Decarbonisation economics and the benefits of biomass conversion at Moneypoint:

1) **Key message:**

   Back in 2007 when they made the decision to go essentially with an 'all wind' strategy to meet EU 2020 renewable target of 16% of all energy production, Ireland chose a target of 40% of all electricity to be produced by renewables and essentially wind in 2020. In fact, this was the only choice on technical and financial grounds. As a consequence, renewables now (end 2012 being the latest official Irish data) produce 19.6% of all electricity and wind makes up three quarters of this component.

   However, there are two major reasons why it does not make sense to concentrate on wind to provide the further 20% of renewable energy to meet the 40% target:-

   a) It is relatively straightforward to accommodate 20% of variable wind power in the electricity supply system, owing to the need to keep some power in "reserve" in case one of the existing large fossil stations were to breakdown.

      If wind supply is to double, the cost of providing this reserve will rise dramatically, effectively increasing the cost of wind power. Moreover, there is also a risk, identified by the Irish Academy of Engineers, that the whole network could become unstable, leading to extended periods of blackout.

   b) Due to changes in the sustainable biomass and residential solar PV markets, lower cost ways to meet the target are now available. As a result, all should support a re-balancing of the renewable electricity strategy to include meaningful amounts of biomass, residential solar PV rather than doubling onshore wind power

2) **Brief background on economics of producing Irish electricity and taking carbon emissions (CO2) out of the atmosphere:**

   a) **Cost premium for 'green' renewable power: 'direct' costs.**

   Zero carbon electricity produced from Irish renewable sources (such as sustainable biomass including wood pellets, onshore and offshore wind and solar etc) is more expensive to produce than electricity from fossil fuels such as coal, gas and oil.

For example, to produce 1 Megawatt hour[1] (MWh) of electricity in Ireland from coal it costs around €31 (€31/MWh), from gas €42/MWh and €70/MWh, is paid by consumers (domestic and industrial) to the developers of onshore wind farms (under the Renewable Energy Feed in Tariff, REFIT, scheme). These are the 'direct costs' at the point of production - they do not include the costs of transmitting the power to the consumer and ensuring that the 'lights will always stay on' through back-up reserve power sources (if a power station were to be put out of action due to a mechanical failure etc, or the wind to stop blowing). These second type of costs are called 'system costs' (see b) below).

Therefore producing electricity from renewable sources (that do not produce carbon emissions unlike fossil fuels which produce carbon dioxide, CO_2, when they are burnt to produce electricity) costs more in Ireland than relying on the traditional sources of fuel i.e. coal, gas and oil. As a result, decarbonising the electricity sector, should involve choosing the least cost option.

Developers of renewable power will often be economical with the truth in how they describe the costs of their renewable power. For example, they will often say that onshore wind costs less than power produced from gas, as wind is 'free'.

What they are doing is distorting the truth about the nature of the direct costs of producing zero carbon power from wind. A key difference between onshore wind and coal or gas fired power is that once you have paid substantial 'fixed' capital costs to build the wind farm, the costs of operating it ('variable costs) are very low, as the wind is available at "no cost", apart, obviously, for the need to maintain the equipment.

As a result, the bulk of the direct costs of producing power from wind are in the substantial set up costs (around 95% of the total direct costs) and are 'fixed' in nature (i.e. they do not vary with the amount of power produced). For a coal or gas fired power plant, the split between the 'fixed' set up costs and 'variable' operating costs are more like 60%-40% as you have to pay for the fuel (i.e. the coal and gas) as well as the cost of building the power plant.

Fundamentally, renewable power in Ireland costs more to produce than power from fossil fuels that emit carbon during the generation of electricity. Renewable developers like to promote the myth that wind power is free as the wind is free - it is simply that, a myth.

[1] One megawatt hour of electrical power (1 MWh) is equivalent to 1,000 kilowatt hours (KWh) of electrical power. An average sized television set uses 1 KWh in four hours of viewing.

b) Why you should worry about 'system costs' directly caused by doubling Irish onshore wind capacity: total 'production costs' ('direct costs + system costs').

Vitally, the broader 'system costs' of ensuring a continuous delivery of power to meet consumer demand (remember that power cannot be stored at large scale so you must always be able to balance near term demand and supply) vary substantially depending on the type and level of power production from different sources.

