Department of Communications,
Marine and Natural Resources

An Roinn Cumarsáide,
Mara agus Acmhainní Nádúrtha

BIOENERGY ACTION PLAN FOR IRELAND

REPORT OF THE MINISTERIAL TASK FORCE ON BIOENERGY

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Foreword

Ireland has a significant bioenergy potential in the form of agricultural land, forestry and recycled waste from municipal, agriculture and industrial sources. All of these sources can be used to generate electricity, refined into fuel for the transport sector, provide heating/cooling for the building sector or as a source for biochemical raw materials for Irish industry.

The development of our bioenergy resources will contribute to our overall security of energy supply and fuel diversity objectives. Increased use of these resources will also contribute to our renewable energy targets, our climate change mitigation policies, our waste policies and, at a time of great change in our agricultural sector, assist in rural development by providing new markets and employment development opportunities for our farming and forestry sectors as well as community enterprise.

The sustainable development of our bioenergy potential and its deployment in the electricity, transport, heating and chemical sectors requires a fully coordinated approach across a number of Departments and State Agencies, working together across the sectors and with all stakeholders. In light of this challenge, the Government established a Ministerial Bioenergy Task Force which oversaw the delivery of the Action Plan.

This Action Plan sets out an integrated strategy for collective delivery of the potential benefits of bioenergy resources across the agriculture, enterprise, transport, environment and energy sectors. It will require sustained multi-agency collaboration, at national, regional and local level, working in strategic alliances to ensure that we realise this potential. It is a key component of the Government's objectives under the Energy Policy Framework 2007 - 2020.

This Action Plan is underpinned by the additional supports provided in Budget 2007 and the Sustainable Energy Programme of the National Development Plan 2007 - 2013. The plan will be kept under review in light of any decisions taken under the EU Strategic Energy Review.

Noel Dempsey, T.D.,
Minister for Communications Marine and Natural Resources,
Chairperson,
Ministerial Bioenergy Task Force.

Executive Summary

Ireland has significant potential to develop its bioenergy resources to generate electricity, for use as transport fuels, for use in heating and cooling our buildings and for conversion to biochemicals as industrial raw materials.

The sustainable deployment of our bioenergy resources will contribute to policy objectives in the energy, environmental, climate change mitigation, rural and regional development policies and for indigenous enterprise development.

This valuable potential will not be realised without sustained Departmental and Agency collaboration at national, regional and local level. The Government will mandate the High Level Bioenergy Working Group comprising all relevant Departments and Agencies to oversee progress on strategies and targets and ensure good collective working to accelerate deployment of our bioenergy resources.

In order to implement the Action Plan in a co-ordinated and cohesive manner, Departments and Agencies have undertaken to deliver the following series of measures.

Department of Communications, Marine and Natural Resources

Electricity sector

- Set a 33% target for renewable electricity for 2020;
- Expand the REFIT feed-in-tariff support scheme to facilitate delivery of co-firing in peat stations of 30% by 2015;
- Expand the REFIT feed-in-tariff support scheme to encourage waste to energy projects by supporting hybrid projects.

Transport fuel sector

- Set a biofuel target of 5.75% for road transport fuel for 2010;
- Set a biofuel target of 10% for road transport fuel for 2020;
- Introduce a Biofuel Obligation Scheme by 2009 to ensure delivery of the 2010 and 2020 targets;
- Support research into second generation biofuels including collaborative projects with other countries through SEI and the energy RTDI programmes under the auspices of the Irish Energy Research Council.

Heat sector

- Set a target of 5% renewable share in the heating sector for 2010;
- Set a target of 12% renewable share in the heating sector for 2020 (taking into account the target of 30% co-firing in the Peat Stations by 2015);
- Expand the Greener Homes Scheme to provide support for residential consumers to adopt renewable technologies for heating. This is being delivered through an additional €20m provided in Budget 2007;
- Expand the commercial Bioheat Scheme to include a combination of renewable technologies e.g. solar and wood chip. This is being delivered through an additional €4m provided in Budget 2007;
- Expand the eligibility of the commercial Bioheat Scheme to include the voluntary and community sectors.

Research and development

- Through the Energy RTDI Strategy under the auspices of the Research Council as well as SEI's R&D programmes to increase support for research projects across the bioenergy sector;
- Through the Charles Parsons Awards programme build increased research capacity across the bioenergy sector.

Department of Agriculture and Food

- Introduce an additional €6m energy crop 'top up' payment of €80 per hectare on top of the existing EU Energy Crops Premium of €45 per hectare payment;
- Introduce an €8m Bioenergy Scheme to provide establishment grants to encourage farmers to plant new energy crops such as miscanthus and willow;
- Introduce a €1.2m dedicated Wood Biomass harvesting machinery grant programme for wood chippers and forest residue bundlers;
- Encourage a rate of afforestation that is suitable for and sufficient to meet increased market demand for wood in the medium to long term;
- Introduce a FEPS scheme to facilitate increased levels of afforestation;
- Develop and support the forest wood energy chain to deliver quality wood fuel at a competitive price;
- Fund research in collaboration with DCMNR & SEI to identify and select plant varieties and crop production and management systems that are most suited to biofuel production in the Irish context.

Department of Environment, Heritage and Local Government

- Amend planning guidelines to facilitate development of micro renewable technologies at domestic level;
- Initiate research into the extension of exempted development provisions for micro-renewables at industrial and retail/commercial sites;
- Examine the rebalancing of annual motor tax to incentivise the motoring public to drive cleaner cars and to impose penalties for cars with higher $C0_2$ emission levels. A public consultation has been launched on this issue;
- Provide for the energy labelling of vehicles to empower consumer decision making;
- Promote the use of biofuels at up to 5% blends in Local Authority fleets and when purchasing new fossil fuel vehicles ensure that they are capable of taking much higher biofuel blends, in the range of 30% and higher;
- Review within 12 months the Part L Building Regulations to incentivise the use of renewable technologies for heating in buildings and significantly raise the energy efficiency requirements in new buildings by at least 40%;
- Require all street lighting and traffic lighting systems to be energy efficient.

Department of Finance

- Five year excise relief scheme introduced in Budget 2006 at a cost of over €200m.
- Renewing the Business Expansion Scheme with effect from 1 January 2007 for a seven year period to 31 December 2013. The BES company limit is being increased from its current level of €1 million to €2 million, subject to a maximum of €1.5 million to be raised in a twelve month period. The annual investor limit is also being increased from its current level of €31,750 to €150,000;
- Renewing the Seed Capital Scheme from 1 January 2007 for a seven year period to 31 December 2013. The SCS permits employees who leave employment to invest in certain new businesses and take up a job in the relevant business to claim a refund of tax for up to the previous six years. The investor limit is being increased to €100,000 per year;
- The 50% VRT relief for Hybrid Vehicles has been extended to flexible fuel vehicles in Budget 2006 and to electric cars in Budget 2007;
- Launch a public consultation on the revision of the current VRT system to take greater account of environmental issues, in particular CO_2 emissions;

Office of Public Works

- Develop the new building programme to include bioenergy heating systems. Bioenergy heating systems will become the standard norm in new OPW buildings;
- Convert within 12 months, 20 of the State's large existing buildings to bioenergy heating systems;
- Increase the use of passive design measures to ensure all new buildings are more energy efficient;
- Establish an initial target of 10% energy savings in 20 of the OPW's largest buildings, through the piloting a new web-based energy monitoring system, and expand this programme to a further 230 buildings on completion of the pilot programme;
- Use biomass combined heat and power (CHP) technologies in future major site developments;
- Give more favourable consideration to buildings which use bioenergy and other renewable technologies when considering new buildings for lease;
- Require the public sector to lead the way on energy efficiency with a mandatory programme of efficiency measures including the sole use of energy efficient lighting in offices, hospitals and other public buildings.

Department of Transport

- CIE transport companies to ensure that all of their new fossil fleet purchases are capable of using biofuels at blends of at least 30% by including the requirement for such technical capability to be specified in procurement tenders;
- CIE transport companies mandated to move as soon as possible towards a 5% blend in all their existing diesel fleet;
- Publication of a Sustainable Transport Action Plan before the end of 2007 which will identify further measures that will help a switch to biofuels and more energy efficient forms of fuel for transport.

Department of Education and Science

- Expand existing programme of biomass heating in schools, starting with 8 additional schools in Summer 2007 with a view to broadening this on a significantly wider scale on a national basis;
- The Department has already developed a number of generic school designs with SEI which minimise energy use and costs in new schools. This design will be implemented in 40 new schools which will be capable of being 2.3 times more efficient in energy terms than best international normal standards.

