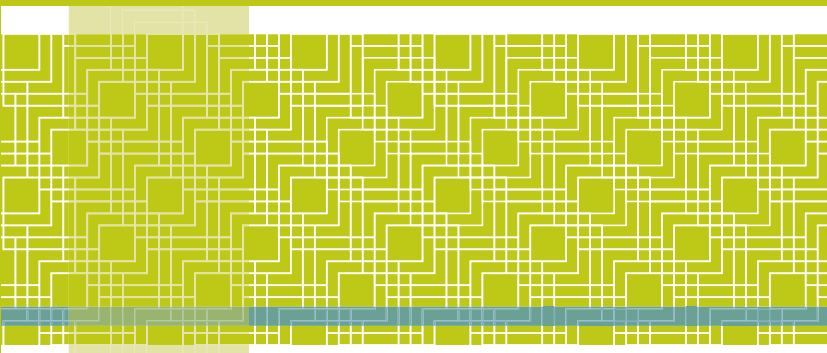
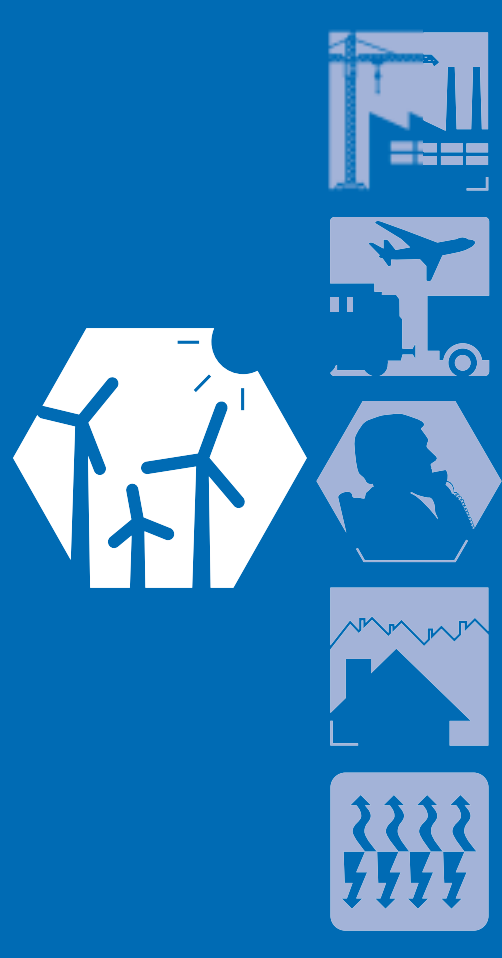


Renewable Energy in Ireland

2005 Update



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Report prepared by
Fergal O' Leary, Martin Howley and Dr. Brian Ó Gallachóir

A View from Northern Ireland Update prepared by Terry Waugh of Action Renewables

January 2006

Sustainable Energy Ireland

Sustainable Energy Ireland (SEI) is Ireland's national energy agency. Established on May 1st 2002 under the Sustainable Energy Act 2002, SEI has a mission to promote and assist the development of sustainable energy. This encompasses environmentally and economically sustainable production, supply and use of energy, in support of Government policy, across all sectors of the economy. Its remit relates mainly to improving energy efficiency, advancing the development and competitive deployment of renewable sources of energy and combined heat and power, and reducing the environmental impact of energy production and use, particularly in respect of greenhouse gas emissions.

SEI is charged with implementing significant aspects of the Green Paper on Sustainable Energy and the National Climate Change Strategy as provided for in the National Development Plan.

SEI manages programmes aimed at:

- assisting deployment of superior energy technologies in each sector as required;
- raising awareness and providing information, advice and publicity on best practice;
- stimulating research, development and demonstration;
- stimulating preparation of necessary standards and codes;
- publishing statistics and projections on sustainable energy and achievement of targets.

SEI is responsible for advising Government on policies and measures on sustainable energy; implementing programmes agreed by Government and stimulating sustainable energy policies and actions by public bodies, the business sector, local communities and individual consumers.

Energy Policy Statistical Support Unit

SEI has a lead role in developing and maintaining comprehensive national and sectoral statistics for energy production, transformation and end use. This data is a vital input to meeting international reporting obligations, for advising policy makers and informing investment decisions. Based in Cork, the Energy Policy Statistical Support Unit is SEI's specialist statistics team. Its core functions are to:

- collect, process and publish energy statistics to support policy analysis and development in line with national needs and international obligations;
- conduct statistical and economic analyses of energy services sectors and sustainable energy options;
- contribute to the development and promulgation of appropriate sustainability indicators.

Highlights

- The contribution of renewable energy to Total Primary Energy Requirement (TPER) was 2.2% in 2004 compared with 1.9% in 2003. The growth in 2004 is attributable to increasing wind and solid biomass output.
- Using a Primary Energy Equivalent (PEE) approach based on fossil fuel displacement, renewable energy's contribution to TPER in 2004 was 3.5% (534 ktoe).
- In absolute terms the primary energy for renewables was 325 ktoe in 2004 representing a growth rate of 18% relative to 2003 and a 94% increase (4.8% per annum on average) on 1990 levels.
- In 2004 the largest contribution of renewable energy to TPER was from solid biomass, followed by wind, hydropower, landfill gas, biogas, waste water biogas, solar thermal and geothermal. In 2004, wind was the second largest contributor to TPER overtaking hydro for the first time.
- The total contribution from renewable energy to gross electrical consumption in 2004 was 5.2% (compared to 4.3% in 2003 and 4.8% in 1990).
- The output from wind generation increased in 2004 alone by 44% to 655 GWh, representing 2.4% of gross electrical consumption making it the largest renewable contributor.
- The total installed capacity of wind farms in Ireland (December 2005) was 495.5 MW_e an increase of 46% (157 MW_e) on 2004. The deployment in 2004 (171 MW_e) was greater than the cumulative deployment from 1992 to the end of 2003 (167 MW_e). Overall growth in 2005 is expected to exceed that in 2004.
- The increasing importance of wind is highlighted by the fact that the installed capacity of wind (495.5 MW_e) was in December 2005 more than double that of hydro (241 MW_e).
- Renewable energy has increased its contribution to the indigenous fuel mix from 5% (of 3,424 ktoe) in 1990 to 20% (of 1,602) in 2004.
- The estimated quantity of carbon dioxide (CO₂) avoided by renewable energy in 2004 was 1.5 million tonnes.
- In 2004 / 2005 Action Renewables compiled a renewable energy statistics database for large and small scale renewable energy projects in NI. Total installed capacity of large scale (>20kW_e) projects is 115 MW_e while the total installed capacity is 1,266 kW_e for small scale projects (<20kW_e). Wind is the most widespread technology for both large and small scale.

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1 Introduction

This report examines the contribution made by renewable energy to Ireland's energy requirements for the period 1990 to 2004 with a particular focus on renewable energy production data in 2004 and capacity data and policy developments in 2004/ 2005. This update should be read in conjunction with a report published in August 2004 entitled, "*Renewable Energy in Ireland Trends and Issues 1990 – 2002*". This is the first in a planned series of annual data updates.

The report is structured as follows:

- Section 2 provides the context for renewable energy development, examining recent energy trends and the impacts relating to the environment and security of supply.
- Section 3 explores the major policy developments in the area of renewable energy at an international, European and national level.
- Section 4 analyses the total contribution made by renewable energy to meeting Ireland's needs for electricity, and thermal energy. It also develops further the primary energy equivalent (PEE) approach for renewables and links it to avoided CO₂ emissions through fossil fuel displacement.
- Section 5 assesses recent energy production trends for individual renewable energy sources and technologies.
- Section 6 provides an update from Northern Ireland on renewable energy.

The national energy balance data presented in this report are the most up-to-date at the time of writing. The national energy balance is updated whenever more accurate information is known. To obtain the most up-to-date figures visit the statistics publications section of the SEI website².

Feedback and comment on the report are welcome and should be addressed by post to the address on the rear cover or by email to "epssu@sei.ie".

2 Context for Renewable Energy Deployment

This section outlines the energy context within which renewable energy trends are assessed. It draws on trends in primary energy supply and final energy demand during the period 1990 to 2004. These trends are discussed in more detail for the period in a separate SEI publication³.

Ireland's total energy supply is discussed in terms of changes to the total primary energy requirement (TPER)⁴, also known as gross inland consumption. TPER represents the consumption of energy by all sectors of the Irish economy and includes the energy consumed in conversion processes such as electricity generation and oil refining.

Figure 2.1 illustrates the trend in energy supply over the period 1990 to 2004, indicating the overall growth pattern and the contribution of individual fuels to gross energy consumption. The small contribution from renewable energy sources to Ireland's primary energy supply is clearly illustrated. The contribution of renewable energy to TPER increased from 1.8% in 1990 to 2.2% in 2004. The contribution in 2003 was 1.9%, indicating a significant increase occurred in 2004. This was the result of increasing wind and solid biomass output.

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 energy⁵ to TPER was 168 ktoe in 1990 rising by over 94% (4.8% per annum) to 325 ktoe in 2004. The increase in 2004 alone was 18%. This is discussed further in section 4.1.

