Wind Energy - how does it fit into Ireland's hope for a green future?

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Contents

Acronyms	2
Introduction	2
Renewable energy technologies	2
Wind energy	5
Policy	9
Arguments for and against wind energy	11
Community acceptance	17
Alternatives	18
Conclusions	20

Editorial

The International Panel on Climate Change recently confirmed climate change is happening and it is extremely likely that the dominant cause is the release of greenhouse gases from the combustion of fossil fuels by people. To reduce emissions from conventional fuels, governments need to consider alternative energy sources such as renewables (wind, water, solar, geothermal and biomass).

National and international obligations to reduce greenhouse gas emissions and increase the percentage of renewables in our energy mix has encouraged Ireland's use of wind energy. With one of the best onshore wind resources in Europe, renewable energy contributed to 19.6% of our electricity supply in 2012, 74% of which came from wind. If we continue to expand our wind energy portfolio, Ireland has the potential to export this wind energy in the future. However, an Intergovernmental Agreement between Ireland and the UK in this regard has just fallen through.

Wind energy benefits include mitigating climate change, job creation and security of energy supply. Disadvantages include visual impacts, effects on host communities and the inherent variability of wind as an energy source.

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Acronyms

CC	Climate change
DCENR	Department of Communications, Energy and Natural Resources
DECLG	Department of Environment, Culture and Local Government
EWEA	European Wind Energy Association
EU	European Union
GW	Gigawatt of energy
GHG	Greenhouse gases
IEA	International Energy Agency
IWEA	Irish Wind Energy Association
Ktoe	Kilo-tonnes oil equivalent
kW	Kilowatt of energy
MW	Megawatt of energy
RE	Renewable energy
RES	Renewable energy source
RES-E	Electricity from RES
RES-H	Heat from RES
RES-T	Transport from RES
WE	Wind energy
SEAI	Sustainable Energy Authority of Ireland

Introduction

In order to offset greenhouse gas (GHG) emissions and mitigate climate change, renewables now form an intrinsic part of Ireland and Europe's energy portfolio. Wind energy makes the largest contribution to the Irish renewable sector and is subsequently the most prominent of the renewables here and the one which makes the most headlines. The Library & Research Service presents this *Spotlight* on wind energy which aims to inform members on some of the current issues associated with the industry in Ireland. It is laid out as follows:

We first take a brief look at the various renewable energy sources and technologies commercially available. We then focus on wind as a renewable energy source/technology and the rise of the modern wind energy industry in Ireland. From there we consider how viable a solution expanding wind energy production really is in Ireland including an examination of wind speeds, feasibility, costs and funding. Ireland's various policy obligations and the role of wind in meeting our national and international renewable energy targets are then set out.

There is very strong support for wind energy in some sectors of Ireland, but also many opponents to how the industry is operated here. The *Spotlight* reviews some of the main arguments for and against wind energy.

Finally, we assess two important issues presently affecting wind energy in Ireland, social acceptance in host communities and whether we are doing enough to vary the renewable energy stream.

It is important to note that wind energy is a vast subject and this *Spotlight* does not attempt to consider all aspects. Rather it focuses on some the key issues which may be raised in debates on future energy policy proposals for Ireland.

Renewable energy technologies

In Ireland, conventional energy is generally derived from the combustion of finite fossil fuels, such as coal, natural gas, oil and peat. Due to the resulting rise in atmospheric GHG emissions, governments have had to look towards alternative sources of energy. The most recent impetus for this comes as the Intergovernmental Panel on Climate Change (IPCC) published their Fifth Assessment Report (AR5) on climate change. The volume of the AR5 on impacts, adaptation and vulnerability (March 2014)[1] states, *inter alia,* that the effects of climate change are already

[1] IPCC, 2014. Climate change 2014: impacts, adaptation and vulnerability

happening across all continents and oceans and it is *extremely likely* (95-100% probability) that human influence has been the dominant cause of the observed global warming since the middle of the 20th century.

Renewable energy (RE) uses non-finite natural resources which do not release climate change causing GHG emissions (or can be carbon neutral in the case of biomass).The most reliable and commonly used RE techniques are briefly described hereunder and include energy from biomass, geothermal, solar, water and wind.

Biomass can be broadly divided into two categories – energy crops and organic residues. Energy crops are crops specifically grown for use as an alternative energy source. They include short-term rotation forestry to produce wood fuel from fast growing trees such as willow, production of other woody crops such as *miscanthus* (Elephant grass), and hemp and cultivation of liquid biofuel crops including oil seed rape. Organic residues include forest, and agricultural residues, wood wastes or by-products, and municipal solid waste.

Biomass is converted to energy through combustion, anaerobic digestion and a number of techniques which process biofuels into liquid transport fuels.

Prior to 2008, solid biomass[2] accounted for the largest share of renewable energy.

The Sustainable Energy Authority of Ireland (SEAI) states that biomass consists of contributions from solid biomass, landfill gas, renewable portion of waste and other biogas. Electricity generated from biomass accounted for 8% of renewable electricity in 2012. Biomass energy use doubled between 1990 and 2012 and by 2012 the renewable share of thermal (or heat) energy stood at 5.2% (growing from 2.4% in 2000). This growth in renewable energy (dominated by biomass) is mostly due to increased use of wood waste as an energy source in the wood products and food sub-sectors of industry. Wood chips, pellets and briquettes make up approximately 18% of all solid biomass consumed in Ireland.[3] The latest report from SEAI (2014)[4] stated that the share of solid biomass in renewable energy contribution to gross energy in 2012 was 30.5%.

There is huge potential for solid biomass as a RE source in Ireland as we have the best growth climate in Europe. According to the SEAI[5], the indigenous supply of solid biomass is increasing.

Geothermal refers to heat energy stored in the ground. Heat is supplied to the ground from two sources – the hot core of the planet and the sun. The hot core of the earth is approximately 4,200°C. Some of this heat is produced from the geological process which helped to form the earth 4.5 billion years ago, but most of the heat is provided by the decay of radioactive isotopes. The majority of this heat arrives at the surface of the earth at too low a temperature to be used for heating or power generation activities. The deep geothermal energy can only be accessed when it arrives at the earth's surface through geological processes such as through fault lines on the earth's crust (or areas of volcanic activity) or by drilling through the surface to access it. The second source is from solar radiation which is absorbed by the surface of the earth each day. This energy can be regarded as stored energy which stays relatively warm throughout the year. Geothermal energy is generally trapped and utilised through heat pumps.

