EVALUATION OF GRID LINK STAGE 1 REPORT

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SUMMARY

1 - Executive Summary

The Grid Link Project: Lead Consultant's Stage 1 Report prepared for EirGrid by RPS Group in September 2013 ('Stage 1 Report') fails to address two key strategic and financial issues:

• More wind power threatens to destabilise the entire network risking power 'blackouts'.

Not only does Ireland have the largest wind power percentage contribution to renewable energy in the EU but also plans to more than double current capacity to meet 2020 targets. Connecting a large proportion of variable wind power to a relatively small, islanded network leads to increased risks of uncontrollable changes in frequency of the network. This may force the entire system to shut down leading to extended power 'blackouts'[1].

• Major otherwise unnecessary costs 'of €3.8bn from higher network risks caused by wind power driven frequency instability.

Domestic Irish consumers already pay pre-tax electricity prices nearly 25% above EU average before further unnecessary costs take effect. Higher network risks can only be solved by a combination of constraining already paid for wind power, upgrading the transmission network and by building uneconomic interconnectors to export wind power to GB or France. This will harm industrial competitiveness and squeeze consumer costs of living.

Rather than offering 'development potential of a significant renewable energy export industry', an interconnector is essential to manage Ireland's projected variable wind power. The Irish Academy of Engineering reported in 2011 that a far cheaper option is for England and Wales to import power from Scotland through an interconnector, rather than from Ireland. Furthermore, wind power exports will not even count towards Ireland's renewables target.

Therefore, the unnecessary €3.2bn costs of the Grid25 transmission system upgrade and the €0.6bn for an additional interconnector should be included when calculating the total cost of Irish wind power.

• Ireland, along with other EU countries, should prioritise more growth in renewables technologies that offer better value, do not risk destabilising the power network and that create domestic jobs.

Recession and the belated recognition that costly renewables subsidies paid by domestic consumers were not necessarily creating national jobs are leading many EU countries to revise their approaches. Croatia is the most recent example. In October 2013 it refocused its policy from wind power to biomass, biogas, cogeneration plants and small scale hydroelectric schemes. It is claimed this will cut the cost of meeting Croatia's 2020 target by 34% and create substantially more domestic jobs.

• Faster growth in biomass, combined heat and power plants and support for energy efficiency offer better value, do not risk destabilising the entire power network and create local employment.

Ireland has a strong agricultural sector but its contribution to renewable energy production from biomass and waste has been below the EU average.

In light of higher network risks and additional wind power costs, Ireland should re-examine its strategy for meeting the EU 2020 target for

1 See Irish Academy of Engineering Report " Energy Policy and Economic Recovery, 2010-2105", February, 2011, p24

renewable energy. In particular it should review the contribution that could be made from more investment in biomass and energy efficiency instead of doubling wind power capacity.

2 - Introduction

This report highlights and evaluates the key strategic, economic and policy assumptions that underpin the EirGrid Grid Link Project 'Stage 1 Report' of September 2013.

The EirGrid 'Grid Link Project' is a core part of Ireland's current National Renewable Energy Action Plan that aims to deliver 16% of Ireland's gross final energy consumption from renewable sources by 2020. This national target directly results from the aggregated EU target to deliver 20% of gross final energy consumption from renewable sources by 2020[2]. The 'Grid Link Project' is estimated to cost €500m and is the largest single part of the overall Grid25 project. The Grid25 project plans to spend €3.2bn to upgrade Ireland's power transmission network by 2025.

Each EU Member State has a different national target and is responsible for developing its own delivery plan regarding the mix of renewable technologies. This report will put Ireland's specific plans and performance to date into a wider EU context.

In common with most EU countries Ireland has focused renewables investment in the electricity generation sector (RES-E). Whilst this sector is the smallest component of overall Irish energy demand out of the three sectors, namely electricity generation (RES-E representing 19% of final energy consumption in 2012), heating (RES-H representing 42% of final energy consumption in 2012) and transportation (RES-T representing 39% of final energy consumption in 2012), targets for renewables in the latter two sectors are much lower. As a result, Ireland is targeting 40% of electricity generation from renewable sources by 2020 to deliver an overall target of 16% of final energy consumption from renewables by 2020.

