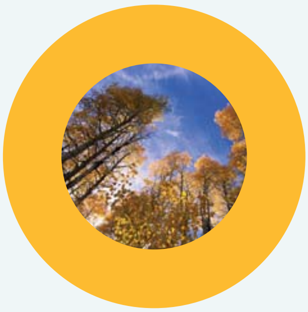
Department of Communications,
Marine and Natural Resources
Roinn Cumarsaids, Mara agus Acmhainni Nadura

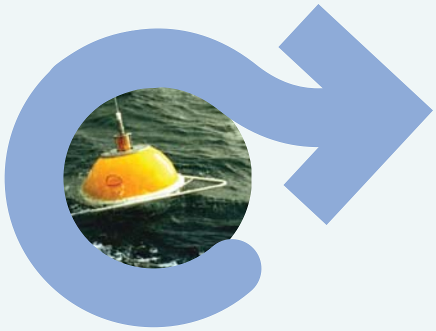
Renewable Energy Development 2006

CHP in Ireland

Renewable Electricity to 2010



Bioenergy in Ireland



Ocean Energy in Ireland

sei SUSTAINABLE ENERGY IRELAND

Department of Communications, Marine and Natural Resources
Roinn Cumarsáide, Mara agus Acmhainní Nádúrtha

Renewable Energy Development 2006

An overview of policy and strategy evolution

April 2006

SUSTAINABLE ENERGY IRELAND

Minister's preface

The publication of this report marks a major crossroads in the development of a more sustainable energy path for Ireland.

Never before has the development and management of our energy resources been more critical. Sustainable energy now plays a key, central role in the development of policies to ensure security of supply, environmental protection and a competitive economy. The work carried out in researching this report has provided a platform from which we are developing innovative and ambitious new policies for renewable and alternative energy sources.

The last two years has seen record growth in renewable electricity capacity. I am determined to ensure that this growth continues, underpinned by the new REFIT programme. While there have been many challenges along the road, we are now well on track to, at the very least, meet the 2010 targets we have set for renewable electricity.

With the benefit of the analysis carried out in this report a number of new initiatives have also given a significant boost to the development of a renewable heat market. In March, I launched a €27m grants package for domestic renewable heat technologies and this is being complimented by a grants scheme for large-scale wood heating systems and a further programme to grant aid Combined Heat and Power. All of these initiatives are part of an innovative €65m investment package announced in last year's Budget.

In the transport area, we have introduced new initiatives to help stem the rise of emissions, which include the introduction, for the first time in Ireland, of tax incentives for the production of environmentally friendly fuels and VRT relief for hybrid vehicles. These initiatives will have the effect of providing 2% market penetration of biofuels by 2008, thus reducing Ireland's reliance on imported fossil fuels, creating opportunities for rural communities and protecting the environment.

Considerable progress is also being made in the development of an all-island energy market, in which sustainable energy will have a high priority. We recently published a preliminary consultation paper on a '2020 vision' for renewable energy on the island of Ireland, seeking views on how a sustainable and competitive all-island energy market should develop over the next two decades. As part of this work, a major all-island grid study has commenced to facilitate a significantly higher renewable energy share of our electricity generating capacity by 2020.

A great number of people have been involved in the policy development process and this is reflected in the work detailed in this report. A particular feature of this policy development work has been the degree of co-operation across several Government departments, statutory bodies, agencies, institutions and renewable energy industry representatives. The success of these groups in bringing together public and private sector stakeholders is notable and we will continue to work in this integrated and effective manner.

I would like to thank all who contributed to the work documented in these reports. Many people have invested considerable time and expertise in the process, and the final outputs have benefited richly from this. I would particularly like to thank SEI for its work in all of the groups and in commissioning and co-ordinating so much of the research and analysis that informed the process.

Noel Dempsey T.D.

Minister for Communications, Marine and Natural Resources

April 2006

Chapter 1 - The Context

Introduction

Increasing the contribution of renewable sources and high efficiency CHP in Ireland's energy supply is a key objective of national energy policy. Ireland is rich in potential renewable energy resources, but to date success in delivering these resources as viable, economic energy supply has been limited. However, growth in recent years, in wind energy deployment in particular, has been strong and there is now a firm base of expertise and experience in the sector on which stronger future growth can be built.

Renewable energy deployment fits with a range of policy imperatives across many areas. It has clear environmental benefits and helps meet our international environmental commitments. It reduces reliance on imported fuels, reducing dependence and bringing associated economic benefits. It can align with waste policy, agricultural policy and rural development, as well as building Ireland's capacity and competence in a business sector growing strongly around the globe.

The Department of Communications, Marine and Natural Resources (DCMNR) holds responsibility for renewable energy policy in Ireland. The past two years have seen considerable activity in both policy and implementation, as evinced by the four major reports published alongside this overview document. This overview document reports on this activity and sets out the progress that has been made in advancing the development of renewable energy in Ireland.

The development of sustainable energy policy in Ireland

The current phase of the process of mapping out future renewable energy strategy began formally with the launch in December 2003 of the consultation document *Options for Future Renewable Energy Policy, Targets and Programmes*[1]. The document set out a range of indicative sustainable energy source penetration targets for the electricity market: 13-20% for the year 2010 and 15-30% for the year 2020. It discussed future renewables policy and market issues, considered some of the barriers to be addressed and set out some of the options for support mechanisms. The consultation paper invited inputs on a number of questions and for suggestions as to what future targets and supports should be.

Around the same time, the Commission for Energy Regulation (CER) made a decision to place a moratorium on further wind energy connections to the grid, above the 600 MW or so already agreed, because of concerns raised by the ESB National Grid about the ability of the grid to accommodate such connections.

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[1] This and related reports available at www.dcmnr.gov.ie/energy/

These developments set the scene for the establishment in May 2004 by the Minister of the Renewable Energy Development Group (REDG). The group, comprised of representatives from several Government departments and agencies, sectoral and industry nominees and a representative of the NI Department of Enterprise Trade and Investment (DETI), was charged with the task of mapping the road to 2010 targets and considering targets for beyond 2010. Among the issues assigned to the group were consideration of the next market support mechanism; the introduction of net metering; research and development; the grid upgrade programme; the applications backlog and the wind moratorium.

REDG's first priority was to secure a route to achievement of Ireland's 2010 target for electricity from renewable sources. This target comes from the EU Directive Electricity Production from Renewable Energy Sources (2001/77/EC), commonly referred to as the RES-E Directive. The directive commits Ireland to the production of 13.2% of electricity demand from renewable energy sources by 2010. The sub-group formed to examine this first target was called the Short Term Analysis Group.

Two other groups were formed to feed into REDG's work. These were the Bioenergy Strategy Group and the CHP Policy Group. These groups, made up of experts from the public and private sectors, undertook research and consultation and developed strategies for the delivery of higher penetration of bioenergy and CHP respectively. The Bioenergy Strategy Group submitted its report in December 2004, the CHP group in February 2006.

At the same time, Sustainable Energy Ireland (SEI) and the Marine Institute were working together to develop a strategy for the promotion of ocean energy in Ireland. The process developed from a public consultation in late 2002, followed by the commissioning of a number of policy studies feeding into the final report submitted to DCMNR in October 2005.