Heat pumps access the ambient heat in the ground and transfer this heat to

[2] Solid biomass refers to wood, wood waste and other wastes (such as tallow) which may be used for heating production (SEAI, 2013. *Energy in Ireland 1990-2012*)

[3] SEAI, 2013. *Energy in Ireland 1990-2012*
[4] SEAI, 2014. *Energy in Ireland: key statistics 2013*
[5] *Ibid*

buildings and are used for space heating in winter and cooling in summer.

The share of geothermal in renewable energy contribution to gross energy in 2012 was 2.1%.[6]

Solar – There are three basic approaches used today to gain maximum benefit of solar energy in buildings: passive solar, active solar heating and photovoltaic (PV) systems.

Passive solar architecture is a building design approach which seeks to maximise solar gains in the building, avoid heat losses and ensure a high degree of comfort.

Active solar heating uses solar collectors attached to the roof of the building to transform sunlight into heat to provide space and/or water heating.

Solar photovoltaic systems use daylight (not necessarily direct sunshine) to convert solar radiation into electricity.

The share of solar in renewable energy contribution to gross energy in 2012 was 1.2%[7].

Water – both tidal and wave ocean energy are still at research stage. While tidal is more reliable, neither are currently used in Ireland on a commercial scale with the one exception. SeaGen, the machine which harnesses tidal energy in Strangford Lough was installed in 2008 and generates enough electricity to power more than 1,000 homes.

Hydropower uses water at high pressure to generate electricity. Historically, hydro was the largest contributor to renewable electricity in Ireland. Dependent on rainfall, the hydro resource increased in 2012 as a result of a very wet summer and is the second largest contributor to renewable *electricity* after wind.

[6] *Ibid*
[7] *Ibid*

The share of hydro in renewable energy contribution to gross energy in 2012 was 8.1%[8]

The renewable energy contribution to gross energy is detailed in Table 1, overleaf.

Current statistics

The 2014 most recent SEAI publication on energy in Ireland[9] states the following key facts for renewable energy in Ireland:

- Electricity generated from renewable energy (normalised) reached 19.6% of gross electricity consumption (RES-E) in 2012. The national target for 2010 was 15% of electricity consumption generated by renewables and the EU target for Ireland was 13.2%. Ireland's target for 2020 is 40%.
- RE contribution to thermal energy (RES-H) was 5.2% in 2012. Ireland's target for 2010 was 5% and the year 2020 RES-H target is 12%.
- RE in transport (RES-T) reached 2.4% in 2012, or 3.8% when weightings are applied to biofuels from waste and second generation biofuels. Ireland's target was 3% by 2010 and is 10% by 2020.
- In 2012, renewable energy grew by 0.6% to 838 ktoe[10], representing 7.1% of Ireland's gross final energy use. Ireland's target under the EU Renewable Energy Directive is to achieve a 16% RE penetration by 2020.

[8] *Ibid*
[9] *Ibid*
[10] Ktoe = kilo-tonne oil equivalent (meaning the amount of energy released by burning 1,000 tonnes of oil)

Table 1: Renewable Energy Contribution to Gross Energy

	1990	2007	2008	2009	2010	2011	2012	1990	2012
Hydro	60	57	83	78	52	61	69	35.7	8.2
Wind	0	168	207	254	242	377	345	0	41.1
Solid Biomass	105	182	176	193	211	213	256	62.9	30.5
Landfill Gas	-	36	39	42	44	44	43	-	5.1
Biogas	2	10	10	13	14	14	13	1.4	1.5
Biofuels	-	22	56	78	93	100	85	-	10.1
Solar	-	1	3	4	7	8	10	-	1.2
Geothermal	-	12	16	17	17	18	18	-	2.1
Total	168	490	590	679	679	834	838		
Share of GFC	2.3%	3.5%	4.0%	5.0%	5.5%	6.4%	7.1%		

Note that solid biomass refers to wood, wood wastes and other wastes (such as tallow).
Source: SEAI, 2014. *Energy in Ireland – key statistics 2013* (page 23)

Renewable energy stakeholders

The Sustainable Energy Authority of Ireland (SEAI) is the State energy authority and *inter alia* provides advice and publishes statistics on renewable energy while the Department of Communications, Energy and Natural Resources (DCENR) is responsible for Ireland's energy policy (in conjunction, at times, with the Department of Environment, Community and Local Government [DECLG]) and supports RE through the Renewable Energy Feed-in Tariff (REFIT) programme. The Irish Wind Energy Association (IWEA) is the largest wind energy representative group in Ireland.

As the focus of this paper is wind energy, various aspects of the industry are discussed in further detail in the following section.

Wind energy

Introduction

Wind energy (which harnesses the kinetic energy of moving air and converts it to electrical energy) has been the dominant source of RE in Ireland since 2008.

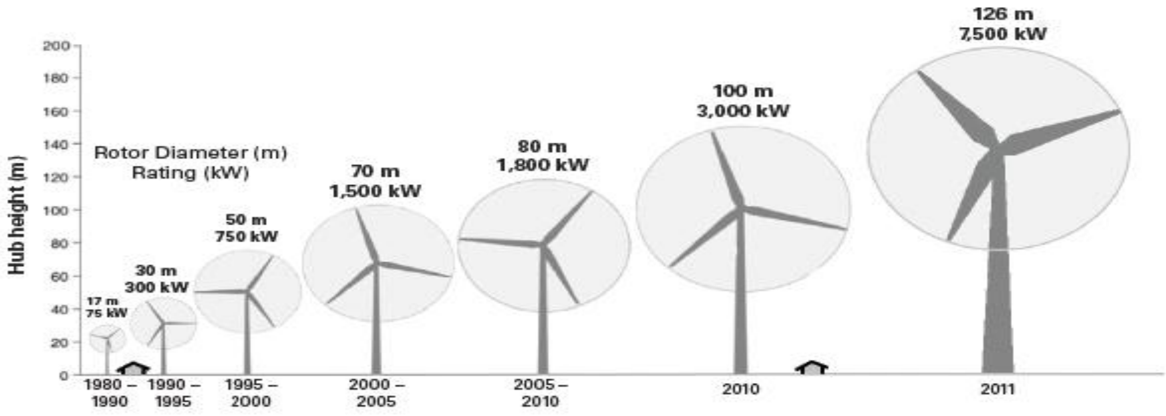
The first modern commercial wind farm in Ireland was developed in Bellacorrick, County Mayo in 1992 by Bord na Mona with turbines 53 meters high and is still in operation. Since then, the number of wind farms across the country has risen dramatically year on year and the size of the wind farms have also increased. For example, the Meentycat wind farm in Donegal compromises of 38 turbines across five sites and has an installed capacity of 72MW, generating enough electricity to power the equivalent of approximately 45,000 homes per year[11].

