



# Future Generation

## *RENEWABLE ENERGY POLICY IRELAND*

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# 1 A Current Overview Energy in Ireland

*Ireland is struggling to meet its targets for Greenhouse Gas emissions reductions. According to the EEA [EEA, 2004a], Ireland was among the three EU Member States furthest away from their Kyoto target in the year 2002. Annual emissions are decreasing, but as stated [EPA, 2004], "achieving the Kyoto target will require huge efforts from all sectors of the Irish economy over the next four to eight years."*

*Agriculture is also facing difficult times. GATT reforms and the EU Common Agricultural Policy (CAP reform) are already resulting in job losses in agri-business, most recently in the sugar beet industry. Further loss in employment and severe structural changes are expected. Renewable energy development will bring some relief to agriculture if the opportunities for employment in emissions-reducing indigenous energy are taken.*

*Increasing use of renewables in the overall energy supply will bring Ireland additional gains like new industry developments and increased security of energy supply.*

## 1.1 Overall Primary Energy

COFORD [2003] provides an overview of total Irish energy consumption and its development since 1990. Figure 1-1 shows that overall energy consumption is roughly divided into three nearly equal shares: 35% for heating fuels, 35% for electricity generation and 30% for transport fuels. Details on the division of energy consumption by fuel and by sector are shown in Figure 1-2 and 1-3 respectively.

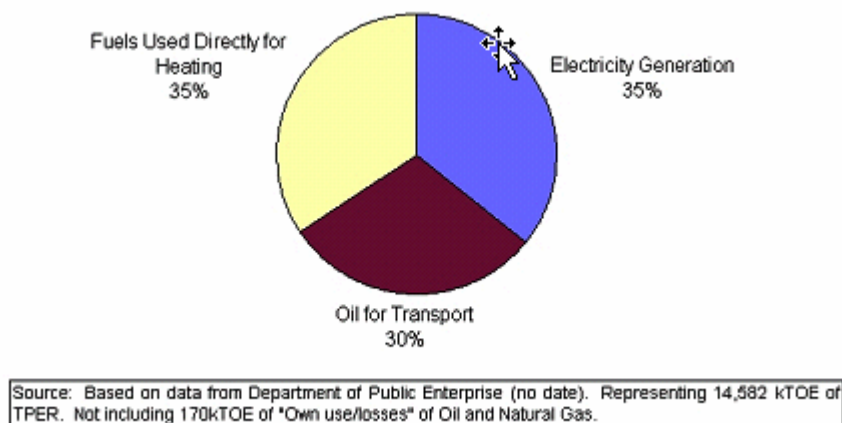


Figure 1-1 Breakdown of Total Primary Energy Requirement 2001

## 1.2 Primary Energy by Fuel and by Sector

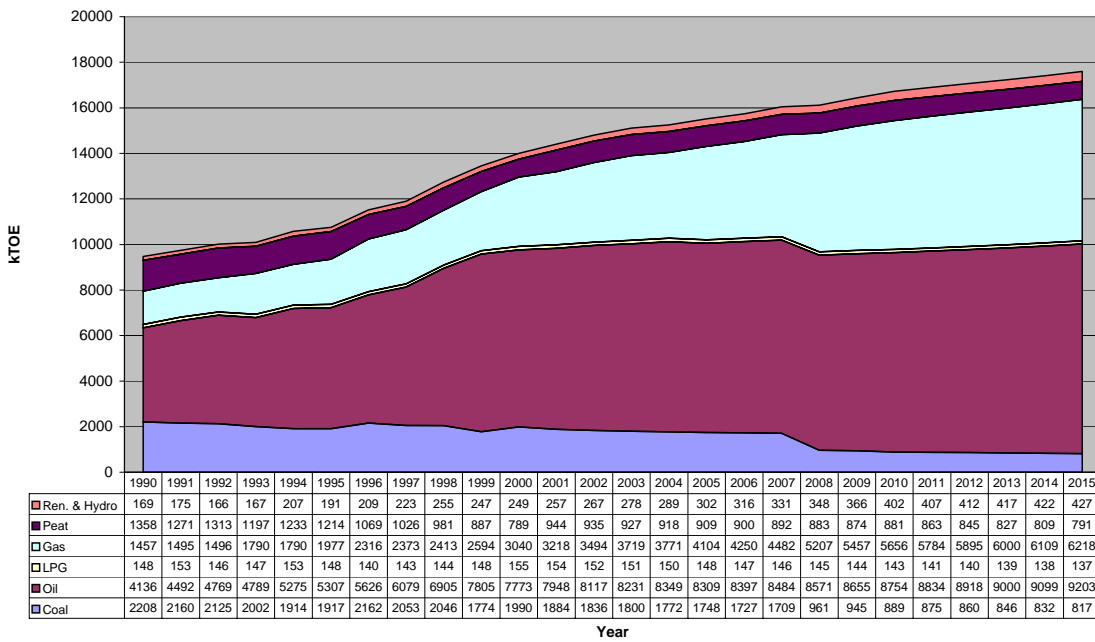


Figure 1-2 TPER

by Fuel

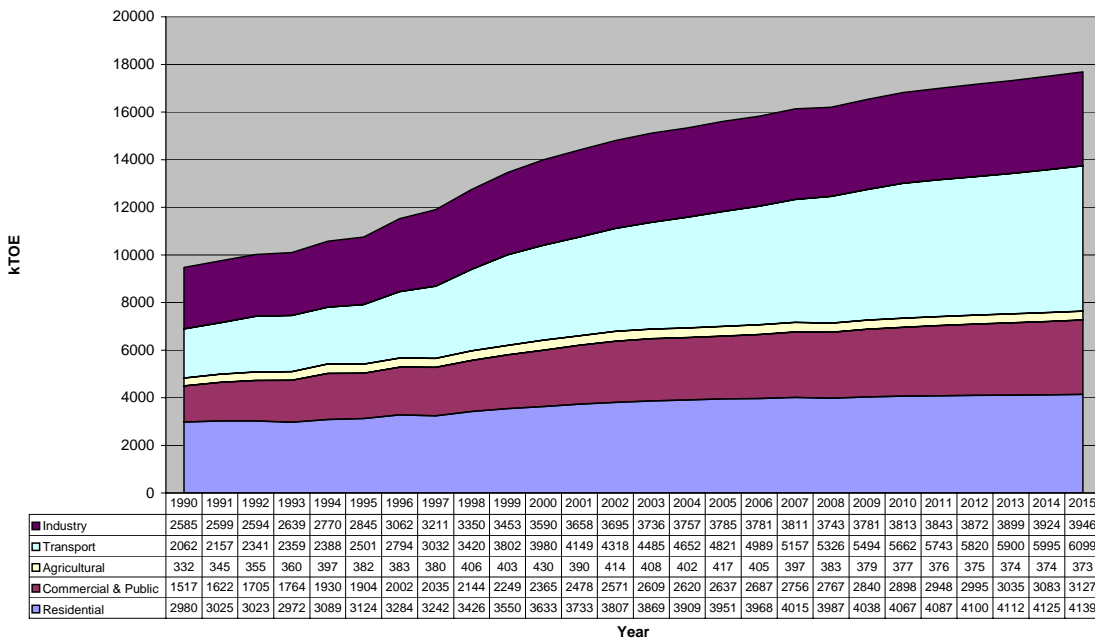


Figure 1-3 TPER

by Sector

## 1.3 Greenhouse Gas Emissions

Based on the policies set out in the National Climate Change Strategy, Figure 1-4 shows the projected developments of Greenhouse Gas emissions and the current situation. Ireland's Kyoto target limits Greenhouse Gas (GHG) emissions in 2008-2012 to 13% above the 1990 level.

**National Climate Change Strategy  
Greenhouse Gas 'Business as Usual' Projections**

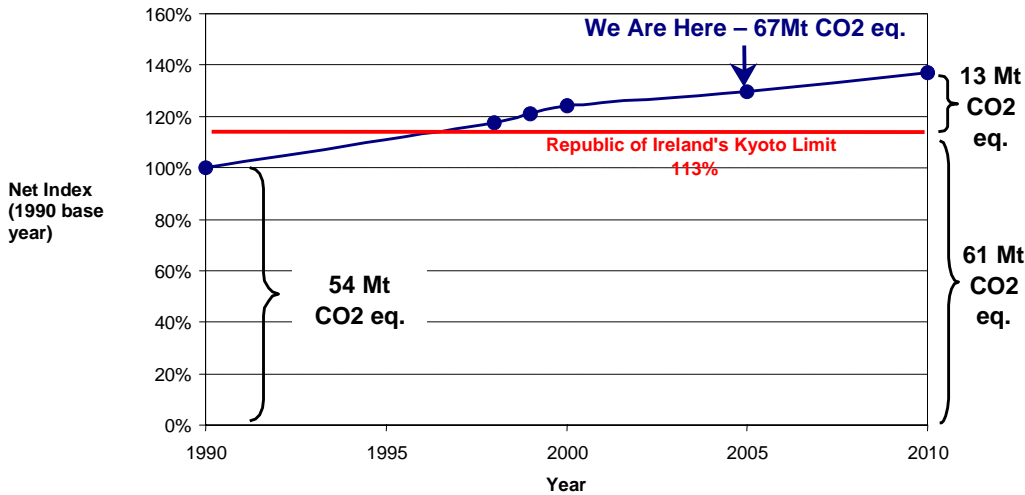


Figure 1-4 Path to Kyoto target (update of figure from COFORD, 2003)

Concentrating on the developments in the last few years, we clearly see that the trend in Greenhouse Gas emission growth has been curbed, but that emissions are still largely above the path to reaching the Kyoto target (see Figure 1-5).

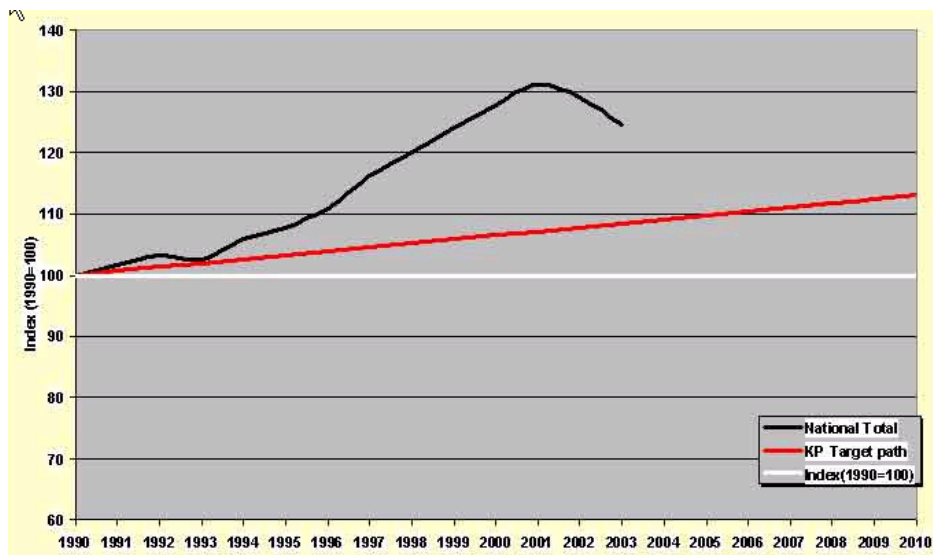


Figure 1-5 National emissions compared to Kyoto target path (source: EPA, 2004)

Figure 1-6 shows the development in sectoral emissions in the period 1990-2003. Clearly, emissions from energy and especially transport have been growing rapidly in previous years. Agriculture still contributes to a large part of overall Greenhouse Gas emissions.

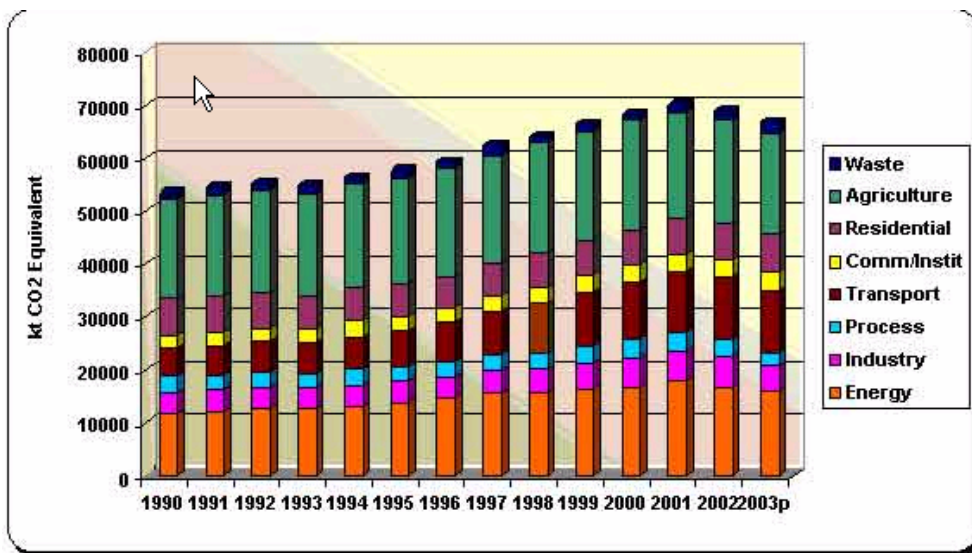


Figure 1-6 Development of sectoral greenhouse gas emissions (source: EPA, 2004)

What is Ireland's situation compared to other EU Member States in Western Europe? The European Environment Agency reports the so-called distance-to-target indicator (DTI), measuring the deviation of actual emissions from a hypothetical linear path between 1990 emissions and the Kyoto target [EEA, 2004a]. Ireland is among the three countries in the EU-15 that are furthest from their linear target path (see Figure 1-7 below). To cover part of this gap the government is planning to buy carbon credits. At the cost of €10 per tonne, 3.5 million tonnes of CO2 per annum are planned to be purchased in the period 2008-2012, resulting in costs of 35 million Euros per year, thus 185 million Euros in total. Even allowing for this proposed purchase of credits through Kyoto mechanisms, Ireland is still in serious weather for meeting its target.