All of this work took place in the context of a number of EU Directives that were informing Irish policy and targets. These include the RES-E Directive already mentioned, which requires member states to contribute to goals to increase the consumption of renewable energy sourced electricity within the EU. Also, the CHP Directive (2004/8 EC) provides for a range of measures to promote CHP, and, more recently, the EU Biomass Action Plan (COM(2005) 628 Final) which proposes actions to increase bioenergy deployment in heat, electricity and transport. Key Irish policy statements of relevance include the Green Paper on Sustainable Energy (1999), the Electricity Regulation Act (1999), the National Climate Change Strategy (2000) and the Sustainable Energy Act (2002).

The SEI Renewable Energy RD&D Programme

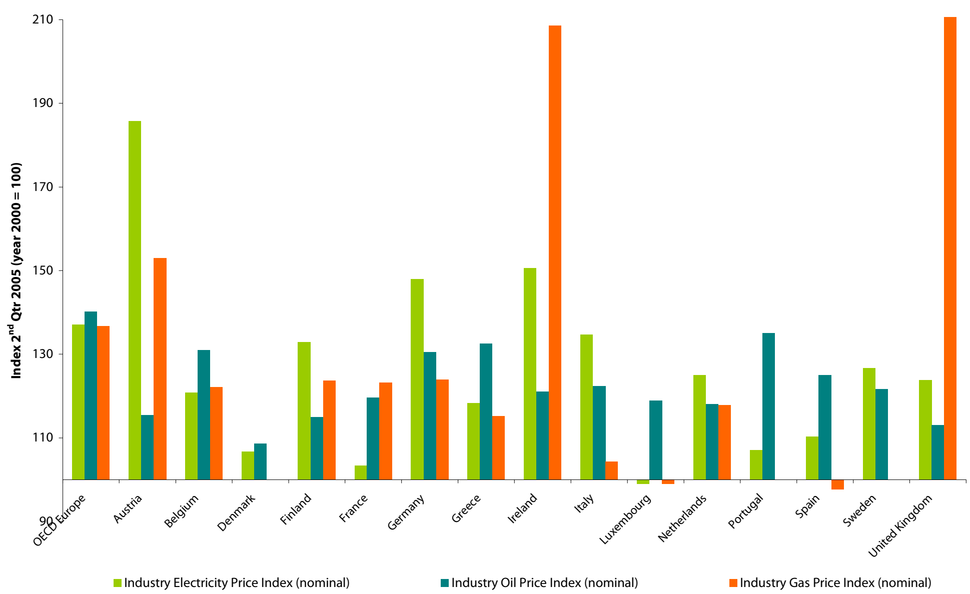
The goal of SEI's Renewable Energy Research, Development & Demonstration (RE RDD) programme is to stimulate the deployment of renewable energy technologies that are close to market and to assess and develop technologies that have prospects for the future. The programme provides support for renewable energy product research and development, market demonstration of new technologies, resource studies and public good research activities. It also commissions research and feasibility studies aimed at developing policy options, defining the market structure, reducing costs, improving reliability and/or opening new markets.

The RE RDD strategy was refined in May 2004 with more emphasis on support placed on wind energy, biomass heating, liquid biofuels, wave energy and energy storage technologies. Ocean Energy continues to be a strong R&D area of interest in Ireland with a number of projects and studies supported, as detailed later in this report. Support has also been provided for a number of commissioned studies in the area of liquid biofuels and wind energy. Specific wind projects include the development of a wind atlas for Ireland, an investigation into wind turbine design and implementation for small Irish wind farms, and the development of a 1.2kW domestic wind turbine. SEI also supported the Grainger Sawmill biomass CHP project with grant support of € 500,000 in 2004. Also, grant support from the programme assisted the installation at Coillte headquarters of a 100kW wood chip/wood pellet biomass boiler that will be used to provide training for Irish technicians in the installation and operation of wood heating systems. More information on the programme and on projects funded is available at www.sei.ie

The changing energy context

Since the REDG and other groups commenced work, the context for renewable energy in Ireland has been changing in many ways. Most notably, energy prices have been rising steadily, as illustrated in the following graph showing the trend of prices of energy to industry across the EU:

Figure 1: Nominal energy price change to industry since 2000 in EU-15 (index)



Source: SEI, *Energy in Ireland 1990 – 2004*

At the same time, while there has been some success in decoupling energy consumption from economic growth, Irish energy demand has been growing and is expected to continue to do so:

Figure 2: Total Primary Energy Requirement 1990 - 2020

Source: SEI, *Security of Supply Metrics: First Report 2006*

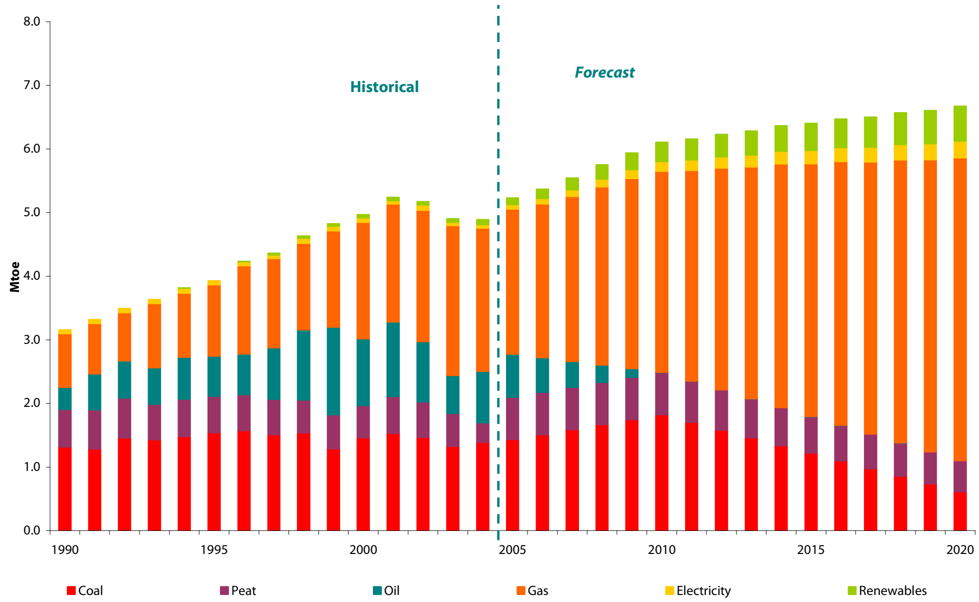
Renewable energy increased its contribution to primary energy consumption in Ireland from 1.8% in 2003 to 2.2% in 2004. Wind, which accounts for most of this growth, has now overtaken hydro in terms of renewable energy contribution. Biomass (mostly domestic wood burning) remains the largest contributor.

In absolute terms the primary energy contribution of renewable sources was 325 ktoe in 2004 representing a growth rate of 18% relative to 2003 and a 94% increase (4.8% per annum on average) on 1990 levels. The estimated quantity of carbon dioxide avoided by renewable energy in 2004 was 1.5 million tonnes.