Technology

Wind turbines come in many different sizes depending on the amount of energy that is required to produce, from roof-top mounted for individual household use to large commercial scale projects. The larger the turbine, then (generally), the greater the amount of electricity produced. In 1985 wind turbines were under 1MW with rotor diameters of about 15 metres. By 2012, the average size was 2.5MW with rotor diameters of 100m (typically standing on 50-100m tall towers) with the capacity to power more than 1,500 average EU households.

[11] Mott Macdonald, 2012. *Meentycat wind farm*

Figure 1, Growth in size of typical commercial wind turbines



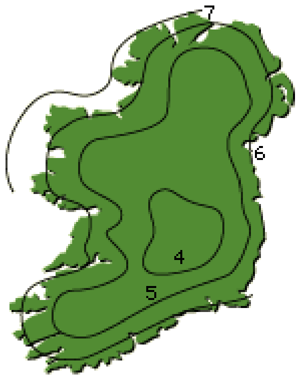
Source: http://en.wikipedia.org/wiki/File:Wind_turbine_size_increase_1980-2011.png

A typical offshore wind turbine of 3.6MW can power more than 3,312 average EU households. However, 7.5MW turbines are the largest today with blades about 60 metres long, 15MW turbines are planned and 20MW turbines are considered to be theoretically possible (European Wind Energy Association [EWEA], n.d.[12]).

While onshore wind energy technology is already being commercially manufactured and deployed at a large scale, offshore wind energy technology is less mature. However, offshore wind energy technology will likely become more prevalent as the offshore market expands. The primary motivation for this is the access to additional wind resources offered in areas offshore which aren't constrained by planning and siting conflicts in the same way as onshore wind farm development. It is expected that larger turbines in the 5 to 10MW range may come to dominate this segment (IPCC 2011[13]). There is currently only one off-shore wind farm in Ireland. This is the Arklow Bank with a capacity of 25.2MW.

Wind speeds and location

Ireland (in particular the north and west coasts) has one of the best wind resources in Europe and is in a prime position to take advantage of the considerable potential from this indigenous source of energy.



Mean annual wind speed
(units in m/s)

The amount of energy produced depends on the wind speed, so site location is very important. According to Met Eireann, the wind at a particular location (onshore) can be influenced by a number of factors such as obstruction by buildings or trees, the nature of the terrain and deflection by nearby mountains or hills. For example, the rather low frequency of southerly winds at Dublin Airport is due to the sheltering effect of the mountains to the south. The prevailing wind direction is between south and west. Average annual wind speeds range from 7mph in parts of south Leinster to over 18mph in the extreme north. On average there are less than two days with gales each year at some inland places like Kilkenny but more than 50 a

[12] EWEA, n.d. *Wind energy's frequently asked questions*
[13] IPCC, 2011. *Special report on renewable energy sources and climate change mitigation – technical summary*

year at northern coastal locations such as Malin Head. [14]

The wind resource of a site is defined as the expected mean wind climate over the next 10-20 years. The overall estimation of the mean energy content of the wind over a large area results in wind resource maps. The decision on where to locate a wind farm is based primarily on the prediction of the average yearly energy production of a specific wind turbine at a specific site. SEAI has developed a wind atlas for Ireland. This is a digital map of Ireland's wind energy resource and provides detailed information on wind speeds, electricity transmission and distribution networks for specific locations around Ireland at national and county levels.

Current statistics[15]

Since 2008 wind has been the dominant source of renewable energy.

- The share of wind in renewable energy contribution to gross energy in 2012 was 41.1%
- By March 2013, a total of 159 wind farms were connected to the grid, bringing the total installed capacity for wind to 1763MW
- While 132MW of new capacity was added in 2012, wind energy decreased by 8.4% in 2012 to 4,010GWh. The share in wind in overall energy use in 2012 was 2.6%. The decrease was attributable to lower wind speeds in 2012 than 2011.
- Electricity production from wind energy has increased to the point that it accounted for 81% of the renewable electricity generated in 2011. This fell back to 74% in 2012 due to the lower wind resource relative to 2011.

In order for Ireland to achieve our 2020 RE targets (detailed in the next section), we would need to more than double our current installed wind capacity which will be challenging at the current annual rate of build.

Modernisation of the grid

Two major projects are proposed by Eirgrid to modernise and upgrade Ireland's existing electricity transmission network through their Grid 25 project - Grid Link and Grid West. If, and when these projects come to fruition, they will, *inter alia,* enable the grid to cope with increasing levels of wind energy coming on stream.

The East-West interconnector was completed by Eirgrid in 2012 and connects the Irish power system to the electricity grid in Britain through undersea and underground cables.

Feasibility

To ensure a feasible wind energy project, the most important issue is the wind resource. Areas with wind speeds of 7.5 metres/second or more are generally considered commercially viable. Access to the electricity grid (often a limiting factor) and site accessibility are also both important considerations.

Options for development include leasing the land, a joint venture or purchasing land. Project development steps include conducting a feasibility study, land negotiation, Environmental Impact Statement (EIS), planning, structure, power purchase agreement (PPA) with the electricity supplier, Operation and Maintenance (O&M) agreement, turnkey contract, finance and construction.

[14] Met Eireann, n.d. *Wind over Ireland*
[15] Stats taken from the two SEAI publications, SEAI, 2013, *Energy in Ireland 1990-2012* and SEAI, 2014, *Energy in Ireland, key statistics for 2013.*

Cost effectiveness

A modern wind turbine produces electricity 70-85% of the time, but it generates different outputs dependent on wind speed. Over the course of a year, it will generate about 31% of the theoretical maximum output. This is known as its load or capacity factor. The load factor of conventional power stations is on average 50% (IWEA n.d.).

According to the EWEA (n.d.)[16], regarding wind energy, "costs vary but the biggest cost is the turbine itself. This is a capital cost that has to be paid up front and typically accounts for 75% of the total. Once the turbine is up and running there are no fuel and carbon costs, only O&M, which are minimal compared to e.g. a gas power plant where O&M is 40-70% of total costs, and the rest of the cost is fuel."

Specifically relating to Ireland, the International Energy Agency (IEA) (2012) reports that onshore turbine prices in 2012 averaged approximately €900/kW for projects involving multiple turbines. Total development costs averaged €1,500/kW for a typical project in 2012.[17]

Offshore wind farms require substantially higher capital costs. According to the IPCC (2011), historically, the investment costs have been 50 to 100% higher for offshore than for onshore. Lower power plant availabilities and higher O&M costs are common due to the comparatively less mature state of the technology and because of the inherently greater logistical challenges of maintaining and servicing offshore turbines.