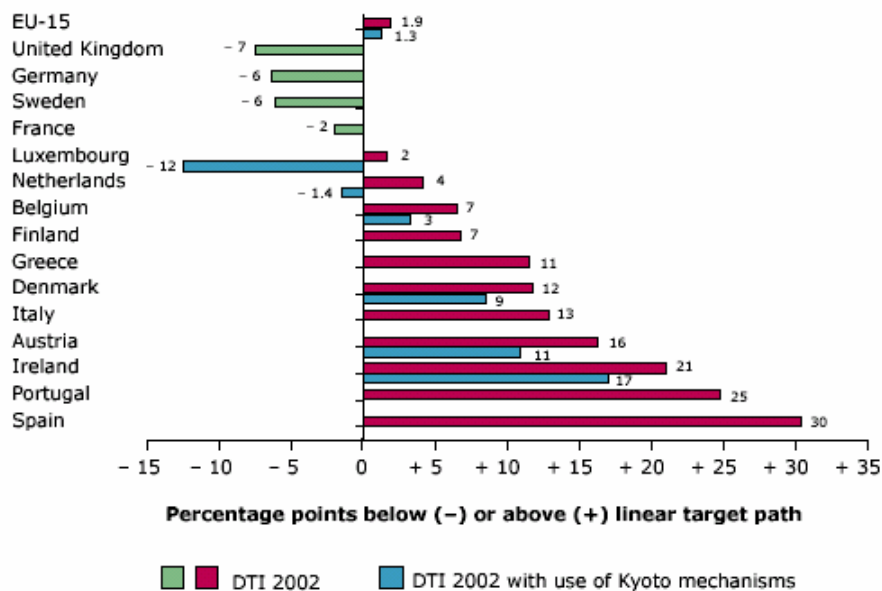


Figure 1-7 Greenhouse gas indicator on distance-to-target for EU-15 Member States in 2002 (source: EEA, 2004a)

## 2 Filling the Energy Policy Vacuum

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*Despite the large potential for renewables, the Irish renewable energy market is characterised by a lack of stable and transparent supporting policies. This has created large investment uncertainties and a failure to realise Ireland's full potential for renewable energy. Only the most recent AER competitions have resulted in a reasonable uptake in wind energy. In all other sectors an effective policy vacuum exists.*

### 2.1 Opportunities in the Irish renewable energy market

In the past two decades Ireland has experienced strong economic growth, resulting in a big increase in energy demand. With a lack of substantial domestic fossil fuel resources and a relatively low level of interconnectivity in the electricity sector, concerns exist about the security of energy supply.

The Irish energy market has significant opportunities for extensive development of all renewables in all energy sectors, and the establishment of a strong national renewable energy industry should have been relatively easy. Ireland has high renewable resource availability and a highly skilled workforce, especially in engineering and raw material processing.

Clear external incentives are evident at national and regional level in terms of Greenhouse Gas emission reductions, and economic development and employment, especially in rural and less economically developed areas.

However, the potential for large deployment of renewable energy production capacity or the establishment of solid industries has so far been missed. In fact, the only area that has shown significant expansion is the wind power market. Small developments have taken place in areas such as landfill gas generation and the expansion of small scale hydropower, but other substantial initiatives have not been taken.

Over the last 15 years Ireland has begun to trail well behind countries that are committed to developing renewable energy industries such as Denmark, Germany, Austria or Spain.

### 2.2 Achievements to date

To date renewable energy sources provide approximately 2% of Ireland's total energy consumption, as illustrated in Figure 2-1.

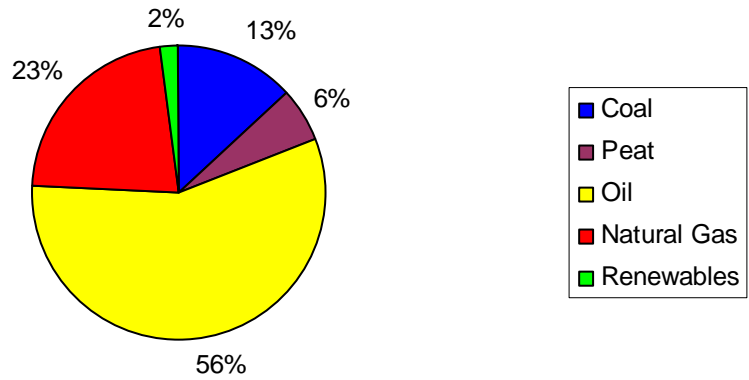


Figure 2-1 Irish Total Primary Energy Requirement by source (2002) Source: based on SEI (2004c).

The lack of a stable policy climate with long-term certainty of supporting instruments has clearly made investors and lenders quite reluctant to enter the Irish renewable energy market. The dominance of existing market players, the relatively small size of the market and the support of other energy sources such as peat and gas further reduces investment interests.

With a mandatory EU target set only on the electricity sector, government action has been largely confined to delivering the minimum necessary to meet this target. Thus the figure for renewables above is largely wind energy in the electricity sector, on top of the pre-existing Shannon and other hydro resources. In terms of electricity, renewables currently contribute to about 6% of total generating capacity. Figure 2-2 shows the development of renewable power capacity in the period 2000-2003, illustrating the ever dominant position of hydro power and the recent acceleration in wind power. The share of renewable power in total electricity generation dropped from 5.4% in 2002 to 4.1% in 2003 due to low rainfall reducing hydro production. These numbers are still far from the targeted 13.2% in 2010. Data for 2004 as reported by SEI is included in the Annex.

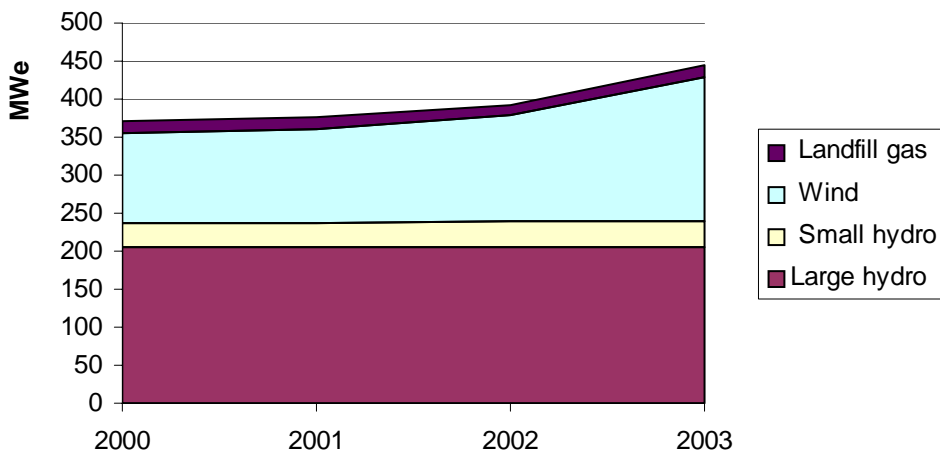


Figure 2-2 Renewable electricity production capacity 2000-2003

## 2.3 Irish policy and targets

The main drivers for Irish renewable energy policy have been the new electricity market arrangements, the national climate change strategy (NCCS) and specific policies and instruments for the promotion of renewable energy, including the Green Paper on Sustainable Energy (1999), the Alternative Energy Requirement and the Public Service Obligation (PSO). These have laid a good foundation for greater development of the electricity sector of renewable energy market, but due to a fundamentally flawed approach in the AER process, progress is much less than what it could have been over the 12-year period.

### 2.3.1 Electricity Policy/Targets

Since 1994, the development of electricity generating capacity from renewable energy has been encouraged through a series of Government supported Alternative Energy Requirement (AER) competitions. Successful competitors are offered ESB power purchase agreements of up to fifteen years. Six AER competitions have been held to date; the results are listed in the Annex.

Basic flaws in the AER process include its “stop-start” nature that left potential projects waiting too long for the next competition, its early price-competitive basis which rendered the completion of a lot of winning projects uneconomic and its failure to deliver a stable planning regime that would allow businesses to develop opportunities as they arose. Indeed, the design of the AER process has been criticised by farmers groups as favouring large corporations and incumbents, and not suited to introducing new players to the energy market.

Aside from the wind energy sector, it is clear that most expert opinion would recommend a fixed-feed-in tariff regime to encourage biofuels, biomass and the sort of long-term dependable planning horizon required by farmers and other business people seeking investment finance to support projects around the country.

The *Green Paper on Sustainable Energy* among others specified a target of an additional 500 MWe of renewable electricity generation capacity in the period 2000-2005. The Paper specified that the majority of this new capacity was expected to come from wind energy. Combined with the step-wise opening-up of the electricity market this has given rise to an accelerated development of wind power, including a limited number of new market participants. It is surprising that the duopoly of Veridian and the ESB has been allowed to enhance its position in the Irish energy market by participation in AER competitions.

Other renewable energy electricity markets have not really taken off. Combined with grid restrictions that to some extent limit further growth in wind power, worries have been expressed whether Ireland will meet its renewable electricity target of 13.2% in 2010 as agreed with the European Commission.

In December 2003 the Minister of the DCMNR launched a consultation process on the renewable energy sector, mainly targeted at the renewable power market. The review aims to stimulate debate on developing future renewable energy policy, meeting the 2010 targets (at least for renewables) and setting out longer-term developments until 2020. So far no large policy changes have been proposed.

### **2.3.2 Heat Policy/Targets**

Approximately 80% of total energy consumption in the Irish residential sector is used for space and water heating. The energy sources used are oil, natural gas, propane/butane and solid fuels (coal and peat mostly). Most of these fuels are imported. Renewable energy covers a small share, approximately 5%.

Aside from some excellent research by SEI, no “process with teeth” exists in the renewable heating sector, e.g. a public service obligation to kick-start the sector.

Some progress is being made in the wood board and food processing sectors with CHP installations feeding power to the grid, but the relatively high cost of gas compared with electricity in Ireland has distorted the potential in this area.

Enterprise Ireland/Industrial Development Authority (IDA) do not regard fossil fuel import substitution as one of their objectives, and confine themselves to industries with export potential. Thus significant opportunities in supporting modern industries in areas like wood pellet, anaerobic digestion or wood chip processing are foregone.

### **2.3.3 Transport Fuel Policy/Targets**

The European Union has specified targets on the share of biofuels in total transport fuel consumption of 2% by 2005 and 5.75% by 2010. Despite the significant potential of the agricultural sector in Ireland, no progress has been made to date in Ireland’s renewable biofuel market. Again some good reports have been commissioned by SEI, but opportunities arising from the CAP reform and from structural changes in agriculture arising from the latest GATT rounds have been foregone.

A clear need exists to link Development of Irish Agricultural Policy with Irish Energy Policy.

### **2.3.4 Summary on Targets**

The lack of a stable policy climate with long-term certainty on supporting instruments has clearly made farmers, businesses, investors and banks quite reluctant to enter the Irish renewable energy market. The dominance of existing market players, the relatively small size of the market and the support of other energy sources such as peat and gas further increases investment uncertainty.

Serious worries have also been expressed about meeting the Kyoto target (limiting GHG emissions in 2008-2012 to 13% above 1990 emissions) and the biofuel target (5.75% share of biofuels in transport fuels by 2010). The European Environment Agency ranks Ireland among the three countries with the greatest distance to their Kyoto target, even including the proposed purchase of credits through Kyoto mechanisms (EEA, 2004).

Interestingly the Government announced in January 2005 a programme of purchasing €35,000,000 million per annum of carbon credits from the world market between 2008 and 2012. This figure is three times more than is spent on renewables per annum support via the PSO. Finally, the implementation of a “carbon tax” was dropped in the December 2004 budget, delaying once again potential progress in the heat and transport fuel sectors.

## 2.4 Employment

The debate on renewables in Ireland to date has largely been around limiting the “damage” that a move to renewables will do to competitiveness and employment in the Irish economy. This is quite surprising given the record of other EU countries in generating sustainable well-paid employment in the various industry sectors associated with renewable energy, especially in rural areas. This is an important factor to be considered in a post-CAP reform Ireland.

Figure 2-3 below depicts the EU forecast for employment in these sectors. Irelands failure to develop its industrial base in renewable energy is quite unacceptable in this context, given our potential indigenous strength in this sector.

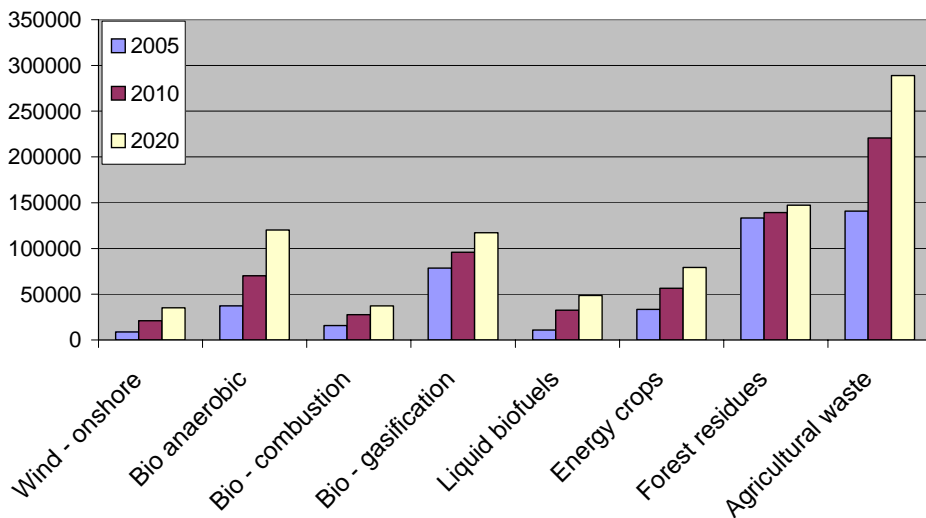


Figure 2-3 Projected employment in the EU for biomass technologies. Wind is included for comparison (courtesy of SEI). Source: EU Altener Report: Impact of RES on Employment, 2000.

### 3 Potential for the Electricity Market

*The main renewable energy market in Ireland at this time is in the electricity market. Although significant potential exists in other sub-sectors, developments in past years have mainly concentrated on enhancing wind power. This chapter focuses on the additional renewable electricity potentials, with a strong focus on biomass.*

#### 3.1 Introduction

Electricity demand has been continuously growing and an upward trend is expected to continue in the coming years. [COFORD, 2003] includes an historic overview as well as an overview of future electricity demand by sector until 2015 (see Figure 3-1). A second figure includes similar data on domestic electricity supply by source. The scenarios have been developed by the Economic and Social Research Institute (ESRI).

