12.0 EFFECT ON THE ENVIRONMENT: Climate & Energy.

12.1 Introduction.

12.1.1 Chapter 12 – Climate & Energy has been prepared by Malone O'Regan, RPS Ireland and Cunnane Stratton Reynolds Ltd. and discusses the potential impacts of the Draft Planning Scheme on the existing local climate in the area and in a wider context on the global climate.

12.2 Assessment Methodology.

12.2.1 Various national and international documents on climate change were reviewed in order to compile this section of Chapter 12 – Climate and Energy. Section 12.7 provides a list of the documents reviewed.

12.2.2 Figures quoted for CO_2 generated are taken from a report prepared by RPS in 2008 for the Draft Planning Scheme entitled Carbon Emissions and Water Use Reduction which is enclosed as Appendix 12.1.

12.3 The Receiving Environment.

12.3.1 Global Environment.

12.3.1.1 Climate change is now recognised as the most serious global environmental problem. While natural variations in climate over time are normal, human interference with the global atmosphere system through the emission of very substantial amounts of greenhouse gases is causing a discernible effect on global climate. Continuing change in the global climate system is expected in the future due to further emissions of greenhouse gases. Many changes in climate are expected over the next century and beyond, including an average rate of warming probably greater than anything seen in the last 10,000 years.

12.3.2 Kyoto Agreement.

12.3.2.1 Ireland is committed to advancing implementation of the 1992 United Nations Framework Convention on Climate Change. The ultimate objective of the Convention is the stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous human-induced interference with the climate system. 1997

marked the beginning of a new phase in efforts to tackle greenhouse gas emissions. The Kyoto Protocol (adopted in December 1997) which has more powerful, and legally binding measures, requires developed countries to reduce their overall emissions of greenhouse gas by at least 5% below 1990 levels in the period 2008 - 2012.

12.3.2.2 Following a comprehensive consultation process, the Minister for the Environment and Local Government launched the National Climate Change Strategy in November 2000. This strategy was reviewed in 2002 and is followed by the latest National Climate Change Strategy 2007-2012, which takes account of the public consultation process carried out in 2006. Successful implementation of this Strategy will ensure that Ireland can meet its international commitments under the Kyoto Protocol.

12.3.3 Commitments.

12.3.3.1 The Kyoto Protocol sets targets for developed country parties to achieve a 5.2% reduction in emissions of an aggregate of six greenhouse gases by 2008 - 2012 (referred to as the first commitment period) compared with 1990 levels. For most parties, including EU Member States, 1990 is the base year for this part of the basket.

The 'first basket' consists of the following gases:

- carbon dioxide (CO_2)
- methane (CH_4)
- nitrous oxide (N_2O)

12.3.3.2 The 'second basket' consists of the following gases:

- hydrofluorocarbons (HFCs)
- perfluorocarbons (PFCs)
- sulphur hexafluoride (SF_6)

12.3.3.3 Ireland has selected 1995 as the base year for these gases, in common with the approach of most parties.

12.3.3.4 The Protocol provides that the European Community and Member States may achieve the EU 8% reduction target jointly. A "burden sharing" agreement has been reached on the distribution of this overall target between all Member States. This takes into

account a number of factors such as projections for future greenhouse gas emissions, including economic growth factors, and relative efforts to meet the Kyoto target, so as to achieve an equitable distribution of the overall burden involved.

12.3.4 Situation in Ireland.

12.3.4.1 Under this agreement, Ireland has agreed a national target to limit the increase in its greenhouse gas emissions to 13% above 1990 levels in the period 2008-2012. The national target reflects a number of factors, including the relatively underdeveloped state of the economy in the base year (1990), as well as subsequent economic growth, available projections for greenhouse gas emissions and anticipated wealth by the end of the commitment period.

12.3.4.2 Without any action, the official estimates are that net annual emissions of greenhouse gases would increase by 45.6% over the period 1990 to 2012. In order to limit the growth in greenhouse gas emissions to 13% above 1990 levels, reductions in the projected figure of 16.8 million tonnes of CO_2 equivalent are required.

12.3.5 Local Climate.

12.3.5.1 Information on the existing climate was obtained from the Irish Meteorological Service from data collected at Dublin Airport Weather Station and also from the Waste to Energy Project EIS which contained data from an onsite meteorological station situated in Poolbeg from 2004 – 2005. Wind speed, wind direction and temperature were measured during that time period.

12.3.5.2 *Temperature* - For the period 1961 to 1990 (the latest period for which a 30 year average report is available) the annual average absolute minimum temperature ranged from -10.1 ^{o}C for December to 4.8 ^{o}C for July. The annual average absolute maximum temperature ranged from 15.3 ^{o}C for February to 28.7 ^{o}C for August.

12.3.5.3 *Rainfall* - For the period 1961 to 1990, the greatest daily total was 60.2 mm for August, the mean monthly total ranged from 49.9 mm for July to 75.6 mm for December. There was more than 0.2 mm of rain on 185 days of the year while rainfall exceeded 5.0 mm on 48 days.

12.3.5.4 *Wind* - For the 1961 to 1990 period at Dublin Airport, the average mean monthly wind speed varied from 8.0 knots in June and July and 12.2 knots during January. The highest gust detailed occurred during January with a windspeed of 75 knots. The average annual number of days with gales (wind speeds in excess of 33.5 knots) was 8.2 days.