The IPCC Report (2011, pg. 98) states that "no insurmountable technical barriers exist that preclude increased levels of wind energy penetration into electricity supply systems". However, at higher levels of wind energy penetration, there will be concerns about additional costs, for example, additional flexible back-up and the costs to the transmission system.

There are many variables when it comes to determining the cost effectiveness of wind energy in comparison to other renewables and fossil fuel-based power plants such as site specifics, wind resource, flexible back up available etc. As such, a detailed analysis is not undertaken here. However, acording to the IPCC (2011, pg. 95), "in some areas with good wind resources, the cost of wind energy is already competitive with current energy market prices, even without considering relative environmental impacts. Nonetheless, in most regions of the world, policy measures are still required to ensure rapid deployment."

Public investment – REFIT

The Renewable Energy Feed-in Tariff (REFIT) scheme is the primary means through which RE is supported financially in Ireland. To help achieve Ireland's RE targets and to encourage development of the RE industry, the government introduced the legacy Alternative Energy Requirement (AER) tender scheme (mid 1990's-2003) and subsequently, the REFIT programme.

Under AER, applications were invited from prospective generators to build, own and operate **new** wind, hydro, biomass and waste to-energy facilities (the AER was closed to new applicants in 2005).

REFIT I replaced the AER scheme and was announced by the DCENR in May 2006. Administered by the DCENR, REFIT is the main policy mechanism for promoting our Renewable Energy Sources-Electricity (RES-E) targets and supports the construction of **new** electricity generation plant powered by biomass, hydro or wind. State aid clearance[18] for the scheme was obtained from the European Commission (EC) to

[16] EWEA, n.d. *Wind energy's frequently asked questions*

[17] IEA Wind. *Annual Report 2012*

[18] State aid clearance was necessary as the Public Service Obligation (PSO) levy is a form of state aid.

accept applicants into the scheme until end of 2009.

€119 million was allocated under REFIT to support 55 new RE plants with a combined capacity of 400MW. During its first year, 98% of all support had been allocated to wind energy.

Pricing mechanism & PSO

REFIT is designed to provide price certainty for eligible generators of electricity through renewables and their participation in the scheme enables them to secure the necessary investor confidence to finance debts[19]. REFIT is paid to eligible electricity suppliers (e.g. Airtricity) via the Public Service Obligation (PSO) levy. A form of state aid, the PSO is levied on all final electricity consumers in Ireland by their electricity suppliers (ESB, Airtricity, Bord Gais etc). The Single Electricity Market Operator (SEMO) (a part of Eirgrid and operator of the Single Electricity Market [SEM] in Ireland) then collects this money from all of the electricity suppliers and is responsible for paying all relevant PSO stakeholders (including those electricity suppliers eligible for REFIT payments). The Commission for Energy Regulation (CER) is responsible for calculating the amounts due.[20]

How REFIT works

Under REFIT an electricity supplier and a RE generator enter into a PPA (for no more than 15 years). The electricity supplier buys the output of the wind farm at a fixed rate determined or influenced by the policy mechanism (i.e. the feed-in tariff which is fixed but index linked). As the wind generator knows what tariff the electricity supplier will get under REFIT, often the generator will negotiate a higher price for supplying the wind energy. The supplier then sells the electricity into the SEM pool. If the aggregate revenue a supplier receives from each trading period throughout the year is less than the policy tariff then the difference is paid through the PSO levy. Under REFIT, suppliers also receive a balancing payment – 15% of the large wind category tariff – to cover the cost of managing the short term variable production of wind energy[21].

REFIT II was introduced in 2012 and covers small and large scale onshore wind, biomass landfill gas and small hydro (≤ 5MW.)

Level of subsidy

Under the REFIT II scheme, the reference price is adjusted for annual indexation. For the year 2014, the reference price is €69.581/MWh for large (> 5MW) onshore wind and €72.023/MWh for small (≤ 5MW) onshore wind[22].

Policy

Internationally, there is a major drive towards sustainable power generation and this is reflected in Irelands European and national commitments to generate energy from renewable sources.

Nationally Ireland's energy policy hinges on three principal objectives:

1. security of supply;
2. protection of the environment; and
3. cost effectiveness.

Our policy aims to decouple energy from reliance on imported fossil fuels with the ultimate goal of decarbonising our energy systems.

[19] REFIT is a voluntary scheme but most commercial wind farmers choose to join as participation offers stability and guarantees a minimum price for the wind energy they generate.

[20] DCENR, 2010. *Ireland's NREAP*

[21] Eirgrid & SEAI, 2011. *Impact of wind generation on wholesale electricity costs in 2011*

[22] Further information is available at: http://www.dcenr.gov.ie/Energy/Sustainable+and+Renewable+Energy+Division/REFIT.htm

Ireland's renewable energy targets are set out in the 2007 Government White Paper, *Delivering a sustainable energy future for Ireland – the energy policy framework 2007-2020*. Specifically, the White Paper set a 15% target for electricity consumption from renewables by 2010 increasing to 33% (this figure was increased to 40% by the Government in 2008) by 2020.

The National Renewable Energy Action Plan (NREAP) for Ireland requires that the 16% overall target set out under European Directive 2009/28/EC on renewable energy be achieved by around 40% of electricity consumed being from renewable sources (RES-E), 12% of consumption in the heat sector (RES-H) and 10% consumption in the transport sector (RES-T).

Ireland's 40% contribution to electricity from renewables by 2020 is being largely met by wind energy. Ireland's interim target of 15% RES-E by 2010 has already been exceeded however, it will be challenging for Ireland to reach our 2020 RE targets - while 132MW additional wind capacity was added in 2012, this is well below the annual capacity additions of over 200MW/yr estimated to be required to achieve these targets.[23]

In 2012, the Department published the *Strategy for Renewable Energy 2012-2020.* Under this strategy, the five goals for RE for Ireland are:

1. Progressively more renewable electricity from onshore and offshore wind energy for the domestic and export markets;
2. Sustainable bioenergy sector for renewable heat, transport and power generation;
3. Green growth through R&D of renewable technologies including ocean energy;
4. Increase sustainable use of biofuels and electrification in transport; and
5. Intelligent, robust and cost efficient energy networks system.

Focusing on wind energy, regarding Strategic Goal 1, the government anticipated that Ireland has the capability to meet its RES-E 2020 targets, primarily from onshore wind energy[24]. The long-term goal is to export wind energy to the UK and Northern Europe. Strategic Goal 5 ties into this, as the growth in wind energy requires modernisation and expansion of the electricity grid (especially if we are going to realise our RE export objectives).