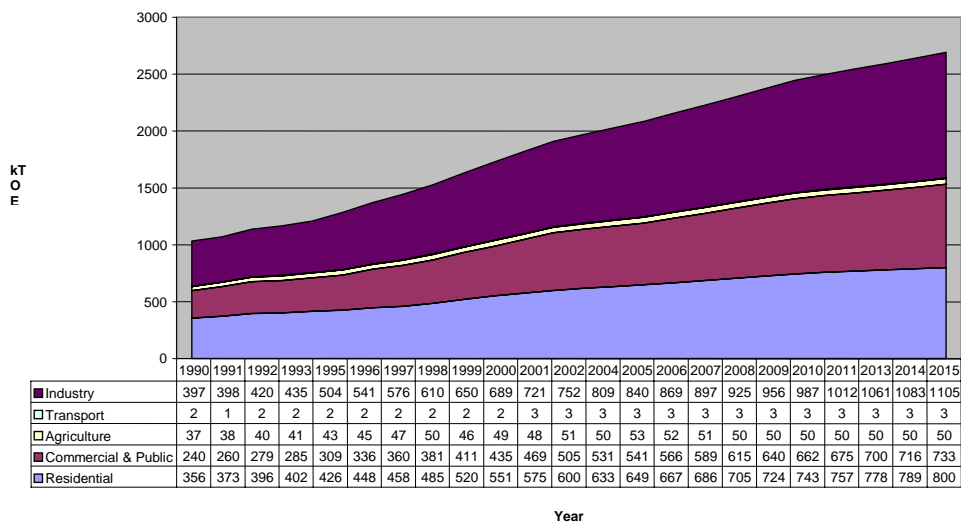


Figure 3-1 Electricity

Demand by Sector

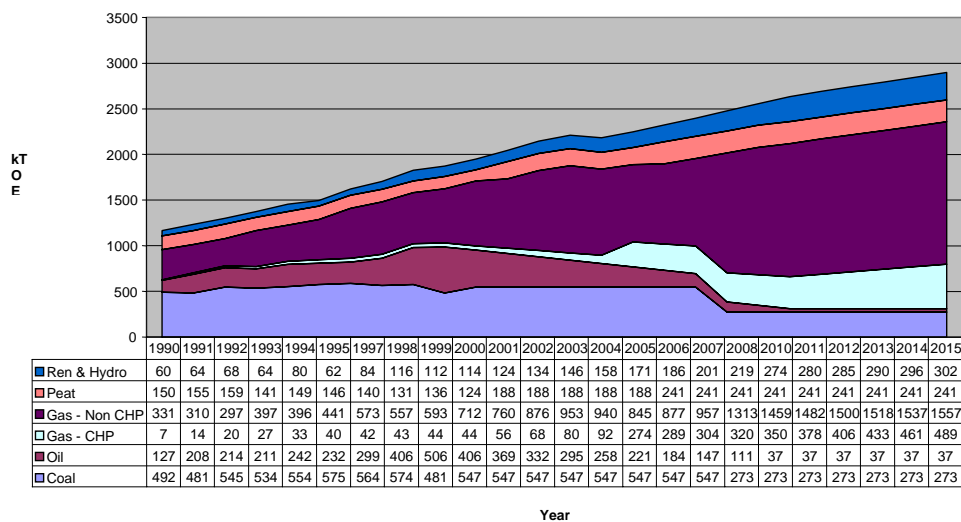


Figure 3-2 Electricity Generation by Fuel

In December 2003 the Ministry for Communications Marine and Natural Resources launched a consultation process on the renewable energy sector, focusing on future target setting and the choice of renewable energy promotion policies. The consultation document [DCMNR, 2003] identified the target paths for renewable electricity as shown in Figure 3-3. **Note that the DCMNR required the consultants to consider a long-term BNE price of €42 per MW in carrying out their report. BNE is now €73 per MW.**

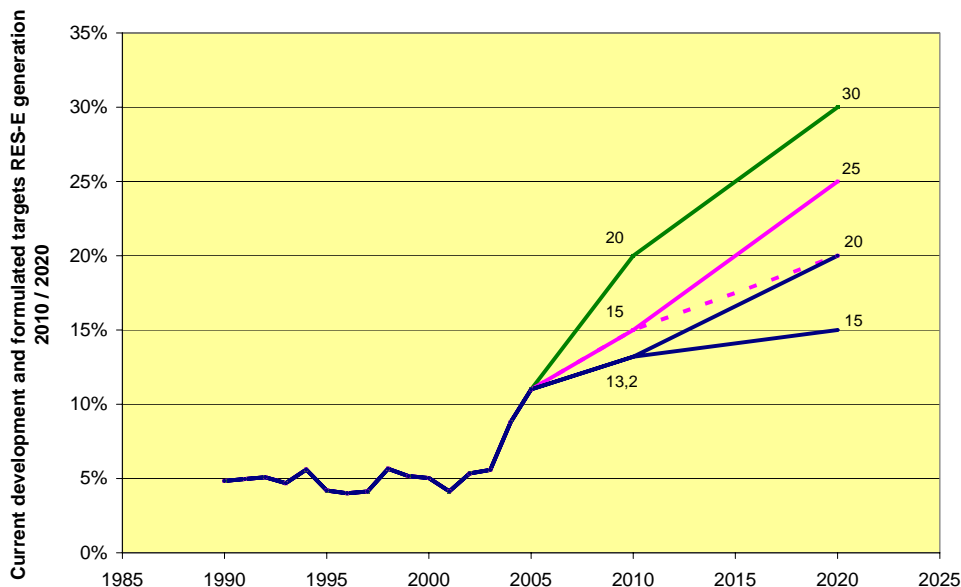


Figure 3-3 Potential “target paths” for renewable electricity identified in DCMNR policy consultation

### 3.2 Short term potential

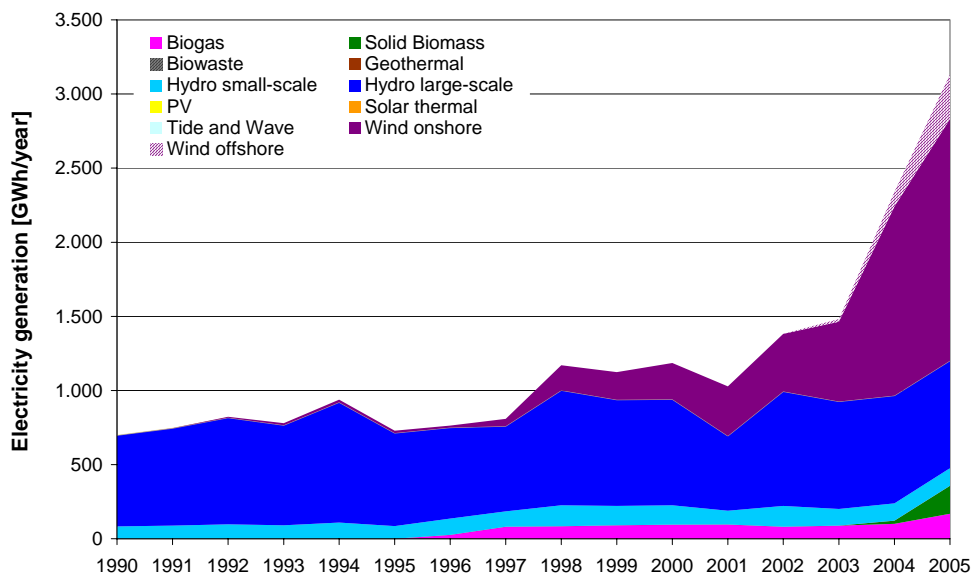
In the short term, further renewable electricity generating capacity will come on stream as projects awarded contracts under AER6 are commissioned. It is thus more likely that the targeted 500 MW additional renewable

electricity capacity as stated in the Green Paper on Sustainable Energy will be achieved. Table 1 pictures the assumed new renewable electricity capacity until 2005. It is not likely that more renewable electricity capacity will come on stream, nor will any significant other renewable energy come on line.

Table 1 Assumed new renewable electricity capacity up til 2005.

Technology	2001-2005
Biogas	2 MW
Landfill gas,	11 MW
Sewage gas	0
Solid Biomass (all sub-categories)	0
Biomass CHP	27 MW
Hydro small-scale	2 MW
Wind-onshore	509 MW
Wind-offshore	75 MW
<b>TOTAL</b>	<b>626 MW</b>

Graphically these figures mirror figure 3.7 above, and thus it can be seen that renewables are not yet meeting even 10% of Irelands demand for electrical energy .



### 3.3 Mid-term and longer-term potential

For the mid-term (until 2010) and longer-term period Ireland has clearly one of the best renewable energy resources in Europe, specifically in terms of electricity and biomass heat. On its website SEI (2004d) indicates the potential for further renewable energy developments in Ireland in GWh/year for the year 2020. The numbers included are so-called ‘practicable’ renewable energy resources - that is, the portion of the total resource that could deliver electricity at a realistic cost, taking a range of limiting factors into account. The result is a conservative estimate of the renewable energy resources available. Detailed data at county level are included in the Annex.

Table 2 Potential renewable electricity production by 2020 (source: SEI, 2004d)

Technology	Potential in the year 2020 in GWh/year
Hydro small-scale	359 GWh
Municipal solid waste	525 GWh
Landfill gas	321 GWh
Agricultural solid waste	467 GWh
Short rotation forestry	136,303 GWh
Industry residue	2328 GWh
Forest residue	1779 GWh
Wind-onshore	3208 GWh

In addition [SEI, 2004f] identifies 11.1 TWh annual potential offshore wind energy and 833 MW ocean wave energy potential to be developed on a short-term basis and at acceptable costs.

[Huber et al, 2004] identify even greater potential for practicable renewable electricity productions by 2020. The main reason for these higher potentials is that they assume that existing market barriers can be overcome and that active support is being implemented. Clearly this would largely increase the opportunities for renewable electricity in Ireland. Figure 3-4 and Figure 3-5 present the assumed potentials for 2020 as well as the assumed realisations by 2005.

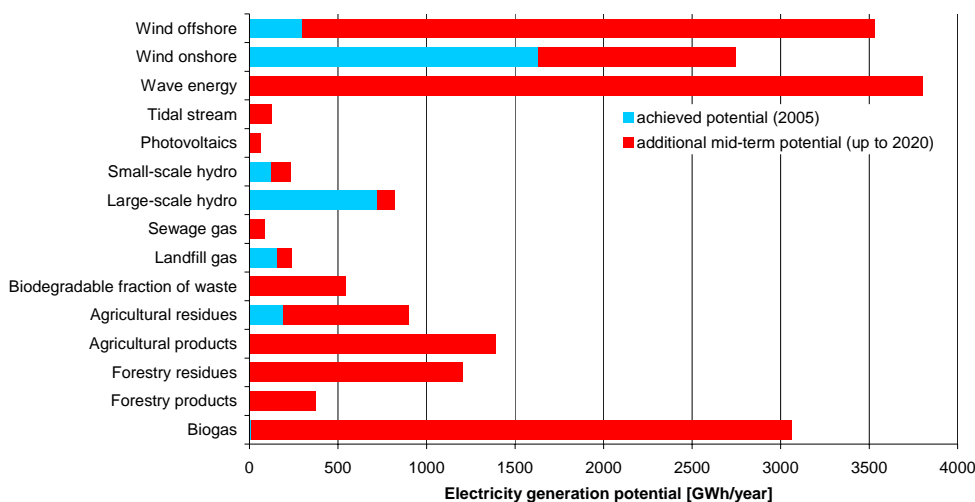


Figure 3-4 Overview of RES-E electricity generation potential for Ireland (Source: Huber et al, 2004)

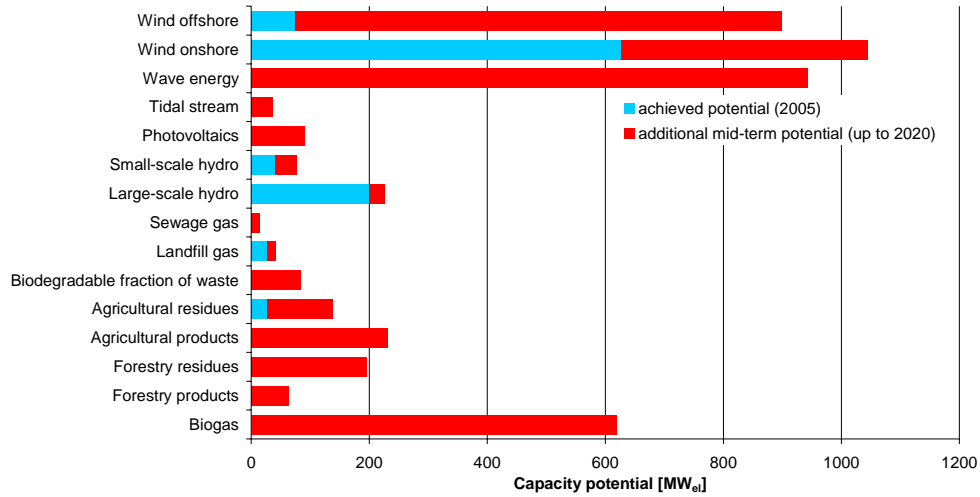


Figure 3-5 Overview of RES-E generating capacity potential Ireland (Source: Huber et al, 2004)

[Huber et al, 2004] also provide a comparison between business-as-usual (BAU) developments and the possible scenario paths for renewable electricity developments until 2020. Business-as-usual developments include a continuation of current policies, but no additional incentives to either push forward currently planned renewable developments or support additional development of renewable electricity capacities. This scenario would result in a share of 11% renewable electricity in 2010, and thus not meeting the targeted 13.2%. Growth after 2010 would be really small in the BAU scenario, resulting in a share of only 12%.

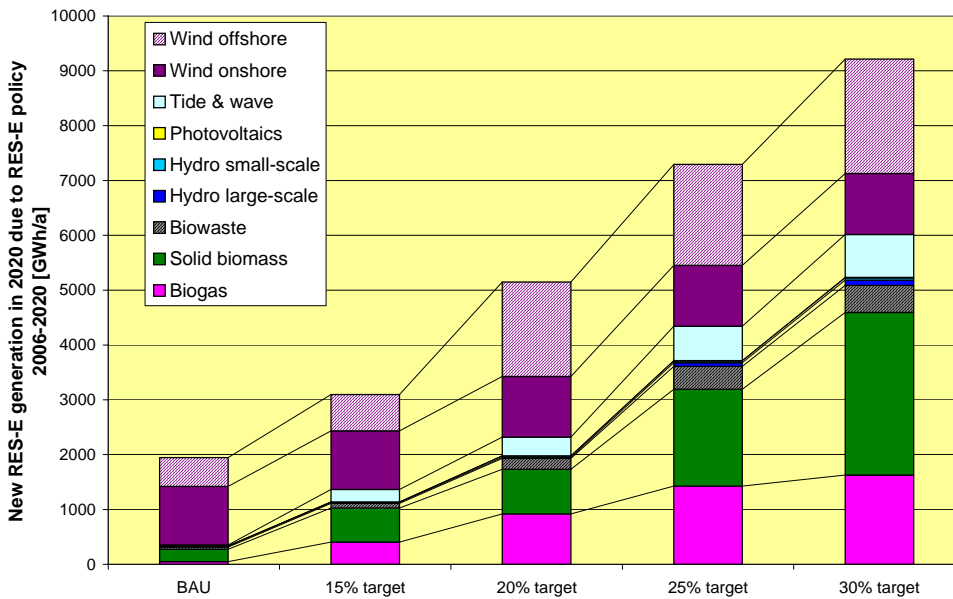


Figure 3-6 Comparison of several scenarios for renewable electricity developments until 2020 (Source: Huber et al, 2004)

### 3.4 Biomass

[SEI, 2002] reports that Ireland has the lowest use of biomass in Europe. This is due to many factors, including a lack of consumer awareness and understanding that biomass is a clean renewable resource. There is also a lack of familiarity with the use of biomass for energy and a lack of policy and targets for biomass development. Ireland has, however, considerable experience in solid fuels, especially through the existing peat and forest industries. The

current government support structure for biomass electricity - the AER – includes very little incentives for biomass. AER I and III supported only landfill gas and no other biomass technologies. The targeted 30 MWe from biomass in AER II will not go ahead. AER IV was open to all CHP types but only gas fed projects were successful. AER V and VI did include some biomass, but the resulting amounts of over 3 MW from landfill gas and 0.8 MW from biomass are really small compared to another 234 MW of wind energy.

