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Conflicts Between Energy Policy Objectives and the National Climate Change Strategy in Ireland

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by

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Executive Summary

The thesis underpinning this research project is that it will not be possible to deliver on the National Climate Change Strategy (NCCS) unless the conflicts between energy policy objectives and the NCCS measures are resolved.

The project investigated separately the issues associated with, and measures arising from, the three pillars of energy policy, namely cost competitiveness, security of supply and environmental responsibility. The project assessed the interactions, conflicts, potential conflicts, complementarities and resulting impacts of these on the NCCS measures targeting the electricity sector. The project focused on two NCCS measures in particular, namely:

1. The closure of the Moneypoint coal-fired power plant in 2008, displacing it with gas-fired power generation, to achieve a target of 3.4 Mt CO_2 emissions reduction, and

2. The achievement of an additional 500 MW of renewable energy power generation between 2000 and 2005, to achieve a target of 1 Mt CO_2 emissions reduction, with significant further targets for the period 2005–2010.

This project took place in the period March 2003 to February 2005, a time in which there were significant developments in energy and climate change policy that impacted on the original focus, namely:

(a) The implementation of the EU Emissions Trading Directive (2003/87/EC) marking a shift away from prescriptive central decisions regarding power plants (for example closing Moneypoint coal-fired station by 2008) towards market-based decisions for individual power plants based on emission allocations coupled with a trading regime.

(b) A change away from emission reduction measures solely within Ireland to including emissions reductions from measures taken internationally from which Ireland would benefit as a result of investment or by purchasing credits.

(c) The moratorium placed by the Commission of Energy Regulation on the issuing of any new grid connection agreements for wind farms in December 2003 and lasting effectively 18 months.

All of these developments affect significant elements of the interactions between energy policy objectives and the NCCS, including the electricity supply dimensions of the NCCS, which account for about 38% of the greenhouse gas emission reductions sought in the NCCS and which are the core focus of this research project. The project continually sought to incorporate new developments into the research as they arose, in order to make the results more useful.

The project assessed the security of supply concerns regarding the level of dependency on natural gas for electricity generation that reversed the NCCS decision to close Moneypoint. It also proposes a number of measures that would significantly increase the security of gas supply that would allow the Moneypoint closure to be considered in a new light in the future.

The project also showed the impact on delivery of renewable energy targets of security of supply concerns that prompted the introduction of a moratorium in December 2003 on all new grid connection agreements for renewable energy. This conflict did not impede the 1 Mt CO_2 emissions reduction but did impede the delivery of significant further targets for the period 2005–2010. The research showed that the moratorium was a crude instrument to deal with the security of supply issues associated with increasing wind energy deployment and suggests an alternative route that could have been chosen to avoid the conflict with this NCCS measure.

In researching the energy policy pillar of environmental responsibility, the focus was on renewable energy policy. The research showed that the 500 MW target was not achieved on time but 18 months late. This was due to misalignments between measures relating to market support and those relating to spatial planning and also between measures relating to market support

and those relating to grid integration. This raises important issues that need to be addressed if the significant further targets for the period 2005–2010 are to deliver their full potential in terms of CO_2 emissions reduction.

Against the backdrop of delays in achieving renewable energy targets in Ireland, coupled with the challenges of supporting renewable energy in the new liberalised electricity market, this research explored international experience relating to market support for renewable energy within liberalised electricity markets. Drawing on the innovative approach adopted in Spain (where wind-farm owners can avail of a fixed price per unit of electricity, or a fixed premium added to the market price), the project developed an Irish market mechanism modelled on the support system in Spain. The project developed a computer simulation model to test how this might affect investment decisions in Ireland, focusing on revenue and internal rates of return. The research showed that this would provide an attractive alternative to the current market support mechanism in Ireland and would increase the probability of delivering the ambitious renewable energy targets within the time frame required to deliver emissions reduction in Ireland.

This research found that there are a number of significant conflicts between energy policy and the NCCS. The implications are that there will be a shortfall in delivery of the NCCS targets of 3.4 Mt CO_2 emissions reduction due to security of supply concerns. The NCCS measure to introduce carbon taxation was reversed due to cost competitiveness concerns that this research challenges. The research also explores other conflicts and suggests mechanisms by which these concerns can be addressed while also ensuring maximum delivery of the NCCS targets.

1 Introduction

Under the EU Burden Sharing Agreement (Decision 2002/358/EC) (European Council, 2002) relating to the Kyoto Protocol, Ireland made a commitment to limit the growth of greenhouse gas (GHG) emissions to 13% above 1990 levels in the period 2008–2012.

The National Climate Change Strategy (NCCS) (Department of the Environment and Local Government, 2000) set out a framework and identified measures agreed by Government to meet this commitment and position Ireland for more ambitious targets in the post-2012 period. According to the NCCS, Irish GHG emissions in 1990 were equivalent to 53.75 Mt of CO_2 and were projected to grow to 73.79 Mt under a base-case (without measures) scenario by 2010. This amounts to 13.05 Mt above the target levels (60.74 Mt = 53.75 × 1.13) for the 2008–2012 time frame or 37.3% above 1990 levels[1].