¹ Available from www.sei.ie

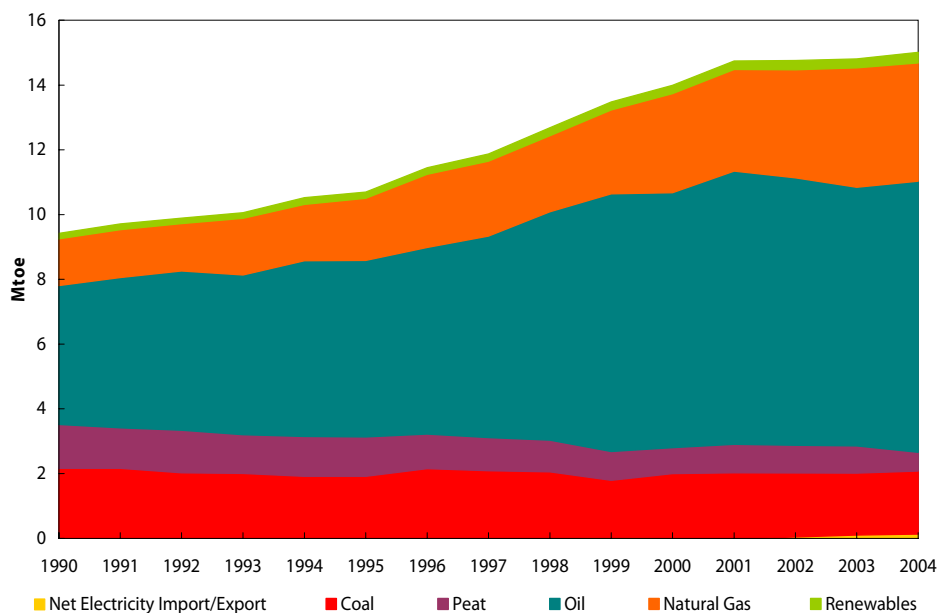
² Ibid.

³ SEI, 2006. *Energy in Ireland – Trends, issues and indicators 1990 – 2004*. Available from www.sei.ie

⁴ TPER is defined as the total amount of energy consumed in a given year.

⁵ Including large scale hydropower and excluding electricity generated pumped storage.

Figure 2.1: Total Primary Energy Requirement by Fuel 1990 to 2004

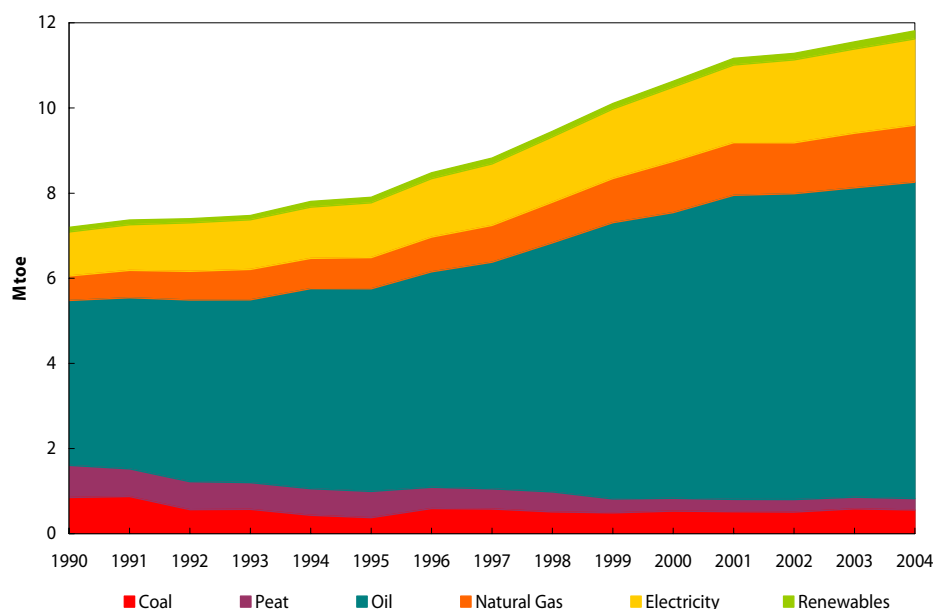


Source: SEI

Final energy demand⁶ is a measure of the energy that is delivered to energy end users in the economy to undertake activities as diverse as manufacturing, movement of people and goods, essential services and other day-to-day energy requirements of living. This is also known as total final consumption (TFC) and the changes in TFC by fuel over the period 1990 to 2004 are shown in figure 2.2.

Final renewable energy consumption increased by 78% over the period 1990 to 2004 but due to a 64% increase in TFC the contribution of renewable energy to TFC increased slightly from 1.5% in 1990 to 1.6% in 2004. The contribution in 2003 was 1.4%.

Figure 2.2: Total Final Energy Consumption by Fuel 1990 to 2004



Source: SEI

It is important to note that the renewable energy share of TFC here includes only those renewables contributing directly to final thermal and transport energy consumption, namely solid biomass, solar thermal energy, geothermal energy, biogas and biofuels. The electricity generated from the other renewable energy technologies (wind, hydro and landfill

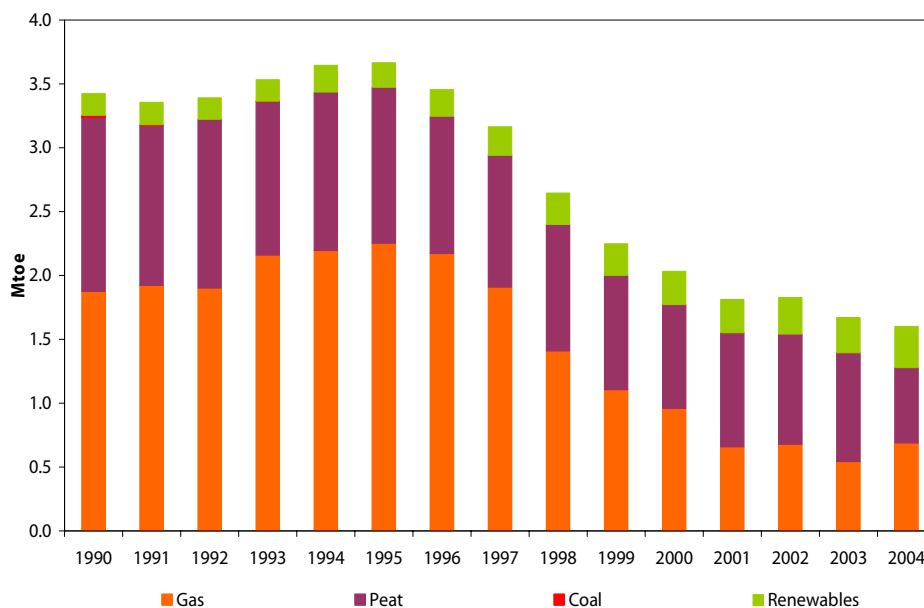
⁶ Essentially the total primary energy requirement less the quantities of energy used to transform primary sources such as crude oil into forms suitable for end use consumers such as refined oils, electricity, patent fuels etc.(Transformation, processing or other losses entailed in delivery to final consumers are known as "energy overhead").

gas) is included within the electricity portion of TFC, rather than under the renewable energy, in line with international best practice. This issue is examined further in section 4.2.

Figure 2.3 shows the indigenous supply fuel mix in Ireland for the period 1990 to 2004. Total indigenous energy decreased by 53% over the period, from 3,424 ktoe in 1990 to 1,602 ktoe in 2004.

Renewable energy has increased its contribution to the indigenous fuel mix from 5% (168 ktoe) in 1990 to 20% (325 ktoe) in 2004. During the same period the contribution from natural gas has dropped from 55% (1,877 ktoe) to 43% (690 ktoe) (although, as can be seen in figure 2.3, its contribution increased in the mid 1990s) with the reduction in output from the Kinsale gas field. Peat's share of indigenous supply decreased from 40% (1,362 ktoe) in 1990 to 37% (588 ktoe) in 2004. There was also a small amount of coal extraction which ceased in 1995.

Figure 2.3: Indigenous Energy by Fuel 1990 to 2004



Source: SEI

The overall reduction in indigenous energy supply coupled with the increase in energy consumption discussed above, have resulted in Ireland's energy import dependency increasing from 69% in 1990 to 87% in 2004. This trend contrasts with the average for the EU 15 and 25, where import dependency has remained at between 45% and 50% during the period 1990 to 2002; data are not available for 2003 and 2004.

3 The Policy Context

This section outlines the key policy changes and developments that have occurred since the publication of SEI's original renewable energy report.

3.1 Biomass Action Plan / Electricity from Renewables

The European Commission in December 2005 adopted a detailed action plan⁷ designed to increase the use of energy from forestry, agriculture and waste materials.

The plan announced more than 20 actions; most of which to be implemented from 2006 onwards. For transport biofuels, they include promotion of "biofuels obligations", through which suppliers will include a minimum proportion of biofuels in the conventional fuel they place on the market. In 2006 the Commission, in the context of a possible revision of the Biofuels Directive, intend to prepare a report which will examine the implementation of the Directive in Member States.

A report on support schemes for electricity from renewable energy was also published by the European Commission in December⁸ 2005. The report analyses the different support mechanisms used by Member States to promote electricity from renewable energy. It finds that feed-in tariffs, which are fixed prices for green electricity and used in the majority of Member States, are currently in general cheaper and more effective than so called quota systems, especially in the case of wind energy.

⁷ Full details of the action plan are available from http://europa.eu.int/comm/energy/res/biomass_action_plan/index_en.htm.

⁸The report is available at http://europa.eu.int/comm/energy/res/legislation/support_electricity_en.htm.

The Commission concludes that it is premature to propose a harmonised European support scheme. In the short and medium term, Member States are therefore recommended to coordinate the existing schemes at European level. In the report, the Commission also urges Member States to remove barriers to the development of green electricity.

3.2 Sustainable Energy Europe

The European Commission, in July 2005, launched a 4 year plan aimed at increasing public awareness of the potential of sustainable energy. The €3.7m campaign titled "Sustainable Energy Europe"⁹ is designed to help the EU meet its targets of increasing the share of renewable energy to 12% by 2010 and reducing energy consumption by 2020.

The main focus of the campaign is to act as a catalyst for continued development and promotion of sustainable energy technology. Measures included in the campaign are annual sustainable energy awards and an annual conference and campaign website for the media and public. The campaign also aims to develop sustainable energy partnerships involving organisations which are planning projects that will impact on the EU's energy environment.

3.3 All-Island Energy Market

Co-operation between Northern Ireland and the Republic of Ireland on energy matters is being advanced in the context of the development of an All-Island Energy Market. This takes place under the auspices of a Joint Steering Group (JSG) established in July 2003. The JSG is comprised of senior officials from the Department of Communications, Marine & Natural Resources (DCMNR) and NI Department of Enterprise, Trade and Investment (DETI) and the offices of the two Regulatory Authorities, Commission for Energy Regulation (CER) in the South and Northern Ireland Authority for Energy Regulation (NIAER) in the North.