The published Green paper projection for biomass electricity is 84 MWe installed by 2005, but this is thus very unlikely to be achieved.

### 3.4.1 Biomass potential

The biomass resource potential in Ireland is significant, as illustrated for instance by the estimated feasible resource for the year 2020 as reported in [SEI, 2002] and extracted from the ESBI/ETSU Altener Report 1997 (see Table 3). The largest share is short rotation coppice for which actual usage of its potential would however imply that some 2 million ha or almost 50% of the land currently under agriculture would be required to growing of crop. The study estimates that were short rotation coppice planted on 420,000 ha, or about 10% of the land under agriculture the energy produced would be equivalent to that provided by coal in 2000, or about 14% of the total Primary Energy Supply (TPES) in that year. SEI argues that this is a reasonable assumption, given the set aside policy and the changing situation within the agriculture sector.

With an estimated present day feasible resource for electricity from biomass at 311 MWe, and 9,443 MWe (66,556 GWh) in 2020, the installed capacity to date (15 MWe of landfill) is just a small fraction of its possible realisation. Note that all estimates are calculated at a price range of 3.3 to 7 Eurocent per kWh, so would certainly not require more support than is currently provided within PSO payments. Moreover, As the agricultural sector will continue to be undergoing large changes in the next years, partly due to the CAP reforms and GATT agreements, at least part of these new activities would be very welcome to replace current activities. [Huber et al, 2004] report that without major changes land availability is up to 330,000 ha, already providing a significant imputus to the production of energy crops when actively used. Table 3 also reports on the possible employment resulting from additional use of biomass.

Table 3 Feasible biomass resource until 2020

	Feasible capacity (MWe)	Feasible energy (GWh/yr)	Investment required (Meuro)	Jobs – constr. & install. (FTE)	Jobs – O&M (FTE)	Indigenous potential % of TED	energy % of TPES	GHG savings Mton CO <sub>2</sub> eq.
Short rotation coppice	8,506	59,512	12,503	212,300	30,946	119.28	23.71	44.3
Landfill gas	305	2,438	282	1,275	195	4.89	0.97	11.6
Industrial wood residue	273	1,912	401	2,378	131	3.83	0.76	1.4
Forestry residue	197	1,397	290	1,714	280	2.80	0.56	1.0
Dry agricultural residue	86	689	126	747	318	1.38	0.27	0.3
Wet agricultural residue	73*	585*	292	2,427	351	1.17	0.23	3.1
Sewage gas	3*	23*	12	100	6	0.05	0.01	0.1
<b>Total</b>	<b>9,443</b>	<b>66,556</b>	<b>13,906</b>	<b>220,641</b>	<b>32,287</b>	<b>133.40</b>	<b>26.58</b>	<b>61.8</b>

Source: SEI 2002, from an ESBI/ETSU Altener Report published in 1997.

Resource based on 15% discous rate and wholesale price cap of 7 Euroct/kWh, except for \* where price would be greater than 7 Eurocent/kWh.

The same study reports on possible targets to be set for 2005 and 2010. It identified the following possible targets:

- Biomass could provide an additional 45MWe installed electrical capacity in 2005 (33MWe from wood and agri-residue biomass CHP, 10MWe from landfill gas and 2MWe from biogas).
- A further 35MWth capacity of biomass heating plant can be installed by 2005.
- The combined total capacity of 80MW would contribute 0.4% of the total primary energy supply in 2005, with the fuel coming mainly from the available biomass residues/wastes stream including forest residues, industrial wood residues and agri-residues.
- In the medium-term (by the year 2010), a practical installed capacity of 195MWe of biomass power can be achieved, with a further 145MWth capacity from biomass heating.
- The combined total capacity of 340MW would contribute 1.4% of the total primary energy supply in 2010, with the fuel coming, once again, mainly from the available biomass residues/wastes stream including forest residues, industrial wood residues and agri-residues.

As no real developments have taken place since the publication of this report with respect to the installation of new capacity, all estimates will have to take an additional 3-5 years installation time into account, but clearly potentials are believed to be there also by SEI.

Table 4 Suggested additional biomass targets, GHG savings and estimate of employment and cost impacts of achieving the proposed targets

		Suggested additional target	Annual electricity produced	Possible jobs		Total inv. Cost	GHG savings		
		(MW)	(MWh/yr)	C&I (FTE)	O&M (FTE)	(Meuro)	Mton CO <sub>2</sub> eq.		
Biomass electricity or CHP	Landfill gas	2005	10	80,000	40	7	9.3	0.35	
		2010	22	176,000	90	14	20.4	0.77	
	Biomass steam cycle CHP	Ind. Wood	2005	25	200,000	161	16	37.5	0.07
			2010	130	1,040,000	860	83	195	0.36-1.19
		Agri-residue	2005	8	64,000	52	17	12	0.02
			2010	36	288,000	238	75	54	0.1-0.33
	Biomass AD Multifuel	2005	2	16,000	59	6	8	0.004-0.014	
		2010	7	56,000	224	23	28	0.1-0.314	
Biomass heating	Biomass heating Industrial	2005	20		52	21	12	0.06	
		2010	70		185	73	42	0.20	
	Large buildings	2005	15		32	16	7.5	0.04	
		2010	75		165	189	37.5	0.21	
<b>Total</b>	<b>2005</b>	<b>80</b>		<b>396</b>	<b>83</b>	<b>86.3</b>	<b>0.54-0.55</b>		
	<b>2010</b>	<b>340</b>		<b>1,762</b>	<b>457</b>	<b>376.9</b>	<b>1.74-3.01</b>		

Source: [SEI, 2002] and EU Ecotec, RES & Employment Report, 2000

### 3.5 Wood Biomass

[COFORD, 2003] advises on the contribution which wood can make to Ireland meeting its EU environmental targets. It identifies the following main options for the potential use of the minimum available wood-energy:

1. Used for heat supply, with the potential to save about a third of a million tonnes of CO<sub>2</sub> emissions per year increasing to almost one million tonnes per year by 2015. This is equivalent to respectively 3 and 8% of Ireland's Kyoto target.
2. When used for renewable electricity supply, it could fire a 50MWe power plant, increasing to 132MWe by 2015. This would contribute to respectively 9% (0.4 TWh) and 23% (1 TWh) of Ireland's annual renewable electricity target of 4.5 TWh.
3. Trials have shown that wood biomass can be mixed with milled peat at the new peat burning power stations with no negative effect on boiler efficiency. There is also the added benefit of reduced SO<sub>x</sub> emissions resulting from burning less peat. This means that all of the wood biomass could be used to co-fire the peat

burning stations at no additional capital cost. Some minor investment in material handling equipment would be necessary. This would be insignificant in the context of a value of €75.8 million (at a value of €10/tCO<sub>2</sub>) accruing from emissions reductions over the first two Kyoto commitment periods.

Joe O'Carroll, operations manager of COFORD, wrote a paper in 2004 called "Carbon Emissions Reduction Potential from Wood Biomass" in which he examined the existing potential of forestry by-products based on existing resources if Ireland implemented a policy of "fuel switching". He concluded that wood biomass can make a significant contribution to the national climate change strategy and could contribute a reduction of up to 9.9 Mt in CO<sub>2</sub> emissions over the first two commitment periods, an average of 1 Mt/year. In 2008 the reductions would be 0.73 Mt, or 5% of the 15.415 Mt target outlined in the NCCS.

### **3.5.1 Existing resources**

Ireland has a significant energy potential in the country's wood resource. Exploitation of this resource as an energy source could yield a number of benefits including:

- Stimulation of rural development and employment as wood fuel supply chains evolve to meet market demands;
- Development of an environmentally beneficial fuel resource to replace the use of fossil fuels and consequently reduce the emissions of greenhouse gases.
- Contribute to national fuel diversity and enhance the security of national fuel supplies;
- The displacement of imported fossil fuels and the redirection of money back into the Irish economy.
- The realization of Government investment in forestry.
- Contribute to Ireland's European Union target for green house gas reductions and electricity generation from renewable sources.
- Generating base-load renewable electricity (in contrast to the unpredictability of wind power electricity generation).

### **3.5.2 Wood Biomass Supply**

Wood biomass can be in many forms:

- Sawmill residues (chip, sawdust, bark, offcuts)
- Forest residues (poker tops, brash, roadside residues from whole tree extraction, also arboriculture waste)
- Pulpwood (shortwood system)
- Whole tree chips (generally first and second thinning)
- Recovered wood (packaging material, construction and demolition waste)

### **3.5.3 Energy Generation Potential**

The amount of energy generated from the wood biomass sources outlined above depends of the technology chosen and the efficiency of the combustion process. However, the available biomass resource could generate 50 MW of electrical power, rising to 132 MW by 2015. This is equivalent to 10%, rising to 26% of the 500 MWe target outlined in the Green Paper on Sustainable Energy.

Trials have shown that wood biomass can be mixed with milled peat at the new peat burning power stations with no negative effect on boiler efficiency. There is also the added benefit of reduced SO<sub>x</sub> emissions resulting from burning less peat. This means that all of the wood biomass could be used to co-fire the peat burning stations at no

additional capital cost. Some minor investment in material handling equipment would be necessary. This would be insignificant in the context of a value of €75.8 million (at a value of €10/tCO<sub>2</sub>) accruing from emissions reductions over the first two Kyoto commitment periods.

### 3.5.4 Emissions

There is currently no generation of electricity from wood biomass in Ireland. However, if fossil fuels were replaced by wood biomass, significant CO<sub>2</sub> emissions reductions would accrue. Table 5 lists CO<sub>2</sub> emissions from solid fuels. CO<sub>2</sub> emissions from the combustion of woody biomass are compensated by the sequestration of CO<sub>2</sub> from the same wood during its lifetime. In other words, the net CO<sub>2</sub> emissions from woody biomass are zero.

Table 5 Carbon dioxide emissions from solid fuels

<b>Fuel</b>	<b>Emissions kg CO<sub>2</sub>/kWh</b>
Peat	1.100
Coal	0.912
Oil	0.782
Average Fuel Mix	0.504
Gas – Simple Cycle	0.489
Gas – CCGT	0.346
Gas - CHP	0.238
Wood biomass	0.000

Assuming that the 50MWe annual potential from wood biomass was realised at 90% efficiency, it would yield 394,200 MWhr (394,200,000 kWhr) per annum. Table 6 indicates the reduction in carbon dioxide emissions that would be gained if wood biomass displaced other fuel sources.

Table 6 Potential Reductions in Carbon Dioxide Emissions from Fuel Switching in 2003

<b>Fuel</b>	<b>Reduction in CO<sub>2</sub> Emissions Tonnes per annum</b>
Peat	433,620
Coal	359,510
Oil	308,264
Average Fuel Mix <sup>1</sup>	198,677
Gas – Simple Cycle	192,764
Gas – CCGT	136,393
Gas - CHP	93,820

The potential from wood biomass by 2015 will be 132 MWe. The same analysis for this potential yields the emissions reduction potential outlined in table 4.

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<sup>1</sup> Projected fuel mix for 2010.

Table 7 Potential Reductions in Carbon Dioxide Emissions from Fuel Switching by 2015

Fuel	Reduction in CO2 Emissions
	Tonnes per annum
Peat	1,144,757
Coal	949,108
Oil	813,818
Average Fuel Mix <sup>2</sup>	524,507
Gas – Simple Cycle	508,896
Gas – CCGT	360,078
Gas - CHP	247,684

### 3.6 Combined Heat and Power (CHP)

Biomass-fired CHP production has the potential to be another future renewable energy market in Ireland. The NCCS specified a target of saving 0.25 Mt CO<sub>2</sub> per year up to 2010 from CHP. To meet this saving it was estimated that an additional 250 MWe of CHP plant would be needed to be installed by 2010. [SEI, 2004e] reports that relative growth of installed CHP capacity in Ireland in the period 1994-2000 was much higher than in Europe as a whole: 76% compared to 20%. However, in absolute numbers the amount of production is small<sup>3</sup> and the growth is grossly inadequate to meet the targeted growth. Total installed capacity of CHP in Ireland at the end of 2002 was 131.5 MWe, an increase of 2.8 MWe (2.2 %) over 2001 and that CHP growth for 2003 would not be greater than 4 or 5 MWe. [SEI, 2004e] also concludes that the targeted additional 250 MWe will not be achieved. Even if the additional 65 MWe of installed capacity as included by ESB National Grid in its most recent Generation Adequacy Report 2004 –2010 will actually come on stream.

Very little CHP is fuelled by biomass. In 2002 81% of installed capacity (106.1 MWe) was fuelled by natural gas. Next to that, coal and peat are important sources for fuelling CHP plants. A real market for biomass-CHP does not yet exist in Ireland.

So far little support has been provided for CHP in Ireland and most of this is not directed at biomass-fired CHP. Of the six AER competitions three have included CHP: AER I included 10.72 MWe of CHP, AER IV awarded 57.977 MWe of gas-fired CHP plants and AER VI awarded 26.83 MWe of Biomass CHP. However, not all winning projects have proceeded with developing plants. For instance, in AER IV only 18.3 MWe out of the awarded 57.977 MWe is being developed. CHP is also facing investment uncertainties resulting from the current policy vacuum. Some of the existing market barriers are:

- Uncertainty of future support for CHP in the AER or alternative promotion schemes.
- Lack of continuity of support – need for open feed in tariffs for different fuels
- Lack of awareness and support for cofiring biomass in existing fossil-fuelled plants.
- Competition from peat-fired electricity generation supported within the PSO programme, making it economically more attractive than biomass-fired CHP.
- Uncertainty with respect to the treatment of CHP under the proposed carbon taxation scheme (despite the fact that this scheme has been postponed several times)

<sup>2</sup> Projected fuel mix for 2010.

<sup>3</sup> Next to Luxembourg, Ireland has the smallest amount of electricity production from CHP in the EU-15. In terms of percentage of total electricity production Ireland has the second-lowest share in the EU-15, next to Greece.

- Uncertainty with respect to the classification of high efficiency CHP projects as referred to in the EU CHP Directive and the proposed possibilities for tax exemption.
- Insufficient information on the roles of environmental and planning authorities in encouraging CHP developments as an alternative to separate heat boilers and conventional fossil-fired electricity generation.