The NCCS proposed a series of measures to meet Ireland's burden-sharing commitment by reducing emissions to 15 Mt of CO_2 equivalent below projected levels by 2010. Most of these reductions (10.4 Mt) are associated with energy consumption in the transport, industrial, services (public and private) and domestic sectors. More that half of these (5.65 Mt) arose from measures identified in the generation and end use of electricity.

The thesis underpinning this research project is that it will not be possible to deliver on the NCCS unless the conflicts between energy policy objectives and the NCCS measures are resolved.

The project investigated separately the issues associated with, and measures arising from, the three pillars of energy policy, namely cost competitiveness, security of supply and environmental responsibility. The project assessed the interactions, conflicts, potential conflicts, complementarities and resulting impacts of these on the NCCS measures targeting the electricity sector. The project focused on two NCCS measures in particular, namely

1. The closure of the 915-MW Moneypoint coal-fired power plant in 2008, displacing it with gas-fired power generation, to achieve a target of 3.4 Mt CO_2 emissions reduction, and

2. The achievement of an additional 500 MW of renewable energy power generation between 2000 and 2005, to achieve a target of 1 Mt CO_2 emissions reduction, with significant further targets for the period 2005–2010.

1.1 Policy Developments Affecting the Project

This project took place in the period March 2003–February 2005, a time in which there were significant developments in energy and climate change policy that impacted on the original focus.

The specific changes in policy of relevance to this project were:

(a) The implementation of the EU Emissions Trading Directive (2003/87/EC), marking a shift away from prescriptive central decisions regarding power plants (for example closing Moneypoint coal-fired station by 2008) towards market-based decisions for individual power plants based on emission allocations coupled with a trading regime. A feature of the National Allocation Plan (NAP) that marked a change in focus compared with the NCCS was the indication of intent by the Government to purchase allowances – 18.5 million (3.7 million per annum) on the international market in the period 2008–2012. This signalled a change away from emission reduction measures solely within Ireland to including emissions reductions from measures taken internationally for which Ireland would benefit as a result of investment or by purchasing credits.

1. The base-year emissions have been revised to 55.6 Mt CO_2 equiv., which means the Kyoto target is 62.8 Mt CO_2 equiv. and the 2010 emissions projections in the 2000 NCCS are 11 Mt above target levels or 33% above 1990 levels.

(b) The new market arrangements for electricity in Ireland and the potential impact on renewable generated electricity, resulting in an All-Island Single Electricity Market in autumn 2007.

(c) The moratorium placed by the Commission for Energy Regulation (CER) on the issuing of any new grid connection agreements for wind farms in December 2003 and lasting effectively 18 months.

(d) Updated work on baseline and with measures GHG emissions projections. This resulted in a new base year figure, average annual projections for the period 2008–2012 (as distinct from using projections for the single year 2010) and new distance to target data. Table 1.1 presents the NCCS data along with revisions in 2004 and 2006 used to inform the 1st and 2nd NAPs, respectively.

The most recent projections contained in the Environmental Protection Agency's (EPA's) emissions projections in September 2008 for the period 2008–2012 indicate a gap to target of 8.7 Mt, significantly lower than the 13.1 Mt gap to target contained in the original NCCS. The NCCS 2007–2012 targets 8.56 Mt reductions and clearly indicates that the use of flexible mechanisms will be employed to deliver 3.6 Mt allowances (through purchases). This will be combined with projected savings of 4.95 Mt from additional measures. The additional measures include the EU Emissions Trading Scheme (ETS) and the report informing NAP2 suggested that achieving ETS targets would involve the purchase of ETS allowances of over 2 Mt in addition to domestic action by the ETS enterprises.

All of these developments affect significant elements of the interactions between energy policy objectives and the NCCS, including the electricity supply dimensions of the NCCS, which account for about 38% of the GHG emission reductions sought in the NCCS and which are the core focus of this research project. The project continually sought to incorporate new developments into the research as they arose, in order to make the results more useful.

Table 1.1. Greenhouse gas (GHG) emissions projections. (Base case (with measures) GHG emissions projections / Mt $CO_{2\ equiv.}$).

	1990 (base year)	Kyoto target	2008–2012	Distance to target
NCCS (2000)[1]	53.75	60.74	73.79	13.1
NAP1 (2004)[2]	53.35	60.37	69.53	9.2
NAP2 (2006)[3]	55.78	63.03	70.21	7.2
NCCS (2007)[4]	55.78	63.03	71.17	8.1
EPA (2008)[5]	55.61	62.84	71.5	8.7

NCCS, National Climate Change Strategy; NAP1, 1st National Action Plan; NAP2, 2nd National Action Plan; EPA, Environmental Protection Agency.
[1]Department of the Environment and Local Government (2000).
[2]ICF *et al.* (2004).
[3]ICF and Byrne Ó Cléirigh (2006).
[4]Department of the Environment, Heritage and Local Government (2007).
[5]EPA (2008).

