of national targets for renewable energy penetration, but the current total capacity of wind farm sites in all stages of development exceeds that required to meet government targets. Therefore, additional demand for the grid connection of wind farms beyond that in official projections is likely. Planning permits have a five-year lifetime, and delays in project execution due to non-availability of grid connection can compromise their viability.

Significant research effort will be required in the coming years if the technical issues associated with the grid connection of increasing amounts of wind generation are to be identified and solved. There has been a deficit of rigorous, in-depth research on these issues in the initial years after national targets were set.

As mentioned, the two electricity regulators on the island of Ireland commissioned a study on the possible penetration of wind energy in the Irish electricity system, and the final report of this study was published early in 2003. This report provided static load-flow simulations and indications of future limits on which penetration in the electricity network would be based. The report also identified areas in which further research would be required to facilitate this penetration level.

Since the publication of this report, Sustainable Energy Ireland has

commissioned a study on the effects of higher wind penetration on electricity system reserve requirements and also a study on the implication of the proposed new electricity trading arrangements upon renewable electricity generators. Sustainable Energy Ireland anticipates that these studies will be the first in a program of work to address issues on renewable electricity integration.

10.6 ECONOMICS

Trends in Investment

The renewable electricity price support scheme divides onshore wind projects into two classes: (1) those less than 5 MW in size and (2) those more than 5 MW. Based on this demarcation, indicative average total costs for onshore wind farm construction for 2003 were: (1) 1,168.00 euro/kW installed, with the delivered cost of the turbine accounting for 830.00 euro/kW of this; balance of plant (BOP) cost accounting for 200.00 euro/kW, and miscellaneous site development cost making up the rest; and (2) 1,024.00 euro/kW installed, with turbine delivered costs accounting for 690.00 euro/MW and BOP accounting for 225.00 euro/kW. Costs for off-site grid connection assets will generally fall within the range of 60.00 euro/kW to 200.00 euro/kW, connected with the average at 100.00 euro/kW. Annual operating and maintenance (O&M) costs are estimated at 5.5% of project capital costs.

Limited cost data exist for offshore wind energy projects because only one offshore project has been built. According to Sustainable Energy Ireland (2002), *Cost Benefit Analysis of Government Support Options for Offshore Wind Energy,* estimated costs for developments in Irish coastal waters range from 1,270.00 euro/kW to 2,050.00 euro/kW installed, the lower cost probably not including grid connection. Information relating to offshore projects under development, albeit of a small scale, indicate costs at the higher end of this range. The costs for such developments are highly sensitive to project scale.

Trends in Unit Costs of Generation and Buy-Back Prices

Price caps in the sixth and final tender round of the AER prices support scheme – the results of which were announced in July 2003 – were 0.05742 euro/kWh for projects smaller than 5 MW, 0.05216 euro/kWh for those larger than 5 MW, and an indicative price cap of 0.084 euro/kWh for offshore wind farms (to a total capacity limit of 50 MW and 25 MW per site).

Contracts awarded under this support scheme have a 15-year duration and include full indexation. An accelerated capital recovery mechanism was included in this tender round whereby projects could obtain increased payments in the first seven years of the contract period, with rates reduced commensurately in the final eight years. The actual price bids by winning projects are confidential and weighted average prices were not published for this tendering round.

Average wholesale prices for comparison to wind power are unobtainable because the majority of wholesale electricity in Ireland is traded through bilateral contracts. However, the Commission for Energy Regulation does calculate annually a benchmark Best New Entrant (BNE) electricity price to be used in setting prices in the secondary balancing market, including the "top-up" price for electricity. This price, based on CCGT generating plant, was 0.0471 euro/kWh in 2003; and wind power compares favorably to it, with generating costs in Ireland ranging from 0.003 euro/kWh to 0.006 euro/kWh, according to Sustainable Energy Ireland (2002), *Renewable Energy Research, Development and Demonstration Strategy*.

10.7 INDUSTRY

Manufacturing

There is no significant wind turbine manufacturing industry in Ireland, although there have been several initiatives to set up manufacturing of specific wind turbine components and to manufacture micro-scale turbines. Sustainable Energy Ireland has funded several R&D projects in these areas, which are detailed in the following section.

Industry Development and Structure

Sustainable Energy Ireland has funded a study on offshore wind energy potential and associated industry development in Ireland. When completed, this study will serve to inform government policy on the development of this industry sector.

10.8 GOVERNMENT-SPONSORED R,D&D

Priorities

The *1999 Irish Government Green Paper on Sustainable Energy*, along with setting renewable energy targets for Ireland, set out a program of Sustainable Energy R,D,&D with a budget of 50 million euro for the years 2000 to 2006. Sustainable Energy Ireland was charged with administering this budget. Of this budget, 16 million euro was specifically allocated to renewable energy research, while other parts of the program also contain renewable energy elements. Priorities identified within the green paper included techniques for assessing the wind regime on land-based sites and their adaptation to Irish conditions and site evaluation techniques for offshore wind farms.

