IEA Annual Report Ireland 2009
www.IEAWind.org

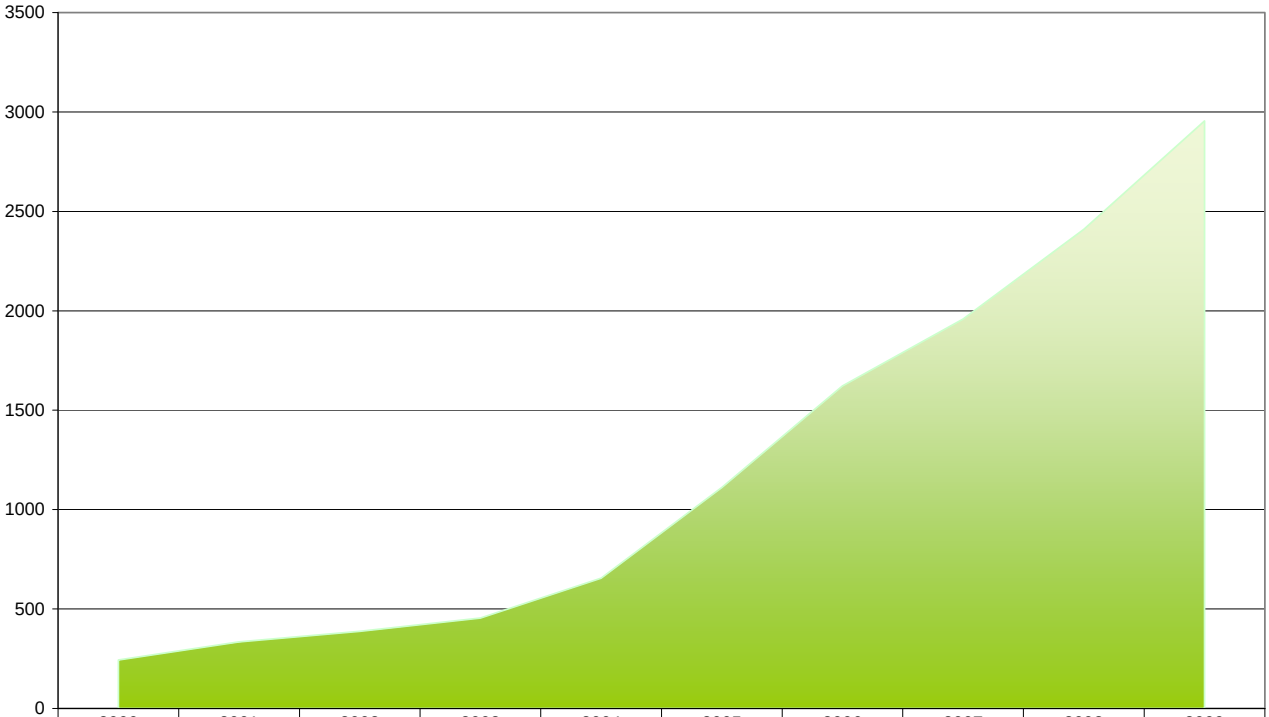
1.0 Overview

Wind energy's contribution to Ireland's electricity supply continues to rise as record capacity is added (Figure 1). Ireland is on course to achieve its national target for RES-E contribution to electricity demand in 2010 (15%). 10.5% of 2010 electricity demand, or 75% of renewable electricity supply, is expected to be met from wind energy. By December 2009, a total of 85 wind farms were connected to the electricity system, bringing the total installed capacity for wind to 1,264MW. Wind farm connection rates have been maintained above 200MW for the second year with 237MW connecting in 2009, a slight increase on 2008. 237MW is a new record for additions of wind capacity in Ireland.

Total installed wind generation	1264MW
New wind generation installed	237MW
Total electrical output from wind	2,955,000MWh
Wind generation as % of national electric demand	10.5 %
RES-E Target 2010: RES-E Target 2020 :	15% 40%

Table 1: Key Statistics 2009: Ireland

A new quarter-hourly record for the amount of electricity generated by Ireland's wind farms was also achieved. The output of Ireland's wind farms reached its 2009 peak of 1064MW on October 24th with enough power generated at that time to supply over 600,000. At times towards the end of 2009, the amount of wind power on the system was meeting 45% of the national electricity demand with no issues reported by EirGrid, the Irish transmission system operator. This is remarkable given the small isolated nature of Ireland's electricity grid.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
GWh	244	334	388	454	655	1112	1622	1958	2410	2955

Figure 1: Wind-sourced electricity in Ireland, 2000–2009. Source: EirGrid & SEAI EPSSU.