In June 2004 a Draft All-Island Energy Market Development Framework paper was published. Following a period of consultation, the Development Framework was finalised in November 2004¹⁰. The framework defines the All-Island Energy Market, lists the benefits against which progress should be measured and details the short to medium term priorities. These include increase the electricity and gas infrastructure, establishing a single wholesale electricity market, addressing market dominance and increasing the penetration of sustainable energy.

3.3.1 A 2020 Vision for Renewable Energy

The Sustainable Energy Working Group of the JSG issued a consultation paper entitled 'Renewable Electricity – A '2020' Vision' in July 2005¹¹. The objective of this preliminary consultation was to inform and seek stakeholders' views on the potential for electricity generated from renewables (RES-E), the basis for a '2020 Vision', and the further work that would need to be undertaken to produce a joint vision, which includes policy measures and possible targets.

The document posits a range of illustrative RES-E generation scenarios and identifies the policy and electricity system issues that would require examination to establish a vision for 2020. It highlights the means to determine the contribution that renewable energy could and/or should make to electricity supply on the island of Ireland by 2020, through addressing the economic, technical and regulatory facets of RES-E implementation

The consultation period ended on the 30 September 2005. The responses and consolidated summary is expected to be placed on the DCMNR and DETI websites in early 2006.

3.4 Renewable Energy Feed in Tariff

The Minister for Communications, Marine and Natural Resources in September 2005 announced a new target to increase the installed capacity of renewable energy based electricity generation to at least 1,450 MWs by 2010. This figure is in line with our international commitment under the EC Directive 2001/77/EC¹² for 13.2% of electricity consumption to be sourced from renewable technologies by 2010.

In addition, the Minister has introduced a new market mechanism to encourage deployment of renewable energy technologies, following a period of consultation with the renewable energy industry. The new Renewable Energy Feed in Tariff (ReFIT¹³) programme replaces the Government's previous support mechanism, the Alternative Energy Requirement (AER) programme which has been in place since 1993 and provides financial support of €119m to renewable energy projects over a fifteen year period.

⁹ Full details of the campaign can be found at <http://www.sustenergy.org/>.

¹⁰ Available from <http://www.dcmnr.gov.ie/Energy/North-South+Co-operation+in+the+Energy+Sector/>.

¹¹ Ibid.

¹² European Union, 2001. *Directive 2001/77/EC of the European Parliament and of the Council on the Promotion of Electricity from Renewable Energy Sources in the Internal Electricity Market.*

Available from http://europa.eu.int/eur-lex/pr/eu/oj/dat/2001/l_283/l_28320011027en00330040.pdf.

¹³ Full details of the ReFIT programme can be found at:

<http://www.dcmnr.gov.ie/Energy/Renewable+Energy+Division/Renewable+Energy+Division.htm>.

The scheme will support the construction of at least 400 MWs of new electricity generating plant powered by renewable sources. Most of the new capacity is expected to come from onshore wind projects but there is also support for biomass, landfill gas, anaerobic digestion plants and hydro projects.

The proposed feed in tariff levels are as follows:

- Large-scale wind energy (over 5 MW's) @ 5.7 cent per kilowatt hour,
- Small-scale wind energy (under 5 MW's) @ 5.9 cent per kilowatt hour,
- Biomass (landfill gas) @ 7.0 cent per kilowatt hour,
- Hydro and other biomass technologies @ 7.2 cent per kilowatt hour.

3.5 Biofuels Mineral Oil Tax Relief

In July 2005 the Minister for Finance announced that excise relief would be granted for two years to eight individual biofuels projects. The initial provision specified that a total of 16 million litres (€6 million) of biofuel would be granted relief.

The purpose of the scheme is to:

- pilot a programme to investigate and evaluate the market for biofuels in Ireland,
- stimulate the initial development of that market,
- instil consumer confidence in biofuels through the application of appropriate quality standards,
- provide a basis on which future policy decisions can be made.

In December 2005¹⁴ the Minister for Finance, in presenting the 2006 Budget, expanded the excise relief scheme. The level of excise relief will start at €20 million in 2006 and will be increased to €35 million in 2007 and to €50 million in each of the following three years. This relief, when fully operational, is expected to support the use and production in Ireland of some 163 million litres of biofuels per year, representing 2% of transport fuels by 2008.

3.6 Renewable Energy Grants / Energy RTDI Programme

The Minister for Finance in December 2005¹⁵ also allocated up to €65 million to provide support for the implementation of several innovative grant schemes, relating to biofuels, combined heat and power, biomass commercial heaters and domestic renewable heat grants, during the period 2006 to 2010.

The Book of Estimates for 2006 also contained funding for a new Energy Research, Technological Development and Innovation (RTDI) Programme. Funding for 2006 of €4.17 million is allocated to DCMNR for this initiative¹⁶.

4 Renewable Energy Contribution to Ireland's Energy Requirements

This section examines in detail the contribution made by renewable energy to Ireland's energy supply.

4.1 Contribution to Primary Energy

As previously stated in section 2, the total contribution from renewable energy to TPER is relatively low and has only increased its share of the total by 0.4% percentage points over the period 1990 to 2004.

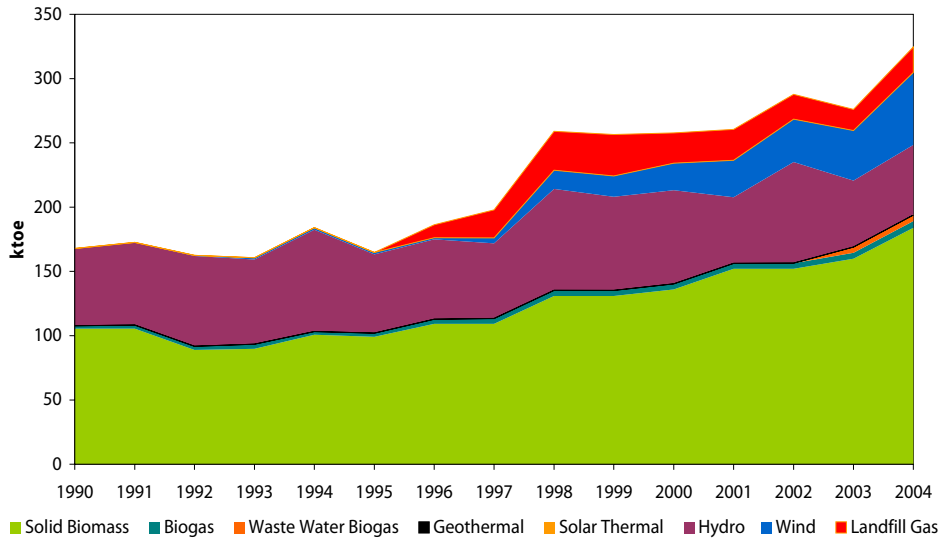
The significant increase in overall TPER, masks the fact that renewable energy has grown considerably in absolute terms since the mid 1990s. The trend is shown in figure 4.1, where the contribution of the different renewable energy sources is illustrated.

¹⁴ The measures were announced in the 2006 Budget speech. The full text can be found at <http://www.budget.gov.ie/2006/default.asp>.

¹⁵ Ibid.

¹⁶ Full details are available from <http://www.finance.gov.ie/documents/speeches/estimates2006.pdf>.

Figure 4.1: Renewable Primary Energy 1990 to 2004

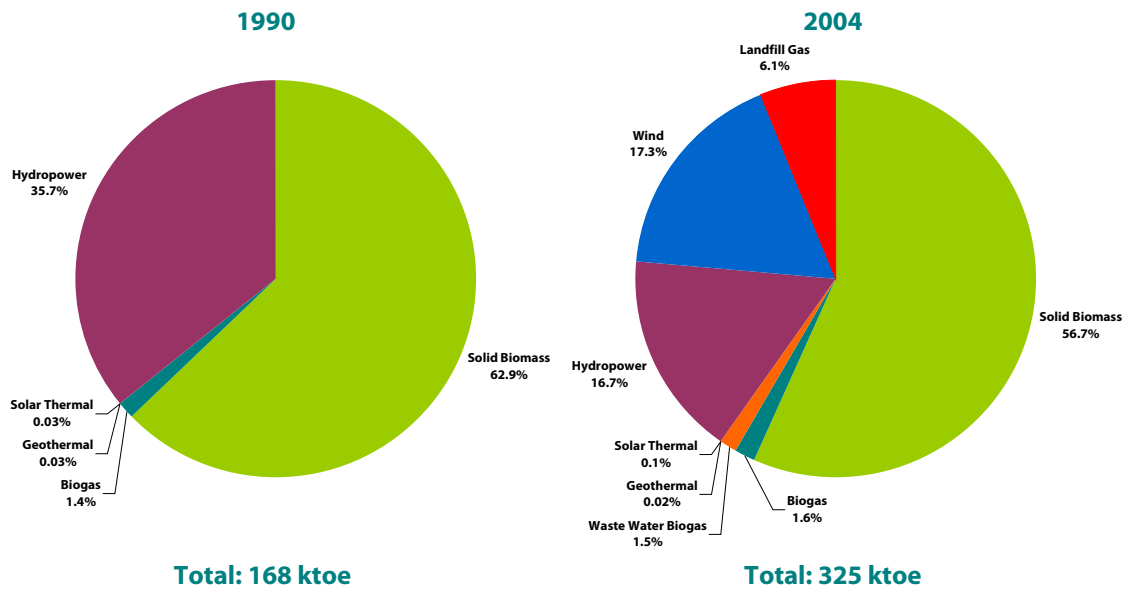


Source: SEI and ESB National Grid

The contribution from renewable energy¹⁷ to TPER was 168 ktoe in 1990 rising by over 94% (4.8% per annum on average) to 325 ktoe in 2004. There was an 18% increase in 2004, compared with 2003. The growth in 2004 is for the most part attributable to an increase in solid biomass but wind has also exhibited a significant increase.