2 Security of Supply

This section relates particularly to two measures identified in the NCCS, namely fuel switching at Moneypoint electricity generating plant from coal to gas and the increase in deployment of variable renewable energy sources, such as wind and wave energy.

2.1 Switching from Coal to Gas

Fuel switching at Moneypoint is the single NCCS measure with the biggest 'hit' (3.4 Mt) in terms of GHG reductions. The initial rationale for building Moneypoint was to diversify energy supply in the aftermath of the two oil crises in the 1970s (FitzGerald *et al.*, 2005). Over-dependence on oil in electricity generation was replaced with a more diverse fuel mix comprising coal, oil and natural gas. The NCCS proposed to effectively reduce this diversified supply mix by converting Moneypoint to natural gas. It is also anticipated that the use of oil in electricity generation will be replaced by gas. The net result envisaged in the NCCS is an 80% dependence on gas within the electricity supply industry. The NCCS did recognise, however, that it would be necessary to ensure security of supply.

2.1.1 Physical gas supply risk in Ireland

Because of Ireland's projected dependence on gas for electricity generation in particular, short-term physical supply interruptions can have a significant impact on the economy, due to potential associated interruptions in electricity supply. One approach in place to offset this is a licensing obligation on all large thermal electricity generators in Ireland to maintain a 5-day supply of secondary fuel on-site, which requires all natural gas generators to have dual-fire capability.

With more than 80% of gas in Ireland coming from imports (Howley *et al.*, 2007), there is a physical risk of supply disruption, especially in the future with gas resources depleting in the UK and the need for new suppliers from farther away.

The integrity of the physical supply infrastructure (including interconnector capacity and operation and liquefied natural gas (LNG) terminals) holds the key to ensuring short-term (physical) supply security. In the longer term, physical supply security is linked to the depleting European gas resources, the consequent increase in distance from Ireland to gas sources, and the end-of-pipe characteristics of Ireland's geographic location on the international gas pipeline.

The risks associated with short-term gas supply to Ireland are linked to two characteristics of the supply infrastructure, namely the single point of failure on the gas interconnector onshore in Scotland and low-pressure gas in the Cork area.

In order to increase short-term gas security, a second interconnector (IC2) between Ireland and Scotland was built in 2002. This pipeline feeds natural gas from the UK's Transco pipeline at Beattock (Moffat) in Scotland to Gormanstown *via* Brighouse Bay. It complements the original interconnector (IC1), which has been in operation since 1993 and connects Beattock with Loughshinny. If there is an interruption in supply in IC1, gas can still follow through IC2 and *vice versa*.

While the onshore pipeline in Scotland was reinforced with the construction of IC2, through a twinning of the pipeline from Beattock to Cluden (30 km), the remaining 50 km pipeline between Cluden and Brighouse Bay remains as a single pipeline and hence a single point of failure on the system.

In addition, there is a further pipeline to Northern Ireland connected to this single pipe section, at Twynholm, the Scottish Northern Ireland Pipeline (SNIP). While plans are in place to build an interconnector between Belfast and Gormanstown, this single pipeline between Cluden and Brighouse Bay remains a key concern.

In case of an incident or accident disrupting supply between Cluden and Twynholm, all gas from Moffat is lost completely for Ireland. If such an event occurs between Twynholm and Brighouse Bay, it will still be possible to transport a certain amount of gas to Northern Ireland by SNIP (approx. 8 mscmd (million

standard cubic metres per day), and subsequently to the Republic of Ireland[2].

A further issue relating to short-term supply security relates to the Cork area. The region is provided with gas mainly from the Kinsale Gas Field *via* the compression station in Midleton. Originally the Cork gas pipeline was designed for 70-bar pressure, but with the Kinsale gas reserve depletion, gas is supplied at the lower pressure of 30 bar. When gas from the Kinsale Gas Field is insufficient for the Cork area, gas is supplied from the Dublin region at a pressure of 70–80 bar. This would force the gas from Kinsale back to Inch terminal and as a result the gas from Dublin has its pressure stepped down at the Midleton Compressor Station. In the case of a pipeline leak or failure in the Cork area, this low pressure shortens the time frame available for the problem to be addressed.

A long-term physical gas supply risk in Ireland is linked to depletion of domestic gas resources, the high level of gas import dependency and the increase in distance from Ireland to gas sources. It is important to look beyond the time frame of UK gas depletion and consider use of LNG and new pipeline routes from Russia *via* Eastern Europe and from Iran *via* Turkey and the Mediterranean pipeline.