Despite increases in wind power output, the average emission factor for electricity generation was 554kgCO_2/MWh in 2008. The increase in wind output was offset by a recovery in peat fired generation output after outages in 2007. Wind energy accounted for 63% of renewable sourced electricity in 2008 and 73% in 2009. The average emission factor for 2009 was 530kg CO_2/MWh. Reduction in the reliance on imported sources of energy is a key benefit of indigenous sources such as wind. Ireland is already nearly 90% reliant on imported energy.

2.0 National Objectives and Progress

2.1 National targets and progress

Ireland's target is to supply 15% of electricity demand from renewable sources during 2010, a target which is expected to be achieved. Wind has contributed, and will continue to contribute, the vast majority of the required additional renewable generation. Added to other renewable generation stock, an estimated 1,350MW of wind capacity is required to meet the target for 2010. An indicator of future wind power capacity additions is the queue of planned wind farms awaiting grid connections. Planned wind farms with connection contracts totaled 1,412.3MW at the end of 2008 and total 1257.5MW at the end of 2009. The reduction in planned capacity additions reflects the connection of contracted sites and the lag between the last tranche of connection offers (known as *Gate 2*) and the current, *Gate 3*.

The term *Gate* is used to describe the overall process by which each tranche of grid capacity is assigned. As the system for allocating renewable capacity in Ireland is primarily based on a date-order queue system each round of capacity is allocated to those applicants in the connection queue prior to gate closure. The Commission for Energy Regulation (CER) directs the system operators on the process and on the total capacity to

be allocated in each Gate. Not all applicants in the queue at gate closure receive offers however as the capacity of the completed applications exceeds the required capacity. The successful applicants are taken from the applicant queue via a group processing approach (GPA), which is discussed later in this section.

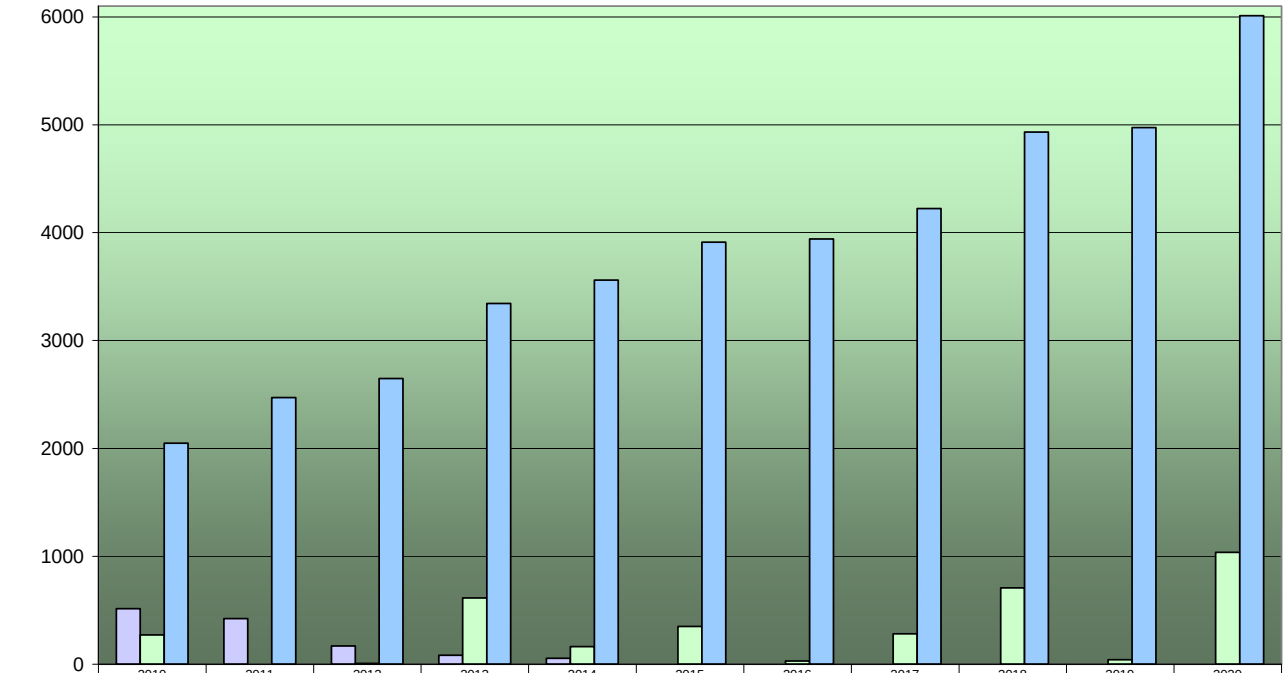
	2002	2003	2004	2005	2006	2007	2008	2009
Capacity Factor	34.1%	34.7%	33.4%	32.5%	31.4%	29.1%	31.7%	31.3%
Capacity Additions (MW)	12.7	75.5	127.5	174.7	231.8	48.2	207.7	237