In 2004 the largest contribution was from solid biomass, followed by wind, hydro, landfill gas, biogas, waste water biogas, solar thermal and geothermal. Figure 4.2 shows the contribution of renewable sources to TPER in 1990 and 2004 broken down by individual source. In 2004 wind was the second largest contributor to TPER overtaking hydro for the first time. The increasing diversity in the mix of renewable energy sources is also noticeable in figure 4.2.

Figure 4.2: Primary Renewable Energy by Source 1990 and 2004



Source: SEI and ESB National Grid

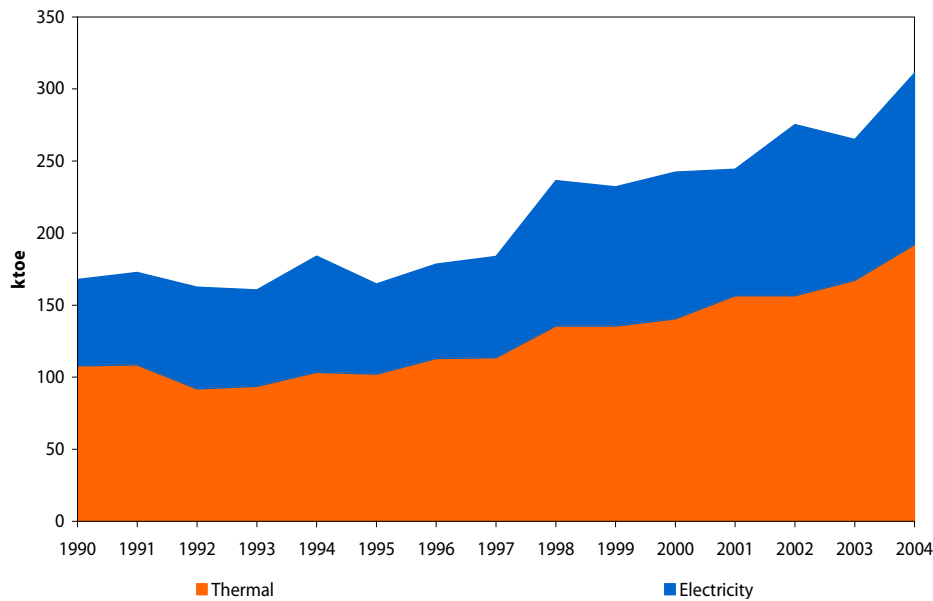
¹⁷ Including large scale hydropower and excluding electricity generated pumped storage.

4.2 Contribution of Renewable Energy to Total Final Consumption

Figure 4.3 shows the contribution from renewable energy to the thermal and electricity markets¹⁸. It can be seen that renewable energy contributes more to thermal energy (62%) than electricity production in 2004.

Thermal final energy consumption increased in absolute terms from 108 ktoe in 1990 to 192 ktoe in 2004, an increase of 78% (4.2% per annum on average). Growth in 2004 was 15%. It is this thermal energy contribution that accounted for 1.6% of Ireland's final energy consumption in 2004, as mentioned in section 2. Adding the electricity generated from renewable energy to the thermal output equals the total contribution from renewable energy to final consumption, which in 2004 was 311 ktoe (2.6%) an increase of 17% on 2003.

Figure 4.3: Total Final Consumption of Renewable Energy by Mode 1990 to 2004



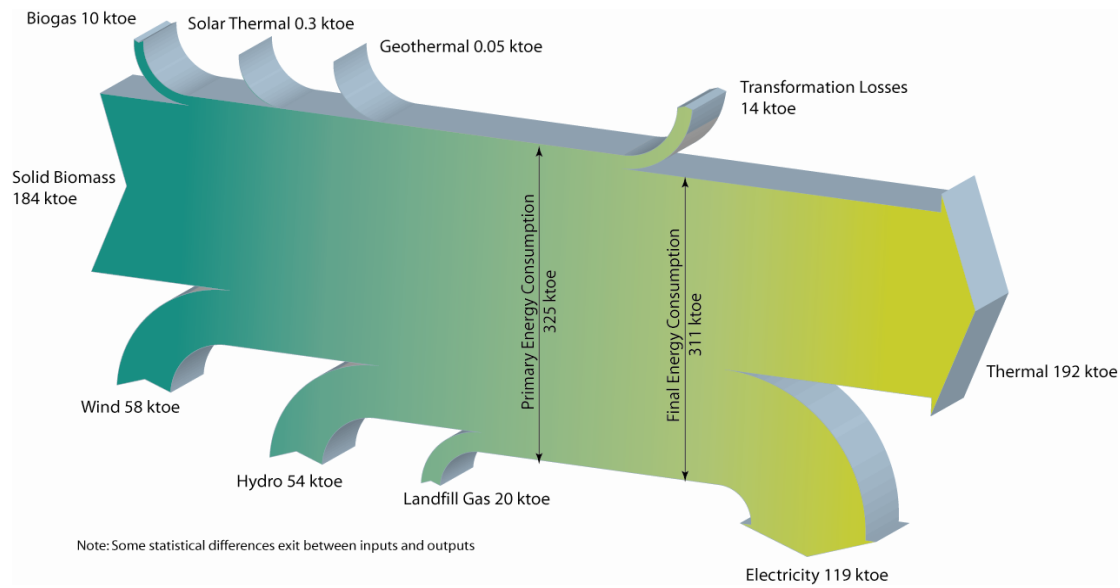
Source: SEI and ESB National Grid

The amount of electricity generated from renewable sources increased from 60 ktoe in 1990 to 119 ktoe in 2004, an increase of 99% (5% per annum). Growth in 2004 was 22%.

Figure 4.4 shows graphically the flow of renewable energy in Ireland. Fuel inputs on the left are the primary energy inputs illustrated in figure 4.1 while the outputs on the right are the final consumption figures from figure 4.3. What is particularly striking in figure 4.4 is the small amount of transformation losses associated with renewable energy, only 14 ktoe or 4.3% of the primary fuel input.

¹⁸ There was also a small contribution, by liquid biofuels, to the transport sector, see section 5.1.4.

Figure 4.4: Renewable Energy Balance 2004



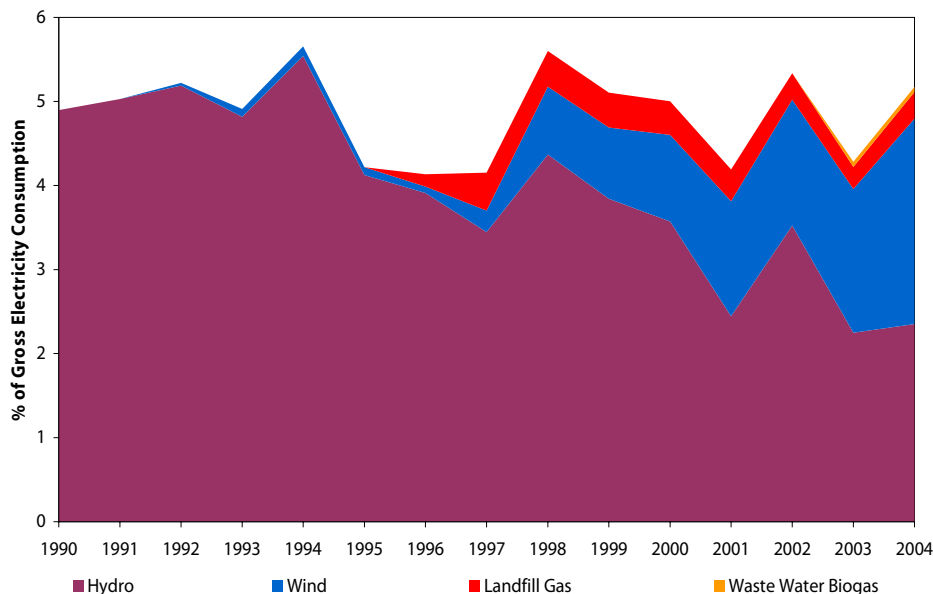
Source: SEI

Figure 4.5 graphs the electricity from renewable energy as a share of Ireland's gross electricity consumption¹⁹ in the period 1990 to 2004, showing the contribution from the individual technologies.

While the contribution from hydro has declined, figure 4.5 shows how electricity production from wind energy and landfill gas has increased. There was also a small contribution from waste water biogas (0.1%) in 2003 and 2004. Wind and hydro energy in 2004, respectively, accounted for 2.44% (1.7% in 2003) and 2.35% (2.2% in 2003) of Ireland's gross electrical consumption while landfill gas was responsible for 0.32% (0.26% in 2003).

The total contribution from renewable energy to gross electrical consumption in 2004 was 5.2% (compared with 4.3% in 2003 and 4.8% in 1990), providing an indication of the scale of the task to achieve the 13.2% indicative target contained within the EU RES-E Directive²⁰.

Figure 4.5: Renewable Energy Contribution to Gross Electricity Consumption 1990 to 2004



Source: SEI and ESB National Grid

¹⁹ Defined as total electricity generated plus net imports.

²⁰ European Union, 2001. *Directive 2001/77/EC of the European Parliament and of the Council on the Promotion of Electricity from Renewable Energy Sources in the Internal Electricity Market.*

Available from http://europa.eu.int/eur-lex/prl/en/oj/dat/2001/l_283/l_28320011027en00330040.pdf.

4.3 Primary Energy Equivalent

Figure 4.4 illustrates that primary energy and final consumption for renewables are very similar. For most fuels this is not the case, due to the energy conversion losses associated with electricity generation. Depending on the efficiency of electricity generation, typically between 25% and 55% of the energy content of the fuel input into power plants is output in the form of electricity.

The primary energy of fossil fuels and combustible renewables is defined as the calorific content of the fuel, according to internationally agreed methodologies for presenting energy statistics²¹. For non-combustible renewable sources (wind and hydro) the primary energy is equated with the quantity of electricity generated. This follows the IEA principle that the primary energy should be the first energy form, downstream of the production process for which multiple energy uses are practical.