This focus on wind power primarily drove Irish renewable energy production at annual average growth rates of 16% between 2003 and 2011. This was one of the highest annual growth rates in the EU-27 and meant that Ireland's share of final energy consumption coming from renewable energy had reached 6.7% by 2011 (up from 2.4% in 2004 and compared to Ireland's 16% 2020 target).

By 2010, Eurostat, (the EU statistical service) reported that wind energy represented 39% of Irish renewable energy primary production, easily the

largest percentage contribution in the EU 27. To put this in perspective, this was 5.1x larger than the average percentage (7.7%) contributed by wind energy to renewable energy primary production in any other EU-27 country in 2010.

Furthermore, for an economy with a strong agricultural sector, the proportion of renewable energy production from biomass and waste was already below average for an EU 27 country in 2010 (EU-27 average of 67.6% compared to Ireland with 51.8%).

Despite this substantial penetration of wind power, Ireland plans to continue to expand this sector. The June 2012 'Renewable Energy in Ireland 2011' report by the Sustainable Energy Authority of Ireland (SEAI) forecast that installed wind energy capacity would rise from just over 1,600 MW to 3,521 MW by 2020.

2 European Directive 2009/28

The EirGrid €500m ‘Grid Link Project’ clearly results from the decision to prioritise continued growth in wind power to meet the overall 2020 renewable targets over other renewable power generation sources such as biomass.

In the ‘Stage 1 Report’ three key drivers were highlighted to justify the need for the further development of the electricity transmission network in the south and south - east of Ireland. These were:

• ‘The integration of new generation: significant levels of new renewable generation are to be connected to the transmission and distribution networks in the south of Ireland. This renewable generation on its own and/or together with existing conventional generation connected to the transmission network in the south of Ireland gives rise to network constraints within the single electricity market on the island of Ireland, driving the need to reinforce the transmission network’.

• ‘Ensuring that security of supply is maintained: reinforcement of the transmission network is necessary in order to ensure that demand in the south – east can be securely supplied at all times, regardless of where the power is generated.’

• The facilitation of possible future interconnections with either Great Britain or France: EirGrid has a statutory obligation to explore and develop opportunities for interconnection of its system with other

systems. Given the development potential of a significant renewable energy export industry on the island and proximity of the south and east of Ireland to Great Britain and France, regional reinforcements such as the ‘Grid Link Project’ must take into account requirements to ensure compliance with this statutory obligation.’

Clearly, the continued growth in Irish wind power with perceived export opportunities to Great Britain and France represent two key assumptions on which the EirGrid ‘Grid Link Project’ is based. Neither of these assumptions should be accepted without further examination for technological and commercial reasons.

The achievement of these targets would represent a dramatic shift in the form of generation in Ireland. Previously, the sector’s structure followed the common arrangement for nationalised monopolies; a group of large fossil fuel fired stations connected by a high voltage transmission system. This allowed the sector to benefit from economies of scale in generation, the ability to coordinate the operation of the stations and to minimise the costs of providing back up in case of plant failure.

The goal of switching to a system deriving a large proportion of its production from a dispersed group of relatively small wind-farms, each with variable output, will require a major reconfiguration of the transmission networks.

The Irish electricity industry successfully accommodated a major transformation over the past decade in order to comply with the European Large Combustion Plant Directive (LPCD). This involved replacing most of the former coal, peat and oil fired stations with combined cycle gas turbine stations (CCGTs) fired with natural gas.

However, it is now becoming clear that the ability to cope with large swings in generation output, as will be expected with wind generation, may not be so easily achieved.

3 - Substantial Technical Challenge To Integrity Of Irish Power System Of Even More Wind Power

The relatively isolated power system in Ireland and Northern Ireland is likely to have difficulty accommodating a large proportion of variable wind power in such a relatively small market. Balancing demand and generation in a small 'islanded' network will lead to increased risks of uncontrollable changes in the frequency of the entire network, risking extended 'black out' periods lasting several days at a time.

The Irish targets for renewable electricity production have increased over the past decade, putting most of the burden on the electricity sector, rather than transport or heating and cooling.