12.3.5.5 *Relative Humidity* -For the same period the relative humidity measured at Dublin Airport at 09.00 hours, varied from 76% for May and June to 86% for January, November and December and at 15.00 hours varied from 67% for May to 81 % for December. Relative humidity values are generally highest in the morning (09.00) and decrease during the afternoon period (15.00).

12.3.5.6 *Sunshine* - The mean daily duration of sunshine at Dublin Airport station for the period 1961-1990 throughout the year was 3.9 hours, with the greatest daily duration, 15.9 hours occurring in June. The mean number of days with no sunshine ranged from 1 in July to 11 in January and December.

12.3.6 *Recent Weather.*

12.3.6.1 *Temperature* - From January to November 2008, the mean monthly temperatures recorded at Dublin Airport ranged from 5.8°C in February to 15.2°C in August, with an average of 9.9°C throughout the year up to 26th November 2008.

12.3.6.2 *Rainfall* - From January to November 2008, the total monthly rainfall throughout the year ranged from 14.7 mm in February to 189.9 mm in August. The annual total rainfall up to 26th November 2008 was 903mm. The wettest months were August, September, July and March.

12.3.6.3 *Wind* - The prevailing winds on site are more westerly, north westerly with reduced frequency of south westerly winds compared with the data recorded at Dublin Airport. Wind direction and speed is presented in Chapter 10.0, Section 10.3.1.

12.3.6.3 *Micro Climate* -Micro-climate can be described as the climate within 1-2 km of the site. The micro-climate of an area is influenced by both the natural (topographic) and built environment (buildings and structures). The construction of every house, road or

factory destroys existing microclimates and creates new ones of varying complexity depending on the design, density and function of the building. The degree to which a development can favourably influence micro-climate is frequently determined by the size, location and nature of the site.

12.3.6.4 There are no documented references to an existing micro-climate of specific note present at Poolbeg peninsula.

12.4 Relevant Characteristics of the Draft Planning Scheme.

12.4.1 Macroclimate.

12.4.1.1 As with all new and existing development, there is a potential for emissions of greenhouse gas emissions as a result of building design, heating systems and transport modes. A report on Carbon Emissions and Water Use Reductions has been prepared for the development by RPS and key features of the scheme which will improve sustainability in terms of avoiding or reducing green house gas emissions are discussed below.

12.4.2 Microclimate.

12.4.2.1 Within the proposed development, the potential exists for wind effects, overshadowing and adequate daylighting issues may exist. These items are dealt with in the relevant chapters of this EIS.

12.5 Likely Impacts of the Draft Planning Scheme.

12.5.1. Construction Phase.

12.5.1.1 The main impacts will relate to carbon emissions associated with the production of the building elements (for example the production of one tonne of Portland Cement involves the emission of the same amount of CO_2 to the atmosphere). In comparison, the emissions of CO_2 from earth moving and construction equipment, and construction traffic at the site proper will not be significant.

12.5.2 Operational Phase.

12.5.2.1 Operational Phase Green House Gas (GHG) emissions resulting from the development of the peninsula will come from a range of activities. For the most part, these emissions

will be associated with the utilisation of energy and water and the production of waste on the peninsula by its new inhabitants and the workforce employed there. It is estimated that approximately 11,784 tonnes of CO_2 per annum would be produced to satisfy the residential heating requirement on the peninsula with approximately 15,129 tonnes of CO_2 per annum produced to satisfy the electricity requirement (modelled on a building satisfying the 2007 Building Regulations). Approximately 9,850 tonnes per annum of CO_2 would be produced to satisfy the heating requirement of the commercial/retail building stock with 19,330 tones per annum being produced to satisfy the electricity requirement of the building stock (in this case using the relevant 2005 Building Regulations as the baseline).

12.5.2.2 Section 12.6 below addresses proposed mitigation measures for the development in terms of building efficiency, control of emissions and aspects of sustainability.

'Do Nothing' Scenario.

12.5.2.3 All new development has the potential to increase GHG emissions. Therefore the 'Do Nothing' scenario is likely to result in less GHG emissions than the 'Do Something' scenario. Even though some industries will be moving as a result of the development, in all likelihood they will continue operations elsewhere and, potentially may have increased GHG emissions if, for example, additional transportation is required in order to carry out their activities. A 'full detailed' assessment which is beyond the scope of this EIS would need to be carried out to prove otherwise.

12.6 Mitigation.

12.6.1 Suitable mitigation measures which will be put in place during both the construction and operational phase are outlined below.

12.6.2 Construction Phase.

- Intelligent design will allow a reduction in the amount of raw materials required for the development.
- Architectural salvage and recycling of materials will be promoted during construction.
- Where possible local materials and resources will be sourced.

12.6.3 Operational Phase.

12.6.3.1 A range of targets will be set for developers which will ensure that the Poolbeg Peninsula is a low carbon development. Improved levels of performance above those currently set by the Building Regulations will be put in place to ensure this. These targets and levels of performance, covering a range of areas, are contained in the Poolbeg Peninsula Planning Scheme Sustainability Toolkit, which is attached as Appendix 5 to the Draft Planning Scheme document. These targets cover a broad range of Building Design Areas including:

- Building Envelope and Insulation
- Airtightness
- Lighting
- Space and Water Heating
- Ventilation
- Sustainable Energy Utilisation
- Fixed Electrical Appliances

12.6.3.2 These targets should achieve a dramatic reduction in the CO_2 impact from the baseline calculated above regarding a Building Regulations Standard Baseline. For heating-related CO_2 emissions it is estimated that a reduction in production of CO_2 of 6,361 CO_2 tonnes per annum can be achieved in the residential sector, with a reduction of 8,168 achieved in electricity-related CO_2 production per annum. In the commercial sector it is anticipated that 4,911 tonnes per annum could be saved with regard to heat-related CO_2 and a further 9,763 tonnes per annum saved with regard to electricity generated CO_2.