This allows for harmonised international comparisons, but it does not accurately represent how fossil fuels used for electricity generation are displaced by non-combustible renewable energy. This is because, in primary energy terms, the fuel input into a fossil fuel plant is currently equated with the electricity output from a non-combustible renewable energy plant, such as a wind farm or hydro-power plant. An alternative approach is to equate the primary energy of the renewable energy with the primary energy of the fuel that would have been required to produce the equivalent amount of electricity.

This is the principle behind the primary energy equivalent (PEE) based on the partial substitution method. It requires an assumption to be made about the efficiency of the fossil fuel based electricity generation being substituted by the non-combustible renewable generated electricity. The contribution from the renewable energy source is, under this approach, equated to the fossil fuel energy input that it displaces. The PEE for non-combustible renewable energy essentially represents the thermal fossil fuel energy avoided through the generation of renewable based electricity. By quantifying the fossil fuel displacement achieved by renewable energy, the environmental benefits and indeed the security of supply benefits may be quantified and used to inform policy decisions.

This raises a key question however – what electricity generation is being displaced by renewable energy generated electricity? In the previous report²², the calculation of PEE was based on a theoretical displacement by each kWh from renewable energy of a kWh generated from the entire fossil fuel plant mix. This methodology is improved here drawing on approaches that have been developed for use in baselining studies in credit based emissions trading systems²³.

Renewable energy plants are not generally displacing electricity from either ‘must-run’ plants (peat) or from baseload plants (coal fired station at Moneypoint and the combined cycle gas turbine (CCGT) plants). Calculating the PEE based on the remaining plant provides a more accurate estimate than using the entire plant mix and the approach is known as the *Operating Margin Approach*. There are clear limitations in this analysis but it does provide useful indicative results. The assumption underpinning this approach is that the renewable plant is displacing the last plants to be dispatched to meet electricity demand, i.e. the marginal oil and gas plant.

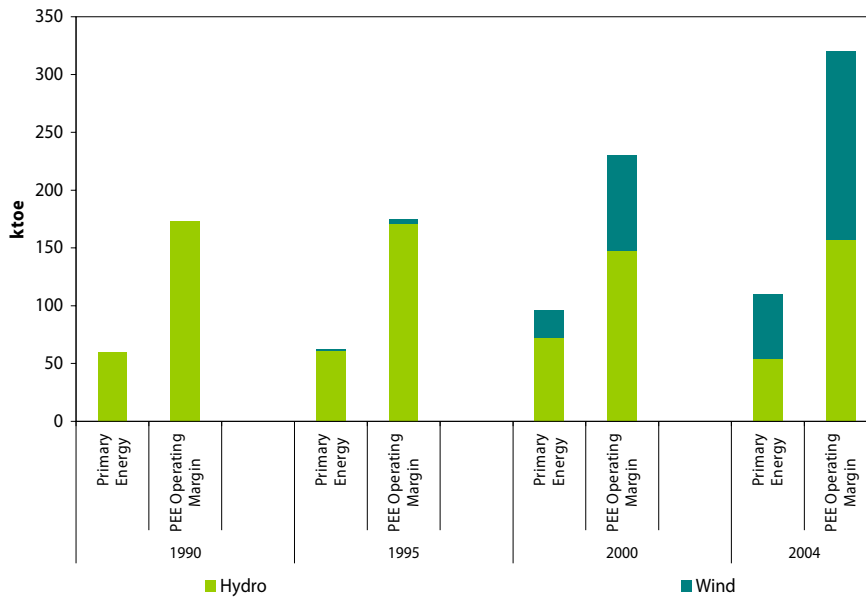
Based on this analysis the PEE (Operating Margin) for non-combustible renewable energy (wind and hydro) is compared with the primary energy values in figure 4.6 at five yearly intervals since 1990. The difference between the primary energy and PEE is particularly noticeable and also increasing importance of wind. Focussing on the year 2004, the PEE was 2.9 times greater than the renewable primary energy.

²¹ International Energy Agency, 2002. *Energy Balances of OECD Countries 1999 – 2000*. See www.iea.org for details.

²² Available from www.sei.ie

²³ Kartha S., Lazarus M. and Bosi M, 2004. *Baseline recommendations for greenhouse gas mitigation projects in the electric power sector*. Energy Policy 32, 545-566.

Figure 4.6: Primary Energy and Primary Energy Equivalent for Wind and Hydro 1990, 1995, 2000 and 2004

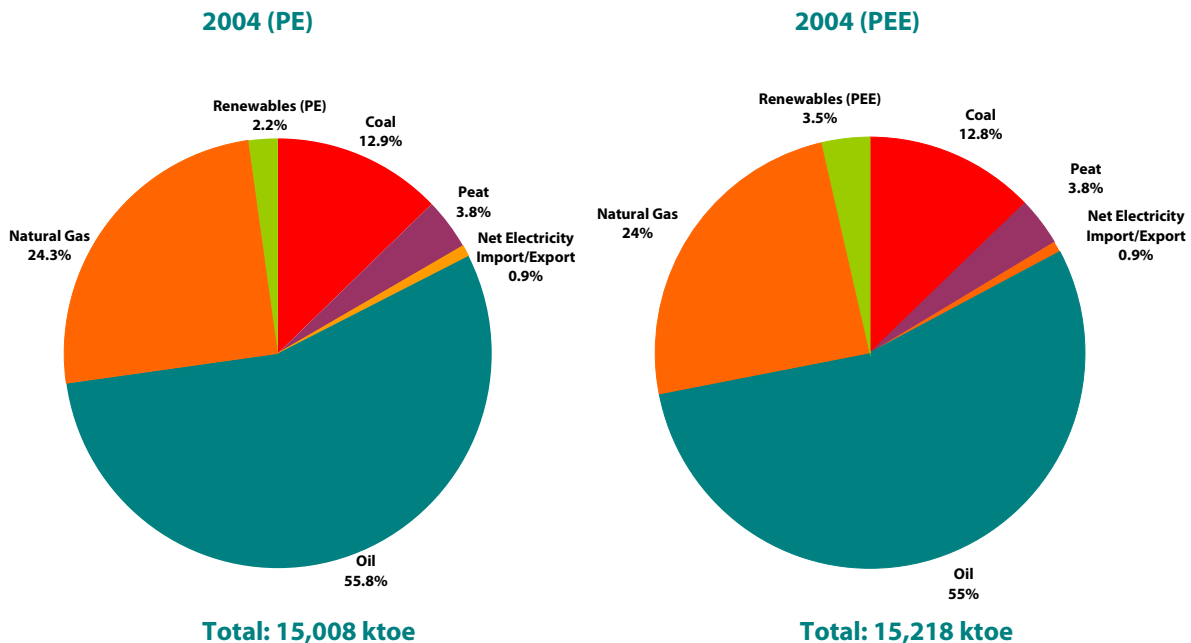


Source: SEI

The total PEE for renewable energy is then calculated by adding the primary energy for combustible renewable sources to the calculated PEE for non-combustible renewables. This provides a new measure of renewable energy’s contribution to energy supply. The total PEE for renewable energy increased from 280 ktoe in 1990 to 534 ktoe in 2004, an increase of 90% (4.7% per annum on average). Focussing on the year 2004, the PEE is 65% higher than the renewable primary energy figure.

Figure 4.7 compares the contribution of renewable energy to TPER using the traditional primary energy (PE) method and the primary energy equivalent (PEE) approach. As stated in section 2, renewable energy accounted for 2.2% of TPER in 2004 (the first pie chart on figure 4.7). Using the PEE approach it can be seen from the second pie chart in figure 4.7 that the contribution to TPER is 3.5%.

Figure 4.7: Renewable Energy Share of TPER - Primary Energy and Primary Energy Equivalent 2004



Source: SEI

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 plant will typically generate increased CO₂ and NO_x emissions compared with CCGT and these emissions should be incorporated into the analysis.

The purpose of presenting a simplified analysis here is to provide initial insights into the amount of fossil fuels that are displaced by renewables and the amount of emissions thereby avoided.

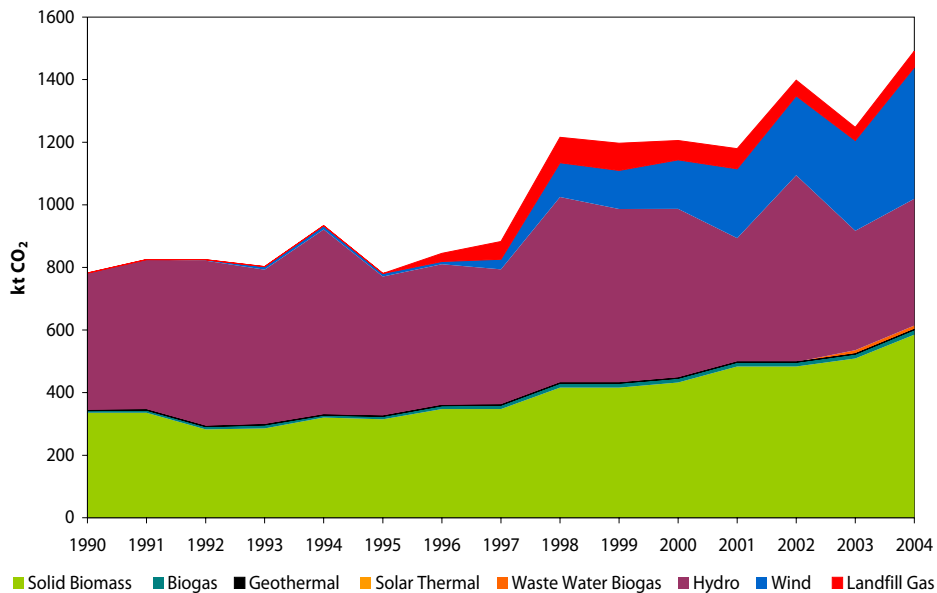
4.4 CO₂ Displacement

One of the benefits of determining the PEE associated with non-combustible renewables is that it can be used to calculate the amount of CO₂ avoided through the use of renewable energy. The caveats associated with the results for primary energy equivalent apply equally to the calculated CO₂ avoided.