The dependence on gas from Russia and Caspian Sea Countries in particular is set to increase. The main gas transmission routes from Russia to Europe are *via* Ukraine and Belarus. Tension between Russia and these countries concerning gas transit creates increased uncertainty and, hence, insecurity for the future. There is a clear threat to the security of supply, in the scenario where Ukraine or Belarus refuses to transit gas again. The option of raising the price of transit is also possible leading to a price risk.

The most pressing issue in this regard is the delay in harnessing the available domestic resource of gas from the Corrib Gas Field, which can provide a 15-year indigenous gas supply and can significantly reduce import dependency.

2. North–South pipeline completed in Q4 2006.

2.2 Improving Supply Security

Based on an analysis of the key issues and within the limitations of the current discussion (electricity market and gas supply), the following recommendations are made with respect to improving security of energy supply in Ireland. It is worth noting that while this research on security of supply was carried out during 2004–2005, a number of the recommendations are aligned with subsequent Government policy, as articulated in the White Paper on Energy (Department of Communications, Marine and Natural Resources, 2007).

2.2.1 Short-term recommendations

1. Ensure that all new electricity generators comply with their licensing requirements to maintain a 5-day minimum supply of secondary fuel.

2. Provide a twinning of the onshore Scotland pipeline Cluden–Brighouse Bay to remove this single point of failure. The construction of this pipeline would cost approx. €75–85 million (CER, 2005).

3. Actively develop and implement a workable solution to the current impasse with respect to the development of the Corrib Gas Field.

4. Consider the following improvement in capacity for the supply infrastructure at Beattock Compressor Station: upgrade the Brighouse Bay Compressor Station and install a compressor station in Twynholm on the SNIP to provide diversification in supply (Kornyeyeva, 2005).

5. Raise the pressure in the Cork area up to 70 bar. This requires an additional bypass pipe from the north side of Midleton Compressor Station going into Cork (approx. 2 km long). This pipeline would provide gas delivery to Cork from Dublin at high pressure, avoiding Midleton (Kornyeyeva, 2005).

6. Develop a long-term strategy for a secure energy supply and an optimal energy mix, providing an appropriate balance between fossil fuel availability and (both physical and price) risks and renewables.

7. Encourage the development of a limited

commercial storage facility as a part of gas trade *via* the interconnectors, which would provide additional gas capacity in case of emergency or unexpected short-term demand growth due to weather conditions, etc.

2.2.2 Long-term recommendations

1. In the longer term it is important to fully explore and maximise geographical diversification in gas supply. One potentially promising option is through LNG trade. This would provide the possibility to transfer gas from remote countries (Algeria, Nigeria, Malaysia, Trinidad and Tobago, United Arab Emirates and Qatar) without using pipelines.

2. Consider future possible routes of gas importation to Ireland after the UK reserves deplete, and provide secure gas transmission. Explore the possibility of secure routes for gas transmission from Eastern Europe. For example, Germany has already started the construction of a gas pipeline from St Petersburg to Germany under the Baltic Sea, avoiding borders. This is expected to provide a more reliable supply from Russia to the West by 2010 (Kornyeyeva, 2005).

3. Explore possible imports from Iran (another major gas supplier), whose gas can be transmitted *via* Turkey and the Mediterranean pipeline. In the current climate, however, it cannot be considered secure, due to ongoing geopolitical activity in the Persian Gulf.

2.3 Security of Supply and Variable Renewable Energy

This section discusses the concerns expressed by Eirgrid, Ireland's electricity transmission system operator (TSO) that led to the introduction of the moratorium on new grid connection agreements. This policy decision, arising from security of supply concerns, posed a real threat to delivery of the NCCS targets for emission reductions from renewable sources (Ó Gallachóir *et al.*, 2007).

The latter 6 months of 2003 provided the TSO with a clear indicator of growth in wind power deployment through the marked increase in the number (and capacity) of grid connection applications for wind farms. By 21 November 2003, there were 166 MW of wind capacity connected to the transmission and distribution networks and a further 534 MW of planned wind capacity that had secured grid connection agreements.

When compared with the installed capacity levels of Germany, Spain or Denmark, the cumulative total of 775 MW (which includes 75 MW of live offers) committed capacity (or even 1,295 MW including applications being processed) is not very large. In Denmark, for example, installed wind capacity reached 3,115 MW by the end of 2004, representing 24% of total generating capacity (EWEA, 2006). In Germany, 18,428 MW were installed (EWEA, 2006), representing 14% of the installed generating capacity.

In terms of accommodating increased wind power penetration into power systems, it is more important to consider the size of the synchronous power system to which the wind capacity is integrated rather than the amount of generating capacity within national borders. The challenge facing the Republic of Ireland becomes clear when this is the manner within which wind power penetration is considered.