12.6.3.3 These savings result in a total saving against the baseline of 56,092 tonnes per annum of 29,205 tonnes or a 51% reduction in overall CO_2 emissions per annum.

12.6.3.4 In addition to these reductions that can be easily calculated, each new building in the Draft Planning Scheme Area will be required to facilitate connection to a District Heating Network should one come on line. A city-wide District Heating (DH)

network is now proposed that could take waste heat from a number of sources including the existing power stations on the Poolbeg Peninsula and the proposed Waste to Energy Facility. Should this DH scheme become a reality then this waste heat will be utilised on the peninsula, further significantly reducing the heat-related CO_2 production, potentially down to zero.

12.7 References.

National Climate Change Strategy, 2007 – 2012.

Atmosphere, Weather & Climate, 6th Edition, R.G Barry, R.J. Chorley, Routledge, 1992, ISBN 0-415-07761-3.

12.8 Appendices

Appendix 12.1 - Poolbeg Planning Scheme, Carbon Emissions and Water Use Reduction, RPS, November 2008.

Appendix 12.1

Carbon Emissions and Water Use Reduction, RPS.

Poolbeg Planning Scheme

Carbon Emissions and Water Use Reduction

DOCUMENT CONTROL SHEET

Client	Dublin Docklands Development Authority					
Project Title	Poolbeg Peninsula Planning Scheme					
Document Title	Carbon Emissions and Water Use Reduction					
Document No.	MDR0558Rp006D04					
This Document Comprises	DCS	TOC	Text	List of Tables	List of Figures	No. of Appendices
	1	1	20	3	0	1

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
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1 CASE STUDY 1 – RESIDENTIAL SCENARIO

1.1 INTRODUCTION

This report contains a direct comparison between the current Building Standards and the Poolbeg Minimum Performance Requirements. The analysis of domestic quarters is compared with the 2007 Building Regulations minimum requirements. The analysis of the commercial quarters is compared with 2005 Building Regulations minimum requirements.

The purpose of the report is to determine the reduction in carbon emissions and reduction in water usage due to the implementation of the Poolbeg Minimum Performance Requirements over the implementation of the relevant Building Regulations, which potential developments in the Poolbeg area may have to adhere to. This will help to determine whether or not it is prudent to introduce these measures.

1.2 ESTIMATES AND ASSUMPTIONS

Due to the nature of this exercise, it is necessary in some cases to make reasonable assumptions and estimates. A brief summary of the main assumptions and estimates applicable to this section of the report follow:

- U-values for the roof of developments assume that insulation is installed on the slope of a pitched roof
- Heat loss estimates are sourced from “A detailed guide to Insulating your home”, published by Sustainable Energy Ireland
- In domestic scenarios, lighting contributes 18% of electrical energy
- Hot water and space heat controls can reduce space heat demand by 30%
- A typical domestic unit has an energy consumption of 200kWh/m^2/yr
- Space heating energy requirements represent 46% of the total energy load
- Water heating energy requirements represent 25% of the total energy load
- Electrical energy represents 49% of the total energy load
- Total net floor area is calculated for each development by dividing the multiplying gross floor area by a factor of 0.85. This attempts to take account of areas occupied by hallways, staircases, lift shafts, storage areas and service rooms which will in most cases will not be heated.

1.3 BUILDING ENVELOPE AND INSULATION

Table 1.1 Proposed U-value Improvements

	Heat Loss	U-Value (2007 Regs)	U-Value (Poolbeg Minimum)
Barriers	**(%)**	**(W/m^2 K)**	**(W/m^2 K)**
Walls	25.00%	0.27	0.22
Roof	20.00%	0.16	0.16
Windows	10.00%	2	1.5
Doors	5.00%	2	1.5
Floor	10.00%	0.25	0.2

Table 1.2 Barrier heat and CO_2 savings

	Improvement	Space heat	Total energy	Total CO_2
Barriers	**(%)**	**Energy saved (%)**	**saved (%)**	**saved (%)**
Walls	18.52%	4.63%	2.13%	1.30%
Roof	0.00%	0.00%	0.00%	0.00%
Windows	25.00%	2.50%	1.15%	0.70%
Doors	25.00%	1.25%	0.58%	0.35%
Floor	20.00%	2.00%	0.92%	0.56%
Total		10.38%	4.77%	2.91%

1.4 AIR TIGHTNESS

Table 1.3 Air leakage heat and CO_2 savings

Air Leakage	Heat loss	Improvement	Space heat	Total energy	Total CO_2
	(%)	**(%)**	**Energy saved (%)**	**saved (%)**	**saved (%)**
Plumbing/junctions	13.00%	50.00%	6.50%	2.99%	1.82%
Ducts	15.00%	0.00%	0.00%	0.00%	0.00%
Electrical openings	2.00%	50.00%	1.00%	0.46%	0.28%
Total	30.00%		7.50%	3.45%	2.10%