Offshore - Ireland's Offshore Renewable Energy Development Plan (OREDP) was published in February 2014. Ireland has one of the best offshore renewable (wind, wave and tidal) resources in the world. According to the OREDP, there is very significant potential in utilising these resources to generate renewable electricity and create sustainable employment and growth in the green economy. Developing offshore renewables could help Ireland become more energy secure and promoting the export of green energy would offset our GHG emissions.

In the UK objections to onshore wind have been increasing and the trend is moving towards a greater emphasis on offshore wind. In the UK, Conservatives have gone so far as to say they plan to propose a ban on onshore wind farms from 2020 and focus on offshore wind energy[25].

It is anticipated that the DCENR will publish a Green Paper on future energy policy in Ireland in the coming weeks (to include for a consultation phase).

A new national planning statement for renewable energy is also expected

[23] IEA Wind. *Annual Report 2012*

[24] Although as already stated, based on current rate of build of new wind farms this is now looking more challenging.

[25] Rowena Mason, 2014. Conservatives give strongest sign yet they will halt wind farm expansion. *The Guardian.* 8 April.

shortly from the DCENR in conjunction with the DCELG. The current guidelines, *Wind Energy Development Guidelines for Planning Authorities* (DEHLG) date from 2006 and while they must be regarded, they are not binding. The new guidelines are anticipated to include planning requirements for wind farms, such as where they can, and can't be built.[26]

In addition, a bio-energy policy is due to be published by the DCENR by the middle of this year and a strategy on the export of renewable energy is also anticipated within the first half of this year.

European - The EU *Council Directive on the promotion of the use of energy from renewable sources* (2009/28/EC) establishes goals for 2020 of:

- Achieving 20% EU energy consumption from renewable sources; and
- A 20% cut in GHG emissions.

Under an EU 'burden sharing' arrangement, Ireland's overall national target for the share of renewable energy sources in gross final consumption of energy in 2020 is 16% to be met across transport, heat and electricity sectors. RES-E will play a significant role in meeting this overall target and the Government has already set a 2020 RES-E target of 40% in their NREAP.

[26] Four thoroughbred horse bodies have requested that the proposed guidelines ensure any new wind farms are kept a safe distance from stud farms due to horses sensitive nature. Further information available here

Arguments for and against wind energy

Wind plays an important role in helping Ireland to reach our national and international energy and climate change targets. From an energy security perspective, the more indigenous green energy we have the better. However, there are concerns over wind energy and some communities feel threatened by proposed wind farms in their localities. Their concerns include visual impacts, potential health effects and minimum benefit to the majority of residents. Other issues being debated are the costs of and possible alternatives to wind energy.

Arguments for Wind Energy

Climate change

The principal environmental benefit from wind energy is that it does not emit GHGs during operation. The IPCC again recently highlighted the significant role anthropogenic GHG emissions has played in changing our climate.

Electricity production is the largest single sector emitting fossil fuel CO_2 at present. Renewables in the electricity sector play a major role in mitigation scenarios with deep cuts to GHG emissions (IPCC 2013). As part of this, wind energy has significant potential to reduce (and is already reducing) GHG emissions by displacing electricity generated from fossil fuel-based power plants.

Impacts arising from the manufacture, transport, installation, operation and decommissioning of wind turbines have also shown that the energy used and GHGs produced during these steps are small compared to the energy generated and emissions avoided over the lifetime of wind power plants. In addition, managing the variability of wind output has not been found to significantly degrade the GHG emissions benefits of wind energy (IPCC 2011).

The 2013 IPCC AR5 Report[27] states that research to date suggests climate change is not expected to greatly impact the global technical potential for wind energy. The report further states that based on their literature review, wind (in suitable locations) can provide electricity with less than 5% of the life-cycle GHG emissions of coal power.

The SEAI (2013) reports that, in Ireland:

"The estimated amount of CO_2 avoided from renewable energy increased by 431% (7.9% per annum on average) over the period 1990 to 2012, reaching 3,187 kt CO_2. The emissions avoided from wind were most significant again in 2012, at 1,931 kt CO_2, followed by hydro at 386 kt CO_2 and solid biomass at 384 kt CO_2."

The IWEA commissioned international consultants, Pöyry (in association with Cambridge econometrics) to assess and report on the economics of wind energy to Ireland. Published in March 2014, the report states[28]:

"The generation output of wind in Ireland is projected to double to 10TWh by 2020 in our *Domestic* scenario doubling the annual carbon emissions avoided and displacing over 21mtCO_2 up to 2020, a 35% increase over our *No Wind* scenario. Over the period 2021-30 over 43mtCO_2 is avoided totalling 64mt CO_2".

Economics & Jobs

Economic benefits from wind energy include:

- employment,
- energy security,
- reduced bills for imported fossil fuel supplies,
- steady income for landowners who enter into leasing agreements to let their land for wind farm development,
- revenue for local authorities through rates; and
- increased competition in the energy market which helps reduce costs to the end user.

A 2012 SEAI[29] report estimated wind energy related employment at 1,300 in 2010. The IWEA[30] reported that in 2012 the wind energy industry supported approximately 2,200 jobs.

The Poyry Report (2014) is a study which aims to assess the overall economic impact of planned wind penetration on energy prices and macroeconomic performance in Ireland. The report considered three scenarios:

- No growth in wind energy post 2014;
- Domestic growth to reach our 2020 RE targets; and
- Export growth to reach our RE targets and help the UK achieve theirs.

No wind growth is taken as the baseline scenario. Under the domestic growth scenario, Ireland would need to more than double the current wind capacity, adding over 2.2GW or 270MW of new capacity annually to reach 3.8GW by 2020. This would require annual investment to 2020 of €430million and would support 12,390 jobs (person-years)[31] during construction and 920 permanent jobs in the O&M sector to support wind farms by 2020. It is expected that the lower wholesale prices as a result of increased wind in the grid

[27] IPCC, 2013. *Mitigation of climate change, Chapter 7 – energy systems*
[28] Poyry, 2014. *The value of wind energy to Ireland*
[29] SEAI, 2012. *The case for sustainable energy, a review and analysis of the economic and enterprise benefits*.
[30] IWEA, 2013. *Economic benefits of wind energy*.
[31] Measured in person-years required to support planned growth in wind capacity with the assumption that one person-year is equivalent to one job.

would broadly offset higher system costs to result in minimal impact on final consumer bills. The report estimated that under this scenario, the net imported energy bill could be falling by €282m in 2020.