Renewable electricity

The total contribution from renewable energy to gross electrical consumption in 2004 was 5.2%, up from 4.3% in 2003. This upward trend in the proportion of electricity from renewable sources, and the expected continuing future growth, can be seen in the following graph:

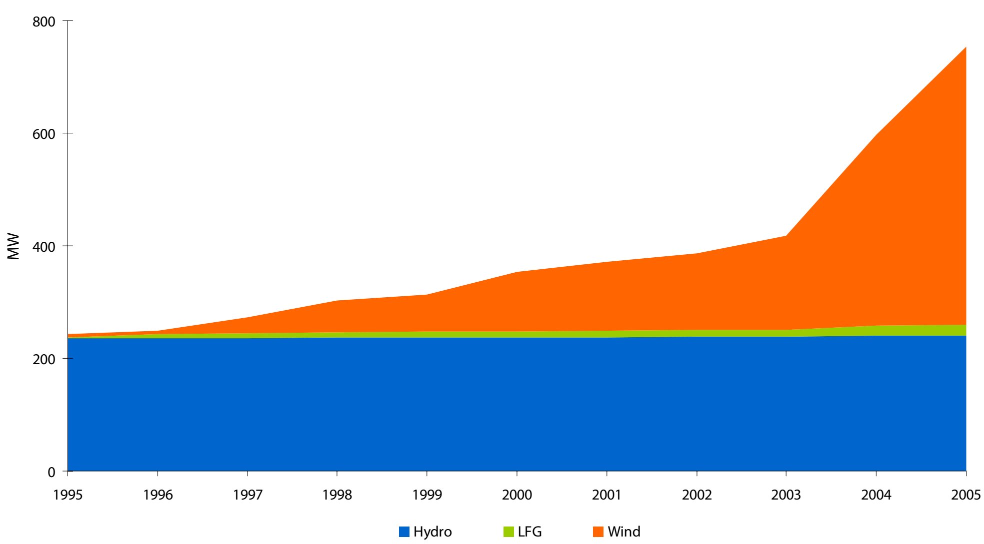
Figure 3: Electricity Primary Fuel Mix 1990 - 2020



Source: SEI, *Security of Supply Metrics: First Report 2006*

The largest growth in renewable energy contribution in recent years has come in the form of electricity generated from wind power. The output from wind generation increased by 44% in 2004 alone and by a further 46% in 2005. The total installed capacity of wind farms in Ireland in December 2005 was 495 MWe.

Figure 4: Renewable electricity capacity growth



Wind energy represented 2.4% of gross electrical consumption in 2004, making it the largest renewable contributor to electricity generation.

Wind power is now a success story in Ireland and growth is expected to continue. There have been challenges along the way, particularly in recent times regarding connection of wind generation to the grid. Applications from wind generators for grid connections represent new capacity almost six times the capacity currently connected. Grid connection issues came to the fore as wind power started to grow rapidly in 2003 and concerns were raised about the capacity of the grid to absorb these generation sources. ESBNG raised concerns relating to security and stability as the total amount of wind power in the system grew, leading to the moratorium on grid connections for wind generation put in place by CER in 2003. Representatives of the wind energy sector and others raised concerns about the effects of this moratorium on the sector and called for an acceleration of the process to develop a grid code for wind connections. CER established working groups to address some of the technical concerns raised by ESBNG and to develop new grid codes at transmission and distribution level.

Following the adoption of these new grid codes, the moratorium was lifted in December 2004, and a group processing approach for grid connection applications was put in place. The first set of connection offers under this approach ('Gate 1') was made during the course of 2005, with a total of 370 MW of new renewable generation across 33 developments receiving offers. The capacity remaining in the queue for connection after the Gate 1 process totals almost 3000 MW, indicating the considerable potential that remains for increasing RE input to the grid. The eirgrid/ESBNG website (www.eirgrid.ie) presents regularly updated figures on wind power connections, offers and applications. The following table presents the data as of the end of February 2006:

Table 1: Wind energy and grid connections, February 2006

Status	Capacity (MW)
Connected to the grid	522.9
Contracted for connection	654.7
In Gate 1 process	104.7
Applied for connection	2988.0

The CER is now developing a Gate 2 system to process applications and allocate a further batch of grid connection capacity. The rules for the process are now being developed through a consultation process undertaken by the CER. ESBNG, with the wind sector, has been working on dynamic modelling of wind generation to assess their impact on the overall system. A set of grid code provisions specifically for wind farm power stations is now in place.

Chapter 2 – The four group reports

Price rises in conventional fossil fuels serve to make the imperative to develop renewables all the stronger. At the same time, these price rises also improve the relative economics of many renewable energy sources. The interest in renewable energy has never been stronger, and there is a real sense of momentum building and of future possibility. This backdrop makes the four reports now being published all the more important as inputs into the Irish policy development process.

The four group reports are:

- *Bioenergy in Ireland*
- *Ocean energy in Ireland*
- *CHP in Ireland*
- *Renewable electricity to 2010*

These reports reflect the different styles inherent in the different contexts, terms of reference and participants in each case. They are published as submitted, between late 2004 and early 2006, and each is based on the data and context of its time. They serve to indicate the nature of issues that have been under discussion and the range of challenges to be addressed in increasing the contribution of sustainable energy sources to the Irish energy mix. They contain a considerable wealth of information as to how these policy objectives can be achieved and indeed each has already had its own impacts on the policy process.

Bioenergy in Ireland

The report of the Bioenergy Strategy Group

Introduction

The Bioenergy Strategy Group (BSG) was formed by DCMNR in December 2003. The group's remit was to consider the policy options and support mechanisms available to Government to stimulate increased use of biomass for energy conversion to produce heat and electricity, and to make specific recommendations for action to increase the penetration of bioenergy in Ireland.

The composition of the BSG recognised bioenergy as an inter-departmental issue, touching on many policy areas through the inclusion of representatives from the Departments of Agriculture and Environment, Heritage & Local Government. The other members of the group came from government agencies, industry and academia. The BSG completed its work in December 2004, submitting a final report to the DCMNR.

The work of the BSG started with an examination of the Irish biomass resource, focusing on the extent of its practical and economic availability. It then looked at the technology pathways that were appropriate to the exploitation of the resource in a 2010 timeframe, and considered the principal barriers to current deployment.

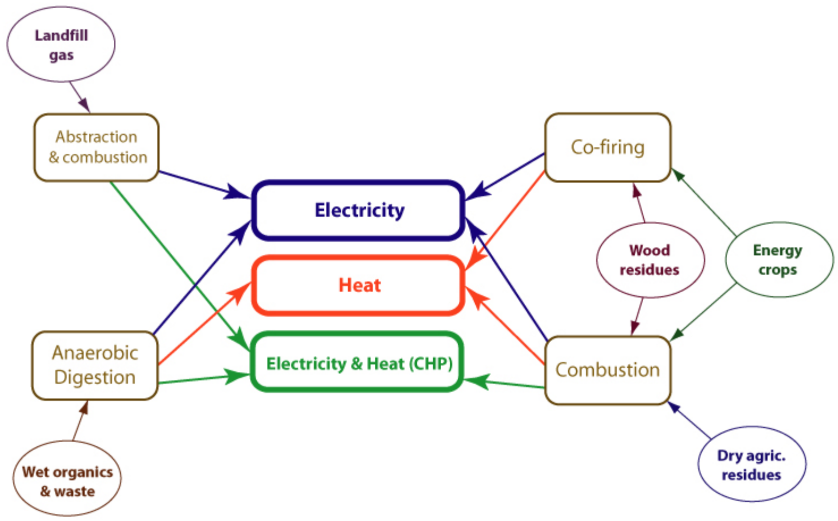
Bioenergy supports a wide range of national policy goals: energy goals such as security and diversity of supply and the development of indigenous renewable energy sources; environmental goals such as greenhouse gas emissions reduction and waste management; agricultural goals offering new opportunities for farmers in the context of CAP reform; and social goals such as employment generation in rural areas and enhancement of local economies.