Doubling onshore wind power will significantly increase system costs because it is variable in nature i.e. it is available only when the wind is blowing and can destabilise the frequency sensitive entire power network if left unmanaged. So if you are having to constantly match supply and demand, it is a very inflexible source of power generation which incurs large system costs. Biomass and solar PV do not add to system costs as they are not variable sources of power generation.

What are these increased system costs caused uniquely by deciding to double Irish onshore wind power? The additional costs are directly caused by choosing such a large proportion of electricity generation from onshore wind because as a variable source of renewable generation, wind power requires reserve generation back up (for when the wind does not blow).

EirGrid's operators endeavour to keep generation in balance with demand at all times. As a consequence, they will maintain the capability to be able to maintain levels of generation even were one of the generating units to suffer a sudden failure.

Indeed, it is one reason why we have a national grid; it allows all to share the costs of keeping spare capacity. That is why the system operator will instruct a few power stations to operate below their maximum output capacity, so that they can respond to a shortage in seconds. Thus, if the largest generating unit on the network is, say, 500MW, the system operator may ask 5 units of 400 MW to operate at just 300MW. Thus these 5 units provide 500MW of "spinning reserve", so that, should the 500MW unit suddenly disconnect, the level of generation could be rapidly recovered. When a generating unit operates below its rated capacity, there will be a reduction in efficiency, so this "spinning reserve" is not free.

As a consequence, it is relatively easy to accommodate a small level of wind onto the transmission system; the reserve requirements to manage sudden changes in generation are likely to be sufficient to cope with the more predictable variations in wind generation.

However, as the amount of wind generation increases, it will no longer be the risk of loss of a large source of power that will determine the quantity of reserve. The amount of wind generation, and its variability, will influence the quantity of reserve held. In other words the nature of the risk management challenge has changed from back up for technology failure to back up for more regular but less dramatic changes in generation.

According to the Irish Academy of Engineering, system costs add another €30/MWh or another 43% to the €70/MWh tariff paid to the wind farm owner making the cost of producing electricity €100/MWh.

This additional €30/MWh comes from:

- €3.2 billion capital cost for Grid25: Transmission system reinforcement to manage the serious destabilisation risk caused by such a large proportion of variable power on the system.

- €0.6 billion capital cost for another inter-connector to GB or France: This is required to siphon off unusable excess power at short notice to other countries to avoid destabilising the entire Irish power network.

- Reserve generation payments: As Irish power generation becomes 40% wind dependent, the need for back up reserve generation provided by gas fired generation (as you can ramp the output up and down at short notice to match supply with demand unlike more wind power) becomes greater and more costly.

- 'Curtailment' payments: Because of the rising risk of destabilising the entire Irish power network caused by more wind power, wind farm owners are paid to spill wind (by feathering the blades of the wind turbine) when it is very windy. However, they are actually paid 'curtailment fees' as if the power had been produced and was eligible for the €70/MWh tariff.

Therefore when you are comparing the total costs of producing power from more Irish onshore wind, the direct cost of production is actually €100/MWh i.e. the €70/MWh tariff + €30/MWh additional 'system costs' directly caused by the decision to double onshore wind power.

As a result, electricity from onshore wind costs 2.4x more to produce than electricity from gas fired generation (€42/MWh) and 3.2X more than electricity from coal fired generation (€31/MWh).

Biomass at Moneypoint and residential solar PV do not increase system costs as they can use the existing transmission system with no upgrades and associated costly investment.

c) **Identifying the 'least cost' option of meeting the EU green electricity target:**

When we compare the costs of the renewable strategies now available in 2014 to meet Irish renewable electricity targets – onshore wind, sustainable biomass and residential solar PV, we need to compare them on the cost of reducing ('abating') carbon emissions. The key point of the green targets is to reduce carbon emissions (that are believed to cause climate change) so 'green economics' is about comparing the cost to 'abate' carbon of each of the three alternatives. The 'cost of carbon abatement' is the internationally recognised standard by which the economics of renewable power generation are compared.

We won't bore you with the precise details but we calculate the power production costs of the renewable technologies (see onshore wind example above), we then see what type of fossil fuel power production it will displace. As different fossil fuels have different levels of carbon emissions produced when they are burnt to produce power (for example coal emits twice as much carbon dioxide as gas when it is burnt to produce electricity) we then adjust the costs for the amount of carbon saved depending on what source of fossil fuel generation was displaced.