Progress to date in CHP has been largely confined to the board-making and food-processing sectors where the availability of cheap raw material or a very large heat-load has made CHP economical even under Irish conditions.

For CHP to be attractive to investors, there needs to be a sufficient gap in price between the feed-stock (gas or wood) and the price the company is being paid for electrical power for the investment to be recovered. This has not been the case to date in Ireland. This situation is made worse by Bord Gas through its programme of cost-recovery of a large infrastructural development cost for gas pipelines against a low base of gas users.

### **3.7 Possible target setting**

**A recent report on behalf of the European Commission concluded that if Ireland would implement the currently best-available policies at technology level used on the European market, it could achieve a much higher share of renewable electricity.** A possible target achievement of 21 to 22% in the year 2010 is cited. Shares of 30-35% are cited for the year 2020. This would require continued strong wind power promotion strategies and solid biomass policies at a level formerly supported by the Austrian Renewable Energy Act. Strong support levels would also be required for the development of other renewable electricity technologies in the Irish market. Higher production levels could then be reached after 2010, for instance for ocean energy.

## 4 Potential transport market

### 4.1 Introduction

Energy consumption in the transport sector, and therewith Greenhouse Gas emissions from transport, is the fastest growing source of energy requirement in Ireland. In 2002, energy related CO<sub>2</sub> emissions from transport were 123% above 1990 levels and represented 25% of Ireland's energy related CO<sub>2</sub> emissions. Improvements in the technical efficiency of passenger cars have improved the overall energy and CO<sub>2</sub> efficiency of the private car fleet. The purchasing trend towards larger (and less efficient) cars however, has considerably offset this efficiency gain. [Ó Gallachóir and Howley, 2004].

Without additional measures Greenhouse Gas emissions from transport are expected to increase to nearly 2.8 times 1990 emissions, according to the National Climate Change Strategy (see Figure 4-1 below). Total reductions that have been proposed in the NCCS would have to result in an annual reduction of 2.67 Mton of CO<sub>2</sub> eq., which is still far from an equivalence of effort among all sectors to meet the Kyoto targets. Without strong additional policies renewables will hardly play a role in this matter. With no advancements so far in the market for biofuels, Ireland does not seem to meet the requirements set in the EC Biofuels Directive. These requirements specify the share of fossil fuels sold on the transportation market to be replaced by biofuels, namely 2% by 2005 and 5.75% by 2010.

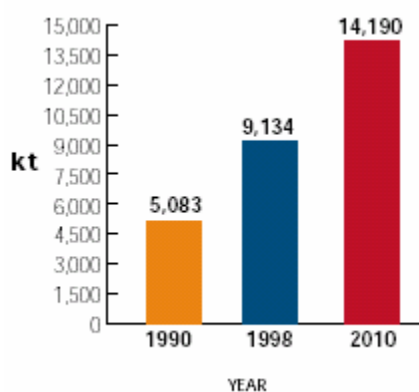


Figure 4-1 Greenhouse gas emissions from transport for 1990, 1998 and 2010 projections (source: NCCS, 2000)

### 4.2 Potential use and benefits of biofuels

[SEI, 2003] reports that the Irish land resource is sufficiently large in relation to its energy use to make a significant contribution to national energy supply. With an assumed moderate biomass dry matter production of 10 tonnes/ha and a net calorific value of 13 GJ/tonne, an area of 50,000 ha (1% of the area under agriculture and forestry) would produce 6.5 PJ of primary energy. The report calculates that this is approximately 1% of the national primary energy requirement of 620 PJ (14.8 Mtoe).

[Hamelinck et al, 2004] report on the resource potentials based on using currently available technologies and more advanced technologies. Using only currently available technologies, biofuel resources in Ireland are able to produce about 12 PJ of biofuels per year, which would approximate to the 2010 target. However, the report notes that this would imply that part of the current feed crops be used for energy purposes and thus require additional feed imports. Fully avoiding such induced importation would result in a biofuel resource availability of 2.8 PJ (79 % of the 2005 and 23 % of the 2010 target). When in the medium and longer term (post 2010) lignocellulose residues are used, an amount of 12 PJ could be produced from indigenous biomass resources.

Clearly much attention is paid to the environmental benefits of biofuels as an alternative to conventional fuels and one of the few short-term actions that can be implemented to curb greenhouse gas emissions in this sector. When comparing the well-to-wheel (WTW) Greenhouse Gas emissions for rapeseed biodiesel with conventional diesel approximately 50% of emissions is saved. Comparing emissions from gasoline with WTW emissions from bioethanol, approximately 55% of emissions can be saved when sugarbeet is used as the source of bioethanol and 67% when using wheat.

Other benefits clearly lie in employment opportunities. Biofuels could bring an important alternative source of income for the sugarbeet industry that is currently in heavy weather. Overall, the introduction of biofuels will still be more costly economically than the current use of fossil fuels, as prices are still higher in the short term. Biodiesel from rapeseed at the refilling station excluding taxes is approximately 0.80 Euros per litre, which is about 2.5 times higher than the cost of conventional diesel. The cost of ethanol from wheat is approximately 0.58 Euros per litre, compared to 0.33 Euros per litre for gasoline. Breakthrough technologies such as Fischer Tropsch diesel are expected to significantly reduce costs to levels that are maximum 30% higher or even competitive compared to fossil fuels, but are not expected to become available before the year 2010.

#### **4.3 State of the Debate on Biofuels in Ireland.**

The following article from the Irish Farmers Journal in February 2005 gives a clear idea of the lack of commitment by the Department of Agriculture and the Department of Communications, Marine and Natural Resources to the development of this vital industry. It indicates that the Green Party must forge an alliance with Irish Farmers to bring about change.

*“The future role of liquid biofuels on tillage farming and the impact they could have on the national fuel supply is finally beginning to get a public airing. It is particularly welcome at the present time when the Irish approach to the Transport Biofuels Directive is starting to take shape.*

*This Directive arose from an examination by the EC of the transport fuel supply situation over the next 20 years. In its preamble it projects the amount of substitution by various alternatives that will be needed to make up for a fall off in supply of petrol and diesel (Table 1). Its conclusion is that we will need to supply about a quarter of the transport fuel market with alternatives by 2020. In the early years it sees biofuels as the main contributor, with natural gas and hydrogen coming in later.*

*In Ireland, if we are to meet the targets set for biofuels, the first 1-2% could be met from residue materials. Subsequent targets would have to be met from crops grown for liquid biofuel production. In the near future there are only two ways we could produce this amount of fuel: we could grow rape-seed to produce fuel for diesel engines (converted to biodiesel or in adapted engines) or produce ethanol from wheat or beet as an additive for petrol engines. Given that each 1% substitution would require anything from 12000 to 40000 ha, it is clear that the attainment of the later targets would require a substantial proportion of our tillage area. So the Irish approach to this Directive will have a major impact on the future of tillage farming.*

*The directive sets out a procedure to achieve the targets of the first five years. It does not at this stage resort to mandatory targets or penalty clauses. Instead it obliges member states to set targets for biofuel substitution (taking account of the Commission's own recommendations of 2% in 2005 rising to 5.75% in 2010), introduce a set of measures to achieve these targets, and report progress annually. The Commission is to review the whole situation in mid-2006. You wouldn't need to be a mind-reader to figure out the intent of the architects of this Directive; if member states do not respond voluntarily they will move to mandatory targets and sanctions.*

*In which case we will end up in a few years either paying penalties or importing biofuels. That might still make some sort of sense if we had plenty of profitable uses for tillage land. But are we saying that feed grain production is going to be so profitable, and is the future of sugar production so rosy, that we can afford to turn our noses up at other opportunities?*

*The Dept of Communications, Marine and Natural Resources has recently submitted its first progress report to Brussels, as required by the Directive. It proposes to reduce the initial Irish substitution target to 0.06 % in 2005 and 0.13% in 2006, and to limit excise relief to 6 million litres of rape-seed oil, 1 million litres of biodiesel and 1 million litres of bio-ethanol. This amount could be produced from 7000 ha of rape and 200 ha of beet. The rape-seed oil relief will be very welcome for the small projects already under way. But the other reliefs are meaningless; the amounts to be excise-relieved are a very small fraction of the production needed to make even one biodiesel or ethanol plant viable.*

*The value of the excise foregone by this amount of relief is about €3M. But French and German studies have shown that most of this amount is eventually returned to the exchequer by the additional economic activity generated. So the real cost of even a much bigger amount of excise relief would still be quite small.*

*Although the DCMNR report may significantly affect tillage farming in the future, it has been drawn up and submitted with virtually no input from the agricultural sector. Surely it is time for the major agricultural stakeholders (farmers, farming organisations, agricultural processors, Department of Agriculture) to make their voices heard and to ensure that their views and concerns are taken on board before the next re-port is submitted. If this does not happen, the opportunity to develop an alternative market for at least some produce will have been lost. Sufficient excise relief to support one biodiesel and one bioethanol plant should be a minimum immediate target. And surely as a country we have some obligation to play a small part in the Commission's efforts to provide a secure vehicle fuel supply for the future".*

Table 8 Substitution targets for transportation fuels (Commission of European Communities, 2003)

Year	Biofuels	Natural gas	Hydrogen	Total
	Biofuel substitution target (%)			
2005	2			2
2010	5.75			5.75
2015	7	5	2	14
2020	8	10	5	23

**Source: Irish Farmers Journal, Feb 2005**

#### **4.4 Ireland lacks support for biofuels**

As earlier mentioned, the EU strongly incentivised the development of biofuels in transport fuels by formulating the Directive on the promotion of biofuels, aiming to increase the share of biofuels in total transport fuels to 5.75% by the year 2010. Moreover, it provided the opportunity to introduce tax exemptions for biofuels. Several EU countries have since then used this opportunity to largely exempt their biodiesel and bioethanol from energy taxes, therewith making them more competitive than common transport fuels. Ireland so far only allows excise duty exemptions on biofuels in certain approved pilot projects and has therewith not been able to set up any production capacity.

#### **4.5 Policy framework in European Union**

The main policies specified to support biofuels at EU level include:

- 1992: the Common Agricultural Policy (CAP) gave EU member States the possibility of growing non-food crops on fallow lands and exempting biofuels from taxes in respect of price competition.
- Directive 2003/30/CE of 8 May 2003, setting a targeted promotion of the use of biofuels in transportation in the EU. The Directive stipulates that each EU Member State must ensure that a minimum percentage of biofuel and other renewable fuels are introduced to their markets. Before July 2004, each member state will have to announce the objectives that it promises to reach, with a minimum threshold of 2% by the end of 2005 and 5.75% by the end of 2010
- Directive 2003/96/CE of 27 October 2003 restructuring the Community taxation framework of energy products and electricity. The Directive allows for tax exemption for biofuels.
- Early 2004, the CAP provided financial assistance for energy crops, other than fallow land, of 45 Euros per hectare, limited at a maximum guaranteed area of 1.5 million hectares.

#### **4.6 Resulting support policies so far in Europe**

The following countries currently provide a tax reduction on biodiesel:

- Finland: 100% exemption from CO<sub>2</sub> tax; approx. 5 cent/litre
- Czech Republic: 100% tax reduction; approx. 22 cent/litre
- Austria: 95% tax reduction; approx. 29 cent/litre
- Spain: 100% tax reduction; approx. 29 cent/litre
- United Kingdom: 42% tax reduction; approx. 29 cent/litre
- France: 84% tax reduction; approx. 33 cent/litre
- Sweden: 100% tax reduction; approx. 34 cent/litre
- Italy: 100% tax reduction; approx. 40 cent/litre
- Germany: 100% tax reduction; approx. 44 cent/litre

The following countries currently provide a tax reduction on bioethanol:

- Czech Republic: 100% tax reduction; approx. 26 cent/litre
- United Kingdom: 42% tax reduction; approx. 29 cent/litre
- Spain: 100% tax reduction; approx. 42 cent/litre
- Germany 100% tax reduction 62 cents per litre
- France: 84% tax reduction; approx. 50 cent/litre
- Italy 100% tax reduction 55 cent/litre

In addition to the above, Poland and the Slovak Republic have formulated some tax reductions for selected biofuels, but the resulting price levels of biofuels are not yet competitive. In Ireland some excise duty tax exemptions are given to some approved pilot projects.

#### **4.7 Sugar Beet Industry Crisis in Ireland**

News that the Sugar Factory is to close in Carlow town has sent an economic chill through Ireland's smallest county. Triggered by forecasted European Union changes to "Sugar Regime" subsidies in 2006, the proprietor Greencore, has decided to close the Carlow plant on 11<sup>th</sup> March 2006 as part of a rationalisation plan. Over three hundred jobs will be lost, and 19,000 farmers will no longer have a market for their crops.

At the same time, all over Europe and North America biofuel plants are being constructed at the moment to meet the growth in international demand for biofuels. Greencore and the people of Carlow have a unique opportunity to turn the Carlow factory into a biofuel plant with the production of ethanol, which can be used as a mix into petrol. Apart from the economic and employment benefits, they curb greenhouses gases. A whopping 55% of emissions can be saved when sugar beet is used as a source of bio-ethanol.

The recently announced Government plans to spend €35 million per annum between 2008 and 2010 buying carbon credits from compliant countries illustrate the costs of meeting Kyoto requirements. However, this €35 million per annum could also be used to support biofuels. If translated into excise reductions on biofuel, it is sufficient to subsidise over 120 million litres of biofuel production every year in Ireland.

To achieve this the Carlow plant should be modified, adding a fermentation plant. A good starting point to facilitate this would be to lift the excise duty on biofuels in line with the EU directive and provide initial investment support for plant conversion. Previous proposals for the production of Ethanol by Greencore have however been rejected by the Department of Finance.

The Carlow plant can produce half of the National quota of sugar in a 12-week campaign (about 100 ktonnes). From this it could produce approximately 1.7% of Irish National Consumption of Petrol or 0.72% of the total transport fuel consumption. This is approximately one third of the EU target, and with refinement Carlow could probably increase this to fully half of the national EU target on biofuels. The plant would create an increase in profits for Greencore, as well as additional benefits to the local economy on a long-term sustainable basis by growing the raw material locally. Were other agricultural feedstocks to be used in addition to beet, Carlow could operate most of the year, thereby fully achieving the targeted share of 2% biofuels for 2005. The additional feedstocks could come from other rural regions in Ireland. Animal by-products are suitable for biodiesel, as is rapeseed. Carbery in Cork can produce ethanol from whey.

Currently 660,000 tonnes of sugar beet pa is processed through the factory, grown by 19,000 growers for €33M with the Government receiving 4.8% VAT on the beet. An annual bill of €3.5 million was paid to hauliers. The wages of 320 workers and their taxes contribute to the local economy and national economy. A large number of ancillary jobs in manufacturing and engineering also exist. Preventing the plant's closure and transforming it into a biofuel plant could preserve all these economic benefits.