Internationally, bioenergy is now the major focus of renewable energy policies and strategies and a future in which biomass is a key energy resource is envisaged. Most EU states have strong targets for bioenergy deployment over the coming ten to thirty years, supported by strong programmes of Government action.

Bioenergy pathways

There are many potential bioenergy fuel sources, and several conversion alternatives. All dry resources can be combusted to produce heat, electricity or both (through CHP), and could also be co-fired in existing solid fuel fired systems. Dry resources include wood and wood residues (forest residues or sawmill residues) and dry agricultural residues such as straw. Energy crops, principally short rotation coppice, can also produce dry fuels for combustion. Wet resources can be processed through anaerobic digestion, producing a methane-rich gas for combustion. Such resources include agricultural slurries, sewage sludge, food and catering wastes and the biodegradable fraction of municipal solid waste. An additional particular bioenergy resource is landfill gas, which can be collected at landfill sites and then combusted to extract its energy value.

Figure 5: Principal bioenergy pathways



Barriers to bioenergy

A key question for the group was what barriers could be addressed to facilitate greater uptake of bioenergy systems looking across fuel supply, extraction, processing, transportation and final use. A characteristic of bioenergy is that systems tend to span a range of sectors and actors in a typical pathway from fuel supply, through conversion to energy consumption. On the supply side, fuel resources of sufficient quality and quantity need to be collected, transported and stored, all at low cost. On the energy demand side, selling electricity in the new market raises access and pricing issues, and selling heat depends on local demand of sufficient size and dependability and on appropriate infrastructure. Some of these issues are common to all renewable energy sources, but many have features unique to bioenergy, and require scale and experience, and some specific interventions, to overcome them.

Bioenergy faces significant economic barriers. At current relative prices between biomass fuels and conventional fossil fuels, most bioenergy pathways are not fully competitive. However, many are close to being so. A building of critical mass would allow experience and confidence to grow and reliable supply and demand chains to become established. It would also bring benefits from economies of scale. Thus supports are required to kick-start the bioenergy market. The important first step is the development of a national bioenergy policy, within an overarching renewable energy policy, with strong targets underpinned by a strategy of supports and accompanying measures to lower barriers and address market failure.

Priority pathways

The priority technology pathways that were considered to be the most promising to 2010 were as follows:

- *Co-firing in electricity generation* – at peat-fired stations in particular. Biomass fuel is competitive with peat fuel. Co-firing would serve to build the market by providing strong, flexible demand for biomass fuels.
- *Industrial wood residue CHP* – many suitable sites exist and could employ well-proven CHP technologies to produce both heat and electricity from on-site or imported fuels.
- *Anaerobic digestion* – offers important waste management solutions in certain situations and could bring benefits in the short term
- *Landfill gas* – many suitable landfill sites exist, and if the resource is not exploited it will be lost. This is a path to biomass fuelled electricity that is easy to capture in a short timeframe. Several landfill gas energy systems are already in place
- *Wood heat in buildings* – a major opportunity for market growth though the delivery of high-quality energy solutions in a range of buildings, from houses up to large public and commercial buildings
- *Energy crops* – attention is needed now to ensure development of this sector, which will be the centre of bioenergy and biomaterials into the future

Conclusions and recommendations

A series of conclusions and recommendations were developed, chief among which were the following:

- Bioenergy is an environmentally and strategically important sector for Ireland to develop
- Government should publish a clear statement of policy supporting bioenergy, including ambitious targets and an integrated strategy for delivery
- In a mid-range projection, bioenergy uptake could represent contributions to total primary energy requirement of 3.4% and 4.8% in 2010 and 2020 respectively
- Supports are required to kick-start the bioenergy market
- Support for electricity production is best linked to output through price support, with feed-in tariffs being recommended. Fiscal incentives for growing energy crops should also be developed
- For bioheat, support through a grant scheme to reduce capital costs covering both domestic and small commercial level installations is recommended
- Other recommendations include co-ordinated marketing and promotion, research, training and the development of public sector exemplar projects

Ocean Energy in Ireland

An ocean energy strategy for Ireland

Introduction

SEI and the Marine Institute have been working together to prepare a strategy to advance Ireland's research and development capabilities so that ocean energy can contribute to Ireland's renewable energy mix. The process commenced with a consultation document published in November 2002 that outlined three possible broad strategic directions for ocean energy in Ireland and invited responses from interested parties. The submissions received fed into the strategy development process of which this report is the final outcome.

While most of Ireland's 2010 RES-E target is likely to be met by wind energy deployment, other renewables will become increasingly important beyond 2010 in meeting future targets. Ocean energy (covering both wave and marine current tidal energy) is one such source. The resource, particularly the wave energy resource, is potentially very large. However, the challenge now is to develop commercially attractive, highly reliable, integrated systems. Ocean energy may be deployed in small scale demonstrations by 2010, but is not expected to contribute significantly to Ireland's electricity supply before 2020.

Ocean energy in Ireland

Ireland possesses some of the greatest potential wave power resources in Europe, with a potential wave energy market at least as large as that for offshore wind energy. In theory, wave energy could provide Ireland's entire electricity demand, though of course this is subject to practical and economic limits. Tidal energy could supply an estimated 6% of Ireland's electricity demand.

Ireland has third level research expertise in a number of areas relating to ocean energy. These include turbine design (University of Limerick), wave tank model testing (Hydraulics and Maritime Research Centre, University College Cork) and wave energy modelling (Queen's University). There are also currently three wave energy prototype developers in Ireland namely Ocean Energy, Hydam and Wavebob. These activities represent the early stages of a potential new industry in Ireland.

To date, national agencies have provided an estimated €1.2m in grant aid to the sector. However, a more sustained long term commitment is required to enable ocean energy to contribute to renewable energy supply in the next decade.

The development of ocean energy technologies in Ireland can be accelerated by increasing the capacity for research and development, both within academic institutions and commercial entities developing devices in Ireland. A structured and phased strategy of development supports may enable Ireland to begin to utilize its ocean energy resource within a decade. Such a strategy could also see Ireland positioned to become a world leader in the manufacture and use of ocean energy systems.

In addition to providing a clean indigenous source of energy, success in building the capability of the ocean energy sector could provide a new market for energy project developers, and an export market in system design and production. Using offshore wind energy as a reference market, the value of a domestic market for ocean energy in Ireland is estimated at €180m by 2020, increasing to €780m by 2025, with additional CO_2 reduction benefits accruing to the economy valued at €2m and €10m by 2020 and 2025 respectively. By securing 20% of the European export market, Irish developers could bring €360m to the economy by 2020, creating up to 600 jobs, rising to €1590m and more than 1300 jobs by 2025.