Table 2: Capacity additions and capacity factor 2002-2009, 2009 CF provisional. Source: EirGrid

Figures from the TSO show that the capacity factor for the wind had been falling over the past number of years reaching a low point in 2007 of 29.1% (Table 2). It appears to have recovered during 2008 and 2009 but further study is required to understand the longer term forces on the capacity factor and determine if the longer term trend is up or down.

As outlined in the Irish government's 2007 Energy White Paper, Ireland had aimed to supply 33% of its electricity demand from renewable sources by 2020. This is one element which will contribute to the overall national target in EU Directive 2009/28/EC of 16% of total final energy consumption from renewable energy for 2020. The 33% target for RES-E was increased voluntarily to 40% in 2008. It can be seen from the figures for current connection applicants (c11,000MW), sites contracted for connection (1,257.5MW), and wind farms already connected (1,264MW) that the wind industry is capable of providing the generation required as long as conducive conditions persist and the system operators can execute planned network upgrades required for renewable generator connections. Approximately 290MW of new renewable capacity is required each year from 2010 to 2020 if the target is to be met. The capacity additions for each year since 2002 are shown in Table 2.

Those wishing to connect to the grid join an applicant queue once their application is "deemed complete." They are then part of the 'Group Processing Approach' (GPA) and are included in the 'Grid Development Strategy' (GDS). In January 2010 the transmission system operator published the results for the Gate 3 firm access schedule. The dates were the result of running the 'Incremental Transfer Capability' (ITC) programme within the GDS. ITC was the methodology adopted by the system operators to assess the capability of the grid to accommodate applicants on a firm basis. Further details of the GPA and ITC are provided in the 2008 IEA Wind Annual Report.



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Gate 2	516	422	170	82	54	0	0	0	0	0	0
Gate 3	271	0	8	613	163	351	30	282	708	43	1036
Rolling Total	2049	2471	2649	3344	3561	3912	3942	4224	4932	4975	6011

Figure 2: Indicative firm grid access quantities 2010 – 2020. Source: ESBN & EirGrid

Non-Gate 3 applicants or other applicants who qualify for consideration outside of the GPA may be eligible to receive connection offers sooner if they meet the criteria set out in the CER Direction CER/09/099: *Treatment of small, renewable and low carbon generators outside of the group processing approach*.

Until this change all renewable generators (<500kW) were subject to the GPA which is effectively a queue system. The new approach differentiates between wind and non-wind renewable generators. However applications by non-wind renewable generators with a capacity less than 5MW will be processed outside of the queue and interaction studies will not be carried out. Only autoproduction wind sites, where the generator (up to 5MW) is installed on an industrial site to predominantly supply in-house demand, will be included in this new arrangement. Wind sites with a direct connection to the grid will not be included and will be subject to the full GPA.

Non-wind renewable generator applicants with a capacity greater than 5MW will also be processed outside of the GPA but will be subject to interaction studies before being assessed for wider public interest benefits on a case by case basis. Public benefits acceptable include diversity of fuel mix, predictability and power system support, environmental benefits and research or innovation.

The East-West 500MW HVDC Interconnector project has progressed significantly in 2009 and remains on course to be completed by 2012. It is hoped that the 260km long interconnector will assist in the deployment of high levels of wind generation and provide generators with greater access to the U.K. electricity market, BETTA. It will have sufficient capacity to satisfy more than 10% of a typical day's peak demand. The European Commission announced a contribution of €110m toward the strategic infrastructure as part of its *Investing today for tomorrow's energy* economic development plan.