Figure 4.8 shows the trend in avoided CO₂ emissions from renewable energy for the period 1990 to 2004. It is assumed the electricity from renewables (wind, hydro, landfill gas and the electricity portion of waste water biogas) avoids the amount of CO₂ produced by the weighted average electricity production from the same marginal plant considered in section 4.3 i.e. oil and single cycle gas plant.

It is further 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 CO₂ avoided from thermal renewable energy is equated with the CO₂ emissions that would have arisen from this oil consumption.

Figure 4.8: Avoided CO₂ from Renewable Energy 1990 to 2004



Source: SEI

Based on this methodology the estimated amount of CO₂ avoided from renewable energy increased by 91% (4.7% per annum on average) over the period 1990 to 2004 reaching 1,458 kt CO₂ in 2004, illustrated in figure 4.8. The emissions avoided from solid biomass were most significant in 2004 (585 kt CO₂ or 40%) followed by wind (421 kt CO₂ or 28%) and hydro (405 kt CO₂ or 27%).

Using the actual generating mix methodology, SEI's original renewable energy report estimated that 1,489 kt CO₂ was avoided in 2002 through the use of renewables. The figure for 2002 using the newer, more robust, methodology is 1,398 kt CO₂.

5 Individual Renewable Energy Sources

This section assesses recent trends for individual renewable energy sources and technologies. Only those that have experienced a change in 2004 are detailed here. For details of other technologies see the original report.

5.1 Biomass

Biomass refers to a wide range of organic materials that have the potential to be converted into either heat, electricity or transport fuels. The technologies used to convert biomass to useful energy range include wood stoves, kilns, CHP plants, gasification units, anaerobic digesters, gas engines and Elsbett engines.

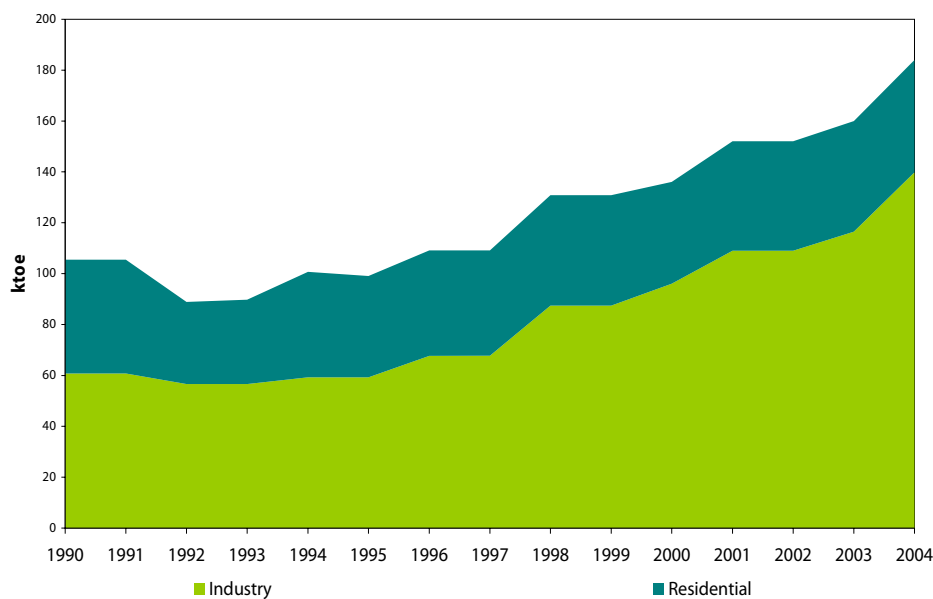
This section groups biomass according to the physical state of the fuel, under the headings Solid Biomass, Biogas, Landfill gas and Liquid Biofuels.

5.1.1 Solid Biomass

Solid biomass²⁴ accounts for the bulk of Ireland's biomass consumption and represented 57% of total final renewable energy consumption in 2004. Figure 5.1²⁵ presents the trend in final consumption of solid biomass by sector for the period 1990 to 2004. It can be seen that solid biomass increased from 106 ktoe in 1990 to 184 ktoe in 2004, an increase of 75% (4.1% per annum). Growth in 2004 was 15%.

The bulk of this solid biomass is used in the wood processing industry (58% in 1990, increasing to 76% in 2004), firing the kilns of the four main board manufacturing plants in Ireland and a larger number of sawmills and joineries. In addition, there is a considerable portion of solid biomass providing heat in the domestic sector, through the combustion of wood logs and pellets.

Figure 5.1: Solid Biomass Final Consumption 1990 to 2004



Source: SEI

Ireland's first solid biomass fuelled CHP plant began operating in late 2004 with an installed capacity of 2.9 MW_e. The CHP plant uses wood processing products such as sawdust, bark and woodchips together with forest thinings to generate heat for Grainger Sawmills' timber drying operations in County Cork. The bulk of the electricity generated is sold under an AER VI power purchase agreement. The project is supported under Sustainable Energy Ireland's Research Development and Demonstration Programme.

5.1.2 Biogas

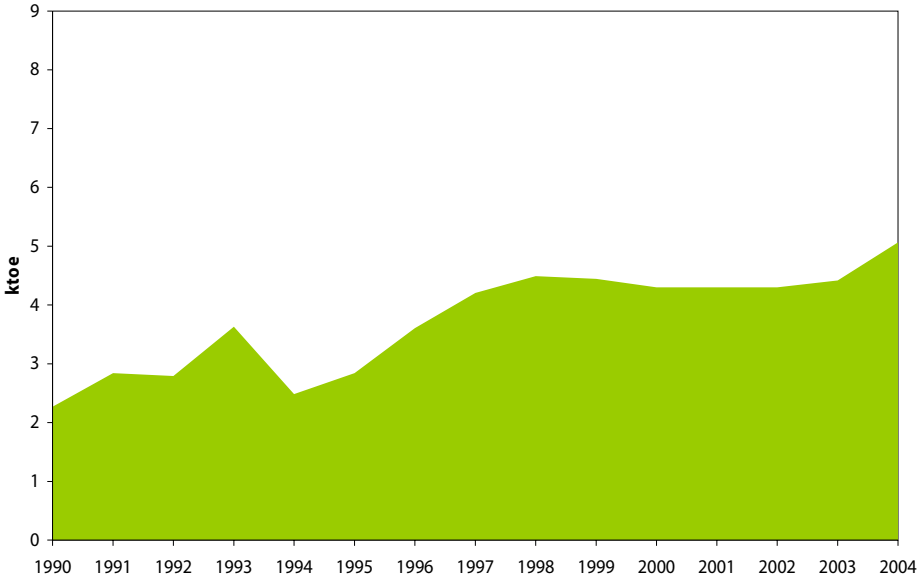
In Ireland there are three industrial sites that use Anaerobic Digestion (AD) technology to produce biogas for heating purposes. More recently there is a growing number of farm based digestors and sewage sludge biogas plants. The production of biogas thermal energy from 1990 to 2004 is presented in figure 5.2. Over the period biogas increased from

²⁴ Solid biomass, for the most part, consists of burning solid wood but also includes a proportion (approximately 22% in 2004) of tallow production in industrial rendering plants.

²⁵ Figures for 1992 to 1994 were revised in 2005.

2.3 ktoe in 1990 to 5.1 ktoe in 2004, an increase of 123% (5.9% per annum). Growth in 2004 was 15%. Most of the consumption is in the food subsector of industry with small consumption levels in the public services sector (waste water treatment plants) and agricultural sector (farm based AD).

Figure 5.2: Biogas Thermal Output 1990 to 2004

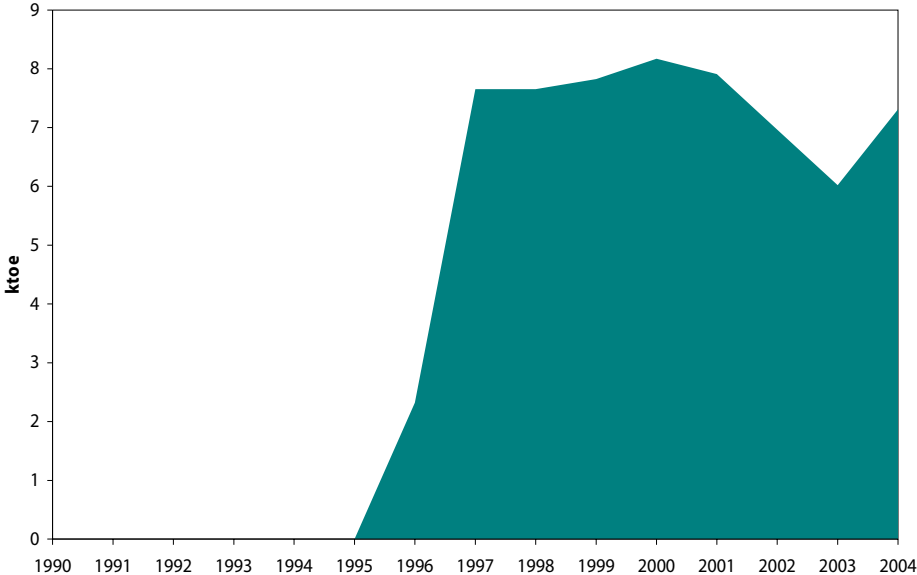


Source: SEI

5.1.3 Landfill Gas

In Ireland there are currently 7 landfill gas electricity generating plants operating with a combined installed capacity of 21.5 MW_e. The first landfill gas sites were installed in 1995. The electrical output from landfill gas is presented in figure 5.3 for the period 1996 to 2004. The electrical output from landfill gas in 2004 was 7.3 ktoe, an increase of 21% on 2003.

Figure 5.3: Landfill Gas Electrical Production 1996 to 2004



Source: SEI and ESB National Grid

5.1.4 Liquid Biomass (Biofuel)

In Ireland there have been a number of research, development and demonstration activities in biofuels. One such project is part of the EU programme CIVITAS I, which promotes strategies to achieve Clean Urban Transport.