1.5 LIGHTING STRATEGY

Table 1.4 Lighting

Lighting	
% Electricity use attributed to lighting	18.00%
Electrical Energy Represents 29% of total energy	29.00%
Expected savings with energy efficient lighting	50.00%
Total Energy Saving	2.61%
Total CO_2 saved	8.12%

1.6 SPACE & WATER HEAT MANAGEMENT

Table 1.5 Heating control

Heating Control (Hot Water & Space Heat)	
Reduction in heat energy demand due to heating control	30.00%
Heating represents 71% of total energy usage	71.00%
Total Energy Saving compared to 2007 regs.	21.30%
Total CO_2 saved	13.20%

Table 1.6 Heating Specifications

Heating Specification	
Condensing Gas Boilers	
Improvement in boiler efficiency	5.00%
Heating represents 71% of total energy	71.00%
Total Energy Reduction	3.55%
Total CO_2 saved	2.20%

Table 1.7 Heat recovery ventilation systems

Heat recovery ventilation	
Reduction in space heat demand	30.00%
Space heating represents 46% of total energy	46.00%
Total Energy Reduction	13.80%
Total CO_2 saved	8.40%

1.7 SUSTAINABLE ENERGY SUPPLY

Table 1.8 Renewable energy

Renewable energy heating system	
Contribution to thermal energy from renewable source	20.00%
Heating represents 71% of total energy	71.00%
DHW energy use represents 25% of total energy	25.00%
Total Energy Reduction	5.00%
Total CO_2 saved	3.20%

1.8 ELECTRICAL APPLIANCES

Table 1.9 A-rated vs. D-rated appliances

Electrical Appliances	
Difference between the use of A-rated appliances and D-rated	55.00%
Amount of electricity used on appliances	45.00%
Electrical Energy Represents 29% of total energy load	29.00%
Total Energy Reduction	7.18%
Total CO_2 saved	13.86%

1.9 ENERGY & CARBON EMISSIONS REDUCTION SUMMARY

Table 1.10 Energy and carbon emissions reduction summary

Technology	%Energy Reduction	% CO_2 reduction
Insulation	3.05%	1.86%
Glazing	1.73%	1.05%
Air-tightness	3.45%	2.10%
Lighting	2.61%	8.12%
Heating Control	21.30%	13.20%
Heating Spec	3.55%	2.20%
Heat recovery ventilation	13.80%	8.40%
Renewable Energy	5.00%	3.20%
Electrical appliances	7.18%	13.86%
Total	61.66%	53.99%

1.10 CARBON DIOXIDE EMISSION REDUCTIONS

The following tables show a direct comparison of CO_2 emissions, contrasting adherence to the 2007 Building Regulations and to the Poolbeg Minimum Requirements for each of the separate developments. The tables are split into reductions achieved through reduction in gas use and reduction in electricity use. The final table in the section adds the CO_2 reductions achieved through both gas and electricity savings.

Table 1.11 CO_2 savings attributed to heat demand reduction (assuming gas as the primary fuel)

	2007 regs CO_2 output	Target regs CO_2 output	CO_2 savings
Gas	(kg CO_2/yr)	(kg CO_2/yr)	(kg CO_2/yr)
Area 1	6,410,338	2,949,634	3,460,704
Area 2	0	0	0
Area 3	2,314,878	1,065,161	1,249,717
Area 4	3,059,007	1,407,563	1,651,445
Total	11,784,223	5,422,358	6,361,866

Table 1.12 CO_2 savings attributed to electricity reduction

	2007 regs CO_2 output	Target regs CO_2 output	CO_2 savings
Electricity	**(kg CO_2/yr)**	**(kg CO_2/yr)**	**(kg CO_2/yr)**
Area 1	8,229,888	3,786,876	4,443,012
Area 2	0	0	0
Area 3	2,971,948	1,367,503	1,604,444
Area 4	3,927,295	1,807,094	2,120,201
Total	15,129,131	6,961,474	8,167,658

Table 1.13 CO_2 savings attributed to gas and electricity

	2007 regs CO_2 output	Target regs CO_2 output	CO_2 savings
Electricity + gas	**(kg CO_2/yr)**	**(kg CO_2/yr)**	**(kg CO_2/yr)**
Area 1	14,640,226	6,736,510	7,903,716
Area 2	0	0	0
Area 3	5,286,826	2,432,664	2,854,161
Area 4	6,986,302	3,214,656	3,771,646
Total	26,913,354	12,383,831	14,529,523

This gives an estimated combined CO_2 saving of 14,529,523 $KgCO_2$/yr as a direct result of the implementation of the Poolbeg Minimum Requirements over the 2007 Building Regulations.

1.11 REDUCTION IN WATER USE

The focus of this section will be on the potential reduction of water use in domestic situations due to the introduction of low flow shower and tap heads, economiser dishwasher and washing machines and dual flush toilets. These measures are the primary measures proposed in the Poolbeg Minimum Requirements aimed at reducing the use of water in domestic situations, along with other technical and behavioural water conservation methods. It should be noted that additional reductions in water usage to those stated in this section of the report could be made through the introduction of additionally proposed measures such as rainwater harvesting (as required by the Poolbeg Minimum standards), grey water re-use, policy etc. but it is not possible to give an accurate estimate of the potential water savings of these elements at this stage.