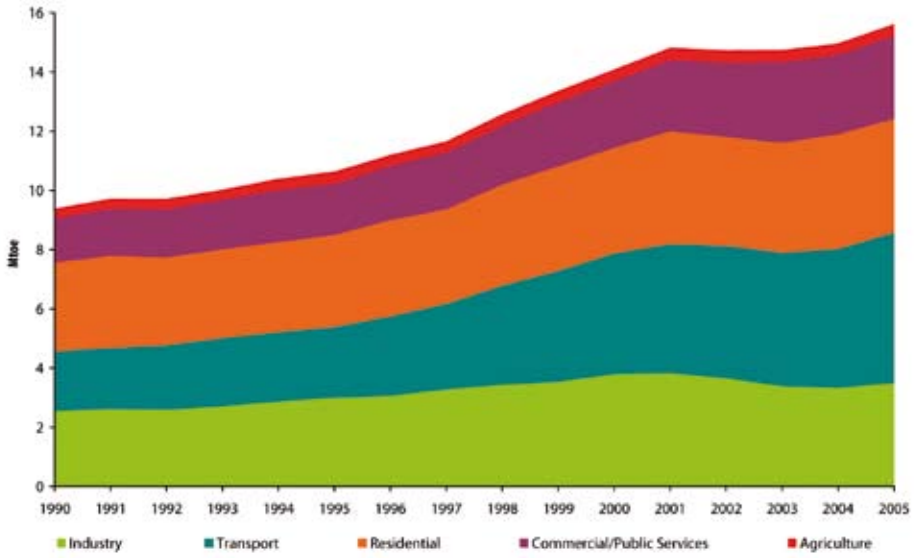
All Departments and Agencies

- Develop a fully coordinated cross-agency information and education programme to provide high quality bioenergy technology information to the public to raise awareness and acceptance of bioenergy technologies;
- SEI and Enterprise Ireland will together develop a set of industry and product standards in the biomass area to ensure high efficiency standards in the developing pellet and woodchip markets;
- SEI and FÁS to ensure that renewable energy installer training is mainstreamed into building industry training programmes;
- Work together through the High Level Working Group to ensure delivery of individual and joint Departmental and Agency responsibilities as well as offering a forum to engage with relevant stakeholders to keep track of progress;
- Coordinate through the High Level Working Group, working in conjunction with the Irish Energy Research Council, the funding priorities for the research, development and deployment of innovative projects in the bioenergy sectors;
- Develop, working with Northern Ireland, an all-island approach to developing the bioenergy sector over the next three years.

Chapter 1 Energy Trends in Ireland 1990 to 2005

The total amount of energy used within Ireland in any given year is referred to as the total primary energy requirement (TPER). The following graph highlights the growth of overall energy requirement in Ireland over the period 1990 to 2005 and breaks it down on a sector-by-sector basis.

Figure 1: Total Primary Energy Requirement by Sector



In 1990, Ireland had a primary energy requirement of almost 9.5 million tonnes of oil equivalent (Mtoe). By 2005 this had increased to 15.6 Mtoe, a 64.3% growth over the 1990 figure. This compares to a 153.7% increase in GDP over the same period and a growth in energy related CO_2 emissions of 49.6%. While this is a major increase in energy requirement, this also represents a significant and prolonged improvement in Ireland's energy intensity, which is the ratio of energy use to gross economic growth over the period.

This dramatic improvement results from a combination of higher economic growth in less energy intensive sectors, structural reform of the economy which saw the closure of 'heavy industry' high energy using companies, more efficient generation stations replacing older stations and in latter years the increased use of renewables in electricity generation.

The primary energy intensity of the economy fell by 35% between 1990 and 2005 (2.9% per annum). In 1990 it required 0.16 kilograms of oil equivalent (kgoe) to produce one euro of GDP (in constant 2003 values) whereas in 2005 only 0.1 kgoe was required.

The table below shows the relative changes in GDP, Energy Requirement and Energy related CO_2 over the period 1990 to 2005 in overall terms as well as in 5 yearly segments.

Table 1: GDP, TPER and CO_2 Growth Rates

	Growth %	Average annual growth rates %				
	1990 – '05	1990 – '05	1990 – '95	1995 – '00	2000 – '05	2005
GDP	153.7	6.4	4.6	9.4	5.3	5.5
TPER	64.3	3.4	2.2	5.5	2.5	3.0
Energy CO_2 (incl. aviation)	49.6	2.7	1.6	4.6	2.0	3.2

The main reason the 2005 increase in energy related CO_2 was higher than the TPER growth was the opening of two new peat electricity generating stations.

The table below shows the primary energy requirement figures broken down by sector and clearly shows how the highest level of growth took place in the Transport sector, which by 2005, with an overall share of 32.6%, had a significantly higher primary energy requirement than any other sector in the economy.

Table 2: Growth Rates and Shares of TPER by Sector

	Growth %	Average annual growth rates%					Shares %	
	1990 – '05	1990 – '05	1990 – '95	1995 – '00	2000 – '05	2005	1990	2005
Industry	37.6	2.2	3.4	4.8	-1.6	5.1	27.0	22.4
Transport	150.9	6.3	3.4	11.3	4.4	8.2	21.6	32.6
Residential	28.1	1.7	0.7	2.8	1.5	-0.8	31.9	24.5
Commercial/ Public	86.3	4.2	2.7	5.5	4.5	4.6	16.0	17.9
Agriculture	23.6	1.4	5.4	-0.9	-0.1	3.0	3.5	2.6
Total	**64.3**	**3.4**	**2.2**	**5.5**	**2.5**	**3.0**		

In absolute terms, sectoral primary energy consumption grew as follows:

- Transport energy use grew by 151% over the period 1990 – 2005 (6.3% per annum) and now consumes one third of all energy in Ireland. Growth in 2005 was 8.2%, almost 3% points above economic growth. There was a 5.1% increase in petrol consumption in 2005 and an 8.2% increase in diesel consumption. Transport was the fastest growing sector in 2005 in terms of primary energy consumption;
- Industry energy use grew by 5.1% in 2005 following three years of falling consumption. Industry's share of primary energy stood at 22% in 2005;
- Commercial and public services (also known as tertiary) use of primary energy grew by 86% over the period 1990 – 2005 (4.25% per annum). Consumption increased in 2005 by 4.6%;
- Residential primary energy use decreased slightly in 2005 by 0.8%. Over the period 1990 to 2004 residential consumption of primary energy increased by 28% (1.7% per annum). In 2005 the residential sector was the only sector to record a reduction in primary energy usage;

- Agriculture energy use grew by 24% (1.4% per annum) over the period. There was a 3% increase in consumption in 2005.

- The growth in energy across all sectors of the economy shows the opportunity and also the necessity that exists to significantly develop our indigenous bioenergy resources. Through increasing use of our bioenergy resources, we will also contribute to

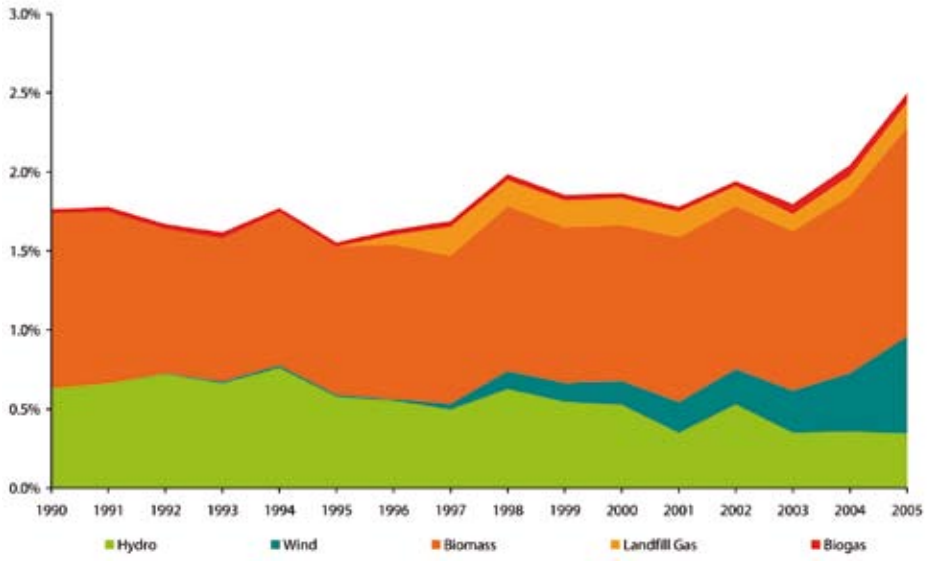
    - our renewable energy targets;
    - our climate change mitigation policies;
    - our waste policies;
    - rural development by providing new markets and employment development opportunities for our farming and forestry sectors as well as community enterprise.

Renewable Energy Definition

Ireland utilises the EU Directive 2001/77/EC definition of renewable energy, which defines renewable energy as 'non-fossil energy sources (wind, solar, geothermal, wave, tidal, hydro and bio-energy)'.

Bioenergy includes biomass, landfill gas, biogases and biofuels. Biomass is defined as the biodegradable fraction of products, waste and residues from agriculture (including vegetal and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste. Energy can be divided into three separate market sectors, namely electricity, heat and transport. Bioenergy technologies can be used as a fuel source in each of the three market sectors.

Figure 2: Renewable Energy Contribution to TPER



Renewable energy has been contributing nearly 2% of Ireland's primary energy supply since 1990. In 2004 the contribution stood at 2.2% and this has risen to 2.5% in 2005, a growth rate of 26%, well above the overall primary energy growth of 3%. Most of this has been delivered by traditional biomass, waste wood used by the timber processing industry for drying and wood burnt by the residential sector for home heating. The second most significant contribution over the period has been from the large-scale hydro power plants, the output of which has varied from year to year depending on rainfall patterns. There were major increases in the contribution from wind in 2004 and 2005 resulting in wind overtaking hydro to become the second most significant renewable energy source.

The significant increase in overall TPER masks the fact that renewable energy has grown considerably in absolute terms since the mid 1990s. The contribution from renewable energy to TPER was 168 ktoe (thousands of tonnes of oil equivalent) in 1990 rising by over 107% (5% per annum) to 391 ktoe in 2005. Reflecting the rapid growth of renewable energy sources, most particularly wind in the last few years, the increase in 2005 was 26%.