An ocean energy strategy for Ireland

To facilitate the development of the Irish ocean energy sector and fully capitalise on Ireland's ocean energy resource, a four phase strategy is proposed with review procedures and decision gates at the end of each phase:

Phase 1 2005 – 2007

This phase focuses on development by supporting product R&D and research facilities. The objective is to develop and test large scale prototype concepts and develop technical leadership in this area. The estimated grant support cost for Phase 1 is €4.9m.

Phase 2 2008 – 2010

Support would focus on the development of pre-commercial grid-connected devices with the objective of demonstrating the potential for a cost effective, fully functional ocean energy converter operating in the Irish electricity market. An option to support either a national developer or an external commercial developer is included. The nature of support envisaged is grant support for product development and a test connection, along with electricity price support. The maximum cost for Phase 2 is €10.5m.

Phase 3 2011 – 2015

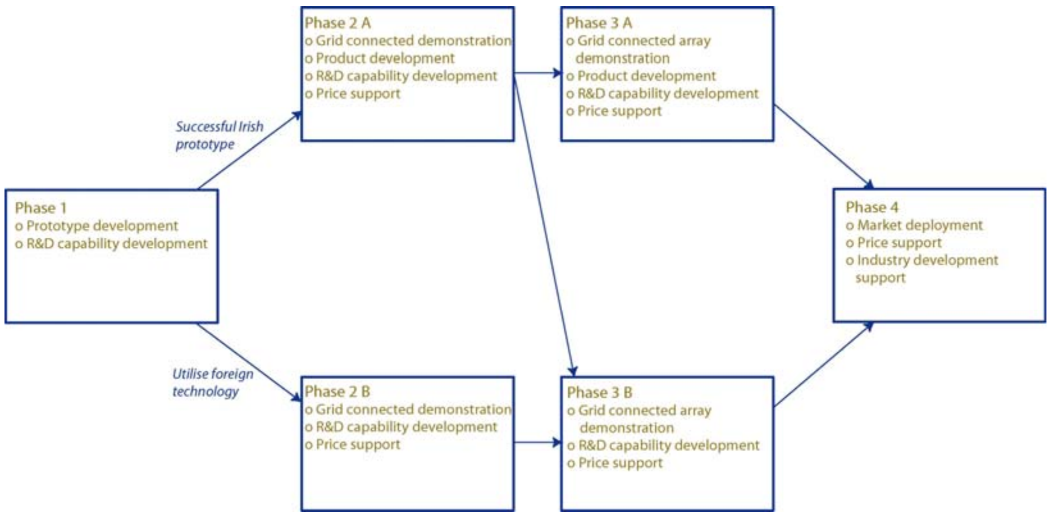
Support is envisaged for a 10MW large-scale array of devices to be connected to the grid. Some level of grant support for product development and grid connection, and possibly electricity price support, is likely to be necessary.

Phase 4 2016 onwards

This phase entails large scale market deployment for ocean energy. It is likely that some level of industry development support will be necessary, particularly if an export-focused industry in ocean energy device manufacture is to be developed.

Delivery of the proposed Ocean Energy Strategy will require a detailed step-by-step implementation plan. An ongoing advisory group made up of the relevant parties is proposed. Such a group could steer the development of a detailed implementation plan and then oversee its delivery to ensure maximum impact of the strategy on ocean energy development.

Figure 6: A four-phase ocean energy strategy for Ireland



CHP in Ireland – Options for a national policy to 2010

The report of the CHP Policy Group

Introduction

The CHP Policy Group was established by the Government to advise on appropriate future policy options, targets and support measures for combined heat and power, examining the period up to 2010. The Group included a range of stakeholders and consulted widely in the course of its work.

CHP is the combined production of heat and power in a single process. It can typically save around 25% of the energy that would have been required to produce electricity in a conventional power station and heat in separate heat-only boilers with commensurate savings of emissions. CHP can contribute significantly to meeting Ireland's energy policy goals of supporting sustainable economic growth, protecting security of supply and ensuring that energy supply and use are environmentally sustainable.

However, despite the energy saved using CHP, it is unlikely that most technically feasible CHP projects will proceed under current market conditions due to inadequate rates of return and high risks associated with investment in the technology. The Group has made a number of recommendations aimed at overcoming these barriers to CHP uptake. Among the factors influencing the viability of a CHP project are the relative prices of gas and electricity (known as the spark-spread), as well as the stability of this price difference. Various aspects of the liberalised energy market also have an impact, such as the rules for importing or exporting electricity from or to the grid, the tariffs and charges, and connections procedures. Improving the market conditions through the removal of barriers and risks will help stimulate the market and facilitate increased deployment of CHP.

Economic analysis

A simplified economic analysis was carried out to assess the economic potential of CHP. The analysis indicates that the levelised costs of the larger industrial CHP plants (greater than 1MWe) are all less than the current BNE, with smaller plants (less than 1 MWe) costing slightly more than BNE. Reduced CO_2 emissions, embedded generation savings, and electricity system costs are not considered in the calculation, and all serve to improve the economic case for CHP.

However when evaluated using investment criteria put forward by industry the economic analysis indicates payback periods ranging from 3.3 to 4.6 years for large plants and 5.7 to 6.8 for small plants. This, coupled with the risks, makes most of the projects insufficiently attractive to industry.

Financial supports via price support or capital grants have been analysed for their impacts on projects and their overall costs and benefits. The cost of support is compared with the national benefit resulting from fuel savings, CO_2 emission reductions and electricity system loss savings. This is done for three scenarios of CHP penetration:

Table 2: CHP penetration scenarios for 2010

	Existing and Planned Plant 2004	2010 Scenarios		
		Low	Medium	High
Installed CHP Capacity (MWe)	295	300	600	830
% of National Electricity from CHP	5.6	6	12	16

Analysis indicates a net national benefit of €10 - 20m annually by 2010 in the medium scenario from the savings induced by support in the range of 0.5 - 1 ct/kWh at a peak annual cost of €11 – 23m. The benefits from 10 - 20% grants as an alternative would be similar. National benefit grows in the high scenario. If met via the PSO, the cost of support would add between 0.6 and 1.1% to the average large end- user.

Support for CHP

The above analysis shows the national economic benefit from deployment of CHP growing with scale of deployment. However, the benefits do not always fall to the user and the return on investment is low when coupled with the risk involved. Thus the Group does not expect that the market alone will stimulate deployment on a significant scale without mitigation of barriers. If accelerated deployment of CHP is to be achieved, action is needed to reduced barriers. Specifically, financial assistance is required in the following areas:

- Financial support to raise the rate of return and lower the risk of the investment in new CHP plants in order to stimulate market deployment. The Group considers that support at the level of 1 ct/kWh (or 20% capital grant) would be necessary
- Research, development, demonstration and information dissemination (€1m between 2005 and 2010)
- On-going policy studies including implementation of the CHP Directive (€0.2m between 2005 and 2008)

This level of support is well justified in that CHP can assist in meeting Government's sustainable energy policy objectives at a cost less than the quantifiable national benefits. Financial assistance to in the form of price support for electricity generated from new high-efficiency CHP is likely to be most effective. This fits within the framework being utilised to support renewable energy. Alternatives such as capital grants should also be considered, particularly for smaller plants.