	2001	2007	2009	2010	2012
Legislation	2001/77/EC	White Paper	2009/28/EC	NREAP[3]	NREAP[4]
Target for renewable energy in Ireland			16% by 2020	16% by 2020	16% by 2020
Irish targets for renewables	13.2% of electricity (RES-E) by 2010	RES-E 15% by 2010 33% by 2020		2020 : RES-E 42.5% RES-H 12% RES-T 10%	2020 : RES-E 40% RES-H 12% RES-T 10%

Electricity is currently very expensive to store. Therefore, the amount of electricity produced must match demand at all times. In systems with predominantly fossil forms of generation, this is relatively easily achieved as the output from fossil generating stations may be varied at will, within certain parameters. The accommodation of variable generation, such as wind power, can pose a problem. Other forms of generation will have to compensate for changes in the contribution from wind.

For small amounts of wind, this is not difficult, as generating systems currently cope with the sudden breakdown of a generating unit and with sudden swings in demand. However, if the contribution from wind is large, it may prove difficult to keep demand and generation in balance. Should this occur, the frequency of the electrical system[5] could rise, or fall, uncontrollably. This may cause damage to generating equipment or force the whole system to shut down. Were this to occur, it would take many days to re-establish supplies across the whole island.

Whilst it is the case that EirGrid is in the forefront of the development of technologies and practices to cope with a large wind component of generation, Ireland is at a dis-

3 National Renewable Energy Action Plans – as submitted to the European Commission under the Directive 2009/28/EC
4 NREAP, 2012
5 In essence, this is the speed with which electrical generators rotate and is known as "mains frequency", and is 50Hz or 3,000 rpm in Ireland. Since the motors driving pumps in power stations also rotate with the same frequency, a sudden fall in generation will cause the frequency to drop, which will cause the pumps to lose power and so generation will fall further, causing the frequency to drop.

advantage since it is a relatively small "islanded" network, with just 5,000MW of peak demand and just under 9,000MW of generation of which 3,500 MW could be variable wind. Therefore swings in renewable generation would have a major proportionate impact on this demand/generation balance.

That means that the system frequency is especially sensitive to changes in the demand/supply balance during times of low demand. In 2010, a technical report by EirGrid and Soni (System Operator Northern Ireland) concluded that the 40% renewables target for Ireland might be technically feasible, assuming that some of the protection equipment on existing generators could be deactivated.

Even so, some 20% or more of the wind would need to be "constrained off", i.e. forced not to generate, in order to maintain stability. The report also assumed that three interconnectors were operating, having 1,500 MW capacity in all; the existing Moyle link to Scotland, the recently commissioned East West Link to Wales and one yet to be built. The ability to export could help reduce the "sensitivity" of the system frequency and so make it easier to absorb more wind power.

Indeed, Denmark currently has a large wind component in its generation mix; it produced 35% of its electricity from wind in 2011. However, the Danish transmission system enjoys five transmission links to neighbouring Norway, Sweden and Germany amounting to a total export capacity of almost 6,000MW, and serves an installed generating capacity of 11,500MW. These links were built so that Northern Europe could take advantage of the Scandinavian hydro resources but has now enabled the Danish system controllers to export surplus wind to Germany and to import fossil or hydro generated power when the wind falls.

As such, Denmark may be considered, electrically at least, as part of an integrated Northern Europe. Denmark's system frequency is set essentially by the North European generation capacity of 667,000 MW[6].

By comparison, the "All Island" system of Ireland and Northern Ireland has only weak connections to the UK, of just 1,000MW. Achieving 3,521 MW of wind capacity[7] would, using current control technologies, expose the system to the risk of collapse and extended 'blackouts'.

4 - Questionable Interconnector Economics To Great Britain

Exporting wind power electricity via interconnectors to Great Britain or even France will be necessary if the Irish system is not to be put at significant risk of collapse due to frequency instability problems. However, the commercial case for such exports is weak if not non-existent.

As a way to ameliorate the difficulty of accommodating variable generation in a relatively small, isolated system, it has been suggested that Ireland could export its renewable electricity to Europe, specifically the UK and France. Indeed, as the previous section explained, the ability to export power over interconnectors

6 The Danish system is split so that Eastern Denmark is linked to the Nordic grid system and the West to the Central European network. See www.enrginet.dk
7 Estimated by EirGrid/Soni report of June 2010 and the NREAP 2012, as required to reach the 40% target.

should not simply be regarded as a further benefit of wind generation. Rather it would be a technical necessity if variable forms of generation are to contribute 40% of all Irish electricity generation.