Total Final Consumption is the measurement of energy that is delivered to energy end users in the economy. This is total primary energy, less any conversion losses that are incurred in distributing or transforming energy e.g. refining crude oil to final end use products. Table 3 below shows the changes in final fuel use over the period 1990 - 2005. The notable growth rate of renewable energy, as highlighted in the table, in the later years is very apparent and this is forecasted to be a continuing trend with the high levels of development and increased investment in this area over the last few years.

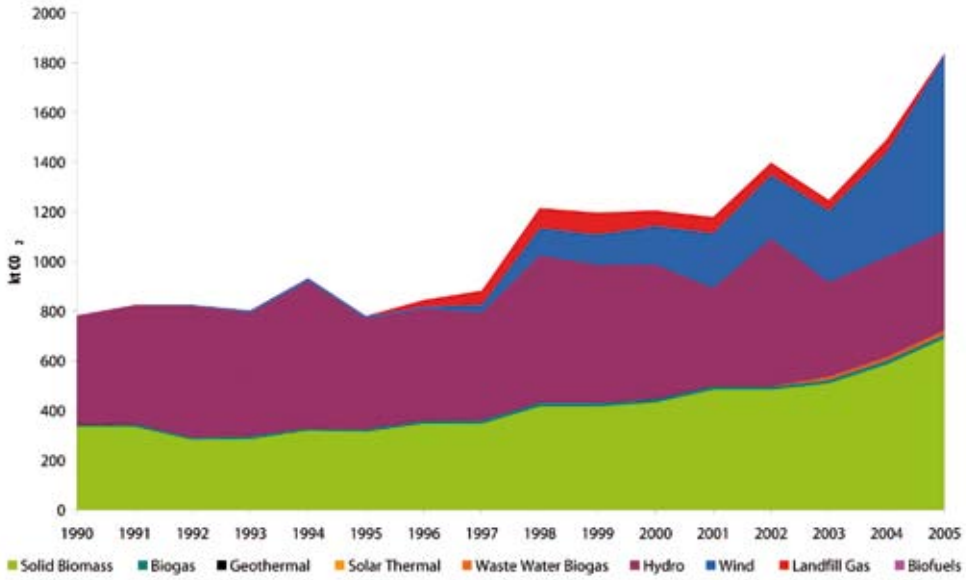
Table 3: Growth Rates and Shares of TFC Fuels

	Growth %	Average annual growth rates%					Shares %	
	1990 – '05	1990 – '05	1990 – '95	1995 – '00	2000 – '05	2005	1990	2005
Fossil Fuels (Total)	66.1	3.4	1.6	6.2	2.6	4.8	84.5	81.6
Coal	-48.3	-4.3	-17.7	4.6	1.8	7.5	11.6	3.5
Peat	-63.9	-6.6	-4.2	-13.1	-2.0	2.5	10.4	2.2
Oil	105.2	4.9	4.4	7.5	2.9	5.4	54.6	65.2
Natural Gas	135.3	5.9	7.0	8.6	2.2	0.9	7.8	10.7
Renewables	96.1	4.6	-1.1	6.6	8.5	21.0	1.5	1.7
Combustible Fuels (Total)	66.6	3.5	1.6	6.2	2.7	5.1	86.0	83.2
Electricity	105.2	4.9	4.6	6.4	3.7	5.6	14.0	16.8
Total	**72.0**	**3.7**	**2.0**	**6.2**	**2.9**	**5.2**		

Figure 3 (over) shows the trend in avoided CO_2 emissions from renewable energy for the period 1990 to 2005. It is assumed the electricity from renewables (wind, hydro, landfill gas and the electricity portion of waste water biogas) avoids the amount of CO_2 produced by the weighted average electricity production from marginal oil and single cycle gas plant.

It is also assumed that the thermal energy from renewable energy (solid biomass, biogas, geothermal and solar and the thermal portion of waste water biogas) displaces thermal energy from oil-fired boilers. The CO_2 avoided from thermal renewable energy is equated with the CO_2 emissions that would have arisen from this oil consumption.

Figure 3: Avoided CO_2 from Renewable Energy 1990 to 2005



There are a number of limitations and caveats associated with this methodology. It ignores any plant used to meet the associated reserve requirements. These single cycle plants will typically generate increased CO_2 and NO_x emissions compared with CCGT and these emissions should be incorporated into the analysis. The purpose of presenting an analysis here is to provide initial insights into the amount of fossil fuels that are potentially displaced by renewables and the amount of emissions thereby avoided.

Increasing the use of our bioenergy resources across the electricity, transport and heat sectors will have clear and demonstrable benefits for Ireland's environmental and economic performance.

Chapter 2 Land Use in Ireland

The land area of Ireland is some 7 million hectares (ha), of which 4.3 million hectares is used for agriculture and approximately 710,000 ha for forestry or about 10% of total land. 79% of agricultural area is devoted to grass (3.4 million ha), 11% to rough grazing (0.5 million ha) and 10% to crop production (0.4 million ha). Table 4 below summarises the area under crops and pasture.

Four arable crops are traditionally grown in Ireland; cereals (325,000 ha), sugar beet (formerly 31,000 ha), potatoes (14,000 ha) and forage maize (20,000 ha).

Table 4: Land Use in Ireland

Land Use	(hectares)	End Use
Wheat	95,000	Primarily animal feed
Oats	17,000	Primarily animal feed
Barley	165,000	Primarily animal feed
Oilseed Rape	4,000	Break Crop/energy crop
Sugar Beet	31,000	Sugar Beet
Potatoes	12,000	Food production
Other crops/fruit/horticulture	113,000	Food production
Area under permanent pasture	3,850,000	Beef/dairy production
Area under Afforestation	710,000	Forestry/wood energy

Reference: CSO Statistics 2005

Under reform of the Common Agriculture Policy, farmers now have the freedom to focus more clearly on exploiting new farming opportunities, including agricultural production for non-food use. The main energy crops that can be grown in Ireland include oilseed rape, cereals, hemp (annual crops) and willow, miscanthus, reed canary grass (perennial crops). Production of energy crops in Ireland is relatively undeveloped mainly due to poor profitability at farm level. Oilseed rape is the main crop grown, however, production declined from a peak of 6,000 hectares in the early 1990s, to approximately 4,000 hectares in 2005.

Developing an indigenous biofuel industry from native raw materials depends on a number of factors including the availability and suitability of land for the various crops, taking account of rotation restrictions and current area in tillage. There are few agronomic factors limiting the expansion of the cereal area and some of the land currently used as grassland, mainly in the South East, could be converted to arable use, subject to some overall EU restrictions on land use.

A large-scale transfer of land to energy crops would be dependent on adaptations at farm level and could give rise to other concerns, including an adverse impact on feed prices and additional animal feed imports. It is envisaged the increased demand for grain and other crops for biofuel will eventually result in competition between the food/animal feed and energy sectors. At present Ireland is self sufficient in barley and oats and just over 70% self sufficient in wheat. In 2005, Ireland imported 766,000 tonnes of cereals of which 721,000 tonnes consisted of wheat imports. There is a demand for approx. 1.5 million tonnes of feed grains for animal feeding. However, this figure may decline due to an expected fall in cattle numbers post decoupling.

FAPRI-Ireland estimates that even, without a World Trade Organisation (WTO) agreement, there will be a reduction by 2015 in cattle and sheep numbers post decoupling. Under the scenarios outlined by FAPRI farmers will de-stock irrespective of a WTO agreement with consequent implications on both animal feed requirements and land availability. This will have a knock on effect on land availability for energy crops if inducements are right.

It is estimated that some 150,000 hectares of arable land have been converted to grassland since 1985. While it is difficult to accurately forecast, estimates suggest that it should be possible to return some 100,000 hectares of this grassland back into tillage, depending on profitability. Ireland also has some 30,000 hectares in set-aside land, which could be used to grow energy crops. Given that set-aside land is by its nature marginal land and in small parcels, it is anticipated that approximately 10,000 hectares will become available for energy crops. The ending of sugar beet production in 2006 has freed up some 31,000 ha of tillage, which could be available for growing energy crops.

By-products of farming and food processing

Several by-products of farming and food processing industries can be recovered and used in various ways as bioenergy feedstock. These are mainly animal by-products (ABPs) such as meat and bone meal (MBM), tallow, animal manures and food by-products.

In 2005, annual production of meat industry by-products amounted to some 546,000 tonnes, which were rendered into 143,500 tonnes of MBM and 88,000 tonnes of tallow. An estimated 37 million tonnes of animal manures are stored on farms annually prior to disposal. In addition, some 676,000 tonnes of municipal food (catering) and garden waste (no breakdown available) are produced annually from both household and commercial sources.

Of the 676,000 tonnes of municipal food waste, an estimated 20,000 tonnes of recovered vegetable oil (RVO) is produced annually, primarily from the catering sector.

Tallow

EU Regulation (92/2005) provides for the conversion of tallow to biodiesel. Two rendering plants have expressed interest in building biodiesel plants for this purpose. Of the total amount of tallow produced, 42,300 tonnes is Category 1 tallow (from specified risk material) and 46,000 tonnes is Category 3 tallow (from animals fit for human consumption). The Category 1 tallow is used, at present, as a biofuel in thermal boilers in rendering plants and larger meat export plants to provide energy. One of the plants intends using a mixture of tallow, recovered vegetable oil (RVO) and rapeseed oil. The other intends using tallow only with possibly small amounts of RVO and rapeseed oil. Category 3 tallow can be used as a fuel but can also be used by the oil or chemical industry or for incorporation in feed. The ultimate use will clearly be determined by commercial considerations.