This section of the report makes the following estimates and assumptions:

- Typical household water usage is 350litres per day (Ref: UK environment agency)
- Low flow shower and tap heads reduce flow by 50%
- Economiser washing machines reduce water usage by 30%
- Dual flush toilets reduce water usage by 50%
- Economiser dishwasher and low flow taps reduce kitchen water usage by 20%

Table 1.14 Typical household water usage

	Typical water usage (%)	Typical water usage (m^3/day)	Potential reduction (%)
Toilets	40%	0.140	50%
Kitchen	15%	0.053	20%
Washing clothes	10%	0.035	30%
Shower/bath and faucets	35%	0.123	50%
Total	100%	0.350	

Table 1.15 Potential water savings due to water saving measures

	Reduced flow (m^3/day)	Water savings (m^3/day)	Water savings (m^3/unit/yr)
Toilets	0.070	0.070	25.550
Kitchen	0.011	0.042	15.330
Washing clothes	0.011	0.025	8.943
Shower/bath and faucets	0.061	0.061	22.356
Total	0.152	0.198	72.179

The previous tables show estimated water saving of 72.179m^3/unit/yr. In order to get approximate water saving for each potential development, it will be assumed that a typical domestic household consists of a net floor area of 120m^2.

Table 1.16 Potential water savings

Development	Net residential floor area (m^2)	Approx no. units	Water savings (m^3/yr)
Area 1	222,930	2,623	189,303
Area 2	0	0	0
Area 3	80,504	947	68,360
Area 4	106,382	1,252	90,335
Total	409,815	4,821	347,999

A water saving of 347,999m^3/yr may therefore be estimated. This reduction in water usage will have a corresponding reduction in electricity used to produce and supply the water, and therefore will in turn contribute to the reduction in CO_2 emissions. However, due to the unavailability of figures indicating how much energy is used in the production and supply of a unit volume of water, it is not possible to give an accurate estimation of the CO_2 saving attributed to this reduction in water usage.

There is currently no direct charge on domestic users of water. It is therefore not possible to give an accurate estimation of the direct cost savings to the consumer, attributed to the quantity of water saved.

2 CASE STUDY 2 – COMMERCIAL (RETAIL)

2.1 ESTIMATES AND ASSUMPTIONS

Due to the nature of this exercise, it is necessary in some cases to make reasonable assumptions and estimates. A brief summary of the main assumptions and estimates applicable to this section of the report follow:

- U-values for the roof of developments assume that insulation is installed on the slope of a pitched roof
- Heat loss estimates are sourced from "A detailed guide to Insulating your home", published by Sustainable Energy Ireland, and are manipulated in such a way as to represent more accurately the retail environment
- In retail environments, lighting contributes 40% of electrical energy
- Hot water and space heat controls can reduce space heat demand by 30%
- A typical retail unit has an energy consumption of 250kWh/m^2/yr
- Space heating requirements represents 38% of the total energy load
- Water heating requirements represents 7% of the total energy load
- Electrical energy represents 55% of the total energy load
- Gross floor areas are used in calculations

2.2 BUILDING ENVELOPE AND INSULATION

Table 2.1 U-value Improvements

Barriers	Heat Loss (%)	U-Value (2005 Regs) (W/m^2 K)	U-Value (Target) (W/m^2 K)
Walls	20.00%	0.27	0.22
Roof	20.00%	0.2	0.16
Windows	15.00%	2.2	1.5
Doors	10.00%	2.2	1.5
Floor	5.00%	0.25	0.2

Table 2.2 Barrier heat and CO_2 savings

Barriers	Improvement (%)	Space heat Energy saved (%)	Total energy saved (%)	Total CO_2 saved (%)
Walls	18.52%	3.70%	1.41%	0.67%
Roof	20.00%	4.00%	1.52%	0.72%
Windows	31.82%	4.77%	1.81%	0.86%
Doors	31.82%	3.18%	1.21%	0.57%
Floor	20.00%	1.00%	0.38%	0.18%
Total		16.66%	6.33%	3.00%

2.3 AIR TIGHTNESS

Table 2.3 Air leakage heat and CO^2 savings

Air Leakage	Heat loss (%)	Improvement (%)	Space heat Energy saved (%)	Total energy saved (%)	Total CO_2 saved (%)
Plumbing/junctions	13.00%	50.00%	6.50%	2.47%	1.17%
Ducts	15.00%	0.00%	0.00%	0.00%	0.00%
Electrical openings	2.00%	50.00%	1.00%	0.38%	0.18%
Total	30.00%		7.50%	2.85%	1.35%

2.4 LIGHTING STRATEGY

Table 2.4 Lighting

Lighting	
% Electricity use attributed to lighting	40.00%
Electrical Energy Represents 55% of total energy	55.00%
Expected savings with energy efficient lighting	40.00%
Total Energy Saving	8.80%
Total CO_2 saved	17.38%

2.5 SPACE & WATER HEAT MANAGEMENT

Table 2.5 Heating control

Heating Control (HW & space heat)	
Reduction in heat energy consumption due to heating control	30.00%
Heat represents 45% of total energy usage	45.00%
Total Energy Saving above from 2005 regs	13.50%
Total CO_2 saved	6.30%