Therefore we calculate the 'carbon abatement' cost of each renewable generation technology. It tells us how much it costs each renewable source of power to save a tonne (t) of carbon dioxide (CO_2) in Euro (€): €/tCO_2.

Essentially, the lowest carbon abatement cost form of renewable power generation is one that has relatively low production costs and displaces a high carbon existing fuel source such as coal. In essence this is what sustainable biomass does by replacing coal fired generation at Moneypoint. The "biomass" is judged to b "sustainable" if the crop is replaced. For example, it is essential to replant the trees used to create woodchip and to ensure that many varieties of tree are used so that "monocultures" are avoided.

3) **How the 2014 options stack up on key criteria:**

In 2014, due to changes in technological development and lower costs there are now three mature, tried and tested types of renewable power production – onshore wind, biomass and household solar photovoltaics (PV) – which could help Ireland meet the 2020 challenge. In 2007, there was only one - onshore wind.

As requested we have compared them on the four issues:

a) Cost of abating Irish carbon emissions.
b) Additional Irish jobs to meet 2020 target.
c) Security of power supply.
d) Wider environmental and economic impacts.

a) Cost of abating Irish carbon emissions:

Irish technology Choice	Cost of reducing Irish carbon	Cost saving vs. Irish wind
More onshore wind	€135 /tCO_2	-
Biomass conversion at Moneypoint	€60 / tCO_2	~55% cheaper
Domestic solar PV	€100/ tCO_2	~25% cheaper

Source: BW Energy estimates informed by Irish Academy of Engineering cost analysis "Energy Policy and Economic Recovery, 2010-2015" p 33, February, 2011.

Fundamentally biomass conversion at Moneypoint is very attractive on a cost of carbon abatement basis as no change to the transmission system is required and biomass displaces high carbon emitting coal.

At a capital cost of €380 million the boilers can be converted- a 1/10th of the capital cost of the €3.8 billion capital cost needed to handle the doubling onshore wind capacity.

Even residential solar PV is now a cheaper way to abate carbon in Ireland (!) reflecting both the halving of solar equipment prices since 2008 and generous Irish onshore wind subsidies.

b) Additional Irish jobs to meet 2020 target.

Total of new Irish regular jobs to meet 2020 target:

Technology	Additional jobs
More wind power	~2,500
Local biomass supply for Moneypoint	~6,000
Domestic solar PV installation	~1,500

Source: Total new wind jobs to meet 2020 target from Sustainable Energy Authority of Ireland (SEAI) June 2012 'The Case for Sustainable Energy-A review and analysis of economic and enterprise benefits' and Poyry March 2014 'Value of the Wind Industry to Ireland' for Irish Wind Energy Association (IWEA). Forestry employment estimate from BW Energy based upon Finnish sustainable biomass forestry analysis. Residential solar PV installation estimate from BW Energy based upon UK market assuming only 25% of Irish households suitable.

c) Security of power supply:

From an energy analyst's perspective there is no real definition of 'security of power supply' but politicians do seem to want to emphasize the importance of 'security of supply'.

For onshore wind, locally provided biomass for Moneypoint and residential solar PV, all of the fuel sources are indigenous to Ireland and are deemed to have 'security of supply'.

If biomass was sourced from overseas for Moneypoint, how secure would the supply be in terms of price, volume and political stability of the supplying country? The answer is very secure – there is plenty of supply availability which can be contracted at a fixed price for 10 years or more from a politically stable country – America.

In terms of security of actual power supply (as opposed to the security of the fuels used to produce the renewable power), doubling onshore wind has definite technical risks, whereas the others do not. This is particularly the case in Ireland as the EirGrid system is relatively small, compared to those in Europe, and it is isolated. As a consequence, the large variations in generation that would be associated with a 40% wind penetration would be difficult to absorb, running the risk of the frequency of the mains becoming unstable. This could lead to extended blackouts.

To date, nowhere in the world has managed to accommodate such a large proportion of variable wind power onto the system. Electrical engineers will argue that these risks are manageable but it will be very costly (additional 'system capital costs' of at least €3.8 billion Euro) and technical risks certainly exist.

d) **Wider environmental and economic impacts:**

- More wind power - negative:

  - Increased risk of transmission system instability and power blackouts.
  - Negative visual impact with potential reductions in local property values and implications for Irish tourism, bloodstock and agriculture industries.