Anaerobic Digestion

Animal manures can be used in a number of ways as bioenergy. These range from relatively large power plants to small facilities for dealing with manure from a single poultry farm.

The production of biogas through anaerobic digestion (AD) from animal by-products other than animal manures must comply with the EU Animal By-products Regulation 1774/2002. AD is a proven technology that extracts energy in the form of biogas from organic waste. The biogas is typically composed of approximately 65% methane plus a range of other gases. It can be used to generate heat and/or electricity. The process leaves a residue called digestate, which is a combination of fibre and liquid. Many biogas plants are now in operation across Northern Europe.

There are a number of circumstances militating against the widespread uptake of AD plants in Ireland. In particular, on the vast majority of cattle farms in Ireland, manure nutrients are recycled on-farm by land spreading in a sustainable and cost effective manner. In general it would not be economic for farmers to transport manures any great distance to an anaerobic digestion plant for treatment and subsequent land spreading. High capital costs are another inhibiting factor. It may be possible for larger farms or farmer co-ops with significant outputs of animal manures and which are located near cities/towns to operate AD on a viable basis, especially if non-agricultural feedstock can be used. Compliance with the EU Nitrates Directive (91/676/EEC) may ultimately change the economics of AD development.

Fluidised Bed Combustion (FBC) System

This system uses poultry litter and is designed to reduce the litter volume to 10% of its original mass and to produce energy to heat chicken sheds. This remaining volume is suitable as a fertiliser. An FBC operates by providing a pre-heated hot bubbling bed of sand for the litter to fall into. The fuel then combusts in a boiler burner and produces heat. If the calorific value and moisture content are appropriate, combustion can be self-sustaining and the pre-heating burner can be switched off. 100% poultry litter fuelling was found to be successful so it is not necessary to supplement with other fuel. FBC could be very effective as a small on-farm poultry litter disposal system that also has bioenergy capabilities for the farm e.g. poultry houses, farm dwelling etc. It is currently being piloted on a farm in Co. Limerick.

Straw

Ireland's agricultural sector creates significant quantities of dry residues, principally straw, which can be combusted to produce electricity, heat or both. Total straw production in Ireland is of the order of 1.1m to 1.4m tonnes. Current uses are animal bedding and ploughing back.

With a typical energy value of 13.5 MJ/kg (at a moisture content of 20%), the theoretical straw energy resource is calculated to be about 16-20PJ (4500-5500 GWh). An SEI study examining the resource, estimated that in reality about 10% of this would be available for utilisation on a practical and economic basis, i.e.1.8PJ or 500 GWh. Teagasc is examining the economics of using dry residues such as straw for heating purposes in various forms.

The Department of Agriculture and Food have recently launched an investment aid scheme for on farm waste processing facilities, which includes the possibility of grant aiding Anaerobic Digestion and Fluidised Bed Combustion treatment facilities.

Chapter 3
Bioenergy for the Transport Sector - Biofuels

Biofuels are renewable fuels, which have significantly less emissions than their fossil fuel equivalents. While a range of biofuels exist, they are principally available in three forms - (1) biodiesel made from pure plant oil, recovered vegetable oil or tallow and typically blended with diesel in a 5% mix, (2) bioethanol made from sugar beet, wheat, whey or other crops and blended with petrol in a 5% mix or in an 85% mix for use in flexible fuel vehicles, and (3) pure plant oil, which is not blended and requires modification of most vehicle engines before use.

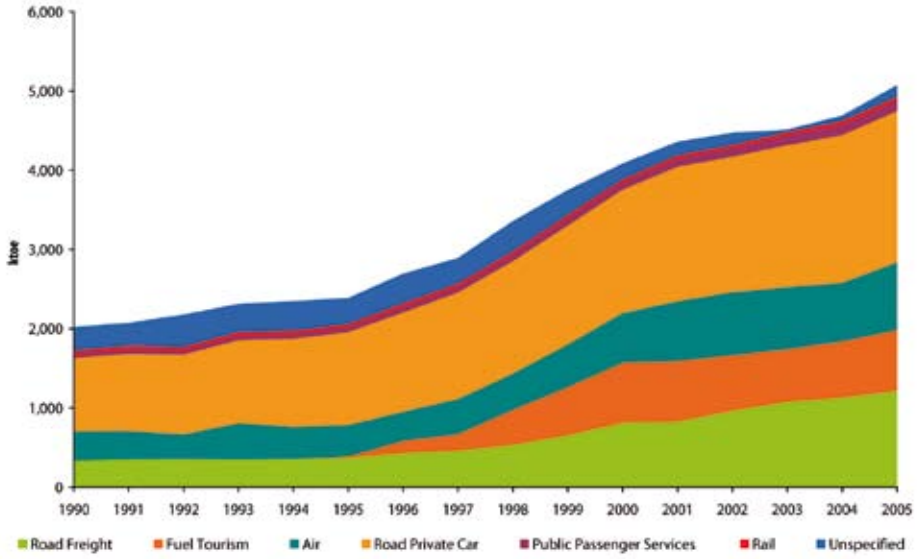
Biofuels offer a tangible and practical means to effect immediate and quantifiable emissions reductions in the transport sector, which is currently trailing behind industry, energy and agriculture in achieving the targeted emissions reductions established in the National Climate Change Strategy. Because biofuels can be made from waste vegetable oils and tallow, which are no longer permitted as animal feed, they can also contribute to waste management policies. In addition to these environmental benefits, biofuels offer significant opportunities for rural communities to diversify into the growing of energy crops. As Ireland relies on imports for all of its transport fuel requirements, the development of a biofuels sector will contribute to security of supply by providing new fuel sources. Table 5 below, from SEI, shows a breakdown of the share of the different fuels used in the transport sector and their relative growth rates since 1990.

Table 5: Growth Rates and Shares of Energy-Related CO_2 Emissions in Transport

	Growth %	Average annual growth rates %					Shares %	
	1990 – '05	1990 – '05	1990 – '95	1995 – '00	2000 – '05	2005	1990	2005
Total Oil Products	152.1	6.4	3.4	11.4	4.4	8.2	99.8	99.8
Petrol	93.2	4.5	3.3	7.5	2.7	5.1	45.6	34.9
Diesel	249.1	8.7	4.6	16.6	5.3	8.2	34.4	47.6
Kerosene	129.3	5.7	1.4	9.5	6.4	15.5	18.5	16.8
LPG	-33.3	-2.7	3.1	-6.5	-4.4	0.0	0.3	0.1
Fuel Oil	-15.0	-1.1	1.9	2.6	-7.4	-5.6	1.0	0.3
Electricity	161.5	6.6	1.6	5.3	13.3	17.4	0.2	0.2
Total	**152.1**	**6.4**	**3.4**	**11.4**	**4.5**	**8.2**		

Figure 4 shows the growth in transport energy by market segment. The main growth over the 1990 to 2005 period was clearly in the private car market segment.

Figure 4: Transport Energy Demand by Mode 1990 - 2005



Biofuels Directive

The EU Biofuels Directive (2003/30/EC) sets indicative targets of 2% market penetration by 2005 and 5.75% market penetration by 2010. These targets are not mandatory and Ireland, in common with a lot of other EU Member States, is developing a biofuel industry from a very low threshold. Ireland is committed to achieving a 5.75% target by 2010 and has endorsed the 10% target by 2020 recently agreed by the EU under the new Energy Policy for Europe. Ireland is committed to achieving, and if possible exceeding, the 10% target.

Biofuels Market in Ireland

In 2005, DCMNR launched a pilot biofuels Mineral Oil Tax (MOT) Relief scheme which resulted in 8 projects receiving excise relief for the production of 16m litres of biofuels over two years. There are 4 pure plant oil, 3 biodiesel and 1 bioethanol projects arising from the scheme. The scheme will result in 16m litres of biofuels being placed on the Irish market by this year. In 2005, 1.3 million litres of biofuels were placed on the market compared with petrol consumption of 8.074 billion litres and diesel consumption of 6.588 billion litres (SEI Energy in Transport 2006 Report).

Under the 2006 Mineral Oil Tax Relief scheme sixteen biofuels projects have been granted excise relief. Four distinct types of biofuels are being supported under the scheme. These include:

- Biofuel or biodiesel complying with diesel standard EN590 and sold at regular diesel pumps. This biofuel is typically made from pure plant oil, used cooking oil and tallow and blended with fossil diesel;
- Biodiesel in higher blends of up to 100% in specific fleets of vehicles whose engine warranties cover these blends;
- Bioethanol made from wheat, barley, whey and other feedstock, blended with petrol and sold at regular petrol pumps. Bioethanol in blends of up to 85% in petrol, which can be used in flexible fuel vehicles are also being placed on the market as a result of this initiative. The 2006 Finance Act allowed for a 50% VRT reduction in such vehicles. A number of companies have now launched flexible fuel vehicles on the Irish market and 200 of these vehicles have been introduced to date;

- Pure plant oil made from the oilseed rape crop and used in specially modified diesel engines.

Under the Scheme **which will cost in excess of €200 million over five years**, 163m litres of biofuels will be placed on the market by 2008, representing 2.2% of the predicted fuel market for that year.

There are recognised challenges for indigenous biofuels in achieving our biofuels targets up to 2010 and beyond.