Cork City Council has modified the engines of 17 light commercial vehicles with Elsbett engine conversion kits. These vehicles operate on rapeseed oil. The cost of the conversion was approximately €1,000 per engine. A total of 47,000 litres was consumed over the period May 2003 to January 2006 yielding 1.5 TJ of energy.

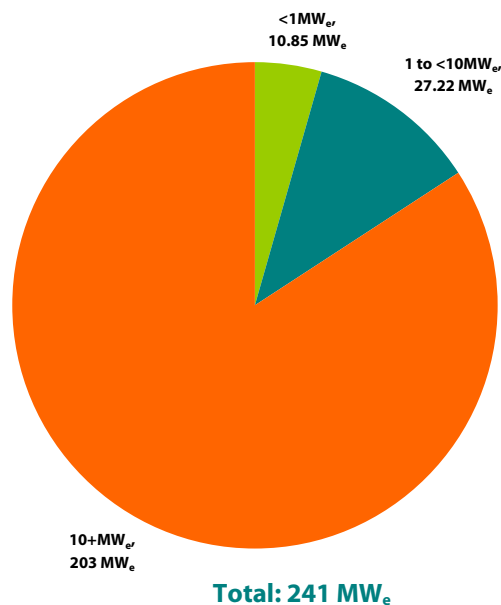
There is also additional consumption in 2005 as a result of biofuels tax relief scheme and an increasing amount of unreported consumption.

5.2 Hydro

The installed hydro capacity in 2004 is shown in figure 5.4. Hydro is divided into three categories large (greater than and including 10 MW_e), small (from 1MW_e to less than 10 MW_e) and micro scale (less than 1 MW)²⁶. Total installed capacity increased from 233 MW_e in 1990 to 241 MW_e in 2004, an increase of 3.4%.

As illustrated in figure 5.4 large scale hydro is responsible for the majority of installed capacity (84% in 2004) followed by small scale (11%) and micro (5%). Over the period 1990 to 2004, total installed capacity for large scale decreased slightly over the period (1.5%) while small scale installed capacity increased by 19% and micro increased by 151%.

Figure 5.4: Installed Capacity of Hydro 2004



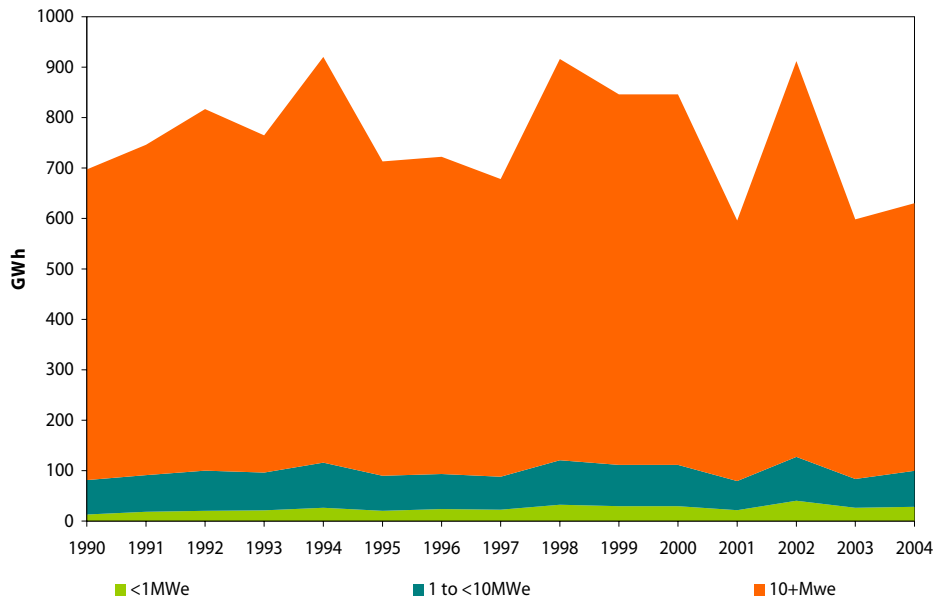
Source: ESB National Grid

Figure 5.5 shows the electricity generated from hydro since 1990 and emphasizes the large degree of variation from year to year associated, in part, with changing annual rainfall levels. Data on the breakdown between categories is estimated according to their share of installed capacity.

In 2004 electrical output from hydro was 630 GWh a decrease of 9.6% on 1990. There was a 5.4% increase in output from hydro in 2004 compared with 2003. As indicated in section 4.2 hydro was responsible for 2.35% of gross electrical consumption in 2004.

²⁶ Hydropower is also used to store night generated electricity for daytime consumption in pumped storage plants. There is a 292 MW_e plant in Turlough Hill but the electricity generated is not considered as renewable (but rather as stored) energy and therefore not included in this analysis.

Figure 5.5: Electricity Generated from Hydro 1990 to 2004



Source: SEI and ESB National Grid

5.3 Wind

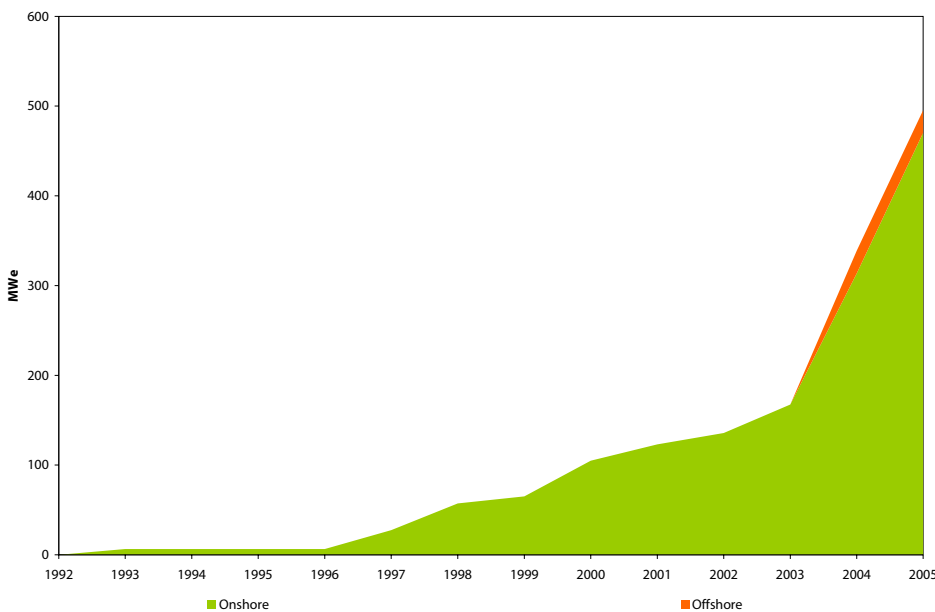
The total installed capacity of wind farms in Ireland (December 2005) was 495.5 MW_e an increase of 46% (157 MW_e) on 2004.

The largest onshore wind farm in Ireland is located at Meentycat, Co. Donegal. The project was completed in 2004 and has an installed capacity of 72.4 MW_e. There is one offshore wind farm in Ireland situated 10 km off the coast of Arklow. The project began operation in 2004 and has an installed capacity of 25.2MW_e.

Figure 5.6 illustrates the evolution in wind capacity in graphical form from 1992 to (early December) 2005. The recent surge in activity is very clear from figure 5.6. The deployment in 2004 (171 MW_e) was greater than the cumulative deployment from 1992 to the end of 2003 (167 MW_e). Overall growth in 2005 is expected to exceed that in 2004.

SEI's first renewable energy report documented a total installed capacity of 229 MW_e in August 2004. Comparing this figure with the total for the end of 2004, 339 MW_e, further emphasises the acceleration in deployment.

Figure 5.6: Installed Capacity of Wind Projects 1990 to 2004

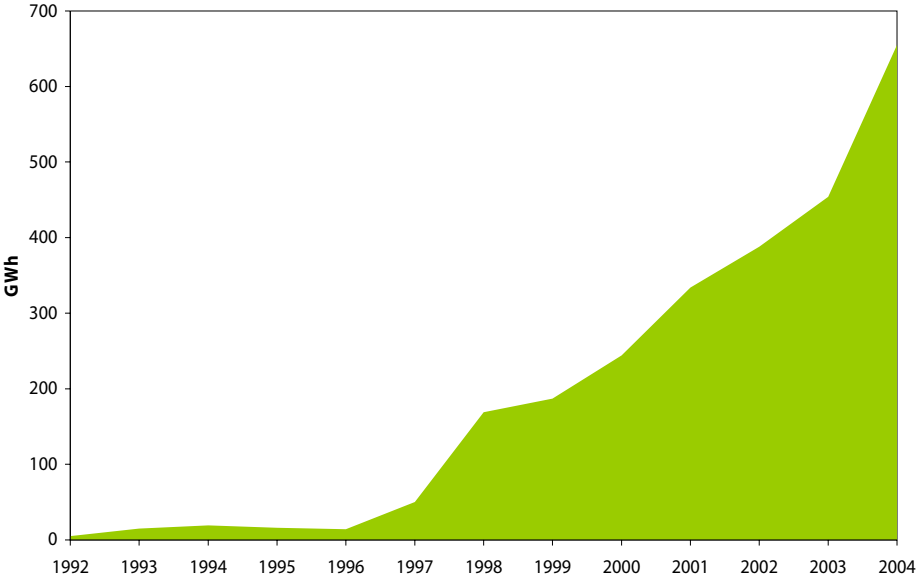


Source: DCMNR and ESB National Grid

Figure 5.7 shows the electricity generated from wind energy and illustrates the rapid rise in electrical output since 1997 when the first of the wind farms supported by the AER programme came online. Total electrical output from wind in 2004 was 655 GWh representing an increase of 44% on 2003. As indicated in section 4.2 wind was responsible for 2.44% of gross electrical consumption in 2004.