## 4.8 Bioethanol production soars in EU and USA

Figure 4-2 shows the production of biodiesel in the EU in the period 1992-2003. Although levels are still small, impressive average annual growth rates of 34.5% have been reached in this period. This resulted in an overall production of 1,434,000 tonnes in 2003. The biggest producing country within the EU is Germany, with a total production of 715,000 tonnes in 2004. Germany is followed by France (357,000 tons) and Italy (273,000 tons). Other producing countries in Europe are the Czech Republic, Denmark, Austria and the United Kingdom.

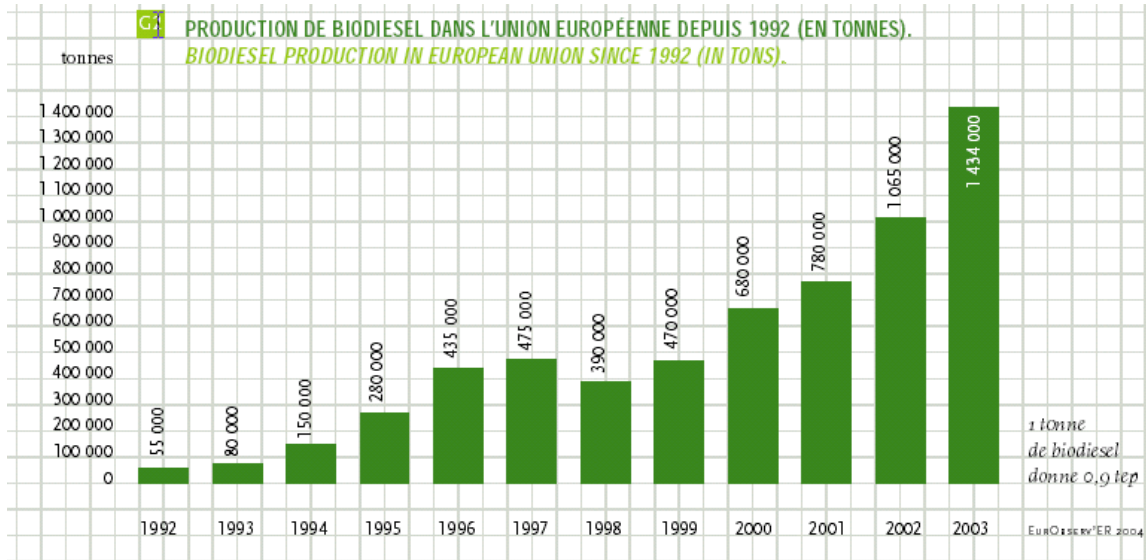


Figure 4-2 Biodiesel production in the EU (source EurObserv'ER)

Ethanol production in Europe is small compared to Brazil and the United States. Some twenty years ago these two countries started large production facilities. Brazil produced 9.9 million tons in 2003, mainly from sugar cane.

Ethanol production in the US was estimated to be 8.4 million tons in 2003, coming essentially from corn. Figure 2 shows the production of bioethanol in the EU in the period 1992-2003. Although levels are still small, impressive average annual growth rates of 34.5% have been reached in this period.

This resulted in an overall production of 1,434,000 tonnes in 2003, totaling 309,500 tons in 2003. The biggest producing country within the EU is Spain (176,700 tons in 2003), followed by France (90,500 tons), Poland (65,700) and Sweden (50,100 tons).

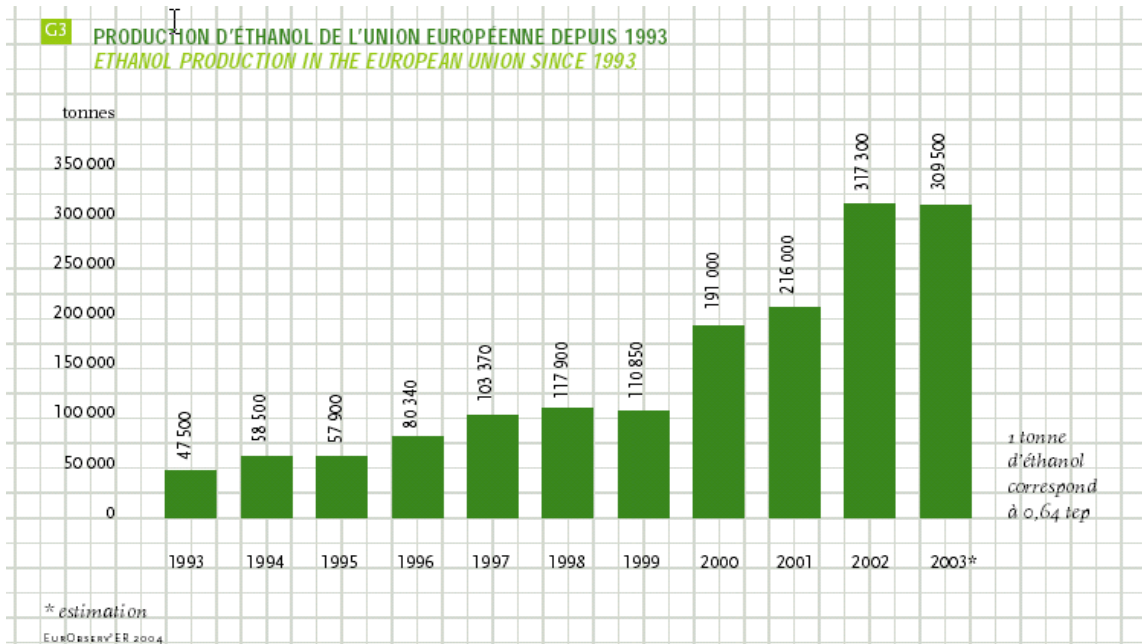
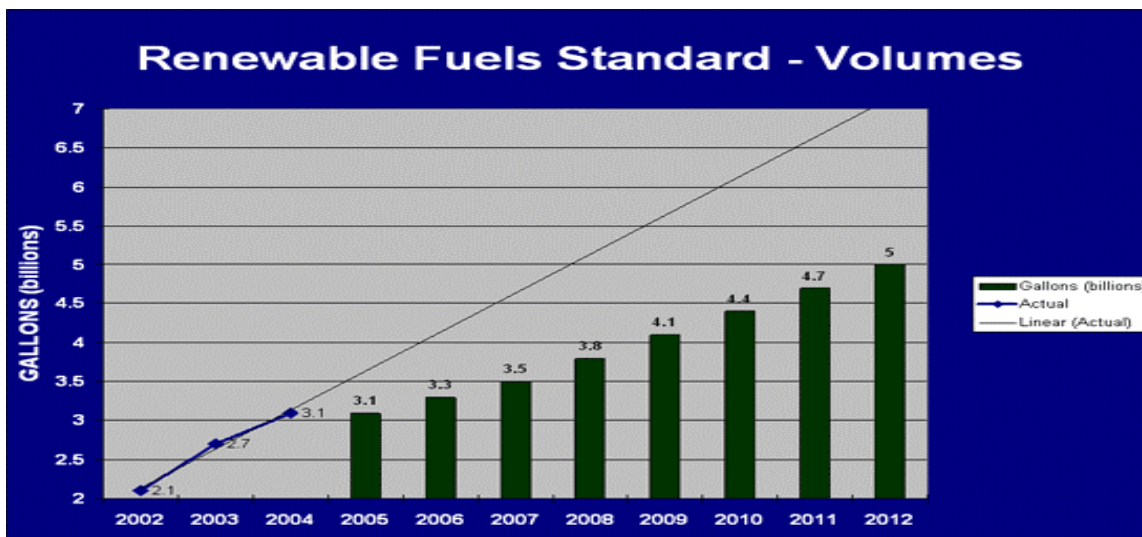


Figure 4-3 Ethanol production in the EU (source EurObserv'ER)

Interestingly, the Carlow sugar factory could produce about 47,000 tonnes of ethanol or 1.25 PJ (LHV) from its sugar output. This is equivalent to all production in the EU in 1993, as we can see from the graph above, 0.72% of Ireland 2005 combined petrol and diesel consumption, or 1.7% from gasoline consumption. More alcohol production could be possible from the waste of the sugar plant.

#### ECONOMY & JOB CREATION BENEFITS OF ETHANOL PRODUCTION IN THE USA

US department of Agriculture figures for Bioethanol production



(The following section is from American coalition for Ethanol)

The production and use of ethanol benefits our economy on all levels –local, state, and national. From the local communities where the crops are grown and processed to the metropolitan areas where drivers fill up with a domestically-produced fuel, American-made ethanol propels the economy.

Ethanol use will cut the U.S. trade deficit by \$34.1 billion by 2012. Doubling ethanol use in the U.S., as called for in the Renewable Fuels Standard, will create nearly 50,000 permanent jobs, with indirect employment totaling over 200,000 new jobs.

In their 1997 study *The Economic Impact of the Demand for Ethanol*, Northwestern University's Kellogg School of Management found that:

- During ethanol plant construction, approximately 370 local jobs are created.
- During ethanol plant operation, up to 4,000 local jobs are created.
- Ethanol plant construction creates \$60 million to \$130 million in additional income.
- Ethanol plant operation creates \$47 million to \$100 million in additional income.

In their 2002 study *Ethanol and the Local Community*, AUS Consultants and SJH & Company found that:

- With an approximate cost of \$60 million for one year of construction, an ethanol plant expands the local economic base by \$110 million each year.
- Ethanol production will generate an additional \$19.6 million in household income annually.
- Tax revenue for local and state governments will increase by at least \$1.2 million per year.
- Nearly 700 permanent jobs will be created in the area near an ethanol plant

#### **4.9 Teagasc Report on Bio Diesel in Ireland**

The bio-equivalent fuel for diesel is basically any pure or purified oil ("PPO"). Oilseed rape is an example of a crop that when "pressed" yields unrefined rapeseed oil which of itself can be used to fuel a simply and cheaply modified diesel engine extremely efficiently.

When a Kilo (a litre) of PPO is used in an engine it gives the same MPG and power as a Kilo of Diesel. Both fuels make almost identical emissions. The difference is evident when the farmer goes to renew that Kilo of PPO. 10-15 kilos of plant stems, seeds, leaves and roots must be produced to make 3 kilos of oilseed, which will in turn produce 1 kilo of PPO. However, growing 10-15 Kilos of plant material will remove more than twice the amount of carbon emissions from the air than is put into the air when 1 kilo of PPO is burned as a fuel. Therefore the growth and use of PPO as a fuel actually makes a positive contribution to the removal of carbon emissions from the air.

Teagasc is the Irish Governments Farm Advisory service, and it concluded a report in 2002 on "Feasibility of local production and extraction of vegetable oil as an alternative fuel for diesel engines" as follows:

1. It is technically feasible to produce vegetable oil on set-aside land, extract the oil in a local small-scale crushing facility, feed the cake to local animals and use the oil as a fuel in local vehicles with modified diesel engines. The machinery and expertise to grow the crop are readily available on Irish tillage farms. Small-scale crushing plants are also readily available. There would be a ready market for oil-seed cake containing some oil and guaranteed GMO-free.

2. The current excise on auto diesel in 2002 is 30.2 cent/litre, equivalent to 36.5 cent/litre after VAT. If no excise were charged on the biofuel, the ex-works prices of the fuels would be equivalent if the diesel price were 19.5 cent/litre. Diesel ex-plant prices have been generally higher than this, so full remission of excise would be sufficient to make the project viable.
3. A successful project of this type could be replicated in many other arable areas. The upper limit would be the amount of set-aside land, which is currently 30,000 ha in 2002. Several groups and individuals in other areas are interested in similar projects. If half of the set-aside land could be brought into oilseed production, it would provide about 15,000t of fuel oil and 30,000t of oilseed cake. The cake would be a native source of GM-free animal feed protein, which is in good demand at present.
4. The benefits expected to accrue from this type of project are as follows:
  - Reduction of Greenhouse Gas emissions. Each tonne of fuel burned would reduce CO2 emissions by over 3 tonnes.
  - Reduction of harmful exhaust emissions from diesel engines. Sulphur would be eliminated, smoke and particulates reduced substantially, and the risk of water pollution by spillages reduced.
  - Provision of native, renewable fuel supply with associated economic activity. The amount of fuel that could be produced in this way is no more than about 1% of our total road usage, but several hundred rural jobs could be sustained/generated by a replication of this type of project.
  - Development of renewable fuel technologies that will be needed in the future.
  - Compliance with substitution obligations in upcoming EU Directive proposals.

Unfortunately the Government have not chosen to follow the path suggested by Teagasc, and significant opportunities are thereby being lost for Ireland farming communities, and for the nation as a whole.

It should be noted that the growing practice in the EU is to convert the oil extracted directly into deisel fuel in a simple process that thereby requires no modification of vehicle engines.

#### **4.10 Teagasc Report on Waste RVO/Tallow**

We include below a synopsis of the recent Teagasc report on waste vegetable oil, and beef tallow from the rendering industry by Bernard Rice of Teagasc, of the crops advisory service in Oak Park in Carlow.

For Ireland to achieve a 2% substitution of road diesel by 2005 in accordance with the EU directive, a production of about 35,000 t/annum of biofuel would be required. The most likely raw materials would be rapeseed oil, recovered vegetable oil (RVO), and beef tallow. RVO and tallow would have a lower cost than rape-seed oil, but their more variable and inferior fuel properties would limit their use options.

Irish RVO dealers estimate that about 7000t of RVO is collected annually at present. They also estimate that this could increase to 10,000t if collection systems were improved and restrictions on illegal dumping were tightened. Traditionally RVO has been used in animal feeds. This use is under threat throughout the EU, and is expected to terminate in Ireland before the end of 2004.

About 50-60,000t per annum of beef tallow is produced by the rendering industry. Tallow from certain sources (all slaughtered herds and fallen carcasses, specific risk material from every slaughtered bovine) is banned from animal feeds.

For a cost comparison with mineral diesel, an allowance for reduced fuel economy should be included. In past Oak Park trials, the reduction varied between 2 and 4% (7). A 3% reduction would add a total of about 1.4 cents/litre to the price. The equivalent price of mineral diesel (i.e. before tax or distribution costs) would therefore need to be at least 38 cent/litre for the biodiesel from RVO to be competitive. For tallow ester to be competitive, the equivalent price of mineral diesel would need to be over 40 cents/litre.