2008: 2.2% Biofuels Target

Teagasc estimates that the 2% substitution target would require 75,000 ha of tillage land, about 20% of our total tilled area. Possibilities include up to 25,000 ha of wheat for ethanol and 50,000 ha of rapeseed for biodiesel or pure plant oil. The latter could be reduced to 30,000 ha or less by using recovered vegetable oil (10,000 t) and some beef tallow. The 2% target, although significant, is achievable without unduly disrupting existing food or feed markets. Under EU State Aids rules, Ireland cannot discriminate in favour of indigenous production in its Biofuels programmes and some imports of feedstock or finished product will also contribute to meeting this target.

2010: 5.75% Target

It will be an acknowledged challenge for Ireland to achieve the 5.75% target purely from indigenous feedstock in the medium-term future as liquid biofuels can only be produced from annual arable crops using current (first generation biofuel) technologies. In the short-term, Teagasc considers that the best prospects are ethanol from cereals and vegetable oil and biodiesel from rapeseed, with a small amount of tallow and waste vegetable oil. In the medium to long term, the possibilities include 180,000 ha of rapeseed for biodiesel and pure plant oil and 75,000 ha of cereals for ethanol.

Another factor is that rapeseed is grown in a one-in-four year rotation and therefore the knock-on effect would require 720,000 ha of land in tillage, almost twice the total present amount. This area of tillage would produce over 1m tonnes of additional cereals for which new markets would be required. There is also the likelihood that we would exceed the 10% reduction in permanent pasture prescribed in the recent reform of the CAP.

Significant longer term potential lies in producing ligno-cellulosic (mainly perennial) crops rather than sugar, starch or oil (mainly annual) crops. The Irish climate is better suited to ligno-cellulosic crops and the emergence of new second-generation biofuel technologies will eventually allow these crops be converted to liquid biofuels. While there is currently expected to be a significant lead-in time before these second generation technologies reach full commercial potential, we will support accelerated development of second generation biofuels including collaborative projects with other countries.

In order to deliver on biofuel consumption targets we need to provide market certainty or allow developers/ market players to develop economically viable scale into their projects going forward. The Ministerial Bioenergy Taskforce has endorsed a move by Ireland to develop an obligation scheme that will oblige fuel distributors to achieve an average of 5.75% biofuels (on an energy basis) of their total annual fuel business by 2009. This will also facilitate the industry in developing appropriate refining, storage, distribution and supply chain logistics.

Under current standards up to 5% blends of biofuel in both diesel and petrol can be used in engines without any modifications. The balance of the 5.75% and 10% targets can be achieved by use of higher biofuel blends in modified engines and suitable captive fleets. The European Commission has recently published a draft amendment of the Fuel Quality Directive (Directive 98/70 as amended by Directive 2003/17) which proposes increases in the volume of biofuels that could be permissible in regular fossil fuels. This initiative, if successful, will assist Member States, including Ireland, to meet the higher targets.

The Government will therefore introduce an obligation on fuel supply companies to have an average of 5.75% of their annual fuel sales as biofuels, and increasing to 10% (on an energy basis) of their overall sales by 2020. Taking full account of developments in the EU, we will publish the detailed proposals on the obligation for consultation later this year prior to the introduction of legislation.

The basic design of obligation schemes is that supply companies have to account for their fuel mix on an annual basis and that if they do not reach the obligated limit, to pay a fixed amount penalty per litre of target not achieved.

2020: 10% target

A target of at least 10% by 2020 will almost certainly involve importing biofuel feedstock or ready blended biofuel as the land implication of achieving this target from indigenous sources would be in the region of 400,000 to 500,000 hectares.

A key determinant in reaching this target will be the development of second-generation biofuels which will mainly use ligno-cellulosic biomass feedstock. While such technologies exist today, they are not fully market competitive and there is a recognised need at EU level for further RD&D in this area. The main advantage of this change in feedstock will be that bioenergy and food or animal feedstock will no longer be competing against each other to the same extent.

Sustainable Development

There are also concerns over the sustainability of imports from countries outside the EU, as there is little point in the EU substituting transport fuel by importing feedstock or already refined fuel from countries that do not apply sustainable agricultural practices. This is an area the European Commission is particularly interested in addressing and an area which we will be following very closely. Ireland would be in favour of the development of overall EU sustainability standards for bioenergy in general and biofuels in particular, to ensure the highest sustainability standards are met.

The Department of Transport has committed to integrating sustainability considerations into the development and delivery of overall transport policy and the Government has committed to delivering a Sustainable Transport Action Plan in this regard.

Promoting the increased use of biofuels as a transport fuel in captive fleets such as public transport bus operators will play a crucial role in our efforts to reduce the level of greenhouse gas emissions and energy intensity of the transport sector.

Dublin Bus is currently piloting the use of 5% biodiesel blend in vehicles in Dublin. This trial, which uses over 1,000 litres of biodiesel blend per week, is proceeding without any major technical difficulties. The CIÉ group consumes approximately 2 million litres of diesel per annum and the Minister for Transport has asked

the group to move all the existing fleet to 5% biodiesel blend and to plan to achieve a 30% biodiesel blend in all new buses.

This initiative holds the potential to significantly promote the uptake of biofuels in Ireland and it is intended that this measure will progress well in advance of the implementation of the national 2009 obligation target.

In addition, the Department of Transport is also working to support the operation of private transport on 100% pure plant oil by providing funding to the German-Irish Chamber of Industry and Commerce for a pilot scheme to operate 50 vehicles on this fuel in 2007.

Under Transport 21 the investment in public transport over the period 2006-2015 will encourage more energy efficient forms of transport. Reduced journey times from the national road network upgrading will also play an important role in improving energy efficiency in the transport sector.

Demand management is a fundamental way of reducing the energy intensity of the transport sector, and a detailed strategy, initially in the Greater Dublin Area, will be developed for Government consideration as the investment programme outlined under Transport 21 proceeds. A public awareness campaign centred around eco-driving holds the potential to deliver reductions in greenhouse gas.

Tax incentives, in conjunction with other measures, hold the potential to encourage the purchase of cleaner more energy efficient vehicles. The 50% VRT relief for Hybrid Vehicles has been extended to flexible fuel vehicles and funding for pilot projects for biofuel and hybrid-electric technologies is provided under Transport 21 to complement the biofuels excise relief scheme. The Department of Finance and the Department of Environment, Heritage and Local Government have simultaneously launched reviews of Vehicle Registration Tax and Motor Tax, with a view to rebalancing these tax systems to provide greater encouragement for consumers to opt for vehicles which produce lower CO_2 emissions.

The Department of Environment, Heritage and Local Government will also introduce a new and improved CO_2 emissions related vehicle labelling scheme. Global technological advances by vehicle manufacturers will also be critically important in bringing more fuel efficient, novel and clean technologies to market. The new European cleaner vehicle initiatives will also serve as a catalyst to manufacturers to make swift progress in these areas.

Chapter 4
Bioenergy for the Heat Sector - Biomass

Wood biomass has the potential to play a major role in Ireland's national bioenergy strategy. Wood energy can be generated from:

- First thinning of plantations;
- Forest residues left on-site following final felling;
- Short rotation forest energy crops (e.g. willow);
- Co-products such as sawdust, bark and offcuts arising from sawmilling and board manufacture;
- Untreated recycled wood.

Wood biomass is arguably the most versatile of renewable energy sources. It can be used for a variety of energy uses such as generating electricity, heat or as combined heat and power (CHP). Energy from wood biomass is renewable, considered carbon neutral and sustainable. Greenhouse gas emissions from the sustainable combustion of wood are not counted under the Kyoto Protocol, as trees that are used for fuel are replaced in the forest. There is therefore a direct national reduction in carbon usage when oil and gas and other fossil fuels are displaced by wood. For example, a biomass use of 450,000 tonnes per annum by 2010 would reduce carbon dioxide greenhouse gas emissions by up to 400,000 tonnes, potentially saving some €4 million per annum depending on the cost of a tonne of carbon. There would however be a reduction in the overall level of excise duty receipts arising from the displacement of fossil fuels.

Solid biomass, mainly in the form of solid wood, is already the largest source of renewable energy in Ireland, accounting for 57% of Ireland's total final renewable energy consumption in 2004. This compares with wind energy, the second largest source of renewable energy, which accounted for 17% of total final renewable energy consumption. The bulk of this solid wood fuel is used in the form of heat energy in the wood processing industry, and to provide heat in domestic dwellings. However, this represents only a very small fraction of the potential contribution wood energy can make to the national energy requirement.

Wood Biomass Supply

The main source of wood biomass potential is from the national forest estate (which currently stands at 710,000 ha) in the form of small diameter timber from forest thinnings, as well as forest residues from clear fell sites. Most of the material from these sources would be chipped before combustion. The growing of short rotation forest energy crops also has the capacity to contribute to the overall development of wood biomass as an energy source, but probably at a significantly smaller scale than from mainstream forestry.

Potential Contribution

A number of studies have assessed the potential contribution of wood-biomass. The Environmental Protection Agency (EPA) has identified a potential 0.5 million tonnes of wood residues available each year for energy recovery. This quantity would have an equivalent energy value of approximately 256 million litres

of home heating oil (kerosene) or some 200,000 tonnes of oil equivalent (toe). This represents one quarter of total kerosene consumption in Ireland in 2004. Transportation and processing costs would diminish this displacement potential and this is why proximity of supply and demand is important when assessing the overall potential for wood energy.

Recent COFORD analysis identified the private sector as the most realistic source for wood-energy (given that much of Coillte's supply is already destined for processing) and demonstrates that the potential supply from that sector is increasing. Looking forward, if annual afforestation of 10,000 ha per annum or more is achieved over the period 2008 to 2035, then wood fuel becomes a sustainable alternative, yielding potential energy of at least 4.5 Petajoules (c. 107,000 toe) per annum from 2030 onwards. If higher levels of afforestation (i.e. 20,000 ha per annum) are achieved over this period it could provide sustainable energy wood supplies of 7.0 Petajoules (c. 167,000 toe) per annum.