Further studies are underway by the transmission system operator focusing on further interconnection to the UK and France with a view to making Ireland a renewable energy exporter.

2.2 National incentive programs

The Renewable Energy Feed-in Tariff (REFIT) is the form of support mechanism employed in Ireland, initially with the aim of meeting the 2010 targets for renewable energy. Different levels of REFIT exist for different renewable technologies to promote diversity in the generation portfolio. At January 2010, the value of REFIT for large-scale wind was 66.35 €/MWh. A wind farm with an installed capacity greater than 5MW is deemed to be large scale for the purposes of REFIT. Please refer to the 2008 IEA Wind report for more details on REFIT.

In 2009 the Department of Communications, Energy, and Natural Resources announced details of a REFIT specific to offshore wind at 140 €/MWh as part of REFIT II. Gate 3 includes 785MW of offshore connection applicants. The details of the offshore REFIT will be finalised in the first half of 2010.

The Business Expansion Scheme (BES) allows individual investors to obtain income tax relief on investments in wind energy in each tax year. There is no tax advantage for the company in receipt of the BES, but securing this funding may enhance their ability to attract other external funding.

In 2008 the Irish Government introduced an Accelerated Capital Allowances scheme for companies investing in energy efficient technologies. Under this scheme corporations investing in qualifying wind turbines may now fully depreciate the investment for tax purposes in the first year (www.seai.ie/aca).

2.3 Issues affecting growth

As is the case internationally, the affects of the credit crunch are being felt by developers in Ireland. Access to finance is a cause for growing concern within the sector. Adding to the concerns about the cost of finance is the continued uncertainty with respect to variable transmission loss adjustment factors and delayed firm access to the grid. Generators are unlikely to find that the sourcing of finance is made easier by the fact that connections will be non-firm and the level of constraint they can expect is unknown. The 3,900MW of Gate 3 connections will be loaded towards 2020 rather than front loaded which will mean the industry will not be ramping up to maximum capacity for a number of years and will likely see a sharp fall in opportunities beyond 2022.

In the micro and small wind sectors, unlike many European countries, there is no Government supported feed-in tariff available to incentivize investment by individuals. ESB Networks and ESB Customer Supply now offer a combined tariff up to a maximum 0.19 €/kWh, with some restrictions. The microgeneration sector is currently not expanding at a rate that would make a significant contribution to electricity demand.

3.0 Implementation

3.1 Economic impact

The design, development, construction, equipping and connection of wind farm facilities in Ireland is estimated to be worth 300 million €/yr over the past three years. Up to 80% of the outlay is spent on imported equipment, including the turbine and associated electrical equipment. Therefore, the value to the local and national economy could be estimated to be worth approximately 60 million €/yr. The value of civil and construction costs to the local economies is approximately 30 million €/yr.

Development of wind farms in Ireland has been undertaken by a wide range of individuals and organizations. The recent trend has been towards consolidation and an increasing proportion of the added capacity is by large utilities. Factors such as economies of scale and access to finance are thought to be driving this trend although small projects in good sites remain viable and bankable. Approximately 1,500 people are directly employed by wind energy companies in Ireland. The future O&M needs of the sector will be the key driver of the increase in local employment as capacity is added towards meeting our targets. Assuming costs are of the order of 1.5% of capital costs it is estimated that O&M is worth approximately €20m to the economy.

3.2 Industry status

2009 saw another major consolidation when semi-state utility Bord Gáis purchased SWS Energy. SWS Energy operated 179MW of wind capacity and had approximately 460MW of new projects at various stages of development at the time of the purchase. BG intends to invest €700m in wind projects in the next five years and to create 250 jobs as a result.

Nordex SE has established a firmer footing in Ireland with the establishment of two service offices in 2009. The German manufacturer has also founded Nordex Energy Ireland Ltd. and by the end of 2010 will open two more offices.

3.3 Operational details

The single electricity market (SEM) has been live for more than 2 years. Northern Ireland and the Republic of Ireland trade most of their electricity through a gross pool operated by the SEM operator; Please see previous IEA annual reports for more details.

The SEM Committee continues to develop a position on the treatment of wind and other intermittent generation in the SEM (SEM/09/073). The aim is to promote discussion on a market of increasing wind penetration with the goal of dealing with issues in a timely manner. Issues such as the process to secure economic dispatch, firm access, the calculation of the average system marginal price, constraint compensation, and capacity payments will be further developed in 2010.