Table 2.6 Heating Specifications

Heating Specification	
Condensing Gas Boilers	
Improvement in boiler efficiency	13.00%
Heating represents 45% of total energy	45.00%
Total Energy Reduction	5.85%
Total CO_2 saved	2.73%

Table 2.7 Heat recovery ventilation systems

Heat recovery ventilation	
Reduction in space heat	30.00%
Space heating represents 38% of total energy	38.00%
Total Energy Reduction	11.40%
Total CO_2 saved	5.40%

2.6 SUSTAINABLE ENERGY SUPPLY

Table 2.8 Renewable energy

Renewable energy heating system	
Contribution to thermal energy from renewable source	20.00%
Heating represents 45% of total energy	45.00%
HW energy use represents 45% of total energy	45.00%
Total Energy Reduction	9.00%
Total CO_2 saved	0.60%

2.7 ELECTRICAL APPLIANCES

Table 2.9 A-rated vs. D-rated appliances

Electrical Appliances	
Difference between the use of A-rated appliances and D-rated	55.00%
Amount of electricity used on appliances	45.00%
Electrical Energy Represents 55% of total energy load	55.00%
Total Energy Reduction	13.61%
Total CO_2 saved	19.55%

2.8 ENERGY & CARBON EMISSIONS REDUCTION SUMMARY

Table 2.10 Energy and carbon emissions reduction summary

Technology	%Energy Reduction	% CO_2 reduction
Insulation	3.31%	1.57%
Glazing	3.02%	1.43%
Air-tightness	2.85%	1.35%
Lighting	8.80%	17.38%
Heating Control	13.50%	6.30%
Heating Spec	5.85%	2.73%
Heat recovery ventilation	11.40%	5.40%
Renewable Energy	9.00%	0.60%
Electrical appliances	13.61%	19.55%
Total	71.34%	56.31%

2.9 CARBON DIOXIDE EMISSION REDUCTIONS

The following tables show a direct comparison of CO_2 emissions, contrasting adherence to the 2005 Building Regulations and to the Poolbeg Minimum Requirements for each of the separate developments. The tables are split into reductions achieved through reduction in gas use and reduction in electricity use. The final table in the section adds the CO_2 reductions achieved through both gas and electricity savings.

Table 2.11 CO_2 savings attributed to gas reduction

	2005 regs CO_2 output	Target regs CO_2 output	CO_2 savings
Gas	(kg CO_2/yr)	(kg CO_2/yr)	(kg CO_2/yr)
Area 1	614,650	268,534	346,115
Area 2	136,688	59,717	76,970
Area 3	34,172	14,929	19,243
Area 4	137,545	60,092	77,453
Total	923,054	403,273	519,781

Table 2.12 CO_2 savings attributed to electricity reduction

	2005 regs CO_2 output	Target regs CO_2 output	CO_2 savings
Electricity	(kg CO_2/yr)	(kg CO_2/yr)	(kg CO_2/yr)
Area 1	2,361,300	1,031,629	1,329,671
Area 2	525,113	229,416	295,696
Area 3	131,278	57,354	73,924
Area 4	528,408	230,856	297,552
Total	3,546,098	1,549,255	1,996,843

Table 2.13 CO_2 savings attributed to gas and electricity

	2005 regs CO_2 output	Target regs CO_2 output	CO_2 savings
Electricity + gas	**(kg CO_2/yr)**	**(kg CO_2/yr)**	**(kg CO_2/yr)**
Area 1	2,975,949	1,300,163	1,675,786
Area 2	661,800	289,134	372,666
Area 3	165,450	72,283	93,167
Area 4	665,953	290,948	375,005
Total	4,469,152	1,952,528	2,516,623

This gives an estimated overall CO_2 saving of 2,516,623 $KgCO_2$/yr as a direct result of the implementation of the Poolbeg Minimum Requirements over the 2005 Building Regulations.

3 CASE STUDY 3 – COMMERCIAL (OFFICE)

3.1 ESTIMATES AND ASSUMPTIONS

Due to the nature of this exercise, it is necessary in some cases to make reasonable assumptions and estimates. A brief summary of the main assumptions and estimates applicable to this section of the report follow:

- U-values for the roof of developments assume that insulation is installed on the slope of a pitched roof
- Heat loss estimates are sourced from "A detailed guide to Insulating your home", published by Sustainable Energy Ireland, and are manipulated in such a way as to represent more accurately the office environment
- In office environments, lighting contributes 45% of electrical energy
- Hot water and space heat controls can reduce space heat demand by 30%
- A typical office unit has an energy consumption of 300kWh/m^2/yr
- Space heating energy requirements represent 57% of the total energy load
- Water heating energy requirements represent 7% of the total energy load
- Electrical energy represents 36% of the total energy load
- Gross floor areas are used in calculations

3.2 BUILDING ENVELOPE AND INSULATION

Table 3.1 U-value Improvements

Barriers	Heat Loss (%)	U-Value (2005 Regs) (W/m^2 K)	U-Value (Target) (W/m^2 K)
Walls	20.00%	0.27	0.22
Roof	15.00%	0.2	0.16
Windows	25.00%	2.2	1.5
Doors	3.00%	2.2	1.5
Floor	7.00%	0.25	0.2