However, the commercial case for such exports through new interconnectors is by no means clear. Indeed, the recent report from the Irish Academy of Engineering[8] demonstrated that the economic case for transporting excess wind power from Scotland to England, via an undersea cable already under construction (The Western Link), is far more robust than for another cable between Ireland and Wales. The capital costs per MW for another 500MW link, as assumed in the EirGrid/Soni report, would be 80% more expensive and incur twice the electrical losses.

Furthermore, following the passage of the Electricity Reform Act through the UK Parliament in December 2013, large renewable electricity schemes will now be remunerated by a Feed in Tariff (FiT), similar to the Irish REFIT scheme in principle if not application. Under this Act, a new organisation, will offer contracts to purchase power from renewable generators. Therefore, any Irish wind power exports will be in direct competition with other potential renewable energy generators in Britain. Irish exports are only likely to win the auctions if the price, delivered to Britain, is lower than the alternative, which is likely to be UK offshore wind. The British Government has indicated that it will not agree to UK offshore wind contracts in 2020 priced at over £100/MWh (or €120/MWh).

It is unlikely that any additional Irish exports could meet this target price. The IAE estimated that the cost of wind power in Ireland, taking into account the additional system costs[9], is around €100/MWh. Allowing for the losses of converting the power and transporting it across the Irish Sea, this suggests a cost of €106/MWh.

The capital cost of an interconnector would be around €1.1m/MW[10], suggesting a unit cost of €35/MWh, at a 7% real pre-tax cost of capital[11]. This leads to a total cost closer to €140/MWh, assuming that the interconnector is utilised for 40% of the time. Thus, either the UK will choose to meet its targets through offshore wind, as the costs will have fallen below the £100/MWh target, or the UK will have rethought its approach to its renewables target. Either way, the financial case for Irish wind exports to the UK is non-existent.

This is hardly surprising as the UK has developed offshore wind as it was considered to have the potential to be as cost-effective as onshore wind, given the ability to accommodate larger turbines and the more favourable wind conditions offshore. Therefore, the need to incur the interconnection costs would make Irish exports uncompetitive.

As a consequence, if further interconnection is built to the UK, Irish exports will be sold into the wholesale market on a short term basis. As such, they will be exposed to the market price for power. Since the times of Irish exports are likely to coincide with periods of high wind generation in Britain, it is likely that market prices will be low, as the

8 Irish Academy of Engineering, "Policy Advisory, The potential for large scale electricity exports", June 2012
9 These costs arise from the need to "part load" fossil stations in case the wind were to drop suddenly.Operating plant in this way lowers their efficiency.
10 See IAE, 2011
11 A rather low value, considering the risks associated with the dependence on the differences between these two markets.

Danish have discovered with their exports to Germany.

Therefore, when estimating the cost of Ireland meeting the renewable energy target by producing 40% of electricity primarily through wind generation, it would be appropriate to include the costs of the interconnectors and upgrading the transmission system, rather than simply assume that the interconnectors are a sound investment in themselves, i.e. the €3.2bn for Grid25 and at least €600m for a further interconnector. Were Ireland to use other forms of renewable generation to meet its 40% target that were not dependent on the weather, such as biomass, the additional costs of interconnection would not be incurred and, depending on the technologies, some of the transmission upgrades could also be avoided.

Whilst onshore wind is relatively cost competitive as a renewable energy source, the difficulties of accommodating a large proportion of variable wind power generation will push up unit costs. This is a result of the need to constrain as much as 20% of wind output to avoid system instabilities.

Due to the structure of the renewable feed in tariff contracts (REFIT), Irish wind farms will still be paid for any power that is spilt (technically described as 'curtailed') to avoid risks of overloading and potentially crashing the transmission network. As a result, effective consumers' unit costs will be accordingly higher.

This will add to costs at a time when Irish industrial and domestic electricity prices are currently 13% and 15% respectively higher than the EU average. For the domestic market pre tax prices are closer to 25% higher than EU average. This will harm Irish industrial competitiveness and further squeeze the cost of living for consumers.