- Biomass conversion at Moneypoint - neutral:

  - Utilises the existing power transmission infrastructure.

- Household solar – positive:

  - Empowers Irish citizens and families to get benefits from fighting climate change. 400,000 domestic installations are not likely to impose additional reserve requirements on the transmission system.

4) **Conversion of Moneypoint coal station to biomass – the pros and cons:**

The arguments for converting Moneypoint to biomass, as a way of meeting the 2020 EU renewable electricity target, are overwhelmingly positive.

The pros are:

- **Moneypoint conversion allows Ireland to meet the 2020 target in a single go. At the end of 2012, Ireland was at 19.6% of power production from renewable sources (compared to a 2020 target of 40%). Converting Moneypoint would achieve the target as it produces close to 20% of Irish power output).**

- **At Drax already, power generators twice the size of Moneypoint has already been operating successfully 100% on biomass for over a year (on schedule and on budget).**

- **It is the least cost option for Ireland to abate carbon and meet 2020 targets. It also offers substantial job creation opportunities and does not negatively impact the tourism, agriculture and bloodstock industries.**

- **With Irish industrial and domestic electricity prices already more than 40% above EU average and the second and third highest respectively in the EU, Ireland must become more cost as well as carbon aware.**

- **As it uses the existing power station and transmission system it does not impact upon heartland Irish industries in bloodstock, agriculture and tourism.**

The attempted criticisms levelled at the idea (none of which are valid):

- **'***It is not a renewable form of generation*': **It is – sustainable biomass is recognised and regulated by the United Nations as a form of renewable power generation. The UN sets the rules on anti - climate change technologies.**

- *'It is not economic':* **It is – our analysis based upon the Irish Academy of Engineering and UN data shows it is less than half the cost of more onshore wind as a form of carbon abatement. The onshore wind lobby conveniently ignore the additional system costs of €3.8 billion capital cost directly caused by dealing with the problems caused by the doubling of onshore wind.**

- *'It requires 10 mt a year of biomass':* **No - it requires only 3.7 mt a year of biomass equivalent to 80% of the current Irish forestry output. Ireland has the best climatic conditions for forestry and is one of the least wooded countries in the EU**

- *'It relies on foreign, volatile fuel prices':* **No – biomass prices have been very stable and you can secure fixed price, ten year + contracts to lock in long term stable prices.**

- *'It requires a lot more ships to transport than coal which will push up carbon emissions':* **No – more ships certainly will be required (biomass has only a third of the energy than the equivalent volume of coal) but Drax has shown that including all emissions it will lead to an 80% reduction in carbon emissions compared to the use of coal. Zero carbon ships are now available. Moneypoint as a deep water port can easily handle the extra ships.**

- *'It will increase our dependence on energy imports':* **No – even if the biomass comes from the US, it will not change the import dependency as the coal comes from America too.**

- ' 2/3rds of the energy generated ...would be lost as waste heat going up the Moneypoint chimney': **No – only 5% of heat would be lost out of the chimney stack, a standard proportion for the global power industry. However, according to the law of thermodynamics, all power stations must "reject heat". In Moneypoint's case, it heats up the surrounding sea water; in Drax, and other fossil fired stations, it is released in the form of water vapour that rises from cooling towers.**

The only negative is for the ESB as they have been importing more cheap American coal into Moneypoint and using less, lower carbon gas as a result. This has increased their profits and pushed the carbon footprint of the Irish power sector back up to 2009 levels. At the same time, Irish consumers have been paying generous subsidies for wind power to decarbonise the Irish power sector (!). Essentially, this policy is contradictory - Irish consumers unwittingly are subsidising the increased profits of ESB.

Fundamentally, it is too early to judge how much biomass could be sourced from Ireland to support Moneypoint and create more Irish jobs as the proper analysis has not yet been done by the Irish Government.

At a minimum, an Irish Government study should be undertaken as a matter of priority to evaluate how quickly an Irish biomass supply chain could be developed. The boilers at Moneypoint could be converted on a staged basis to co-ordinate with the development of a domestic supply chain.

In the meantime, a moratorium on all Irish onshore wind farm development and associated planning processes should be immediately implemented. As Ireland has plenty of excess gas fired generating capacity this would not add to costs.

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