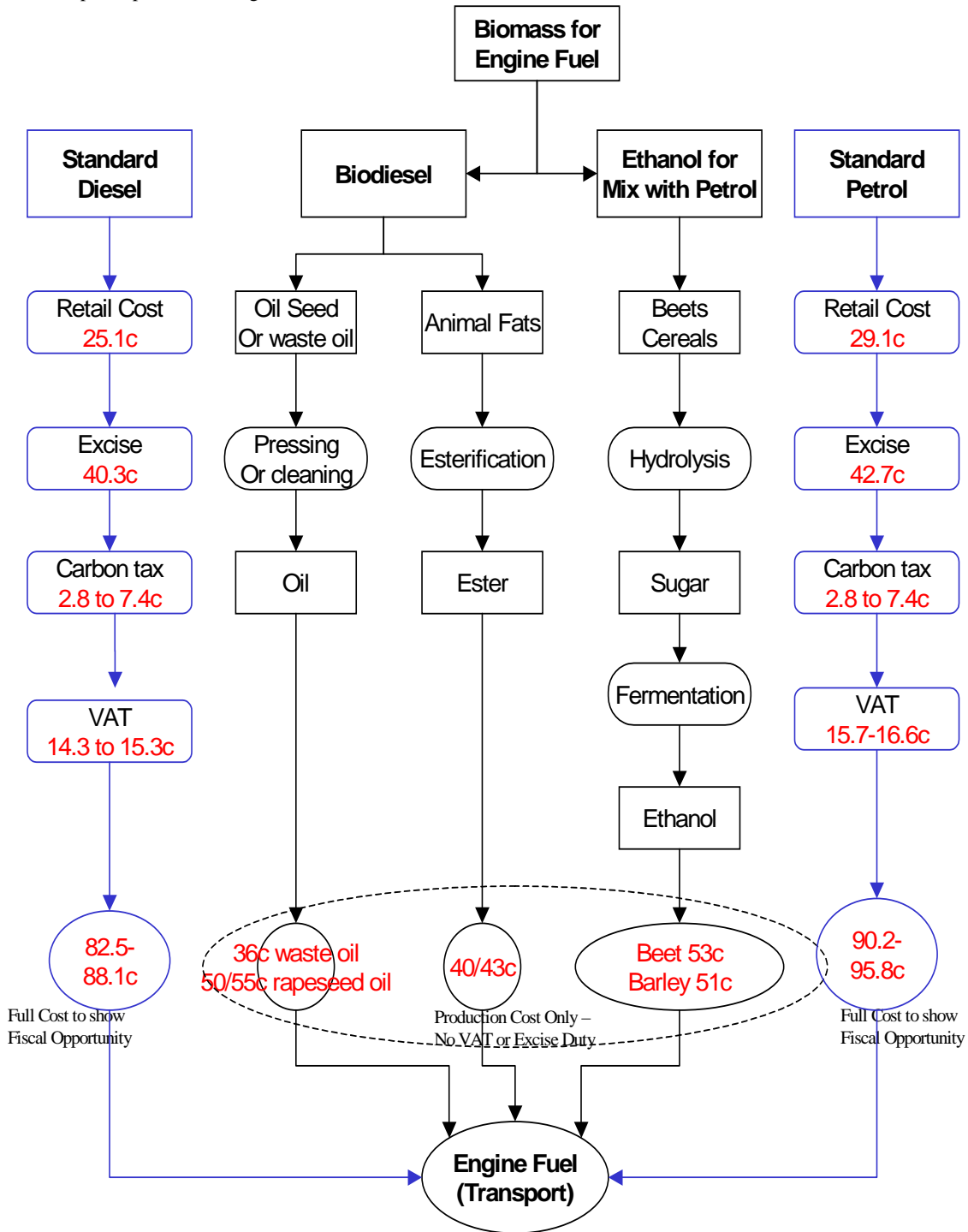
Biodiesel production from RVO is a feasible option; a simple single-stage process should be adequate for most of the material collected, and the fuel quality should be of a fairly high standard. The main problem would be to procure sufficient volumes to achieve a reasonable economy of scale.

Tallow esterification presents more difficulties. On a small scale, the two-stage process would need to be streamlined to maintain plant capacity before it could be recommended.

When allowance is made for the cost of engine modification kits and reductions in fuel economy, the equivalent production cost (before tax and distribution) of mineral diesel would have to be at least 33 cents/litre for RVO to be competitive as a vehicle fuel. Biodiesel produced from RVO would require a mineral diesel price of 38 cents/litre. For tallow ester to be competitive, the diesel price would need to be at least 40 cents/litre. Since these are all well above current diesel prices, some subsidy would be required for the biofuels before they could be marketed at a price competitive with mineral diesel.

Figure 4-4 **Cost in cents per litre including capital assets & Raw Material.(based on data from Teagasc and 2004 fuel prices)**

Simplified process/cost diagrams



## 5 Potential heat market

### 5.1 Introduction

Heat consumption in the building industry in Ireland is relatively high compared to other European countries. [Arsenal, 2004a] reports that Irish insulation levels are among the poorest in Northern Europe. The extent of doubleglazed windows, at 36%, is very low relative to other countries. Ground floor insulation, at one-in-four households, is likewise paltry. Similarly, less than two-in-four households have draught sealing or wall insulation. Figures 5-1 until 5-3 show fuel used for heat supply in the residential, commercial & public, and industry sectors respectively, excluding electricity used for heat supply. The figures are taken from [COFORD, 2003].

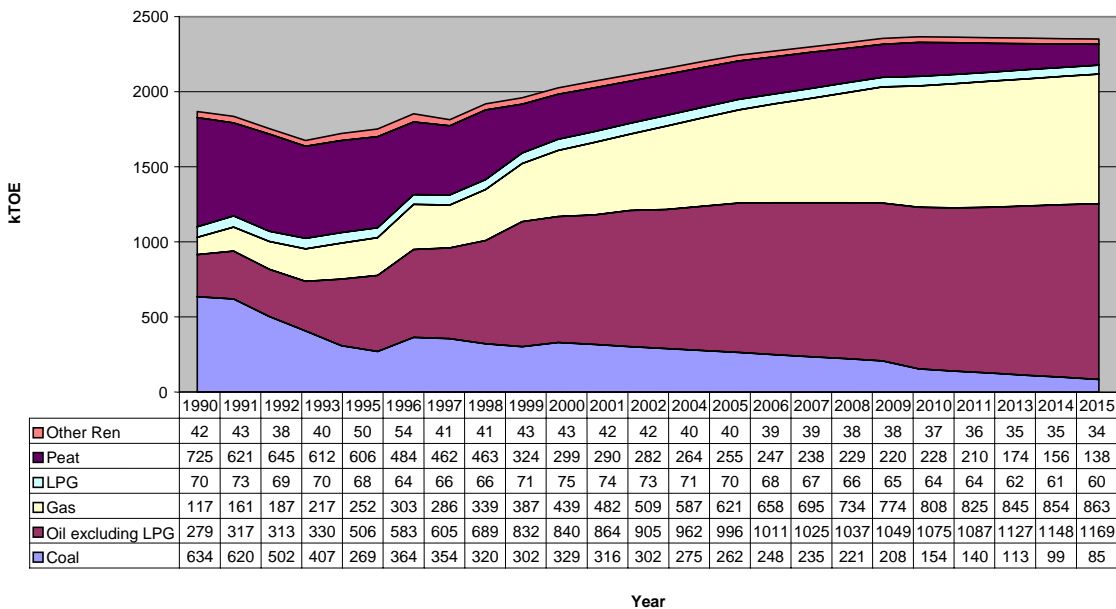


Figure 5-1

Fuel Used for Heat in the Residential Sector (Excluding Electricity)

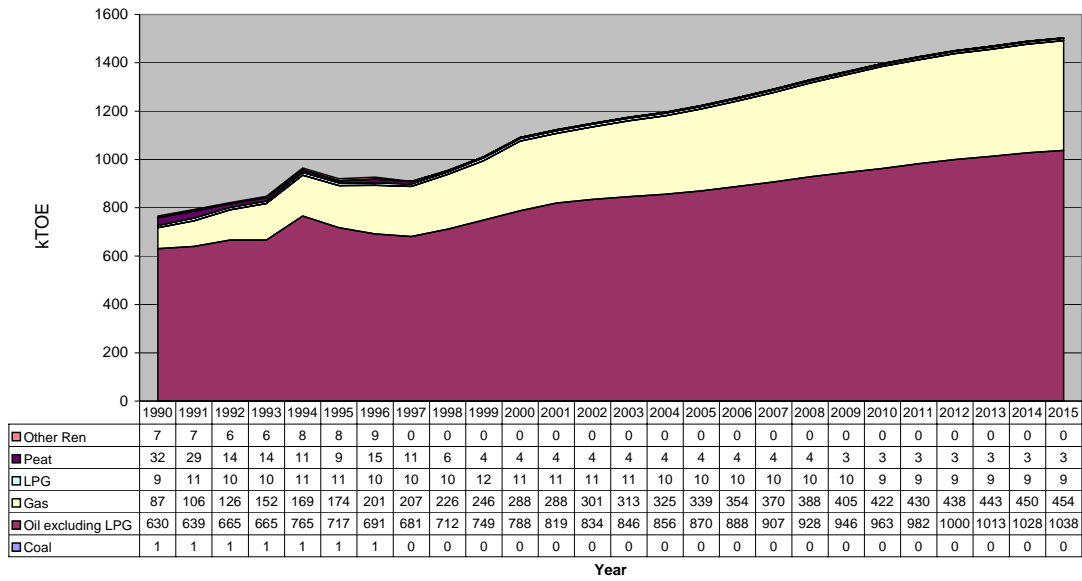


Figure 5-2 Fuel

Used for Heat in the Commercial and Public Sector - Excluding Electricity

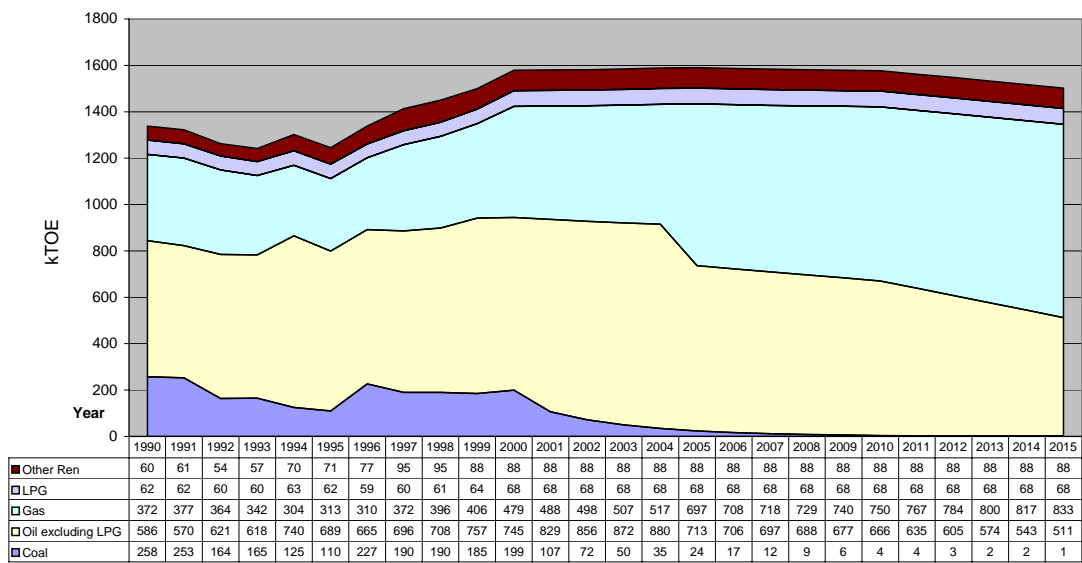


Figure 5-3 Fuel

Used for Heating in the Industry Sector (Excluding Electricity)

## 5.2 Biomass

As in the power market, biomass is an important source of potential renewable heat supplies. Data is included in Section 0.

### 5.3 Wood Biomass

Joe O’Carroll, operations manager of COFORD, wrote a paper in 2004 called “Carbon Emissions Reduction Potential from Wood Biomass” in which he examined the existing potential of forestry by-products based on existing resources if Ireland implemented a policy of “fuel switching”. He concluded that wood biomass can make a significant contribution to the national climate change strategy and could contribute a reduction of up to 9.9 Mt in CO<sub>2</sub> emissions over the first two commitment periods, an average of 1 Mt/year. In 2008 the reductions would be 0.73 Mt, or 5% of the 15.415 Mt target outlined in the National Climate Change Strategy.

COFORD’s paper ignores the potential for increasing dramatically the land used for coppicing and the resulting potential increases in supply of wood-chip or wood pellet supply, and examine the potential use only of existing forestry by-products and wood waste. The electricity industry aspects of this paper are also covered in chapter 3 above.

The paper analyses the key periods in which Ireland must reduce emissions as the ‘commitment’ periods outlined in the Kyoto Protocol. The first commitment period runs from 2008 to 2012 and the second from 2013 to 2017. Assuming that all available wood biomass was used to displace heating oil, significant reductions in carbon emissions would be realised, as outlined in Figure 5-4.

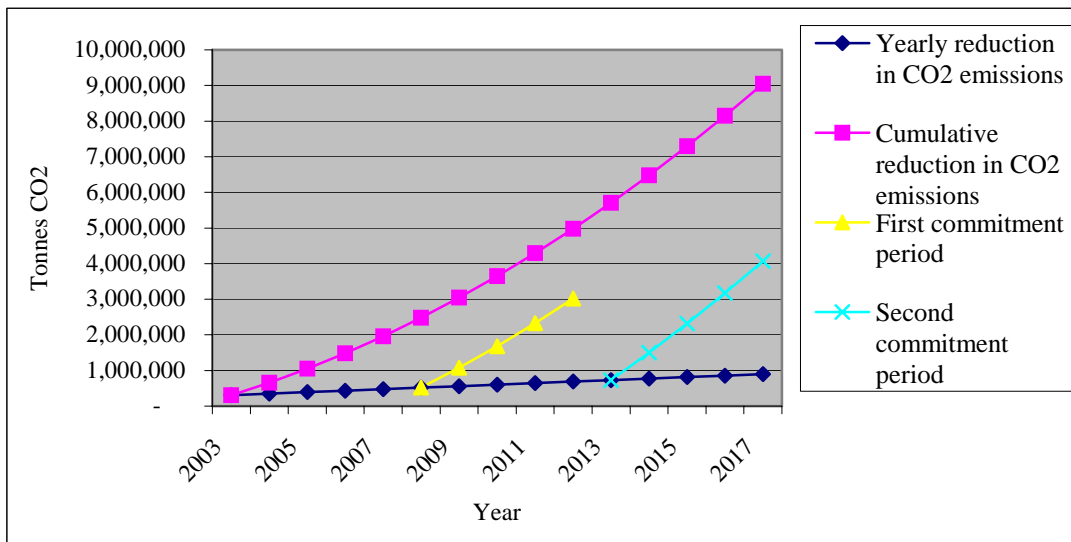


Figure 5-4 Carbon dioxide emissions reduction resulting from displacement of oil with wood biomass.

Over the first commitment period carbon dioxide emissions could be reduced by 3.0 million tonnes and by 4.1 million tonnes in the second period – a total of 7.1 million tonnes over the two periods. Table 9 outlines the reductions potential realisable by displacing different fuels with the wood biomass supply.