The increasing importance of wind is highlighted by the fact that the installed incapacity of wind in 2005 (495.5 MW_e) was for the first time more than double that of hydro (241 MW_e). Also, as already stated, wind output in 2004 was for the first time greater than hydro output.

Figure 5.7: Electricity Generated by Wind 1992 to 2004



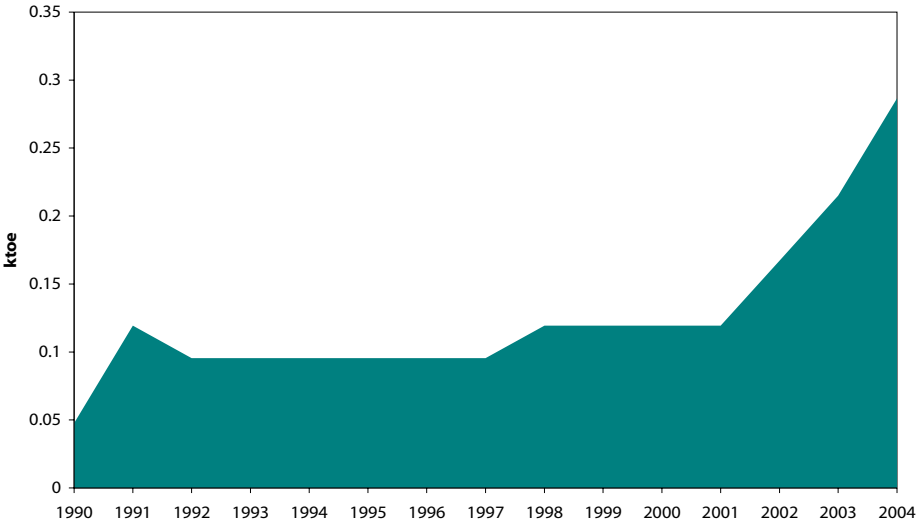
Source: ESB National Grid

5.4 Solar

5.4.1 Active Solar Thermal (Heat)

This technology has been used in Ireland for some time and the trend in thermal output from 1990 to 2004 is presented in figure 5.8. It can be seen that there has been a significant growth of 500% (14%% per annum on average) during the period, albeit from a very small base of 0.05 ktoe. Growth in 2004 alone was 33%. The growth in recent years may be attributable to falling capital costs.

Figure 5.8: Solar Thermal Final Consumption 1990 to 2004



Source: SEI

5.5 Geothermal

Geothermal energy is currently only a modest resource in Ireland. The output or TFC associated with geothermal and heat pumps has remained unchanged over the period 1990 to 2004 at 0.05 ktoe.

6 A View From Northern Ireland

6.1 Installed Capacity of Renewable Energy

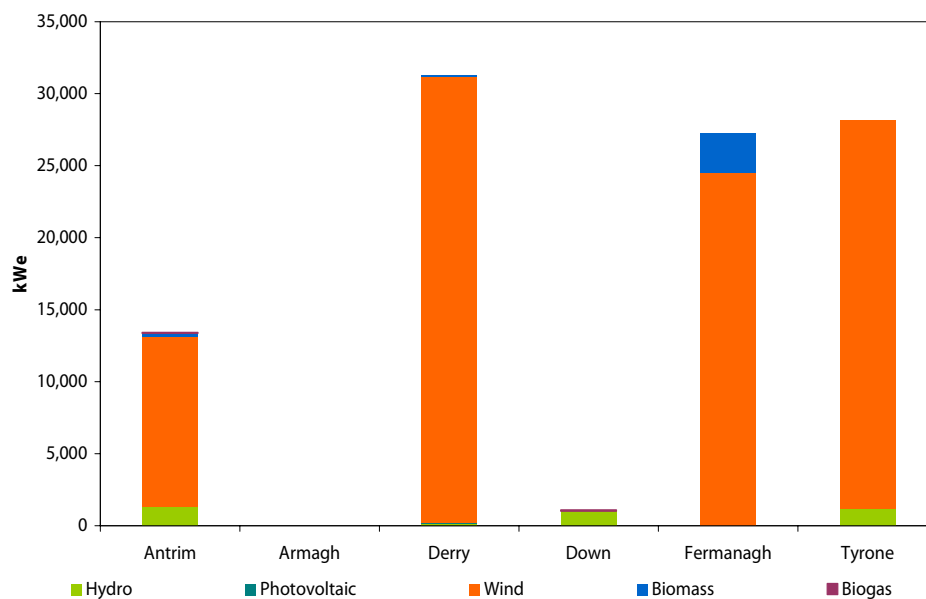
This view from Northern Ireland (NI) outlines the developments in renewable energy since the publication of the last report in August 2004.

In 2004 / 2005 Action Renewables compiled a renewable energy statistics database for large and small scale renewable energy projects in NI.

Figure 6.1 presents the installed electrical capacity of large scale (>20kW_e) renewable energy projects by county in NI. It can be seen that wind is the most common technology with an installed capacity of 108 MW_e²⁷. Total installed capacity is 115 MW_e. Derry is the county with the most installed capacity (27%).

Thermal installed capacity is not included in figure 6.1 but there are a number of ground source heat pumps (totalling 30 kW_{th}) and thermal biomass projects (39,726 kW_{th}) in NI.

Figure 6.1: Installed Electricity Generating Capacity of Large Scale Renewable Energy Projects by County

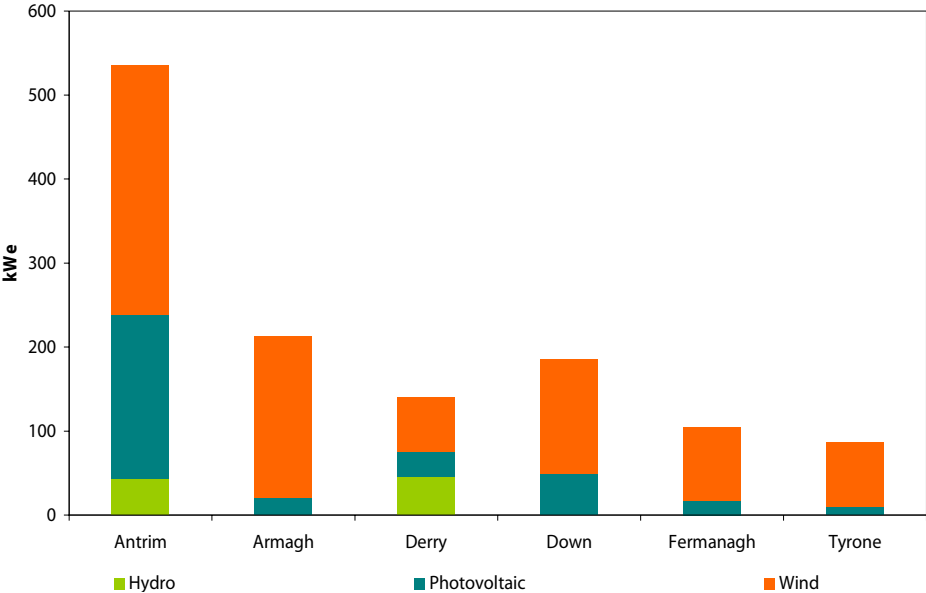


Source: Action Renewables

Figure 6.2 presents the situation for small (<20kW_e) scale electrical capacity. Total installed capacity is 1,266 kW_e with wind (855 kW_e) being the most widespread technology. The county with the highest installed capacity is Antrim (42%). As was the case with large scale there are also a number of thermal projects. Specifically, 639 kW_{th} of ground source heat pumps, 210,862 kW_{th} solar water heating and 1720 kW_{th} of biomass.

²⁷ Includes 13.5 MW_e from Snugborough, Co. Cavan in the Republic of Ireland.

Figure 6.2: Installed Electricity Generating Capacity of Small Scale Renewable Energy Projects by County



Source: Action Renewables

6.2 Geothermal

CSA Group, with funding from INTERREG²⁸, carried out an assessment of the geothermal profile of NI and also a definition of the potential for successful utilisation of low enthalpy geothermal energy, and the creation of a database and map series showing geothermal resources.

The results show a significant geothermal resource, and Gareth Jones of Conodate said that: *“The publication of the Geothermal Energy Review of Northern Ireland, includes a 5,000m depth map which indicates temperatures up to 180°C. This opens up the exciting possibility of producing electricity from an Enhanced Geothermal System. A secure non-fluctuating electricity source would reduce the region’s dependency on imported fuels”*²⁹.

6.3 2020 Vision for Renewable Energy

As stated in section 3.3.1, in July 2005 a preliminary consultation paper on an All-Island '2020 Vision' for renewable energy was published. The consultation paper will now be followed by a range of in-depth All-Island energy studies which will examine, amongst other things, the implications for grid management and energy economics of increased renewable energy penetration up to 2020.

6.4 Northern Ireland Renewables Obligation (NIRO)

The Northern Ireland Renewables Obligation (NIRO), which came into force on 1st April 2005, is a legal obligation on electricity suppliers to source a certain percentage of the electricity supplied to NI customers from renewable energy sources, rising to 6.3% by 2012.

Compliance with the obligation will be demonstrated through a system of certification using Renewable Obligation Certificates (ROCs), which are mutually recognised and can be traded freely throughout the UK. These are issued to qualifying, accredited renewable generators to provide confirmation that the specified quantity of electricity produced from renewable sources has been supplied to a licensed supplier for consumption in NI. By trading ROCs with suppliers either separately or together with the associated renewable electricity, generators are able to receive a premium price for their electricity. Where a supplier does not have sufficient ROCs to meet his obligation in a particular period he may purchase additional ROCs from the marketplace or pay a ‘buy out’ fee, currently £32.33 per MWh. The latest auction of UK ROCs indicates a price premium of £46.05 per MWh over and above the wholesale price of electricity.

²⁸ INTERREG is an EU initiative which aims to stimulate interregional cooperation in the EU between 2000 to 2006. It is financed under the European Regional Development Fund (ERDF).

More information can be found at http://europa.eu.int/comm/regional_policy/interreg3/index_en.htm.

²⁹ The study can be downloaded at www.actionrenewables.org.

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