Under the export scenario, whereby Irish wind would enable us to reach our 2020 targets *and* help the UK to meet theirs, further significant benefits would accrue to the Irish economy. By becoming a net exporter of energy, there is a large potential swing in the balance of energy payments with Ireland transforming from a net importer to a net exporter of energy within the electricity sector. By 2020, Ireland could net export €1.5billion annually rising to €2.8billion by 2030. In addition, the number of jobs created in the wind sector could reach 47,240 by 2020, on a person-year basis.

Box 1: Exporting wind energy

Under the Renewable Energy Directive, 2009/28/EC, governments can agree to help each other reach their RE targets. Proposals to develop large wind farms in the Irish midlands are associated with an Intergovernmental Agreement (IGA) between Ireland and the UK to facilitate trade in the export of wind energy to the UK. These large midlands wind farms would enable Ireland to reach our 2020 RE targets and help the UK reach their RE targets. However, earlier this month the IGA collapsed and the Minister for Communications, Energy and Natural Resources, Deputy Pat Rabitte has advised that the project will not be going ahead as planned at this point in time.

There have been major objections to onshore wind farm developments in the UK in recent years, by locals but also by parliamentarians. Some critics have suggested that one of the reasons the UK looked towards Ireland to help reach their 2020 RE targets was to avoid further controversy there.

Cost to consumers - According to the IEA (pg 111)[32], under the REFIT scheme,

"The cost of the PSO to domestic customers during the 2011/2012 tariff year is €1.61 per account per month. Approximately 66% of the ex-ante fund from which the change is calculated is created by subsidies to non-renewable generators such as natural gas and peat. It is not generally appreciated by consumers that the PSO levy primarily supports fossil-fired generation and that wind depresses wholesale electricity prices. Work carried out by SEAI and EirGrid shows that the latter effect is such that it cancels out the PSO cost for wind."

The Poyry report (2014) also concluded that "the growth of the wind sector does not place a material burden on the Irish consumer as the energy bills are comparable across scenarios".

SEAI further argue that the view by some that increasing levels in our renewable energy stream will led to higher consumer bills is a myth. Their 2014 report[33], states that in the past five years renewable energy has not added to consumers' bills.

Security of supply

Ireland imports 85% of our energy needs making us the fourth most dependent country in the EU-28 on imported fossil fuels.

The SEAI (2011)[34] reports that the increase in import dependency over the last two decades (from 64% in 1994) is due to increased energy demand and a reduction in indigenous energy sources, in particular, the decline in natural gas production at Kinsale since 1995 and decreasing peat production. Oil accounts for just over half of primary energy consumption here (52% in 2009) and

[32] IEA, 2012. *Annual Wind Report 2011*
[33] SEAI, 2014. Renewable energy in Ireland, 2012
[34] SEAI, 2011. *Energy security in Ireland: a statistic review (2011 report).* Available here

60% of total energy imports. Natural gas dependence reached 29% in 2009 (93% of which is imported). Production of indigenous gas decreased by 78% over the period since 1990 and peat by 46%. In contrast renewable energy increased by 150%. Renewable energy was responsible for 40% of indigenous production since 2009, peat for 38%, natural gas for 21% and the remainder was from non-renewable wastes.

Currently there are only three commercial gas fields – Kinsale, Ballycotton and Seven Heads (with a fourth, the Corrib yet to come on stream) and no commercial oil fields in operation offshore Ireland. Although the Corrib, once operational, will enhance our security of supply, the gas field is expected to decline within six years and it will still be necessary to import natural gas[35].

Diversifying the fuel mix enhances energy security by reducing both demand for imported fossil fuels and also the exposure to their variations in price. In addition, reducing our fossil fuel imports saves money. According to the SEAI[36], in the past five years renewable energy has saved over €1billion in fossil fuel imports. As well as the cost implication, diminishing supplies of oil and gas in the EU and OECD (where we source most of our energy imports) will impact on Irish energy security.

Arguments against Wind Energy

Visibility

One of the main objections to wind farms is the visual impact that they have on the landscape. Some find wind turbines beautiful to look at and enjoy seeing them as a part of the countryside knowing what they represent. Others consider them an eyesore and are offended by them. As wind farms are growing in size and wind turbines are increasing in height, they are unavoidably visible in the landscape. Local communities are often concerned that wind farms will mar the landscape, reducing uninterrupted vistas and potentially damaging tourism to the area as a result.

Habitats and species

The principal environmental concerns associated with wind energy relate to the impacts on species (primarily birds and bats) and to habitat disturbance.

The Royal Society for the Protection of Birds (RSPB) states, on their website[37]: "The available evidence suggests that wind farms can harm birds in three possible ways – disturbance, habitat loss (both direct and/or indirect) and collision.

Some poorly sited wind farms have caused major bird casualties, particularly at Tarifa and Navarra in Spain, and the Altamont Pass in California.

Thorough environmental assessment is vital to ensure that all ecological impacts are fully identified prior to consent of any development. If wind farms are located away from major migration routes and important feeding, breeding and roosting areas of those bird species known or suspected to be at risk, it is likely that they will have minimal impacts."

Similarly, bat collisions and fatalities have been recorded at wind farm sites. Again, in order to minimise potential impacts, the proximity to bat colonies, their feeding grounds etc. must be considered when deciding on the siting of any proposed wind farm.

Habitats and other species may also be negatively affected by the construction and operation of wind farms with disturbance to, and modification of ecosystems and associated impacts on wildlife. The significance of these impacts are site and species dependent.

[35] *Ibid*
[36] SEAI, 2014. *Renewable energy in Ireland, 2012*
[37] RSPD, n.d. *Wind farm policy*

Health (including noise and shadow flicker

In early 2009 the American and Canadian Wind Energy Associations (AWEA and CanWEA) established a scientific advisory body in response to concerns that the sounds emitted from wind turbines could cause adverse health effects. They compiled a report of their findings (Colby et al., 2009[38]). The report states:

> Following review, analysis, and discussion of current knowledge, the panel reached consensus on the following conclusions:
>
> - There is no evidence that the audible or sub-audible sounds emitted by wind turbines have any direct adverse physiological effects.
> - The ground-borne vibrations from wind turbines are too weak to be detected by, or to affect, humans.
> - The sounds emitted by wind turbines are not unique. There is no reason to believe, based on the levels and frequencies of the sounds and the panel's experience with sound exposures in occupational settings, that the sounds from wind turbines could plausibly have direct adverse health consequences.

Another review of the literature was carried out by an independent expert panel on behalf of two Massachusetts state departments[39] and concluded that based on the available literature, there is no significant health effects associated with wind farms.

A review for the National Health and Medical Research Centre (NHMRC) in Australia came to the same conclusion. The NHMRC issued a Public Statement with their findings in July 2010[40] (the Public Statement provides a reference list with links to publications on health and wind turbines).