Table 9 Realisable CO<sub>2</sub> reduction potential with wood biomass

Fuel Type Displaced with Wood Biomass	Reduction in CO <sub>2</sub> Emissions 2008-2012 million tonne	Reduction in CO <sub>2</sub> Emissions 2013-2017 million tonne	Total Reduction in CO <sub>2</sub> Emissions 2008-2017 million tonne
Peat	4.2	5.7	9.9

Coal	3.5	4.7	8.2
Oil	3.0	4.1	7.1
Average Fuel Mix <sup>4</sup>	1.9	2.6	4.5
Gas – Simple Cycle	1.9	2.5	4.4
Gas – CCGT	1.3	1.8	3.1
Gas - CHP	0.9	1.2	2.1

Table 10 Value of emissions reductions over the first two commitment periods, discounted to 2008 at 5%

Fuel Type Displaced with Wood Biomass	Value of CO <sub>2</sub> Emissions Reductions at €10/tCO <sub>2</sub> €million	Value of CO <sub>2</sub> Emissions Reductions at €20/tCO <sub>2</sub> €million	Value of CO <sub>2</sub> Emissions Reductions at €40/tCO <sub>2</sub> €million	Value of CO <sub>2</sub> Emissions Reductions at €100/tCO <sub>2</sub> €million
Peat	75.8	151.7	303.3	758.3
Coal	62.9	125.7	251.5	628.7
Oil	53.9	107.8	215.6	539.1
Average Fuel Mix <sup>5</sup>	34.7	69.5	139.0	347.5
Gas – Simple Cycle	33.7	67.4	134.8	337.1
Gas – CCGT	23.9	47.7	95.4	238.5
Gas - CHP	16.4	32.8	65.6	164.1

These values are represented in Figure 5-5 to illustrate the relative difference in values of emissions reductions between different fuel types that could be displaced.

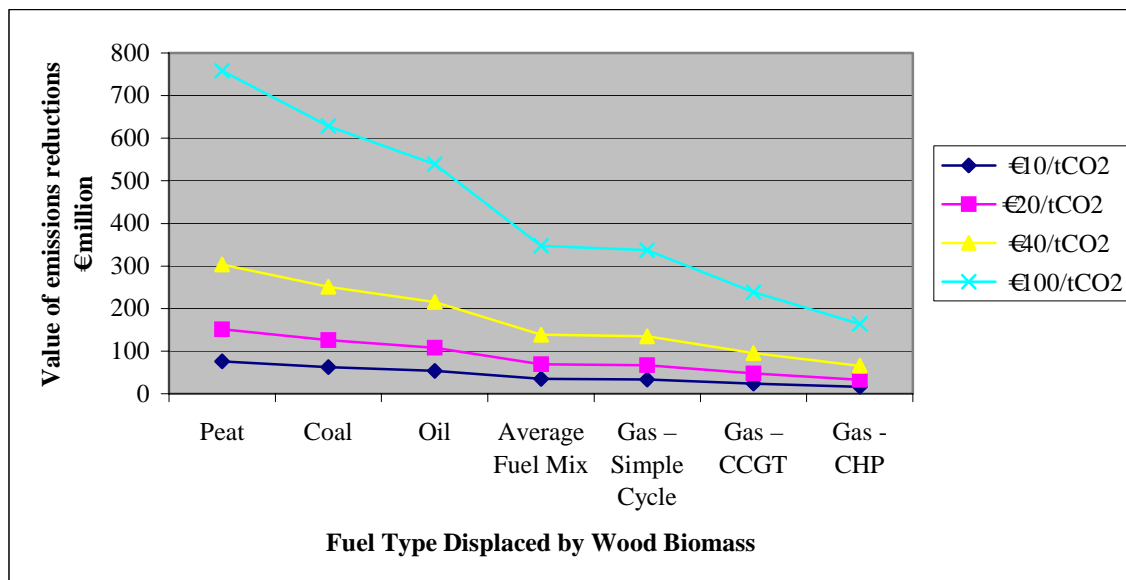


Figure 5-5 Value of emissions reductions

<sup>4</sup> Projected fuel mix for 2010.

<sup>5</sup> Projected fuel mix for 2010.

## 5.4 Renewable heat pumps

SEI is funding a project entitled *Campaign for Take-off for Renewable Heat pumps in Ireland*. The project provides an overview of experiences in Austria, Germany, Switzerland and Sweden and draws conclusions on the requirements for a successful uptake of renewable heat pumps. Moreover it proposed a strategy for the CTO.

The main requirements identified to achieve a sustainable market penetration for heat pump technology are:

1. Availability of heat pump technology (manufacturers, sales representatives) within the country.
2. Economic incentives that facilitate a payback period on the enhanced initial investment of no longer than 5 -7 years compared to other heating alternatives.
3. Legislative initiatives that require efficient heating systems to benefit over other heating systems. For example standards or regulations controlling the maximum amount of CO<sub>2</sub> emissions allowed from new buildings or standards for sizing the heating system to cover the heat loss of the dwelling and transition to low-temperature heating systems.
4. The availability of trained installers.
5. Awareness amongst end-users facilitated by a large scale information campaign on heat pumps as a heating alternative and identifying their benefits in comparison to other heating alternatives.
6. General acceptance of heat pumps, facilitated by high quality technology and installation.

Upper Austria is the most prominent region in Europe with respect to the use of renewable heat pumps. [Arsenal, 2004a] compares the situation in Upper Austria with the situation in Ireland.

1. In the field of market suppliers, Ireland is in a significantly better situation than the four countries mentioned at the start up phase of the heat pump market. Because in Ireland there are already a few qualified and experienced manufacturers and importers on the market.
2. The pay back period for a heat pump in comparison to a gas boiler would be more than 10 years. Therefore, because of the low prices for natural gas the heat pump could not compete against natural gas without the help of financial subsidies. As hardly any financial support exists, the price gap is not closed.
3. In general, policy support in Ireland is inadequate. Surprisingly some strong incentives do exist, but regulation is poorly met. For instance, building regulations for Upper Austria and Ireland are quite similar. However, in Ireland there exists a lack of inspection and therefore motivation to comply with building regulations. Actual heat demand for new buildings is therefore much higher than in Upper Austria.
4. There are very few capable installers for heat pumps and their level of expertise is low.
5. The level of awareness about heat pumps is very poor in Ireland.
6. A low level of confidence exists in heat pumps. Moreover, because of bad installation historically, people do not appreciate quality.

[Arsenal, 2004a] sketches two heat pump development strategies for Ireland in the period 2004 – 2020. The strategy copies the ambitious Swiss heat pump development strategy with a very pro-active government policy. The cost-efficient strategy copies the development of the heat pump markets in the successful districts of Germany (Niedersachsen and Bayern) and Austria (Upper Austria).

	Ambitious strategy	Cost-efficient strategy
New heat pump installations		
• Total in 2004-2020	73,900	30,240
• Annually	4,347	1,779
Generation of full time jobs	1,420	540
Total public costs		
• Total in 2004-2020	41.5 million €	4.1 million €
Energy savings		
• Total in 2004-2020	8.19 TWh	3.45 TWh
• Annually	481 GWh	203 GWh
CO <sub>2</sub> savings in tonnes		
• Total in 2004-2020	2.17 million	0.91 million
• Annually	127,500	53,707
CO <sub>2</sub> reduction costs in €/per tonne	19.2	4.5

## 5.5 Solar thermal energy

The level of penetration of solar thermal panels in Ireland is the lowest in Europe with about 1.5m<sup>2</sup>/1,000 inhabitants compared to close to 250m<sup>2</sup>/1,000 inhabitants in Austria for example. This is despite all the advantages provided by solar thermal systems in terms of comfort, savings and environmental protection.

SEI commissioned a study to inform government policy about the development of the solar thermal market in Ireland and propose an action plan until 2012. The final report [DEA, 2004] sketches three scenarios for the future development of solar thermal energy in Ireland: a low, medium and high scenario with similar levels of support and required promotion efforts. In its final recommendation a scenario is selected between the medium and high scenario, resulting in a total number of 155,000 systems installed in 2020, an average 38 m<sup>2</sup> per 1000 inhabitants. Note that the current European average number of systems installed per 1000 inhabitants is 34.

Scenario:	Low	Medium	High	Recommendation
Solar thermal volume				
• Total number of systems in 2020	40,000	90,000	180,000	155,000
• m <sup>2</sup> per 1000 inhabitants	10	22	44	38
Energy production (GWh)	18	40.5	81	70
Annual emission reduction (tonnes)	8,300	18,700	37,400	32,200
Employment/year (FTE)	200	440	880	734
Total expenses 2004-2010 (million Euro)	4	11	27	20

## 5.6 Biofuel pellet plant in Northern Ireland

In August 2004 UK's Department of Trade and Industry Energy Minister, Stephen Timms MP announced the plans to construct a new biofuel pellet plant at Balcas timber processing facility, outside Enniskillen, Northern Ireland. The Balcas plant will produce 50,000 tonnes of fuel pellets annually, manufactured from sawdust and wood chips from Balcas' timber processing activities. The production will be used to fire an on-site CHP plant that should provide Balsac with all its own electricity and heating requirements and provide the energy requirements of 10,000 Northern Ireland homes. Balcas Managing Director, Ernest Kidney, said: "Inside the next decade, bio fuel pellets could deliver the energy for a quarter of new rural homes in Northern Ireland." "Bio fuel pellets can provide the energy needs of communities where the hinterland precludes wind generation, where the topography is hostile to overhead and underground cabling and where the fuel itself grows from the hillside to the roadside." "Throughout Europe, timber based bio fuel pellets already provide heat, power, and price stability. Timber is a cheap and renewable resource and the bio fuel pellets industry provides a bonus of well-paid rural jobs in harvesting, production and distribution."

Balcas employs 1,000 people in harvesting and processing the output from the renewable forests of Northern Europe. The project has also been supported by a £1 million interest free loan from the NIE SMART programme. The on-site processing of sawdust and wood chips will eliminate 10,000 heavy truck journeys per annum from the roads of Northern Ireland - equivalent to 1.5 million truck miles.

Source: <http://www.nics.gov.uk/press/eti/040823a-eti.htm>

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## 6 Appendix on AER

### Overview of AER projects

The table below provides an overview of AER projects awarded in rounds I to IV as well as the targeted and offered capacity in AER V and VI.

Table A1: AER projects awarded in rounds I to IV

	Capacity awarded AER support	Notes
<b>AER I</b>		
Wind energy: 7 projects	45.8 MW	
Small-scale hydro: 6 projects	2.304 MW	
CHP	10.716 MW	
Landfill gas	11.804 MW	
<b>AER II</b>		
Biomass/waste	30 MW	The project did not proceed
<b>AER III</b>		
Wind energy: 6 projects	37.51 MW	
Small scale hydro	1.67 MW	
Landfill gas	2.928 MW	
<b>AER IV</b>		
CHP: 17 new projects	45 MW	Initial target was 25 MW. Large share of projects did not go through; result 18.353 MW additional capacity.
CHP: 2 capacity extensions	7.6 MW	Initial target was 10 MW

Source: SEI, 2004b

The AER V competition set an initial target set of 255 Megawatts, but a total of 363 MW was contracted. AER V projects must be installed by the end of 2004. Details of the technologies supported are outlined in the table below.

Table A2 Capacity targeted and offered capacity in AER V

Technology	Capacity Cap (MW)	Capacity offered (MW)
Large-scale wind	200	318.3
Small scale wind	40	35.795
Hydro (small-scale)	5	0.949
Biomass (including Landfill Gas)	10	8.008
Totals	255	363.052

Source: SEI, 2004b

AER VI aimed to ensure that the Green Paper target of 500 Megawatt renewable electricity-generating capacity is reached by 2005. Details are depicted in Table A3: A total of 48 contracts, amounting to 365 Megawatts of capac-

ity were offered to the market including - for the first time - two 25MW offshore wind demonstration projects. The successful projects include 234 MW of wind energy, over 3 MW from landfill gas and 0.8 MW from biomass. Projects (other than offshore wind and Biomass-CHP projects) must be built by 31 December 2004.

Table A3: Renewable electricity generating capacities offered under AER VI

	<b>AER VI announcement (incl. AER V) [MW]</b>	<b>AER VI price cap [Euro/MWh]</b>
Biomass	8	64,12
Biomass CHP	28	70,00
Biogas	2	70,00
Hydro	5	70,18
Wind onshore	485	52,16 – 57,42
Wind offshore	50	85,00
<b>TOTAL</b>	<b>578</b>	<b>58,75</b>

Source: SEI, 2004b

Table A4 Renewable Energy electricity generating capacity in Ireland, 2004

<b>Technology</b>	<b>Type Installed capacity (MW)</b>
Large hydro	200
Small hydro	52
Wind	230
Landfill gas	20
Waste to Energy	2
<b>Total</b>	<b>504</b>

Source: SEI

The table below provides a summary of the practicable electrical power identified in this report to be available from selected renewable energy sources in each county by the year 2020 as quoted by SEI.

Table A5 Renewable electricity resources until 2020 in GWh/year

<b>County</b>	<b>Small-Hydro</b>	<b>Municipal Solid Waste (MSW)</b>	<b>Landfill Gas</b>	<b>Agricultural Solid Waste<sup>2</sup></b>	<b>(i) Short Rotation Forestry</b>	<b>(ii) Industry Residue</b>	<b>(iii) Forest Residue</b>
Carlow	22.9				2394	158	16
Cavan	4			34	4853	2	29
Clare	1.4		11		5575	94	129
Cork	35.2	148	56	55	13557	471	186
Donegal	47.1		10		3569	91	133
Dublin	4.5	244	98		2030	9	14
Galway	24.1	79	30		5912	215	160
Kerry	129.7		9		5248	96	141
Kildare	3.6		13	20	4509	16	23
Kilkenny	6.6				5126	34	49
Laois	0.9				4424	100	60
Leitrim	5.8				2843	100	70
Limerick	6.2	54	22	54	6664	35	51
Longford	1.8		22		2525	10	15
Louth	1.1			18	1627	5	8
Mayo	9.5			18	4624	104	153
Meath	9.8			31	7148	7	11
Monaghan	2.4		9	164	3660	9	14
Offaly	4.4		10		4282	27	40
Roscommon	3.2				5487	169	64
Sligo	15.2				3511	39	57
Tipperary	6.5				20120	109	117
Waterford	3.1		11	42	3667	106	73
Westmeath	1.3		9		4692	22	32
Wexford	3.9			31	5544	24	35
Wicklow	4.4		11		2712	276	99
<b>TOTAL:</b>	<b>359</b>	<b>525</b>	<b>321</b>	<b>467</b>	<b>136303</b>	<b>2328</b>	<b>1779</b>