The power systems in the Republic of Ireland and Northern Ireland act as a single power system due to the alternating current (AC) interconnector. The size of this system is 8.1 GW. The British power system is more than nine times larger than that in Ireland. The Nordel power system in Scandinavia is nearly 30% larger than the British power system. The Union for the Co-ordination of Transmission of Electricity (UCTE) system is 593 GW, stretching from the Adriatic to the Atlantic and from the Baltic to the Mediterranean, and covers the bulk of the remainder of Continental Europe. Although Germany and Spain have each a large installed wind capacity, it is small compared with the size of the UCTE power system accommodating it.

The increase in wind power penetration over the period from the end of 2003 to the end of 2005 within each of these synchronous systems is shown in Fig. 2.1.

Wind power penetration (alternatively installed capacity penetration) provides a measure of the installed wind generating capacity as a proportion of

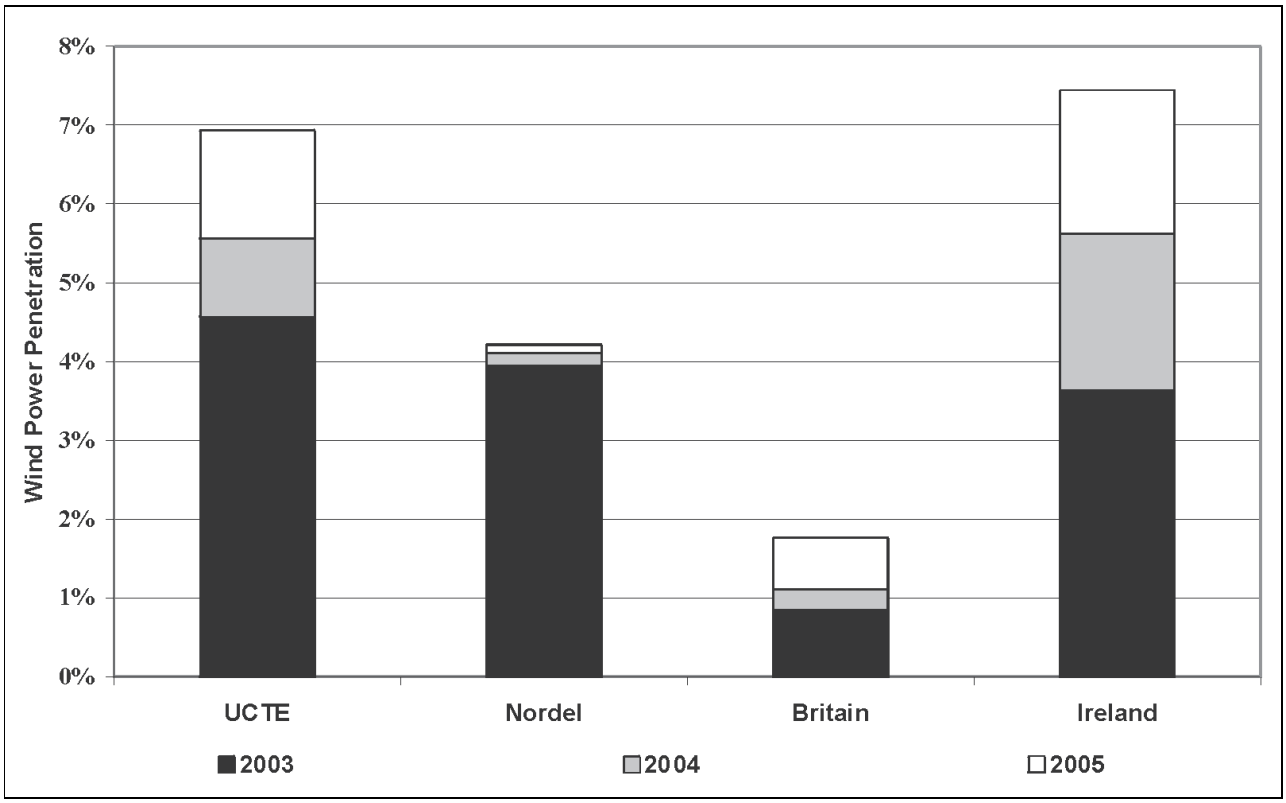

Figure 2.1. Wind power penetration on European synchronous power systems, December 2005. (UCTE, Union for the Co-Ordination of Transmission of Electricity.)

the total installed capacity. Ireland (here including Northern Ireland) had a relatively low level of installed wind power (630 MW) at the end of 2005 compared with Germany (18,428 MW) and Spain (10,027 MW) (EWEA, 2006). The wind power penetration, however, on the Irish synchronous power system was greater than either that of UCTE or Nordel. The recent acceleration in wind energy deployment has brought Ireland from third place in terms of penetration in 2003 to having the highest wind power penetration in the world in 2005 and the indications are that these increased growth rates will continue (ESB National Grid, 2006).

In relation to accommodating wind energy and the technical challenges that poses, a consequence of the penetration shown in Fig. 2.1 is that there is a greater urgency for solutions to be found for Ireland than elsewhere in Europe.