Table 3.2 Barrier heat and CO_2 savings

Barriers	Improvement (%)	Space heat Energy saved (%)	Total energy saved (%)	Total CO_2 saved (%)
Walls	18.52%	3.70%	2.11%	0.59%
Roof	20.00%	3.00%	1.71%	0.48%
Windows	31.82%	7.95%	4.53%	1.27%
Doors	31.82%	0.95%	0.54%	0.15%
Floor	20.00%	1.40%	0.80%	0.22%
Total		17.01%	9.70%	2.72%

3.3 AIR TIGHTNESS

Table 3.3 Air leakage heat and CO^2 savings

Air Leakage	Heat loss (%)	Improvement (%)	Space heat Energy saved (%)	Total energy saved (%)	Total CO_2 saved (%)
Plumbing/junctions	13.00%	50.00%	6.50%	3.71%	1.04%
Ducts	15.00%	0.00%	0.00%	0.00%	0.00%
Electrical openings	2.00%	50.00%	1.00%	0.57%	0.16%
Total	30.00%		7.50%	4.28%	1.20%

3.4 LIGHTING STRATEGY

Table 3.4 Lighting

Lighting	
% Electricity use attributed to lighting	45.00%
Electrical Energy Represents 36% of total energy	36.00%
Expected savings with energy efficient lighting	40.00%
Total Energy Saving	6.48%
Total CO_2 saved	11.66%

3.5 SPACE & WATER HEAT MANAGEMENT

Table 3.5 Heating control

Heating Control (HW & space heat)	
Reduction in heat energy consumption due to heating control	30.00%
Heat represents 64% of total energy usage	64.00%
Total Energy Saving above from 2005 regs	19.20%
Total CO_2 saved	5.70%

Table 3.6 Heating Specifications

Heating Specification	
Condensing Gas Boilers	
Improvement in boiler efficiency	13.00%
Heating represents 64% of total energy	64.00%
Total Energy Reduction	8.32%
Total CO_2 saved	2.47%

Table 3.7 Heat recovery ventilation systems

Heat recovery ventilation	
Reduction in space heat	30.00%
Space heating represents 57% of total energy	57.00%
Total Energy Reduction	17.10%
Total CO_2 saved	4.80%

3.6 SUSTAINABLE ENERGY SUPPLY

Table 3.8 Renewable energy

Renewable energy heating system	
Contribution to thermal energy from renewable source	20.00%
Heating represents 64% of total energy	64.00%
HW and space heat are 64% of total energy	64.00%
Total Energy Reduction	12.80%
Total CO_2 saved	0.60%

3.7 ELECTRICAL APPLIANCES

Table 3.9 A-rated vs. D-rated appliances

Electrical Appliances	
Difference between the use of A-rated appliances and D-rated	55.00%
Amount of electricity used on appliances	45.00%
Electrical Energy Represents 36% of total energy load	36.00%
Total Energy Reduction	8.91%
Total CO_2 saved	20.05%

3.8 ENERGY & CARBON EMISSIONS REDUCTION SUMMARY

Table 3.10 Energy and carbon emissions reduction summary

Technology	%Energy Reduction	% CO_2 reduction
Insulation	4.62%	1.30%
Glazing	5.08%	1.43%
Air-tightness	4.28%	1.20%
Lighting	6.48%	11.66%
Heating Control	19.20%	5.70%
Heating Spec	8.32%	2.47%
Heat recovery ventilation	17.10%	4.80%
Renewable Energy	12.80%	0.60%
Electrical appliances	8.91%	20.05%
Total	86.78%	49.20%

3.9 CARBON DIOXIDE EMISSION REDUCTIONS

The following tables show a direct comparison of CO_2 emissions, contrasting adherence to the 2005 Building Regulations and to the Poolbeg Minimum Requirements for each of the separate developments. The tables are split into reductions achieved through reduction in gas use and reduction in electricity use. The final table in the section adds the CO_2 reductions achieved through both gas and electricity savings.

Table 3.11 CO_2 savings attributed to gas reduction

	2005 regs CO_2 output	Target regs CO_2 output	CO_2 savings
Gas	(kg CO_2/yr)	(kg CO_2/yr)	(kg CO_2/yr)
Area 1	5,944,344	3,019,516	2,924,828
Area 2	1,321,920	671,488	650,432
Area 3	330,480	167,872	162,608
Area 4	1,330,215	675,702	654,513
Total	8,926,959	4,534,578	4,392,380

Table 3.12 CO_2 savings attributed to electricity reduction

	2005 regs CO_2 output	Target regs CO_2 output	CO_2 savings
Electricity	(kg CO_2/yr)	(kg CO_2/yr)	(kg CO_2/yr)
Area 1	10,509,930	5,338,672	5,171,258
Area 2	2,337,228	1,187,229	1,149,999
Area 3	584,307	296,807	287,500
Area 4	2,351,894	1,194,679	1,157,215
Total	15,783,359	8,017,387	7,765,973

Table 3.13 CO_2 savings attributed to gas and electricity

	2005 regs CO_2 output	Target regs CO_2 output	CO_2 savings
Electricity + gas	**(kg CO_2/yr)**	**(kg CO_2/yr)**	**(kg CO_2/yr)**
Area 1	16,454,274	8,358,187	8,096,086
Area 2	3,659,148	1,858,717	1,800,431
Area 3	914,787	464,679	450,108
Area 4	3,682,109	1,870,381	1,811,728
Total	24,710,318	12,551,965	12,158,353

This gives an estimated overall CO_2 saving of 12,158,353 KgCO_2/yr as a direct result of the implementation of the Poolbeg Minimum Requirements over the 2005 Building Regulations.