However, an article by Dr. Christopher Hanning (an Honorary Sleep Consultant in Sleep Disorders Medicine at the Leicester General Hospital) in the British Medical Journal (BMJ) [41] found that noise from wind turbines can result is sleep disturbance. Simon Chapman, a professor in public health at Sydney University, Australia disputes the claims made by Hanning in an article published in *The New Scientist*.[42]

Dr. Nina Pierpont argues in her 2009 book, *Wind turbine syndrome, a report on a natural experiment*[43] that wind turbine syndrome is a real ailment.

A 2013 article in the Irish Times (McGreevy) references "contentious UK noise research" in relation to wind turbines. The research was carried out by the University of Nottingham and studied over 1,000 British households living within one kilometre of a small wind turbine[44]. About one in ten people studied reported health problems such as insomnia but the researchers concluded that it was not the turbines that caused the problem, rather the personalities of those involved. The article states that "those who exhibited signs of neuroticism

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[38] Colby, WD., Dobie, R., Leventhall, G., Lipscomb, D., McCunney, R., Seilo, MT. & Søndergaard, B., 2009. *Wind turbine sound and health effects, an expert panel review, prepared for American Wind Energy Association and Canadian Wind Energy Association.*

[39] Ellenborg, J., Grace, S., Heiger-Bernays, W., Manwell, J., Mills, DA., Sullivan, K. & Weisskopf, M., 2012. Wind turbine health impact study, report of independent panel prepared for: Massachusetts Department of Environmental Protection & Massachusetts Department of Public Health.

[40] NHMRC, 2010. *Wind turbines and health*

[41] Hanning CD, 2012. *Wind turbine noise seems to affect health adversely and an independent review of evidence is needed.* BMJ 2012; 344: e1527 (published 8th March 2012).

[42] Chapman, S, 2012. *The sickening truth about wind farm syndrome.* New Scientist e.2885 (published 8th October 2012).

[43] Available here

[44] Further information on the research paper by Nottingham University is available here

in the questionnaires that accompanied the survey were more likely to complain." However, the study is contentious, in particular because it deals with small wind turbines.

Legislation in Ireland does not refer to possible health hazards from wind farms. However, the private members *Wind Turbine Regulation Bill 2014* initiated by Sinn Féin does propose, *inter alia,* to consider the implications of noise and shadow flicker from wind turbines.

Intermittency

The impact of intermittency or variability is unavoidable due to the very nature of wind energy. However, according to the IWEA, it can be minimised through the use of flexible fossil fuel generation capacity (as a backup)[45], interconnectors and energy storage[46].

The global consulting and engineering firm, Pöyry completed a detailed report in 2009 which looked specifically at the issue of intermittency in the Irish and British energy markets. The report[47] identified that higher levels of wind in the system would increase price volatility in the future Irish energy market with more marked highs and lows than currently (although price spikes would not be as extreme as those experienced in the British market). On the importance of electricity interconnectors to the Irish and British energy markets, the report states:

"Our findings underline the almost critical importance to the Irish market of having interconnection with the British market…. However, there are some notes of caution as well: although stronger interconnection does assist the physical management of the system, it has the consequence that British market price spikes also become a feature of the Irish market.

This study would suggest that interconnectors cannot be the 'golden bullet' to solve the challenges of intermittency, although they are extremely important in helping it work." (Pöyry 2009).

The Pöyry report (2009) concludes that the dependence and value to Ireland from the interconnectors between the Irish and British energy markets stands out.

Pöyry also completed a more recent report on intermittency and interconnection as it relates to renewable energy in European markets. The report, (March 2011)[48] is part of a larger study by Pöyry. The 2011 Pöyry Report concludes that the increase in wind generation in the future will lead to an increase in intermittency of electricity generation. This can be somewhat overcome by the increase in interconnectivity, however, prices will likely become more volatile. During windy conditions, wholesale electricity prices will be low while during times of little / no wind, the price of electricity will spike. The report states, that when solar and wind generation reach their target levels, *in Northern Europe the overall output of the renewable generation will be highly variable, and will not average out because of weather and geography* (Pöyry 2011).

Energy storage – the holy grail of renewable energy is to find a way to store the energy once produced, for example, in batteries. When the wind stops blowing we have to resort to flexible fossil fuel-based power plants for back-up. The only

[45] Back up capacity is needed during long spells with little or no wind. Flexible fossil fuel backup could for example, be the availability of a local gas-fired power plant which would kick in during these times to eliminate / minimise interruption to the electricity supply.

[46] IWEA Green Paper submission, December 2006

[47] Poyry, 2009. *Impact of intermittency: how wind variability could change the shape of the British and Irish electricity markets*

[48] Poyry, 2011. *The challenges of intermittency in North West European power markets, the impacts when wind and solar deployment reach their target level*

way we can fully depend on wind energy is if we can find a way to store excess energy production for use when the wind isn't blowing. Testing various methods of storing wind energy is underway but a commercially viable solution is not yet available.

Community acceptance

Attitudes towards wind farms

The SEAI (formerly SEI) carried out a study in 2003 on attitudes towards wind farms[49]. Key findings of the report included that:

- There is a high level of support for developing more sources of RE in Ireland (84%);
- Support for RE is even higher in areas where wind farms are planned or operational;
- More than eight out of ten believe wind energy to be a very or fairly good thing;
- Two-thirds of Irish adults are either very or fairly favourable to having a wind farm built in their locality;
- There is a preference for smaller, clustered groups of turbines over larger scale installations;
- Preference for larger turbines (in smaller numbers) over smaller turbines (in larger numbers) is clear;
- Although it is clear that some developers do consult with the local community, there is room for improvement in genuine consultation with those most affected;
- There is evidence that local expectations in terms of local employment or economic benefits are not always realized; and
- Over 60% of those living in close proximity to existing wind farms would favour either an additional wind farm in the area or an extension to the existing one. Less than 20% state they would be against further wind farm development, but 7% express themselves as strongly opposed.

From these survey results it can be concluded that, in 2003, over 80% of those questioned are in favour of the construction of more wind farms. However, in the survey there were 7% who were strongly opposed to living near a wind farm.

Community engagement and acceptance

While the importance of community engagement has been highlighted repeatedly by the Government, SEAI and various stakeholders, host communities can sometimes feel voiceless when it comes to wind farm development in their locality.

Generally, the main concerns about wind energy projects are[50]:

- Health and environmental impacts (concerns over visual, biodiversity and well-being impacts on local area);
- Fairness of decision-making process (lack of trust in developers, regulators and the transparency of the consenting regime); and
- Perceived distribution of costs and benefits (fear that external companies accrue key benefits, while local communities bear main costs).