Critically, however, if the afforestation programme falls below current levels, then the supply of small dimension material suitable for wood energy will also fall-off in the coming decades, making wood energy unsustainable. There is a commitment to maintain a high level of afforestation in line with the Strategic Plan for Forestry Development to engender a sustainable supply of fuel.

SEI has carried out the following analysis of the 5% renewable heat target for 2010 from biomass heat. Table 6 shows the 2004 position for biomass in the heating sector.

Renewable Energy Supply – Heat (RES-H)

Table 6: Total Final Consumption as Heat in 2004

	TFC-H 2004 ktoe	RES-H 2004 ktoe	RES-H 2004 %
Residential	2,265	44	1.9%
Commercial	979	0	0.0%
Industrial	1,595	150	9.4%
Total	**4,839**	**194**	**4.0%**

Table 7 forecasts the growth in heat demand up to 2010.

Table 7: Estimated Total Final Consumption as Heat in 2010

	TFC-H 2004 ktoe	Growth 2000-2004 %	Est. TFC-H 2010 ktoe
Residential	2,265	2.9%	2,689
Commercial	979	2.1%	1,109
Industrial	1,595	-1.1%	1,493
Total	**4,839**		**5,291**

Table 8 looks at this growth in terms of wood use to achieve the 5% heating target. The figures show the potential for fuel switching in each sector, particularly in the residential sector. As the sector with the biggest heat demand and the lowest renewable heat development, this will be a priority area to target for further renewable technology growth.

Table 8: Wood requirement for 5% Total Final Consumption as Heat in 2010

	Est. TFC-H 2010 ktoe	RES-H 2010 ktoe	Est. use 2010 ktoe	Wood chip supply @ 50% m.c. tonnes/yr
Residential	2,689	52	1.9%	
Commercial	1,109	49	4.4%	
Industrial	1,493	150	10.0%	
Total	5,291	251	4.7%	
Target 2010		265	5%	
Additional wood for 5% in 2010 vs		71		328,102

Expanding the wood energy sector

One of the issues identified as inhibiting the development of a wood energy sector in Ireland is the slow pace of progress in developing a reliable supply chain from the private sector forest resource. As a result of these supply challenges, potential users of wood biomass have traditionally been reluctant to invest in wood boilers. Consequently, there are currently no medium or large scale producers of woodchip or wood pellets in the Republic of Ireland. A recently installed wood pellet production facility at Balcas Limited in Northern Ireland has experienced its strongest demand from the Republic. It is currently producing at a rate of 50,000 tonnes annually and has capacity to expand.

The Department of Agriculture and Food, and COFORD are actively encouraging the development of the Bioenergy sector in Ireland through a number of support schemes, primarily aimed at the development of an effective and efficient supply chain from forest grower to end user. The new Rural Development Regulation provides a basis for continued support of the emerging wood energy sector. Underpinned by the €1.2m funding made available in Budget 2007, schemes are being designed for the new Programme (2007-2013) to support investment in dedicated processing equipment.

Expand the Renewable Heat Sector

In order to underpin the growth of the renewable heat sector, the Government introduced a capital programme in 2006 of €65m over 5 years. The grant schemes have been developed in conjunction with SEI, which administers the schemes on behalf of the Department. Following a high level of demand in some of the schemes, a further €24m was allocated for these schemes in Budget 2007 and the total funding package over the five year period now stands at €89m.

The grant support schemes are supporting the development of scale in the emerging renewable heat technology market by directly addressing the high start up costs for individuals and small businesses that opt for greener fuels.

Greener Homes Scheme

The Greener Homes grant aid scheme for domestic renewable heat technologies established in 2006 allows individual householders to obtain grants for the installation of renewable heat technologies including wood pellet stoves and boilers, solar panels and geothermal heat pumps. Grant aid of €1,100 to €6,500 is provided depending on the individual technology used. The grant is intended to cover approximately 30 to 40% of the installed cost of the renewable technology. The scheme is being rolled out over a five-year period and was further resourced in Budget 2007 in light of exponential demand.

Table 9: Greener Homes Grant Levels

Technology	Grany Amount
Wood Chip or Wood Pellet Boilers	€4,200
Wood Chip or Wood Pellet Stoves	€1,100
Wood Chip or Wood Pellet Stoves with Back Boiler	€1,800
Heat Pump – Horizontal Ground Collector	€4,300
Heat Pump – Vertical Collector	€6,500
Heat Pump – Water (well) to Water	€4,300
Heat Pump – Air Source	€4,000
Solar (per m^2 to a maximum of $12m^2$)	€300

Bioheat Programme

The grant support scheme for commercial renewable heat technologies enables companies and small businesses to obtain grants for the installation of wood chip and wood pellet boilers in large buildings and commercial premises. Grant aid is up to 30% of overall cost depending on the overall size of the project. For example, an industrial scale 1 Megawatt boiler costing in the region of €250,000 could receive a grant of €75,000 under the scheme. The scheme is being rolled-out over a five-year period and will support the conversion of renewable energy in up to 600 installations depending on overall project sizes. In Budget 2007, an additional €4m was allocated to this scheme and the scheme is now being extended to enable community and voluntary groups to apply for funding and to include other renewable technologies.

Combined Heat and Power (CHP) Grant Scheme

The Combined Heat and Power (CHP) programme provides grants for the installation of CHP units. These units generate electricity at the site where the electricity is used, and can simultaneously use the heat from the electricity generating process.

The scheme is aimed at small-scale units (up to 1 MW), which can be deployed in hotels, leisure centres, small hospitals, offices or commercial buildings, which have a substantial heat requirement. Such units can be fuelled by fossil fuels such as gas, as well as biomass (wood and waste) products. The programme is running over a five-year period.

The CHP programme aims to deliver 10 – 15 MWe Biomass CHP, and 100 – 200 small-scale fossil fuel CHP installations, generating 10 – 20MWe of high efficiency CHP. Potential applications of biomass CHP include board mills and the food industry. There is no limit on the size of installations that can be grant-aided if fuelled by biomass.

Outcomes to date

The grant schemes have been heavily subscribed, in particular the Greener Homes programme which has attracted over 13,000 applications to date. Biomass boilers are proving to be the preferred technology with applications in this category at 45% of overall demand followed by heat pumps (28%) and solar technologies (27%).

In heating terms alone, the Biomass element of these programmes will displace the equivalent of 36 million litres of heating oil per annum. The CHP programme, together with the Bioheat programme, when fully deployed, will displace almost 100 million litres of heating oil per annum, which represents 13% of the heating oil consumed in the commercial sector in 2004.

This level of market growth also represents a very significant development opportunity for renewable technology suppliers, renewable technology installers and renewable fuel supply companies. Already there is considerable market development with new producers, suppliers and installers entering the industry. Quality assurance is a key priority in this context.

Training

A key part of developing the renewable heat market is ensuring the development and up-skilling of sufficient installers to ensure that market demand can be met on a national scale. Building on the successful EU ***Interreg*** programme funded, installer training academies, SEI is developing a comprehensive training programme roll-out with FÁS, the national training agency. This programme will ensure that there is a nationwide network of fully trained installers available to meet growing market demands. The object is to ensure that renewable technologies become a key component of the mainstream heating industry, quality assured to high standards.

Biomass Resource

Solid biomass (solid wood) is already the main source of renewable energy in Ireland. The main source of wood biomass is from the national forest estate, currently 710,000 ha. A potential 0.5 million tonnes of wood residues is available annually for energy recovery. Currently, there are sufficient supplies of raw materials to supply the wood energy and wood processing sectors. The planting of 10,000 ha per annum from 2008 to 2035 would make wood fuel a sustainable alternative and yield 4.5 Petajoules (c. 107,000 toe) from 2030 onwards. 20,000 ha would potentially yield 7.0 Petajoules (c. 167,000 toe) per annum. Accordingly, the availability of indigenous wood fuel is dependent on increasing afforestation levels going forward.

To encourage this development and as part of the 2007 Budget package, the Department of Agriculture and Food have put in place a new 'Bioenergy Scheme' on a pilot basis to grant aid the planting of willow and miscanthus. The scheme involves the payment of establishment grants to farmers to partly offset the high establishment costs and improve profitability at farm level. Establishment costs are estimated at €2,900 per hectare and the proposed grant rate is up to 50% of the costs associated with establishing the crop.

The Department of Agriculture is also putting in place a €1.2m Biomass Harvesting Scheme to encourage growing of specific energy crops by providing grants towards the purchase of wood biomass processing machinery, such as wood chippers and forest residue bundlers.

Chapter 5 Bioenergy for the Electricity Sector

The EU Directive 2001/77/EC on the promotion of Renewable Energy Sourced Electricity (RES-E) in the internal electricity market ("the Renewables Directive") was published in 2001. This Directive addressed individual targets for the increased consumption of RES-E to each Member State. In the case of Ireland the Directive target is 13.2% by 2010.

Work carried out by the Renewable Energy Development Group (REDG) in 2004 equates this 13.2% target to 1450 Megawatts (MW) of installed renewable generation capacity to be operational to the electricity network by 2010.