The growth in wind penetration was anticipated by the TSO in 2003, which proposed (ESB National Grid, 2003) that CER introduce a moratorium on issuing new connection agreements in order to allow time to address the technical challenges associated with accommodating wind power penetration levels beyond the amount already committed to. The particular concerns related to maintaining the stability, security and reliability of the power system.

In addition to halting the issuing of new offers, the moratorium also caused an acceleration in the number of applications for connection agreements. The number of connection applications for wind capacity increased from 422 MW to 2,059 MW within the 10-month period from December 2003 to October 2004 (Grimes, 2004).

A key difficulty associated with processing a large volume of wind-farm connection applications relates to the interactions between them, i.e. the connection of one had an impact on another. Formally written, "*This means that the studies performed and the basis for which an offer is made will change as a result of*

another offer being accepted". This issue of volume is not unique to Ireland and in summer 2005 there were applications for 10,000 MW wind capacity being processed in Scotland, in addition to the 7,000 MW that already have connection agreements (Bayfield *et al.*, 2005).

2.3.1 Alternatives to the moratorium

As a result of the moratorium, no new grid connection offers were issued for wind generators in the Republic of Ireland between 3 December 2003 and May 2005. The uncertainty associated with the time frame for ending the moratorium added considerably to the risks associated with wind-farm development in Ireland. It affected the timescale for project delivery and this in turn caused difficulties due to planning permission lapsing for a number of proposed wind farms, thus having a significant impact on the continued economic viability of a number of projects. These risks are further amplified by the uncertainty regarding the level of constraints that may apply to wind farms in the future.

There are a number of alternative approaches that could have been adopted to avoid the introduction of the moratorium and these are particularly relevant for other energy regulators considering the introduction of a similar approach to that adopted in Ireland:

1. The technical concerns underpinning the moratorium could have been addressed earlier as the challenges were foreseen in 2000 (Renewable Energy Strategy Group, 2000).

2. Projects could have been allowed to continue at the developer's risk.

3. Developments could have been allowed to continue in geographical areas where low-voltage ride-through and the other concerns are not anticipated to have a significant impact, for example where a transmission system fault will not result in an unacceptable loss of wind generation.

3 Cost Competitiveness

The initial commitment to implementing carbon taxation in Ireland was published in the National Climate Change Strategy in 2000 (Department of the Environment and Local Government, 2000). Specifically, the Government agreed to "*put in place an appropriate framework for greenhouse gas taxation, prioritising CO_2 emissions from 2002 on a phased, incremental basis and in a manner that takes account of national economic, social and environmental objectives*".

In October 2001, the then Department of the Environment and Local Government published a paper recommending the introduction of an energy tax, based on the carbon content of fuels used, phased in over a 4-year period starting in 2002/2003 (Department of the Environment and Local Government, 2001).

In the Tax Strategy Group (TSG) Paper 02/23 (Department of Finance, 2002), it stated that the Department of Enterprise, Trade and Employment was seriously concerned that the carbon tax proposals (TSG 02/23a) (Department of the Environment and Local Government, 2002) would undermine the competitiveness of the enterprise sector and would achieve only a relatively small reduction in GHG emissions. In a press release in July 2003, the Irish Business and Employers Confederation (IBEC) stated that EU Directive 2003/87/EC on emissions trading, which was part of the process being used by the EU to meet the climate change targets set under the Kyoto Protocol, would have far-reaching implications for Irish business and the potential to result in company closures and job losses together with upward pressure on electricity prices for both domestic and business customers.

On 10 September 2004, the Government decided to abandon plans to introduce a carbon tax, stating that "*a carbon tax is not an appropriate policy option*" and that "*the environmental benefits would not justify the difficulties that would arise, particularly for households, from the introduction of such a tax*". It also stated that recent energy price increases resulting from ongoing supply and demand issues in the oil market would "*give an enhanced incentive to energy conservation*" (Department of Finance Press Release, 2004).

3.1 Significance of Energy Costs to Industry in Ireland

In this case, in effect, concerns regarding competitiveness blocked the introduction of a carbon tax, a significant NCCS measure. The information available to tease out these concerns was poor however due to the absence of sufficiently disaggregated data. This led to analyses concluding competitiveness impacts based on sectoral rather than company-level data. One study commissioned by IBEC (Boyle, 2000) concluded that 40 sectors of Irish industry had an energy cost/output ratio in excess of 2%, rendering them competitively vulnerable to an energy tax. Company-level rather than sectoral-level data are an essential input to analyse the impacts of the energy cost increases that would be associated with carbon taxation. To shed light on this, this research explores the significance of energy costs to industry as a proportion of the overall cost base, building on work undertaken in conjunction with Sustainable Energy Ireland (SEI) (Howley *et al.*, 2003).