CHP targets

The Group considers that a new national CHP target focussed around the medium scenario (600MWe; 12% of national electricity generation) would be appropriate. The required build rate for new CHP plant is thought to be within the capacity of the industry supply chain. The rate of connections to the electricity system should also be achievable since most of the plants will have existing supply connections, but the combined impact of connections required to meet the 2010 renewable energy target and the 600MWe of CHP will require examination.

Conclusions and recommendations

The Group recommends that Government adopt an enhanced CHP policy to promote the uptake of high-efficiency CHP. This would support national energy policy goals relating to sustainable economic growth, security of supply and environmental sustainability.

A range of specific policy recommendations are made and are spelled out in the full report of the Group. These relate to policy implementation and co-ordination; research and development; adjustment of electricity market rules and charges; planning and regulatory guidelines; and information and awareness.

Renewable Electricity to 2010

Short term analysis group report

Introduction

REDG established a short-term analysis group to identify options for meeting Ireland's RES-E target of 13.2% of gross electricity consumption from RE sources by 2010. Many stakeholders participated in the group and a wide variety of perspectives were included. It also took account of responses to the initial consultation paper. The group worked over a 2½ month period in 2004.

Meeting this target will require a number of measures to address challenges such as grid connection issues; uncertainty about the future structure of the Irish electricity market; difficulties with AER contracts and with the AER instrument; compliance issues with respect to a new grid code for wind energy generators; planning timelines for RE projects; and availability and cost of finance for RE projects in Ireland.

The group's main recommendations are as follows:

- There should be good alignment between the grid connection application process, current or future support mechanisms and wider RE policy
- The financial implications of RE deployment for developers and consumers should be carefully considered and fully costed
- All relevant State bodies should work in a co-ordinated and concerted manner to identify and implement solutions to overcome the barriers to RE deployment
- The RE industry has an important role to play in meeting targets. The industry must be proactive in addressing the challenges faced and needs to act responsibly with regard to both support measures and the connection process so as to maximise the penetration of RE in Ireland.

RE policy must address the complexities of the current situation, the need for difficult decisions in a short time period and the requirement to deliver both short-term (2010) and longer term objectives.

Capacity required to meet 2010 target

The group's analysis of targets indicates that, depending on growth in future electricity demand, Ireland will need to have approximately 1,433 MW of RES-E installed by the end of 2009 to achieve the 13.2% target set out in the RES-E Directive. This target could be met by various combinations of RE technologies but it is expected that wind, hydro and biomass will be the dominant technologies, with the most likely scenario being approximately 1,100 MW of wind energy, 240 MW of hydro[2], 92

[2] Most of the hydro capacity that will contribute to the target has already been commissioned.

MW of bioenergy and 1 MW of ocean energy installed by the end of 2009. These figures and the gaps to target compliance are summarised in the following table:

Table 3: Capacity gap to 2010 RES-E target as of December 2004

	Wind	Bioenergy	Hydro	Tidal	Total
Generating as of November 2004	233 MW	26 MW	240 MW	0 MW	497 MW
Installed capacity required by end 2009 to meet 13.2% RES-E target	1100 MW	92 MW	240 MW	1 MW	1,433 MW
Minimum capacity gap to 2010 target	867 MW	66 MW	<1 MW	1 MW	936 MW

Current status of RE deployment

Analysis of current and proposed RE projects in Ireland highlighted some significant complications for the deployment of various RE projects, including:

- There is nearly 2000 MW of RE capacity in the grid connection application process[3]
- There are several hundred megawatts of RE capacity that has planning permission and a PPA but no signed grid connection agreement, including 268 MW of wind energy capacity with AER V / VI offers
- Given the proposed timeline for processing grid connection applications, some of the planning permissions for these projects with PPAs may lapse
- There are several hundred megawatts of wind energy capacity with signed grid connection agreements and planning permission but no PPA, including 381 MW of wind energy capacity on the AER VI Reserve List.

Challenges to RE deployment

Four specific areas were identified as crucial to increasing RE deployment and a number of recommendations were made to develop policy and procedures to lower barriers. The areas identified were:

- Grid code and modelling
- Constraining generation plant output
- The connections process
- Support mechanisms

[3] As of 20th October 2004 there were 126 applications representing 1,914 MW of wind capacity in the connection process. All relevant figures presented in this report are calculated based on this total value, although this figure may have changed since this date as applications for connection offers are received by TSO & DSO on an ongoing basis.

Support mechanisms to deliver the targets

Various financial support mechanisms were considered, although the exact public financial support requirement to deliver the 2010 target was not quantified. Ranges of the costs were estimated in order to inform the direction for more detailed analysis. The need for both primary and secondary supported was highlighted.

The cost and availability of finance is directly related to the policy and regulatory frameworks established. Long term PPAs are often cited as a pre-requisite for obtaining finance. Certainty is essential for planning.

Potential additional fiscal support mechanisms were discussed and a PPA fiscal support mechanism (competitive tender or fixed feed-in tariff) was considered the most likely instrument to be utilised. For any mechanism employed, targets should be above the 2010 RES-E target to ensure compliance with the Directive and other issues such as compatibility with AER contracts, costs and secondary supports will also need to be considered.

The future

The group discussed a number of topical long-term technical and policy issues. Policy and measures focused on the 2010 RES-E target should be developed and implemented in parallel with addressing the requirement to develop RE in Ireland beyond 2010. This should cover a range of different RE technologies in the transport, heat and electricity sectors. There is also a need to consider capacity building, industrial development and resource (fiscal and human) allocations to areas that require further analysis.

Co-ordination is important in meeting Ireland's RE deployment targets. The members of the group are committed to working in a concerted manner to achieve Ireland's 2010 RES-E target as a high priority, while accounting for issues including security of supply, system safety, system security and least cost to consumers. They will continue to actively engage with the renewable industry and other stakeholders in this process.

Chapter 3 – Recent developments

Introduction

The report summaries in the previous chapter reveal the extent of the challenge in fostering the development of renewables and CHP. There are technical, economic, institutional and market barriers, some more amenable to intervention than others. However, the reports also highlight what can be achieved through concerted effort, and this coordinated inter-departmental, cross agency approach, including the involvement of industry stakeholders, has now become the norm.

All reports emphasise the importance of all the relevant stakeholders working together, not just across Government departments and agencies, but also involving market actors, and inputs from developers and suppliers have been an important part of the process. The analyses outlined in the previous chapters have been important in informing many of the developments discussed below. The analysis here covers just some of the elements of what is a very dynamic area of policy and development activity.