5 - Irish Cost Competitiveness Also To Suffer

Ireland's industrial and domestic electricity prices are currently respectively 13% and 15% higher than the European average (Eu28)[12]. However, when taxes are extracted, the underlying domestic price is closer to 25% higher. This reflects Ireland's location.

Although Ireland has installed a modern efficient set of CCGTs, the gas that fuels these stations is provided over a pipeline from the UK, thereby incurring additional transportation costs. Therefore, any additional costs associated with renewable generation will further impair Ireland's competitive position with respect to its European trading partners.

Furthermore, the previous section reported that curtailment of Irish wind production should be expected if Ireland is to achieve the 40% penetration of renewables in the electricity production mix. Under the current REFIT contracts, wind generators are compensated at the full price for this "constrained" operation. Therefore, the effective cost to consumers will be at least 20% higher, i.e. nearly €90/Mhe in today's prices and this will further exacerbate Ireland's relatively weak competitive position. Indeed, the IAE believed the actual cost was closer to €100/MWhe[13].

12 Eurostat, November, 2013
13 IAE, 2011, page 21

6 - Recession Prompts EU Wide Reconsideration of Renewables Targets

Ireland is just coming out of recession and the economy is starting to grow once more. Potential investors in the Irish wind industry will require some comfort that the European Union will not renege on its commitment to the 20% renewables target, given the impact this is having on the EU's competitiveness. Indeed, the boost given to the USA economy by the aggressive exploitation of shale gas imposes obligations on politicians to examine other ways to proceed. Moreover, investors still remember that, although the EU financial stability pact was 'legally binding' on Germany and France, they were able to break the spending limit with impunity.

All the Member States of the European Union were scheduled to submit to the Commission on 31st December, 2013, and account for their progress towards the 2020 targets established under 2009/28/EC. These returns are likely to demonstrate that a number of countries will have difficulty meeting their renewables targets. There are many reasons for the slowdown in investment in renewables:

• The financial crisis has caused access to finance to become more difficult.

• The balance sheets of the customary investors, the utilities, are under severe pressure, in most cases prompted by political uncertainty.

• Concern that the renewables target itself, may be amended, since renewable power is not, yet, competitive with fossil fuel (partly on account of the weak carbon prices observed in the European Emissions Allowances market).

• The potential for gas prices to fall on account of shale gas discoveries around the world.

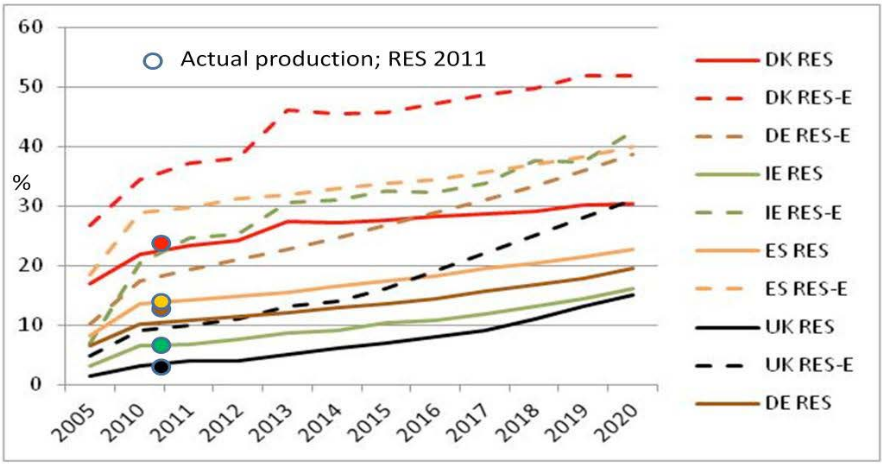
• The failure to reach a global agreement on a replacement for the Kyoto Protocol.

Indeed, the large scale investment in renewables is anticipated for the second half of the decade, as shown in the Figure below, where the solid lines represent the share of renewable energy in final demand and the dashed lines just the renewable component of electricity production.

Many observers, including the Irish Academy of Engineering, are questioning why such a large investment in wind should be undertaken at this stage. Rather there is a case for examining whether, particularly in view of the technical challenges and the questionable market for exports, there are alternative ways of lowering Ireland's carbon emissions and dependence on energy imports.