A relatively small number of developers connected the majority of the additional capacity in 2009. Much of the additional capacity (35%) consisted of extensions to existing wind farms - six. The average size of a turbine was 1.9MW in 2007, 1.65MW in 2008 and rose sharply to 2.2MW in 2009. 105 turbines were installed in 11 wind farms.

Five turbine manufacturers' turbines were installed during 2009; Vestas (52%), GE (16%), Nordex (14%), Siemens (14%), Enercon (4%).

3.4 Wind energy costs

Current total capital costs are in the range of 1.6 to 2 million €/MW installed for wind developments in the 10MW range. Turbine costs have fallen and currently range between 900,000 and 1,000,000 €/MW, depending on the size of the turbine and the project. The trend in costs has turned downward as global demand for turbines and raw materials moderates. A typical cost for connection would be in the range of 150,000 € to 300,000 €/MW. Typical project costs can be apportioned in Ireland as follows:

- 65% - Turbines
- 12% - Grid Connection
- 8% - Onsite Electrical
- 8% - Civil Engineering
- 4% - Development
- 3% - Legal/Financial

Contestability at distribution level is currently under final consultation and its implementation should lead to reduced connection costs for developers (CER/09/193). Contestability is where a contractor other than the transmission or distribution system owner can be engaged to build a connection.

Market Value of Wind Energy

Following on from the technical All-island Grid Study (AIGS) the regulators undertook a study to assess the possible impacts of high penetrations of wind on the SEM in 2020 (SEM/09/002). Details of the study were outlined in the IEA Annual Report for 2008.

At a high level, the study resulted in the following findings when analysing the impact of wind on the market:

- Wholesale market prices are significantly lower with high wind penetration,
- Economic benefits are sensitive to fuel and carbon prices,
- A mixed portfolio of plant including CCGT, OCGT and wind provides the best carbon reduction,
- Incentives may be required for all forms of new generation into the future,
- The SEM design appears to be robust, but continued review will be required to facilitate the changes expected in the next decade.

Generally, a market with more renewable energy will have a lower average SMP than one with little renewable energy. This is due to the lower marginal production cost of renewable energy such as wind relative to conventional generation units.

4.0 R, D&D Activities

Several R, D&D projects continue during 2010 and beyond. These - along with a national smart metering pilot and smart grid demonstrations- will assist the deployment of wind at all scales. The abstracts of a selection of academic research papers will be published with this text at www.seai.ie/wind.

4.1 National R, D&D efforts

Wind Autoproduction

In May Wind Energy Direct Ltd. completed Ireland's first large scale industrial site wind energy installation at Munster Joinery in North Cork. The SEAI supported demonstration project includes two Enercon E82 2MW turbines and the project built on experience gained during other SEAI supported projects in other settings such as the Dundalk I.T. campus turbine.

TSO Facilitation of Renewables Studies –EirGrid and SONI

The AIGS concluded that up to 42% of renewable generation could be accommodated on the power system given the required infrastructure and an investigation into the underlying technical aspects of a power system with large amounts of variable generation sources. As there have been periods with in excess of 40% wind during 2009 it is clear that the power system can sustain such levels of penetration for short periods at least. It is thought however that the characteristics and behavior of the power system with large amounts of variable generation sources for sustained periods will be fundamentally different to the power system of today.

EirGrid and SONI are conducting a series of technical studies which have the objective of increasing our understanding of the power system with levels of renewable generation,

particularly wind power, as forecast for 2020. This, according to the TSO, "will help set standards which are appropriate to the needs of the future power system and to develop operational practices which will ensure the continued security and stability of the power system".

Wind with Storage – Centre for Renewable Energy at Dundalk Inst. of Technology (CREDIT)

In August 2005 DkIT installed the world's first large scale turbine on a college campus. The 850 kW V52 turbine supplies half of the colleges power needs. In 2009 a 125 kW / 500 kWh ZBB flow battery was added to complement the intermittent generator. The benefits of behind the meter storage or demand side management to a system with large amounts of wind power are often stated and the facility will be used to test and model the interactions and potential. Specific research includes:

- Operational Evaluation of a Flow Battery in Conjunction with Wind Autoproduction
- Grid Ancillary Services Provided by Distributed Electricity Storage - A Case Study

Also at CREDIT is a small-scale wind turbine test site which compliments the centres turbine and rotor design activities. Other research topics include investigations into over-speed regulation by blade deformation.