Ratios of energy spend to direct costs show the share of energy expenditure in the overall costs incurred by an enterprise in conducting its business. This is a metric that should be well understood in industry and was chosen because any change in the cost of energy would affect an individual enterprise in proportion to the magnitude of the ratio.

Some key results from the analysis are:

- 96% of industrial gross value added (GVA) was generated by enterprises for which energy costs represented no more than 4% of their direct costs. These 4,387 enterprises comprised 92% of all industrial firms, representing 93% of industrial employment and 64% of energy-related CO_2.

- 99% (4,695) of industrial enterprises had a ratio of less than 10%. These accounted for 76% of industry energy CO_2, 99% of industrial GVA and 98% of industrial employment.
- For no firm did energy expenditure represent more than 50% of direct costs.

These results show that for the enterprises contributing most to Ireland's economic growth, energy represents a small part of the cost base. There are a small number of enterprises for which energy is more significant but these companies contribute little to the economy directly. This challenges some of the rationale underpinning the decision not to implement the NCCS measure on carbon taxation.

It should be pointed out, however, that companies which cannot pass on cost increases to their customers due to competitive pressure will be impacted by even small energy price increases. In addition, the indirect cost impacts of energy price changes that were not included in this analysis require further investigation. These relate to employee salary increases and raw material cost increases (due to embodied energy and transportation costs).

4 Environmental Responsibility

The environmental responsibility dimension of energy policy should clearly complement the NCCS. There are areas where conflict may arise, however, and certainly areas where the complementarity of measures could be brought more to the fore to strengthen the prospects of delivery. The focus is on the NCCS goal to deliver ambitious targets in the period 2005–2010 but also on the 1.0 Mt CO_2 emissions reduction target from renewable energy deployed up to 2005. The research explored how the lessons from the past may be used to provide more robust policy signals for the future (Ó Gallachóir and McKeogh, 2006; Ó Gallachóir *et al.*, 2008). It also examined how the market support mechanisms for renewable energy should evolve to positively interact with the emerging electricity market.

The Green Paper on Sustainable Energy (Department of Public Enterprise, 1999) set a target of an additional 500 MW from renewable energy to be achieved in the period 2000–2005, which provided the basis for the NCCS 1.0 Mt CO_2 emissions reduction target. The policies enacted for the period 2000–2005 to deliver the target sought a steady increase in deployment but there was very little activity in 2001–2003, followed by considerable growth in the 2004–2006 period. This was due initially to misalignment between projects that had secured market access and those that had planning permissions. When this was resolved, there was further misalignment, this time between projects that had secured market access and those that had a grid connection agreement. The net result was that the 500-MW Green Paper target was delayed and was 18 months late when achieved (Ó Gallachóir *et al.*, 2008).

The setting of national wind targets for the period 2005–2010 began with a review of wind energy policy initiated in December 2003. A key development that influenced the target was the finalisation of EU Directive 2001/77/EC (European Union, 2001) on the promotion of electricity from renewable energy sources. This effectively established a new target for renewable energy in Ireland, that of achieving 13.2% of gross electricity consumption from renewable energy sources by 2010. This was subsequently increased to a national target of achieving 15% of electricity from renewable energy by 2010 and 33% by 2020.

To ensure that there are no delays in achieving the 2010 target, it is necessary to develop policy measures that avoid the misalignment that existed in the 2000–2005 period, to learn from the experience of the grid connection moratorium, and to ensure alignment with an evolving electricity market that was changed from a bilateral trading market to a single gross mandatory electricity pool market covering the Republic of Ireland and Northern Ireland (the All-Island Single Electricity Market).

Electricity market liberalisation was designed to reduce the price of electricity to consumers through the introduction of competition in electricity generation and supply. Market opening based on bilateral trading began in Ireland in February 2000 and by February 2005 there was full market opening.

The bilateral trading market was replaced with a new mandatory centralised pool market in autumn 2007. All generators and suppliers, unless exempted, are required to buy and sell electricity through the pool.

4.1 Wind in the Single Electricity Market in Ireland

Based on a review of international experience with different market support mechanisms, the core research carried out within this project on supporting wind within the liberalised market has focused on adapting the Spanish support mechanism to Ireland's Market Arrangements for Electricity (Guidi and Ó Gallachóir, 2004; Guidi *et al.*, 2004; Guidi, 2005) and subsequently updating this to the proposed Single Electricity Market and including comparisons with the Renewable Energy Feed in Tariff (REFIT) 2006 (McCarthy, 2007).

In the Spanish support mechanism, generators can choose to (a) receive a regulated tariff (fixed price) for each kWh of electricity they generate, or (b) to sell the electricity in the market and receive a fixed premium in

addition to the market price for electricity. Both the regulated tariff (effectively a feed-in tariff) and the fixed premium are set each year based on the average electricity tariff (AET – average electricity price paid by final customers in the previous year). To incentivise generators to participate fully in the market, the fixed premium is structured such that those receiving the market price plus the fixed premium receive on average a 10% higher price per kWh than those opting for the regulated tariff. This additional income clearly must also cover the additional costs associated with market risk (for example higher cost of finance) that are borne by full market participation. In this case, the market support targets the wind-farm owner rather than the electricity supplier, which is the case with the REFIT support scheme. In this way it provides a potentially attractive alternative market route for wind-farm generators.