13 IAE, 2011, page 21

Renewables Targets and Production



Sources: Eurostat, NREAPs, ECN, 2012

7 - Alternative Approaches Need To Be Considered

Ireland's energy strategy to meet the 2020 renewables target has been to aggressively focus on wind power. Wind power by 2010 represented 39% of all Irish renewable energy, the highest proportion in the EU and over 5x the EU average wind power contribution. This was the primary driver behind 16% annual average growth rates in renewables since 2003, one of the highest growth rates in the EU 27.

EU Member States have discretion to meet their targets in whichever way they choose. Ireland should follow the lead of other EU countries and prioritise more growth in renewables technologies that offer better value and that create domestic jobs.

Ireland has a strong agricultural sector but its contribution to renewable energy production from biomass and waste has been below the EU average in 2010.

Faster growth in biomass and combined heat and power plants offer good value, do not risk destabilising the entire power network (as the energy production is despatchable and not variable like wind power which depends on the weather), and create local employment. Ireland could also consider further energy efficiency schemes. One would build on Ireland's agricultural heritage and the other could provide further employment and protection from volatile energy prices.

The European Directive, EC/2009/28 only defines the 16% target for the proportion of Ireland's final energy demand that is to be derived from renewable sources in 2020. It is up to each Member State to devise its own delivery strategy.

Recession and the belated recognition that costly renewables subsidies paid by domestic consumers were not necessarily creating domestic jobs are leading many EU countries to revise their approaches. Croatia is the most recent example in October 2013 refocusing from wind power to biomass, biogas, cogeneration plants and small scale hydroelectric schemes. It is claimed this will cut their costs of meeting the 2020 target by 34% and create substantially more domestic jobs.

There is a strong case for Ireland to undertake a similar review. Indeed, Ireland has a vigorous agricultural sector and could well consider the benefits of expanding the use of biomass to produce energy; either through direct combustion, anaerobic digestion and even "third generation" biofuel production. The first two have the advantage of being despatchable, so could be easily accommodated in the Irish electricity system. Indeed, IAE report of 2011 (table 8.1) gave the total costs of onshore wind as close to €100/MWh and this did not include the €3.8bn cost of upgrading the transmission system and providing a further interconnector. Moreover, this IAE report, demonstrated that biomass used in existing power stations is by far the cheapest option and the other biomass options are not far from this figure, when the additional system and transmission costs are taken into account. Of course, the need to transport large amounts of biomass around the country does have an environmental impact. Nevertheless, smaller biomass plant, possibly with combined heat and power (CHP) could also be a viable option. Neither of these options runs the risk, unlike wind, of destabilising the whole network.

The UK has shown that access to capital is hindering the implementation of many small scale energy efficiency measures in the domestic and SME sectors. It has recently launched the "Green Deal"; an arrangement that allows energy consumers to pay for energy performing measures over extended periods by channelling loan repayments through the electricity billing system. The low default rate on electricity accounts has enabled these loans to be offered at very commercial rates. Progress to date has been slow, owing, in the main, to the complications inherent in the UK's particular form of competition and ownership of metering. However, now demand is growing and it has prompted the creation of many small firms to install the various measures. Such a scheme in Ireland could learn from the mistakes in the UK and enable Ireland to cushion the impact of volatile global energy prices.

8 - Conclusions

The case for Grid25 is based on the need to upgrade the transmission system to accommodate additional wind generation and to allow exports via interconnectors. These assumptions are without sound foundation:

• The Irish power system is capable of meeting electricity demand up to 2020 and would not require any further capacity, were it not for the European Renewables Directive.

• Meeting the 40% target of electricity generation from renewables by doubling wind capacity to ~3,500 MW could destabilise the network, putting Ireland at risk of extended 'blackouts'.

• An additional interconnector to the UK could remove some, but not all, of this risk but would be costly (a further €600 million above and beyond the Grid25 €3.2 billion transmission upgrade cost).

• A sound financial case for exporting power to the UK cannot be made.

• Therefore the costs of the transmission upgrade and the additional interconnector totalling €3.8 billion should be included in the costs of Irish wind power.

• In the light of these risks and additional costs, Ireland should re-examine its strategy for meeting the EU target for renewable energy, particularly reviewing the contribution that could be made from investments in biomass and energy efficiency.

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