Smart Networks for Island Communities

SEAI and the Department of Community, Rural and Gaeltacht Affairs (DCRGA) are currently investigating a novel system to deliver a high utilisation of intermittent wind and ocean energy resources through use of distributed energy storage systems. The study will focus on the development of a system which will maximize the use of local energy resources and reduce the need for imported energy on the Aran Islands. It is hoped that the methods developed in this study may also serve to inform the development of the energy system for the whole of Ireland (www.seai.ie/aran).

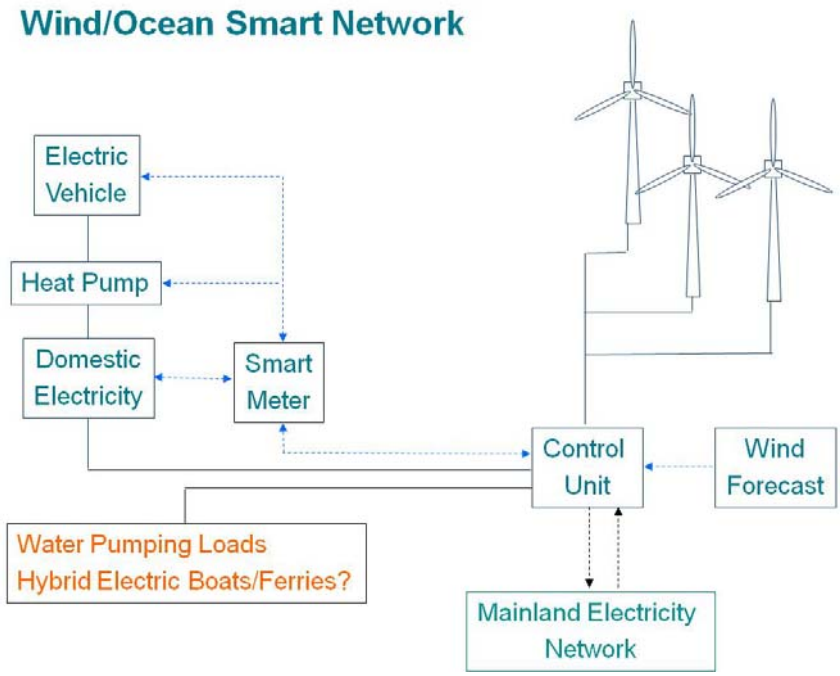


Figure 3: Schematic of Wind/Ocean Smart Energy System

Micro-generation field trials

Interest in domestic power generation was increased when the largest electricity supplier announced an offer of 0.09 €/kWh to its domestic customers for exported electricity. This was on top of a 0.10 €/kWh ESB Networks offering for the first 3,000 kW exported.

The major R, D&D activity at the smaller scales, SEAI's field trials, will continue during 2010. Financial support to meet 40% of the start-up and short-term-maintenance costs was available for approximately 50 trial locations (50% wind) with an overall budget for the study of 2 million € which includes a market study on the potential for the sector and a report on the commercial arrangements for micro-generation. The programme will assess the performance of the technologies and inform future decisions on possible incentives, tariffs, or deployment programs.

To protect customers and prescribe best practices turbine suppliers and manufacturers applying for inclusion in the field trials were required to supply equipment that conforms to the appropriate European standards (EN 61400-2/11/12), as was the case with the associated inverters (EN50438).

Installers were required to undergo wind theory and practical manufacturer training. SEAI has worked with the relevant authorities to deliver a national training standard for PV and micro-wind under the supervision of FETAC. The first candidates will enrol in the course later in 2010.

4.2 Collaborative research

IEA Wind Annexes

Ireland will continue with its participation in two of IEA Wind's Tasks. Namely, Task 28 - *The Social Acceptance of Wind Energy Projects: Winning Hearts and Minds* and Task 25 - *Design and Operation of Power Systems with Large Amounts of Wind Power*. Ireland will continue to contribute research beneficial to the international wind community. Dublin will host the next meeting of the Task 28 working group in September.