In 2004, 5.2% of electricity consumed came from renewable sources. In 2005 this increased to 6.8% and our expectations for 2006 is that this figure will be in excess of 8%. Currently Ireland has just over 1,000 MW of renewable capacity connected to the national grid. This consists of 740 MW of wind generation plant, 236 MW of hydro powered plant, with the balance (c. 35 MWs) made up of different biomass technologies, mainly landfill gas. As a result of progress made in achieving the Directive target the Government subsequently increased the 2010 target to 15%.

Renewable Energy Feed In Tariff (REFIT)

The renewable energy support mechanism known as the Renewable Energy Feed In Tariff (REFIT) marks a move to a fixed feed in tariff mechanism instead of competitive tendering. Applicants in REFIT must have full planning permission, all necessary operating licences and a signed grid connection offer for their projects. They will be able to contract with any electricity supplier licensed in the State for support up to the notified fixed prices.

The fixed price tariffs are (in 2006 prices):

- Large wind energy (over 5 Megawatts) 5.7 cent per Kilowatt hour;
- Small wind energy (under 5 Megawatts) 5.9 cent per Kilowatt hour;
- Hydro 7.2 cent per Kilowatt hour;
- Biomass (landfill gas) 7.0 cent per Kilowatt hour;
- Other biomass 7.2 cent per Kilowatt hour.

The first tranche of projects under the scheme involves 55 developers with projects totalling over 600 MW of capacity. The vast majority of these new developments will be wind generation.

While wind generation is expected to deliver the vast majority of our 2010 renewable electricity targets and contribute significantly towards the 2020 target of 33%, it is an intermittent source of energy. In line with the commitment to develop a broad range of renewable technologies going forward biomass electricity is being actively supported. Biomass electricity has the advantage of being dispatchable, i.e. it is available on demand.

To encourage development of Biomass electricity the REFIT programme provides a significantly higher feed in tariff price for biomass electricity at 7.2 c per kWh compared to 5.7 c per kWh for large wind. This incentive will operate in conjunction with other supports available during the different stages of the biomass development cycle. Some biomass feedstock has the ability to attract a gate price as being a waste product, while other biomass feedstock will have the benefit of establishment grants and/or hectorage payments and equipment support grants in the case of dedicated energy crops.

Co-Firing in peat burning stations

We have set a target of 30% co-firing in peat stations with biomass by 2015. This target will of itself stimulate a very significant demand boost for biomass feedstock.

The three peat-burning stations burn a total of 3 million tonnes of peat per annum. It is estimated that 30,000 ha of indigenous energy crops could replace every 10% of this peat which is co-fired. The possibilities include miscanthus, willow, hemp and reed canary grass.

Potential barriers to this development include the need for a year-round supply of suitable raw material and environmental concerns (biodiversity etc) from growing large amounts of energy crops close to the power stations. With the right crop mix, site selection and husbandry practices these issues can be overcome.

To further encourage the move towards biomass electricity generation, REFIT support will be provided for co-firing renewable feedstock in existing as well as in new thermal plants. This significant change in REFIT conditions, which to date supported only newly built generation capacity is designed to encourage cofiring at conventionally fuelled power generation stations.

Meat and Bone Meal

Subject to addressing environmental and licensing issues, Meat and Bone Meal offers potential as a biomass source for co firing in power generation. Current costs of storage and transport costs of the MBM abroad are considerable and estimates suggest an overall cost of €50m per annum.

Department of Environment, Heritage and Local Government (DEHLG) assessments show a calorific value comparison:

Milled Peat	7.87 Mj per tonne
MBM	18.0 Mj per tonne

Therefore the net calorific value of 1 tonne of MBM is 2.3 tonnes of peat.

CO_2 emissions comparison:

1 tonne milled peat	0.85 tonnes CO_2
1 tonne MBM	0.00 tonnes CO_2

DEHLG estimates that based on its calorific value this MBM could annually replace 322,000 tonnes of milled peat used in power stations (140,000 x 2.3) if such amounts were available for co-firing with peat. This could give an annual reduction of 273,000 tonnes in CO_2 emissions.

The major issue remaining to be resolved would be changes to EPA licences to facilitate using MBM, i.e. whether MBM would be covered by the controls envisaged under the EU Waste Incineration Directive (WID) (2000/76/EC).

Waste Management and Licensing

National waste management policy is committed to the diversion of biodegradable municipal waste away from landfill. Ireland is obliged under the EU Landfill Directive (1999/31/EC) to ensure that no more than 35% of 1995 levels of biodegradable municipal waste is land filled by 2016.

The *National Strategy on Biodegradable Waste*, 2006, sets out the plan for progressively reducing the amount of biodegradable municipal waste (BMW) going to landfill and to encourage the prevention, recycling and recovery of biodegradable municipal waste. The Strategy estimates that it will be necessary to divert 80% of projected outputs of biodegradable municipal waste away from landfill by 2016. The Strategy puts forward a number of integrated options to minimise the environmental impacts of landfilling biodegradable municipal waste and to achieve the targets under the Landfill Directive. These options, in accordance with the internationally recognised waste hierarchy are:

- Prevention and minimisation – avoiding generating the waste;
- Recycling – mainly of paper and cardboard but also of textiles;
- Biological treatment – mainly of kitchen and garden waste including composting;
- Residual treatment – thermal treatment with energy recovery;
- Mechanical-biological treatment.

Waste licences issued for landfill sites by the Environmental Protection Agency (EPA) require evaluation reports by the licensee on the viability of landfill gas collection, flaring and/or energy production. Gas collection and energy generation is undertaken at high gas-yield sites and modern enclosed ground flares are installed at landfill facilities possessing sufficient gas potential to support combustion. In addition, the waste licensing system requires the modernisation of older facilities via the implementation of conditioning plans that are designed to increase the operational standards of landfill sites through a process of continuous improvement.

Mixed waste produced by households or businesses after all materials suitable for recycling and biological treatment have been separated out, residues from recycling and biological treatment operations and other waste that is unsuitable for recycling, is collectively defined as 'residual' waste. Notwithstanding the fact that substantial volumes of biodegradable municipal waste will be diverted from landfill as a result of high levels of recycling and biological treatment, the Strategy acknowledges that significant quantities of residual waste will continue to be generated and that a large proportion of this material will be biodegradable. It is estimated that almost 309,000 tonnes of biodegradable municipal waste will require residual treatment in 2010 rising to 499,762 tonnes by 2016. The Strategy seeks to maximise the recovery of useful materials and energy from residual waste and accordingly suggests thermal treatment with energy recovery as the preferred option followed by mechanical biological treatment with energy recovery and with mechanical biological treatment of fully stabilised residue to landfill as a last resort.

To assist in the development of waste to energy projects, REFIT will be extended to allow support for the renewable portion of mixed renewable and non-renewable generation. This would allow, for example, a waste to energy project to obtain support for the renewable portion of the output. This type of hybrid support mechanism is common in other EU Member States and is fully consistent with the overall 'hierarchy of waste' treatment approach.

Biorefinery Potential

Biorefining is the industrial application of oil refining technology to biomass for the purpose of extracting energy carriers, high value biochemicals and fibres. The energy comes in the form of bioethanol and biogas for the generation of green electricity. Green biomass includes grass cultivated from meadowland and permanent pasture and green crops refer to clover and immature cereals.

Biorefining is an emerging technology area. There has already been some commercial interest in examining the possibility of constructing a green biorefinery in Ireland using primarily grass as feedstock. This type of plant would potentially produce energy, biofuels and high value biochemicals.

The Environmental Protection Agency (EPA) has highlighted Ireland's comparative advantage in grassland production over other European countries, including growth rates, the high knowledge base relating to grass production and the geographical distribution of grassland compared to arable land. The Paper states that "the energy potential based on a grass feedstock could be very substantial and far exceed the energy potential of other energy crops."

The potential of extracting high value biochemicals could ultimately be a significant benefit to Ireland for use in the chemical and pharma industries that play such a significant role in Ireland's economic well being.

EU Biomass Action Plan

In December 2005, the EU published a Biomass Action Plan[1] which announced more than 20 actions. For transport biofuels, they include promotion of "biofuels obligations", through which suppliers include a minimum proportion of biofuels in the conventional fuel they place on the market.

The plan includes reviews of how fuel standards could be improved to encourage the use of biomass for transport, heating and electricity generation; investment in research, in particular in making liquid fuels out of wood and waste materials; and a campaign to inform farmers and forest owners about energy crops. The Commission will also work on future EU legislation to encourage the use of renewable energy in heating.

The Commission's Renewable Energy Roadmap 2007 reiterates the contribution which the biomass sector can make to Europe's renewable energy targets for electricity, heating and transport through full implementation of the Biomass Action Plan.

Technology Deployment Roadmap

In a 2006 report for the European Commission's Directorate-General for Research[2], the Biofuels Research Advisory Council outlined the following likely timescales for biofuel and biorefinery development in the EU:

1 COM(2005) 628 final

2 Biofuels in the European Union. A vision for 2020 and beyond. (2006). EUR 22066.

Phase 1: Short Term (until 2010)

- Improving existing technologies;
- R&D into second generation biofuels from ligno-cellulosic biomass;
- First second generation biofuels demonstration plants;
- R&D into the biorefinery concept.

Phase 2: Medium Term (2010 - 2020)

- Deployment of second generation biofuels;
- Demonstration of biorefinery concept;
- Continued R&D to improve ligno-cellulosic biofuel;
- Development of Integrated biorefinery processes;
- Development of Energy Crops and sustainable agriculture.

Phase 3: Long Term (beyond 2020)

- Large scale production of second generation biofuels;
- Deployment of integrated biorefining complexes.