In this research the regulated tariff and fixed premium for Ireland are referenced respectively against the REFIT tariff and the projected average pool price (in the absence of a published average electricity price). In the Spanish support mechanism, the regulated tariff is front loaded, i.e. the tariff is set at 90% of AET for the first 5 years compared with 85% of AET for the subsequent 10-year period. For Ireland, the regulated tariff is structured in the same way and this results in lower cumulative profit for the generator but higher internal rate of return (IRR) (McCarthy, 2007). This is based on three different sites and simplified assumptions regarding future electricity prices (with sensitivity).

5 Conclusions

This project researched a number of conflicts between energy policy and the NCCS, focusing on two key measures:

1. The closure of the Moneypoint coal-fired power plant in 2008, and

2. The achievement of an additional 500 MW of renewable energy power generation between 2000 and 2005, with significant further targets for the period 2005–2010.

The project assessed the security of supply concerns regarding the level of dependency on natural gas for electricity generation that reversed the NCCS decision to close Moneypoint. It also proposes a number of measures that would significantly increase the security of gas supply that would allow the Moneypoint closure to be considered in a new light in the future.

The project also showed the impact on delivery of renewable energy targets of security of supply concerns, which prompted the introduction of a moratorium in December 2003 on all new grid connection agreements for renewable energy. This conflict did not impede the 1 Mt CO_2 emissions reduction but did impede the delivery of significant further targets for the period 2005–2010. The research showed that the moratorium was a crude instrument to deal with the security of supply issues associated with increasing wind energy deployment and suggests an alternative route that could have been chosen to avoid the conflict with this NCCS measure.

In researching the energy policy pillar of environmental responsibility, the focus was on renewable energy policy. The research showed that the 500-MW target was not achieved on time but 18 months late. This was due to misalignments between measures relating to market support and those relating to spatial planning and also between measures relating to market support and those relating to grid integration. This raises important issues that need to be addressed if the significant further targets for the period 2005–2010 are to deliver their full potential in terms of a CO_2 emissions reduction.

There were a number of other key policy developments that the research project responded to, namely the reversal of the NCCS decision to introduce carbon taxation and the transition within the electricity market from a bilateral market to a gross mandatory pool. The research challenges the rationale underpinning the decision not to implement the carbon taxation.

Against the backdrop of delays in achieving renewable energy targets in Ireland, coupled with the challenges of supporting renewable energy in the new liberalised electricity market, this research explored international experience relating to market support for renewable energy within liberalised electricity markets. Drawing on the innovative approach adopted in Spain (where wind-farm owners can avail of a fixed price per unit of electricity, or a fixed premium added to the market price), the project developed an Irish market mechanism modelled on the support system in Spain. The project developed a computer simulation model to test how this might affect investment decisions in Ireland, focusing on revenue and internal rates of return. The research showed that this would provide an attractive alternative to the current market support mechanism in Ireland and would increase the probability of delivering the ambitious renewable energy targets within the time frame required to deliver emissions reduction in Ireland.

This research found that there are a number of significant conflicts between energy policy and the NCCS. The implications are that there will be a shortfall in delivery of the NCCS targets of 3.4 Mt CO_2 emissions reduction due to security of supply concerns. The NCCS measure to introduce carbon taxation was reversed due to cost competitiveness concerns that this research challenges. The research also explores other conflicts and suggests mechanisms by which these concerns can be addressed while also ensuring maximum delivery of the NCCS targets.

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Glossary

AET	Average electricity tariff
AC	Alternating current
CER	Commission for Energy Regulation
CO_2	Carbon dioxide
CSO	Central Statistics Office
EPA	Environmental Protection Agency
ETS	Emissions Trading Scheme
GHG	Greenhouse gas
GVA	Gross value added
IC1/2	Gas interconnector (1 or 2) between Scotland and Ireland
IBEC	Irish Business and Employers Confederation
IEA	International Energy Agency
IRR	Internal rate of return
kWh	kiloWatt hour
LNG	Liquefied natural gas
mscmd	million standard cubic metres per day
Mt	Mega (million) tonnes
NAP	National Allocation Plan (of emissions under Emissions Trading)
NCCS	National Climate Change Strategy
NORDEL	Nordic Electric Synchronous Power System
REFIT	Renewable Energy Feed In Tariff
SEI	Sustainable Energy Ireland
SNIP	Scottish Northern Ireland Pipeline
TSG	Tax Strategy Group
TSO	Transmission System Operator
UCTE	Union for the Co-ordination of Transmission of Electricity – the association of transmission system operators in Continental Europe