ESB Networks and EPRI

ESB Networks and EPRI (The Electric Power Research Institute), have formed a three year alliance focused on the R&D and demonstration of a number of the key innovations in the Smart Grid strategy. The Smart Grid is seen as a key tool in increasing wind energy penetration of all scales. ESBN have become the Sixth EPRI Smart Grid Demonstration host site. Co-operative project areas relevant to wind energy include:

- Smart green circuit and smart grid demonstration projects
- Electric vehicles infrastructure and standardisation
- Cluster stations resulting in fewer transformers
- Voltage/VAr control
- Use of voltage regulators to limit voltage rise.

ESB Networks Smart Grid project will be carried out on a collaborative basis between ESBN, EPRI and University College Dublin.

Electricity Research Centre, University College Dublin

The ERC is engaged in research on a variety of topics relating to wind energy. In the short time-scales, research on the effect of wind power on voltage stability and system frequency control is ongoing. In the hourly time-frame, the work concentrates on the effect of wind on cycling of conventional plant and the need for storage at very high penetrations of wind power (>50%). In a longer time frame, research which assesses system flexibility continues – both in a simplified general approach and more detailed quantification - for dealing with increased variability and incorporating the need for flexibility into portfolio planning. Optimal planning of the transmission network is being examined for future transmission expansion. Work is also in progress on the effect of wind power on the distribution network and the controls that could be employed here (http://erc.ucd.ie).

The FP5 project ANEMOS identified new research priorities and challenges for the future in the arena of short-term wind power forecasting for a wide range of end-user requirements. One of the main challenges is to efficiently integrate wind power forecasts and their uncertainty into the daily practice of power system management and trading of wind generation. The aim of the follow-up FP6 project ANEMOS+ is to develop wide research and demonstration activities towards this direction. The project is carried out by 21 partners from 8 Member States.

References

Lists of connected and contracted generators, Lists of completed applications
http://www.eirgrid.com/customers/

SEAI EPPSU *Renewable Energy in Ireland* 2010 Update
http://www.seai.ie/Publications/Statistics_Publications/EPSSU_Publications/

SEAI EPPSU *Energy in Ireland* 2009 Report
http://www.seai.ie/Publications/Statistics_Publications/EPSSU_Publications/Energy_in_Ireland_2009.pdf

Delivering a Sustainable Energy Future for Ireland, Department of Communications, Energy and Natural Resources
www.dcmnr.gov.ie/Energy/Energy+Planning+Division/Energy+White+Paper.htm.

2009 Carbon Budget
www.environ.ie/en/Publications/Environment/Atmosphere/PublicationsDocuments/FileDownLoad,18677,en.doc

East West Interconnector updates
www.interconnector.ie

TSO *Studies on Facilitation of Renewables*
http://www.eirgrid.com/renewables/facilitationofrenewables/

Department of Communications, Energy and Natural Resources, "*Terms and Conditions of REFIT*"
http://www.dcenr.gov.ie/Energy/Sustainable+and+Renewable+Energy+Division/Sustainable+and+Renewable+Energy+Division.htm

Information on the microgeneration pilot
http://www.seai.ie/Grants/Microgenpilot/

All-Island Grid Study
www.dcmnr.gov.ie/Energy/Latest+News/All-Island+Grid+Study+Published.htm

Irish Wind Energy Association
www.iwea.com

IWEA Deloitte Report on *Jobs and Investment in Irish Wind Energy*
http://www.iwea.com/index.cfm?page=viewnews&id=55

Centre for Renewable Energy at Dundalk Institute of Technology
http://ww2.dkit.ie/research/credit

Electricity Research Centre, University College Dublin
http://erc.ucd.ie/#/front.swf

Sustainable Energy Research Group, University College Cork
www.ucc.ie/en/serg

CER/08/260 *Direction on Criteria for Gate 3 Renewable Generators*
www.cer.ie/GetAttachment.aspx?id=54270766-56dc-4ddf-b0a1-d3be66a23df1

SEM/09/002 *Impact of High Levels of Wind Penetration in 2020 on the SEM*
www.allislandproject.org/en/modelling-group-minutes-presentations.aspx?article=7e445962-3abe-4224-90a4-82adc6038b91

CER/09/193 *Proposed Decision on Contestability for Distribution and Transmission Level Connections*
http://www.cer.ie/en/electricity-distribution-network-current-consultations.aspx?article=37848dee-ee81-4187-a3e7-33a8ea052f93

IEA Annual Report Ireland 2008

IEA Annual Report Ireland 2007

IEA Annual Report Ireland 2006