Supports for sustainable energy

One of the most significant recent developments in RE policy is the introduction of a renewable energy feed-in tariff (REFIT) support mechanism. This seeks to support at least 400 MW of new electricity generation capacity from wind, hydropower or bioenergy by 2010. The programme aims to increase such capacity to 1,450 MW by 2010. Support is offered to suppliers to offset the net additional cost incurred in contracting to purchase the output from selected new projects at fixed prices. The compensation takes the form of a fixed cost recovery element (15% of the lowest contracted price up to a maximum of the large scale wind price). The price limits (indexed over time) are as follows:

- Large scale wind (above 5MW) category – 5.7 eurocents per kWh
- Small scale wind category – 5.9 eurocents per kWh
- Hydro – 7.2 eurocents per kWh
- Biomass landfill gas – 7 eurocents per kWh
- Other biomass – 7.2 eurocents per kWh

To ensure delivery of projects, applicants must show evidence of full planning permission, a firm connection offer and, in the case of bioenergy, evidence of access to a fuel supply of the life time of the support. The price limits reflect the current market conditions for each category and the scheme explicitly values the wider benefits of renewable energy.

Budget 2006 also brought major new supports for RE. Government announced a €65m multi-annual investment programme that will include grant aid to underpin the biofuels excise relief package and financial support for wood chip and wood pellet boilers aimed at the business, commercial and service sectors. It will also include a grant aid package for the domestic sector that will allow for individual grants to install renewable energy technologies such as wood pellet boilers, solar panels and geothermal heat pumps and a grant aid package to incentivise the installation of combined heat and power in the industrial, commercial and public services sector.

The wood boiler programme will lower the costs of heating systems for industry, business and the services sector to install heating systems that will have lower running costs than traditional fossil fuel systems and will lead to a significant CO_2 saving. It will also provide a boost to the forestry sector and assist in the development of a vibrant wood energy industry in Ireland. The domestic sector grants will support householders in the installation of renewable energy technologies in their homes. Such technologies will be particularly beneficial in areas where householders are dependent on oil or electricity for their heating needs and could lead to savings of several hundred euros per annum for a typical house.

These measures greatly enhance the support context for RE and CHP development. The importance of grant aid was highlighted by both the Bioenergy Strategy Group and the CHP Policy Group, recognising the barrier of high capital costs in these areas.

Support for bioenergy is also available through the pilot *Bioheat Boiler Deployment Programme*, launched by SEI in November 2005. The goal of the programme is to support the deployment of wood heating, as recommended by the Bioenergy Strategy Group, and functions as a pilot programme in advance of implementation of the wider support for bioheat announced in Budget 2006. The programme is targeted at heating in large buildings and small industrial sites, where boiler sizes are typically in the range 60 kW to 1,000 kW. Support is available up to 25% of the eligible capital costs. The volume of enquiries that have been received indicates that there is a significant level of interest in the programme and has provided critical market intelligence to inform the new multi-annual bioheat programme announced in Budget 2006 and scheduled to be launched shortly.

Research for sustainable energy

Part of the work of the policy and strategy groups was to develop the knowledge base for RE and CHP in Ireland and to answer some of the key questions about how to remove barriers and encourage market growth. Several research studies were commissioned as part of the work of the policy and strategy groups, and several more have been commissioned on foot of their recommendations and the ongoing development work of SEI and DCMNR. The studies can be found on SEI's web site www.sei.ie

The work of the Bioenergy Strategy Group led to the commissioning of three bioenergy studies by SEI:

- *An assessment of the renewable energy resource potential of dry agricultural residues in Ireland*

  Commissioned by SEI to inform the development of the resource base for bioenergy for heat and power. It covered straw, poultry litter and spent mushroom compost, identifying the scale of the resource, the current markets for the materials, the unused surpluses and the potential of these materials to deliver heat and power. The study was launched at a workshop in March 2004.

- *Co-firing with biomass*

  The aim of this study was to look at the potential for co-firing with biomass in the Moneypoint coal fired power station and in each of the three new generation peat fired plants in the Midlands. The study was completed in 2004. Since its publication, a number of activities connected to the possible co-firing of peat fired power stations have taken place.

- *Bioenergy training & education needs*

  This was commissioned on foot of the Bioenergy Strategy Group's identification of the lack of sufficient numbers of skilled professionals as a barrier to the growth of the bioenergy industry in Ireland. The study looked at the training that was currently available and identified the gaps in delivery. Proposals were also made addressing the gaps in training and education delivery. The report was launched at an Irish Bioenergy Association conference in January 2006.

There have also been several studies commissioned by SEI to inform the CHP Policy Group in its work:

- *Evaluation of the legislation and regulation affecting new CHP facility installation in Ireland*

  Evaluation of existing legislation and relevant industry codes pertaining to all aspects of CHP installation and operation (including electricity connection and distribution), and a review of the nationally determined procedures for planning and environmental approval of CHP facilities. Involved extensive consultation with stakeholders and made a number of recommendations to facilitate improvements to the CHP licensing process.

- *Study of the projected characteristics of new 'prime mover' technologies for CHP applications*

  Review of the projected characteristics of new 'prime mover' technologies for CHP applications, including their performance characteristics, potential input fuels, and projected capital, installation and operation and maintenance costs.

- *Study of the Irish supply chain capability for CHP applications*

  Examines current and future supply chain capability for CHP applications in Ireland; how it is currently structured and populated, and of how it would be affected under various future market development scenarios. The strengths and weaknesses of the existing supply chain are identified and recommendations are made as to where reinforcement may be required in the case of rapid CHP development.

- *International benchmarking report on the status of CHP in other EU member states*

  This report compares the status of CHP in Ireland to that of other EU Member States. It also identifies examples of best practice policy that could have relevance for the development of CHP Policy in Ireland.

- *Economic model of the costs and benefits of embedded generation*

  An economic model of the costs and benefits of embedded generation was developed for the Irish market, with the intention of including global estimates of the impact of the embedded CHP capacity on network investment.

These studies were commissioned during 2004 and many of their conclusions and recommendations feature in the CHP Policy Group's final report.

SEI has also produced support and information materials for CHP developers, including a published guide to CHP in Ireland and an on-line tool to help site-owners and developers considering CHP.

Support in the area of ocean energy has focused on funding support to developers for R&D activities:

- Wavebob - scale model testing, design and manufacture of 1:4 scale model for open sea trials in Galway Bay
- Ocean Energy - scale model testing and detailed design study of full scale device
- Hydam - numerical model development
- ESBi - wave energy monitoring programme
- UCD - Study to investigate integration of tidal energy to the electricity network

Total R&D funding allocated to developers to date is €450,000.

SEI and the Marine Institute are also involved in funding a number of activities which will provide general benefit to the development of ocean energy in Ireland. Projects supported include an economic study, resource assessments for both tidal and wave energy and the development of the Galway Bay Test Site. Total funding provided to date is €240,000.

This work is part of the first phase of the Ocean Energy implementation plan.

SEI also commissioned a number of studies in 2004 and 2005 to support policy formulation for the 2010 renewable electricity target. These studies address a significant number of the areas highlighted in the work towards the 2010 target and were commissioned to provide independent analysis based on international experience and intimate knowledge of the Irish electricity system and market:

- *Renewable energy in the new electricity market*

  This study examined the impacts of various market design choices on intermittent and unpredictable (non-dispatchable) energy generation. The study included detailed technical, economic, financial, and regulatory analysis and increased the understanding of the range of impacts of market design on the economic and operational viability of electricity generation from wind and other RE in Ireland.

- *Costs & benefits of embedded generation*

  A comprehensive cost benefit analysis of distributed generation in Ireland. The study considered commercial and technical arrangements that might be put in place that would minimise costs and maximise benefits and examined the impacts that these might have on electricity suppliers, the TSO, the DSO, the embedded generator, and the electricity consumer.