The report emphasised the need for increased and continued expenditure on research, demonstration and deployment, both in the area of improving yields and efficiencies from current technologies as well as in the development of second generation biofuels and in biorefinery research.

While the primary interest in this paper is to develop the energy use of bioenergy for the electricity, heat and transport markets, we do recognise that there is also a strong opportunity to develop petrochemicals as raw materials for industrial processes, Second-generation biomass conversion technologies could, over time, provide a suitable fuel and product for both sectors.

DCMNR is giving major priority to the accelerated development of Energy Research, Technology Development and Innovation to underpin energy policy goals including bioenergy development and deployment. The development this year of a comprehensive Energy Research Strategy 2008-2013 overseen by the Irish Energy Research Council will set out the overall priorities.

The recently announced Charles Parsons Awards included funding for biomass-related research at four Universities on the island. Under this programme funding of almost €20m is being provided to seven Universities on the island of Ireland for the purposes of accelerating research in a number of energy related areas. €12m of this funding has been allocated to four Universities whose energy research programmes include biomass research (details overleaf). This research will give us valuable information under Irish climatic conditions which will inform policy in relation to the optimisation of land use for biomass purposes.

Sustainable Energy Ireland (SEI) is also supporting research work in second generation technologies through, for example, grant aid to an Irish University that is involved in an EU FP6 project investigating Biomass-to-Liquid (BTL). In BTL, biomass is converted to synthesis gas through gasification and the synthesis gas can be subsequently transformed to liquid fuel.

Charles Parson's Awards
Summary of funded projects relating to Biomass

Bioresources Research Centre (BRC), University College Dublin

Award: €2,956,856

This award to University College Dublin involves research on bioresource assessment, biomass conversion technologies and environmental impact assessment. The sustainable utilisation of bioresources will focus on the production of biofuel from crops and agri-food industry waste streams.

Centre for Sustainable Technologies, University of Ulster

Award €3,657,008

This award supports a broad range of complementary technologies ranging from energy efficiency in buildings, renewable energies concentrating on biomass and solar activities and cleaner combustion systems. Specifically relating to biomass is the analysis of the production of several types of biomass and investigating their behaviour in thermal conversion processes. Also research investigating the effects of biomass derived gases on the performance of fuel cells is underway.

Microbial Bioenergy Group, National University of Ireland Galway

Award: €2,046,704

The research relating to this award includes anerobic digestion microbiology, bioreactor technology, biological hydrogen production, bioelectric chemistry and electro chemical technology. The key focus of the work relates to biologically-mediated renewable energy research and development including anerobic bioreactor technology and biocatalytic and microbial fuel cell.

Charles Parsons Research Initiative & Graduate School University of Limerick

Award €3,126,656

The award to the University of Limerick covers a range of technologies including biofuels and advanced conversion processes, energy efficiency and energy conservation and wind and ocean generation solutions and storage. Relating to biomass the utilisation of local bioresources of chemical energy (biofuels) in the context of a more independent energy supply in Ireland will be investigated. Advanced catalytic processes involved in biomass utilisation will also be investigated.

Chapter 6 Public Sector Leadership - Driving Bioenergy Demand

The wider public sector in Ireland is the biggest landowner and property owner in the State. At the same time it is the largest tenant in the State, particularly in the office market rental sector in our cities and towns. On a cumulative basis, the wider public sector also owns the largest fleet of transport vehicles in the State.

As a result it is uniquely placed to drive demand for renewable energy technologies, particularly bioenergy technologies. This can be a very powerful tool in driving the market sectors, particularly if it is combined with integrated and high energy efficiency standards.

Already we have seen some Local Authorities take a proactive lead in this area, including Cork City Council and Dublin City Council who are demonstrating biofuel usage in some of their vehicles. Other Local Authorities such as Fingal and Dun Laoghaire-Rathdown leading the way in adopting significantly enhanced energy efficiency standards and renewable energy conditions in their planning guidelines.

Initiatives such as these have shown the way for the public sector as a whole and it is imperative that the good example shown in these demonstrations is now mainstreamed in practice, and in regulation where practicable, to ensure a more sustainable energy future for Ireland.

At the launch of the Interim Review of the National Biodiversity Plan, the Minister for the Environment, Heritage and Local Government announced a series of 13 supporting measures to support the ongoing implementation of the Plan, one of which was the conversion of the National Parks and Wildlife Service fleet of 160 vehicles to biofuels, within a two-year period.

At central Government level the Office of Public Works (OPW) is directly responsible for one of the largest property portfolios in the State. The vast majority of the buildings provide office accommodation for various civil service Departments. The OPW is thus in a key position to effect significant energy savings and consequently reductions in greenhouse gas emissions in its existing building stock and to encourage the market towards the construction of more sustainable buildings.

The OPW recently took the opportunity provided by the procurement process for decentralisation to overhaul its office accommodation specification in order to include higher standards of energy saving and sustainable construction. The specification was also cast in such a way as to encourage greater use of bioenergy to fulfil the heating and energy requirements of buildings.

This specification is now in use in the procurement by OPW of the vast majority of accommodation in the permanent decentralisation locations. OPW is currently examining ways of adapting this specification to the Dublin leased accommodation sector with a view to encouraging and promoting energy efficiency and sustainability in accommodation being offered to us in the city.

The OPW have included as a requirement in most new buildings for the installation of wood burning boilers- either pellet or woodchip as the main heat generation source.

The OPW is currently actively engaged in a three-pronged strategy to reduce CO_2 emissions.

1. **Heating Fuel Conversion Programme:** the OPW is currently embarking on a programme to convert the heating systems in approximately 20 large state buildings from their existing fossil fuel burners (oil/ natural gas) to biomass burners. The biomass fuel will be in the form of wood pellets. It is estimated that this will result in an equivalent reduction of half a million litres of oil being consumed per annum. This will equate to a saving of over 1500 tonnes of CO_2 per annum.

2. **Energy Awareness Campaign:** The national Energy Efficiency Campaign "Power of One" and the forthcoming National Energy Efficiency Action Plan are providing the focus for driving energy efficiency awareness and delivering energy savings in the public sector as well as by consumers and the economy in general. Highly motivated and energy conscientious staff offer the single largest opportunity for zero cost energy savings across the whole building stock. The ethos of "Switching Off" equipment when not in use when applied across a large number of people will lead to substantial energy savings. Published research shows that up to 20% energy savings can be achieved from good energy housekeeping. At the central core of any energy conservation campaign is the ability to benchmark performance. It is then necessary to set a target for energy saving, e.g. a 10% reduction in overall energy consumption or CO_2 emissions and finally, to monitor performance against the target. Over the last 3 years the OPW has been installing web-based energy monitoring units in all the large state buildings which monitor and record electrical and heating fuel consumption every 15 minutes. The data can be accessed via a dedicated website. The OPW is currently rolling out a pilot staff energy awareness campaign in 20 buildings. The target is to reduce energy consumption in each building by 10% through local energy conservation campaigns, energy workshops and close monitoring of the performance of heating/air conditioning equipment. Staff will be able to monitor the energy reductions in their building via the Internet site. Following on from the pilot, it is proposed to roll the energy awareness campaign out to staff in all large OPW buildings (circa 250). DCMNR's "Power of One" campaign will also focus on the public sector generally during 2007.

3. **Energy Efficient Design of New Buildings:** The scope for improving energy efficiency in new buildings is very significant. At design stage there are key factors, which can considerably improve the energy efficiency of the building over its entire lifetime with little or no additional construction costs. With the advances in computer simulation of buildings over the past 10 years, it is now possible to accurately model the energy and environmental performance of a building at the design stage. This is achieved by modelling the effects of using different construction materials, orientations, the amount of glazing, the insulation levels, the type of fuel used for heating, etc. Properly designed naturally ventilated buildings can use up to 66% less energy than equivalent fully air-conditioned types. The use of computer modelling also facilitates the proper design of naturally ventilated buildings by accurately predicting airflows, internal temperatures and internal comfort conditions. This technology is being used by the OPW to optimise energy performance in all new large building projects.

The OPW is also bringing forward plans for the development of two large sites at Heuston Station in West Dublin and on the Mountjoy site in North Dublin when the site becomes available following the construction of the new prison at Thornton hall. These sites would be large enough to support significant stand-alone Combined Heat and Power (CHP) installations to provide the vast majority of these developments' heat and electricity requirements.

The Department of Education and Science, in partnership with SEI, has already developed a number of generic school designs which minimise energy use and costs in new schools. These energy efficient schools provide features such as hot water temperature controls, natural ventilation, air tightness, individual room temperature control, passive solar design, maximisation of natural light, and lighting controls that respond to natural light. 40 new schools are being designed under this programme and the designs are being built in compliance with the Department of Education's Technical Guidance Documents. The designs will ensure that the schools are capable of being 2.3 times more efficient, in energy terms, than best international practice.

In addition to this programme, the Department of Education and Science in conjunction with SEI will be installing biomass boilers in 8 schools over the summer of 2007 with a view to providing generic guidelines for consultants and school managers for the installation of such systems in schools. The schools in question will vary in size and location so that the Department can identify any issues or opportunities that arise in particular school situations. The results of the demonstration project will provide vital information and guidelines to encourage schools to apply for grants under DCMNR's renewable energy grant programmes and with a view to expanding deployment of renewable energy in schools on a significantly wider national scale.

We have highlighted some of the initiatives that the sector is currently developing and rolling out. There will be many more actions developed and there is a determination right across the public sector, that a sustainable energy future is now a priority and that the public sector must lead by example.