3.10 REDUCTION IN WATER USAGE

The focus of this section will be on the potential reduction of water usage in an office-based environment. It must be noted that additional water savings to those in this report may be made through the introduction of additional water saving measures, such as water saving policies, leak detection etc. It is not possible to give an accurate estimation of the potential water savings of these additional measures at this stage.

This section of the report makes the following estimates and assumptions:

- Typical water consumption in an office-based environment is 2.4 litres/m^2/day (Ref; Water key performance indicators and benchmarks for offices and hotels)
- A 6/3 litre flush toilet reduces water usage from 8 litres per flush to 4 litres per flush => 50% reduction
- Low flow tap heads reduce flow by approx 30%
- A PIR (Passive Infra-red) sensor reduces water consumption by up to 80%
- 20% reduction in water usage for cleaning is achievable (through staff education and training)

Below is a table of typical water usage in office-based environments (Ref; South Staffordshire Water plc.)

Table 3.14 Typical office water usage

	Water use (%)	Water use (m^3/m^2/day)	Water use (m^3/m^2/yr)
Toilet flushing	43%	0.00103	0.37668
Washing	27%	0.00065	0.23652
Urinal flushing	20%	0.00048	0.17520
Canteen	9%	0.00022	0.07884
Cleaning	1%	0.00002	0.00876
Total	100%	0.00240	0.87600

Table 3.15 Potential reduction in water usage

	Potential reduction (%)	Potential Reduction (m^3/m^2/yr)
Toilet flushing	50%	0.18834
Washing	30%	0.07096
Urinal flushing	80%	0.14016
Canteen	20%	0.01577
Cleaning	20%	0.00175
Total		0.41698

The previous tables show estimated water saving of 0.41698 $m^3/m^2/yr$. In order to get approximate water savings for each potential development, the estimated gross office area for each potential development will now be multiplied by 0.41698 $m^3/m^2/yr$.

Table 3.16 Potential water savings

Development	Gross office area (m^2)	Potential savings (m^3/yr)
Area 1	152,890	64,957
Area 2	34,000	14,445
Area 3	8,500	3,611
Area 4	34,213	14,536
Total	229,603	97,549

A water saving of 97,549 m^3/yr may therefore be estimated. The 2008 charge for water supplied to commercial entities in the Dublin City area is €1.07 per cubic meter. In order to convert this water saving into economic terms this charge will be multiplied by the potential water reduction figures in Table 3.16.

Table 3.17 Cost savings

Development	Potential savings (m^3/yr)	Cost saving (€/yr)
Area 1	64,957	69,504
Area 2	14,445	15,456
Area 3	3,611	3,864
Area 4	14,536	15,553
Total	97,549	104,378

This gives an estimated cost saving of €104,378 per year due to savings in water consumption.

This reduction in water usage will have a corresponding reduction in electricity used to produce and supply the water, and therefore will in turn contribute to a reduction in CO_2 emissions. However, due to the unavailability of figures indicating how much energy is used in the production and supply a unit volume of water, it is not possible to give an accurate estimation of the CO_2 saving attributed to this reduction in water usage.

4 TOTAL CO_2 AND WATER SAVINGS

Table 4.1 Combined Commercial and Domestic CO_2 reduction

	2007 regs CO_2 output	Target regs CO_2 output	CO_2 savings
Electricity + gas	**(kg CO_2/yr)**	**(kg CO_2/yr)**	**(kg CO_2/yr)**
Area 1	34,070,449	16,394,861	17,675,588
Area 2	4,320,948	2,147,851	2,173,097
Area 3	6,367,063	2,969,627	3,397,436
Area 4	11,334,364	5,375,985	5,958,379
Total	56,092,824	26,888,325	29,204,500

This shows that the total reduction of CO_2 emissions attributed to energy use as a result of adhering to the Poolbeg Minimum Performance Requirements as opposed to the 2005/2007 Building Regulations may be estimated as 29,204,500 KgCO_2/yr.

Table 4.2 Combined Office and Domestic water reduction

Development	Potential savings
	(m^3/yr)
Area 1	254,260
Area 2	14,445
Area 3	71,972
Area 4	104,871
Total	445,548

This shows that the total reduction of water usage attributed directly to the implementation of the water saving measures mentioned earlier in the report may be estimated as 445,548m^3/yr. It should be noted that additional reductions in water consumption may be made through the implementation of auxiliary water saving measures such as leak detection, water policy, rain water harvesting, grey water re-use etc.

APPENDIX A

BENCHMARKS AND GUIDELINES

In preparation of this report, the following documents have been used for guidance in establishing benchmarks and relevant baseline data.

- DoEHLG Building Regulations 2007 Technical Guidance Document L – Conservation of Fuel & Energy
- DoEHLG Building Regulations 2005 Technical Guidance Document L – Conservation of Fuel & Energy
- CIBSE (Chartered Institute of Building Services Engineers) Guide F – Energy Efficiency in Buildings
- BSRIA (Building Services Research & Information Association) Rules of Thumb – Guidelines for Building Services
- SEI (Sustainable Energy Ireland) Report – Energy in Ireland 1990 – 2006
- SEI (Sustainable Energy Ireland) – Residential Report December 2005