In 2001, the government-convened Renewable Energy Strategy Group completed a report specific to wind energy development, titled, *Strategy for Intensifying Wind Energy in Ireland*. This report identified key areas where development is required and work was initiated in these areas. As the majority of requirements initially identified have now been addressed and the wind industry in Ireland has moved from the initial deployments phase to the threshold of large-scale deployment, the priorities for facilitation of future wind energy development have also changed.

The Minister for Communications, Marine and Natural Resources, whose role includes energy policy, has announced the formation of a Renewables Development Group, chaired by his department. Within this department, the renewables industry, the Commission of Energy Regulation, SEI, and network operators will have a permanent forum to share expertise and to solve potential constraints to the development of this key sector. It is expected that this group will identify a new set of research priorities to assist the further deployment of wind energy in Ireland.

In August 2002, Sustainable Energy Ireland launched the Renewable Energy R,D&D program previously mentioned. The focus of the program is to stimulate the application and further deployment of renewable energies, particularly those close to market viability. This could include measures to stimulate the development and produce implementation plans for those technologies with economic potential. The primary objectives are to remove barriers to renewable energy technologies deployment and help stimulate the development of an Irish renewable energy industry.

The Renewable Energy Research, Development and Deployment program, with an indicative budget of 16 million euro, will give priority to supporting the following:

1. Research aimed at developing policy options for enhanced deployment
2. Research to define the market structure for renewable energy technologies with high penetration potential
3. Research aimed at cost reduction, improved reliability, and/or opening new markets
4. Demonstration of non-technical innovation
5. Feasibility studies for renewable energy projects
6. Demonstration aimed at high-risk, high-reward projects
7. Investigation into core areas common to many renewable technologies, such as the electricity system, regulation, technical standards, fiscal and support measures, finance, markets, planning, and policy

For onshore wind energy, specific priorities that have been identified for the program are measures to address the creation of the correct electrical network, and market and social conditions for the wider acceptance of the expanding deployment of wind energy.

New R,D&D Developments

Since its launch, the program in the previous section has had a significant number of applications. The following are among the wind energy R&D projects that have been approved for funding to date:

1. Development of a short-range ensemble prediction system for wind energy forecasting in Ireland
2. Participation in IEA R&D Wind Agreement Task XXI – Dynamic Models of Wind Farms
3. A study titled, Offshore Wind Energy Potential and Associated Industry Development in Ireland
4. A study titled, Wind Turbine Design and Method of Implementation that is Ideally Suitable for Use at Small Irish Wind Farms
5. A study titled, Define of a Monitoring Program for Irish Wind Farms
6. A study titled, Electricity Storage Technologies and their Potential to Address Wind Energy Intermittency in Ireland
7. A marketing/technical feasibility study to determine the possibility of developing a viable small vertical axis wind turbine
8. An investigation of the effects of wind turbines on MSSR radar tracking in Ireland
9. A project titled, Wind Turbine Blade Manufacture with New Materials
10. An evaluation of wind turbine foundation behavior
11. A study titled, The Influence of Mounting Booms and Towers on Wind Speed Measured by Anemometers
12. A study titled, Development of a Demonstration1 0.2-kW Domestic Wind Turbine
13. A study titled, Ownership Models and Financing of Community Renewable Energy Initiatives

Commissioned studies on specific prioritized topics affecting wind energy integration, which have been funded under the Renewable Energy R,D&D, include the following:

1. An updated wind atlas for Ireland with 200-m resolution, providing wind data at 50 m, 75 m, and 100 m for both onshore and offshore areas of the Republic of Ireland
2. A public attitudes survey titled, *Attitudes to the Development of Wind Farms in Ireland*
3. A study titled, Renewable Energy in the New Electricity Market
4. A study titled, Costs & Benefits of Embedded Generation in Ireland
5. A study titled, Impacts on Operating (and Load Following) Reserves of Increased Wind Penetration in Ireland
6. A study titled, Economic Analysis of Policy Mechanisms

Offshore Siting

The mechanism for permitting offshore wind farms is an adaptation, introduced in 2000, of the offshore exploration licensing system and comprises a "foreshore license." A foreshore license allocates exclusive rights to a single developer to allow in-depth site assessment and a "foreshore lease" that assigns exclusive site development rights to a developer.

To date, 11 foreshore licenses have been issued and one foreshore lease, the latter being for the Arklow Bank. Two projects with foreshore licenses were winning tenders, for 25-MW capacity each, in the AER VI competitive tendering round. These, and the Arklow Bank project, are all located on the east coast of Ireland, which is less exposed to Atlantic sea conditions.

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Figure 10.1 Tower construction offshore in Ireland (Courtesy of Airtricity)