Locals may also worry about the potential impacts of proximity to wind farms on their property values.

Ways to improve community acceptance include[51]:

[49] SEI, 2003. *Attitudes towards the development of wind farms in Ireland*

[50] Prof. Geraint Ellis, 2014. *Planning and community acceptance for renewable energy projects.* Speaker at Irish RE Summit, 20 February

[51] *Ibid*

- Recognition by the developer that there will likely be some negative local impacts and which should be mitigated and/or compensated for where necessary;
- High levels of trust between the communities, regulators and developers;
- A transparent decision-making process with adequate opportunities for consultation and community participation; and
- A distribution of costs and benefits that is perceived to be fair and proportionate.

The lack of community-owned schemes in Ireland has also led to higher levels of opposition. It is reported that a higher level of community ownership is associated with higher levels of local support for wind energy projects and lower levels of opposition.[52]

The SEAI commissioned SQW and Prof. Geraint Ellis of Queens University Belfast to report on community acceptance of wind farms in Ireland[53]. The report stated that while developers do engage with communities when proposing wind farms, there is room for improvement. A number of issues were identified as causes for concern by some in host communities. These issues and potential solutions included:

- Spatial planning – identify ways in which the planning process can help;
- Distributional justice – some areas are more suitable to wind farms and it is important that locals benefit from the wind farms, e.g. through the creation of local employment;
- Procedural design – planning policies should be clearly articulated to host communities and they in turn should become more engaged in the creation of development plans and strategies;
- Monitoring and review – energy policies should be regularly reviewed, stakeholders encouraged to suggest ways to mitigate negative impacts from wind farms and where negative impacts are anticipated, these should be monitored; and
- Capacity building – encourage learning and upskilling on wind energy for relevant policy makers, planners and host communities.

As identified above, while reports indicate that there is a high level of support for wind energy in Ireland, some local opposition remains. Evidence would suggest that transparent and early community engagement is essential and communities must see the benefits of hosting wind farms, for example, through the generation of local jobs, improved roads etc.

Alternatives

Questions have been raised about whether Ireland should do more to vary her renewable energy portfolio rather than focusing on wind. Some consider solid biomass a viable alternative and as such, it is considered in more detail below.

Biomass – Up until 2008, solid biomass made the largest contribution to RE in Ireland. Solid biomass could be crucial in our ability to reach our RES-heat targets through Combined Heat and Power (CHP) plants on a domestic and industrial level. District heating systems run on biomass, e.g. wood pellets are common across other European countries such as Germany.

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[52] Renewable Energy Partnership, 2004. *To catch the wind: the potential for community ownership of wind farms in Ireland*.

[53] SQW & Queens University Belfast, 2012. *A review of the context for enhancing community acceptance of wind energy in Ireland.*

Box 2: Biomass: a real alternative to wind?

BW Energy, the body which hosts the anti-pylon website, www.rethinkpylons.org released a report, *Review of the Irish Government's strategy for compliance with the European Directive 2009/28/EC* in March 2014. The Report reviews the merits of having the coal-fired Moneypoint Power Plant in Limerick either co-fire on biomass or convert completely to biomass (e.g. wood pellets) rather than coal. Moneypoint is the largest coal-fired power plant in Ireland. BW Energy refer to Irish Academy of Engineers (IAE) figures as a part of their argument. They argue that having Moneypoint co-fire on- or convert to biomass would be a cheaper and more carbon efficient alternative to expanding our onshore wind energy industry to meet our 2020 RE targets. The report also considers the possibility of co-firing our peat-fired power plants with biomass or converting them 100% to biomass. As Moneypoint provides Ireland with 25% of her overall power demand, the co-firing of a number of fossil-fuel powered plants / conversion of Moneypoint to biomass would result in our achieving our 2020 EU targets (in 2012, RE supplied 19.6% of our energy demand. The Moneypoint coversion would supply another 25-28%). While in 2009, when decisions on the use of wind to meet our RE targets were being made, the biomass supply chain was not reliable, BW Energy claim that this has now changed; the biomass industry is more evolved and reliable and conversion technologies (from fossil fuels to biomass) have improved. The Drax Power Plant in North Yorkshire, the largest coal-fired power plant in Western Europe which began co-firing with biomass in 2010 and is committed to increasing the percentage of energy generated from biomass is used as an example of what can be done.

Economically, BW Energy claim that converting Moneypoint to biomass eliminates our requirement to upgrade our electricity transmission system as we will no longer need to cope with greater amounts of variable wind coming on stream. It also estimates that, as a result, the capital costs and costs to the electricity consumer will be substantially lower.

While the BK Report detailed above highlights the possibility of converting Moneypoint entirely to run on biomass or to co-fire on biomass, critics argue that a steady supply of biomass for this sized venture is not currently available locally. There is no detailed explanation in the report of where the biomass supplies for Moneypoint would come from. There have been issues with biomass supply in Ireland although the SEAI (2013) state that the indigenous supply of biomass is improving. Furthermore, it is argued that the DRAX power plant imports their biomass from North America thereby amassing carbon emissions through the shipment of this cargo across the Atlantic.

Coillte currently use wood thinnings for building product but they are open to considering establishing a supply chain of biomass (as a source of renewable heat production). In order to bolster biomass as a serious alternative to wind, an examination of the incentives recently introduced in the UK may be useful – UK Biomass Heat incentive has led to an increase in CHP which will result in increasing the level of RES-Heat.

As we have seen earlier in this *Spotlight* other mature RE technologies such as solar and geothermal make up only a small fraction of the overall renewable contribution to energy generation in Ireland. Expansion of the hydro sector, however, could be another possibility worth considering.

Conclusion

In conclusion, increasing renewable energy is enshrined in our national energy policy and wind is currently the largest contributor to electricity generated from renewables. As such, it plays an important role in helping Ireland to meet our Irish and European RE 2020 targets.

It is likely that future policy will focus on expanding our wind energy industry, possibly turning more towards offshore wind and including for alternative sources of RE. In the meantime, more stringent planning guidelines and community involvement and greater consideration to alternatives are potential factors to be considered if Ireland is to move forward in achieving our RE targets and win greater support in host communities. The consultation phase associated with the Green Paper on future energy policy, once published, will offer Members and the public a prime opportunity to express their views.

In conclusion, while there are alternatives available and there are lessons to be learnt in the way wind energy has been developed in Ireland, if we want energy independence and want to reach our RE targets, wind energy (both onshore and offshore) will likely continue to be a part of the solution.