- *Impacts on operating (and load following) reserves of increased wind penetration*

  This study is a detailed technical and economic analysis of the impacts of increased wind penetration on the operation of and provision for electricity system operating reserves in the Irish context. A quantification of this impact was produced under a number of scenarios.

- *Economic analysis of policy mechanisms*

  A study on the impacts of various fiscal instruments for supporting renewable energy generation. The study included detailed economic, financial, and regulatory analysis, focusing on the use of dynamic cost curves.

- *Metering options for small-scale renewable and CHP electricity generation in Ireland*

  This study outlines the electricity metering options which might be employed for small scale electricity generators in Ireland. The report identified four small scale electricity generator scale-bands and five associated electricity metering options and analysed the appropriateness of these options for each scale of generation. The results of the analysis provide a guide to the choice of metering for small scale electricity generation.

SEI's Energy Policy Statistical Support Unit (EPPSU) has been active in undertaking and publishing detailed analysis of energy statistics and trends and their policy implications. These have contributed significantly to the information available to policy makers and all analysts, and now represent the largest body of detailed energy data ever available for Ireland. In addition, SEI has a number of ongoing information and marketing programmes to make sure that all actors have up to date information available to them in making energy related decisions. These programmes have promoted investment in technologies for renewable sources and energy efficiency as well as many managerial and behavioural aspects of the purchase, maintenance and use of energy equipment in all sectors.

Biofuels

In 2005, the Government introduced a mineral oil tax relief scheme for pilot biofuels projects. As a result of this initiative, eight biofuels projects have been granted excise relief over a two year period. The programme aims to kick-start the biofuels market in Ireland and will result in 16m litres of biofuels being placed on the Irish market.

Building on the success of this initiative, the Government announced in Budget 2006 a further excise relief package costing €205m over a five year period, commencing in 2006. The package aims to achieve 2% market penetration of biofuels by 2008 and will be critically underpinned by an investment package for biofuel processing facilities.

SEI has also supported two significant studies on policy and strategy issues for biofuels:

- *Liquid biofuels strategy study for Ireland*

  This study, completed in 2004, looked at Ireland's capacity to address the Biofuels Directive in terms of available feedstocks. It examined the technologies that could be applied, the costs and environmental impacts. The study also highlighted policy support mechanisms that could be implemented to help develop biofuels in Ireland.

- *Policy incentive options for liquid biofuels*

  Completed in January 2006, this study considered policy options being implemented around the world for supporting the development of biofuels in Ireland. The study focused on two options that were considered appropriate for Ireland and examined these in detail.

Sustainable energy in an all-island energy context

On July 25th 2005 the Governments of the Republic of Ireland and Northern Ireland jointly issued a preliminary consultation paper on an all-island '2020 Vision' for renewable energy. The paper sought views on the development of a joint strategy for the provision of renewable sourced electricity within the all-island energy market leading up to 2020 and beyond, so that consumers North and South continue to benefit from access to sustainable energy supplies provided at a competitive cost.

The consultation paper sought views on how the electricity infrastructure on the island might best develop to allow the maximum penetration of renewable energy. It noted that further information was required on the resource potential for different RES-E technologies on the island of Ireland in 2020; the extent to which partially dispatchable and non-dispatchable generation can be accommodated; network development options and the economic implications of the policy options outlined within the paper.

A working group was established to specify and oversee the completion of studies that would provide more detailed information on the issues raised in the consultation paper. The working group recommended an *All-Island Grid Study* comprised of 4 work-streams detailed below.

- *Work-stream 1*

  Investigating the renewables resource issues for 2020 and reporting on the details of the renewable resource mix to meet a range of options.

- *Work-stream 2*

  Investigating to what extent, non-dispatchable or partially dispatchable generation can be accommodated on the all island system with regard to variability and predictability. Also investigating the costs and benefits of absorbing various levels of renewable generation and the consequent effects on emissions and existing plant. Workstream 2 to be comprised of two stages: (a) an initial high-level modelling stage; (b) a detailed modelling stage to include simulations of actual 2020 generating plant commitment and dispatch with various projected penetration scenarios.

- *Work-stream 3*

  Investigating network development options for a range of renewable generation penetration levels based on that determined by Work-stream 2(a). At each level, two geo-spread scenarios are to be considered.

- *Work-stream 4*

  Using the results of earlier work streams to investigate the economic impact and benefits of various renewable generation levels. Also investigating impacts on stakeholders and perceptions of various options for recovery of costs incurred for variability management and network development. This work-stream combines the first two tasks to determine the impact of the rate of penetration on the cost burden for the various stakeholder groups and should also recommend any likely/necessary changes to envisaged market arrangements to facilitate the various levels of penetration.

The 2020 Vision for renewable energy sees affordable and reliable energy supply as an essential component of future economic infrastructure. The focus is on increasing both energy efficiency and the use of sustainable energy sources. According to the vision statement, 'finding new and sustainable sources of energy, learning how to integrate them into our normal lives and overall, reducing the amount of energy we consume are amongst the most important challenges we currently face.'

Work on the joint strategy for renewables takes place within the context of the all-island energy market development framework put in place in 2004. It is agreed that competition in the energy market is essential to the delivery of improved services and economic benefits to customers, and that all-island competition will increase choice and support economic growth and greater efficiency. A joint steering group has been in place since 2003, comprising senior officials from the relevant bodies on both sides of the border.

Conclusions

A sustainable energy economy depends on both efficiency in the supply and consumption of energy and in the substantial deployment of renewable sources. Technological development must be facilitated by the correct market design that includes policy and regulatory frameworks and informational supports. Support measures are also appropriate where market barriers prevent the deployment of technologies with wider economic and social benefits.

Whether it is the range of issues discussed by the policy and strategy groups, or even simply the number of different Government departments and agencies and other bodies with an interest in the topic, it is clear how the sustainable energy agenda cuts across many disciplines and policy areas. This is why responses must also cut across such borders and be based on multi-stakeholder dialogue and action. Through the REDG and other bodies, the structures are now in place for future work to take place in an integrated and co-ordinated manner. As the pace of work increases, it will be this co-operation and integration that underpins the potential impacts of new policy, strategy and support measures.

Common Abbreviations

BNE	Best new entrant (electricity generation)
BSG	Bioenergy Strategy Group
CER	Commission for Energy Regulation
CHP	Combined heat and power
CO_2	Carbon dioxide
DCMNR	Department of Communications, Marine and Natural Resources
DEHLG	Department of Environment, Heritage and Local Government
DETI	Department of Enterprise Trade and Investment (NI)
DSO	Distribution system operator
EPPSU	Energy Policy Statistical Support Unit (SEI)
ESB	Electricity Supply Board
ESBNG	ESB National Grid
PPA	Power purchase agreement
PSO	Public service obligation
RDD	Research, development and demonstration
RE	Renewable energy
REDG	Renewable Energy Development Group
RE RDD	Renewable Energy Research, Development & Demonstration Programme
RES-E	Renewable energy sources for electricity
SEI	Sustainable Energy Ireland
TSO	Transmission system operator

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