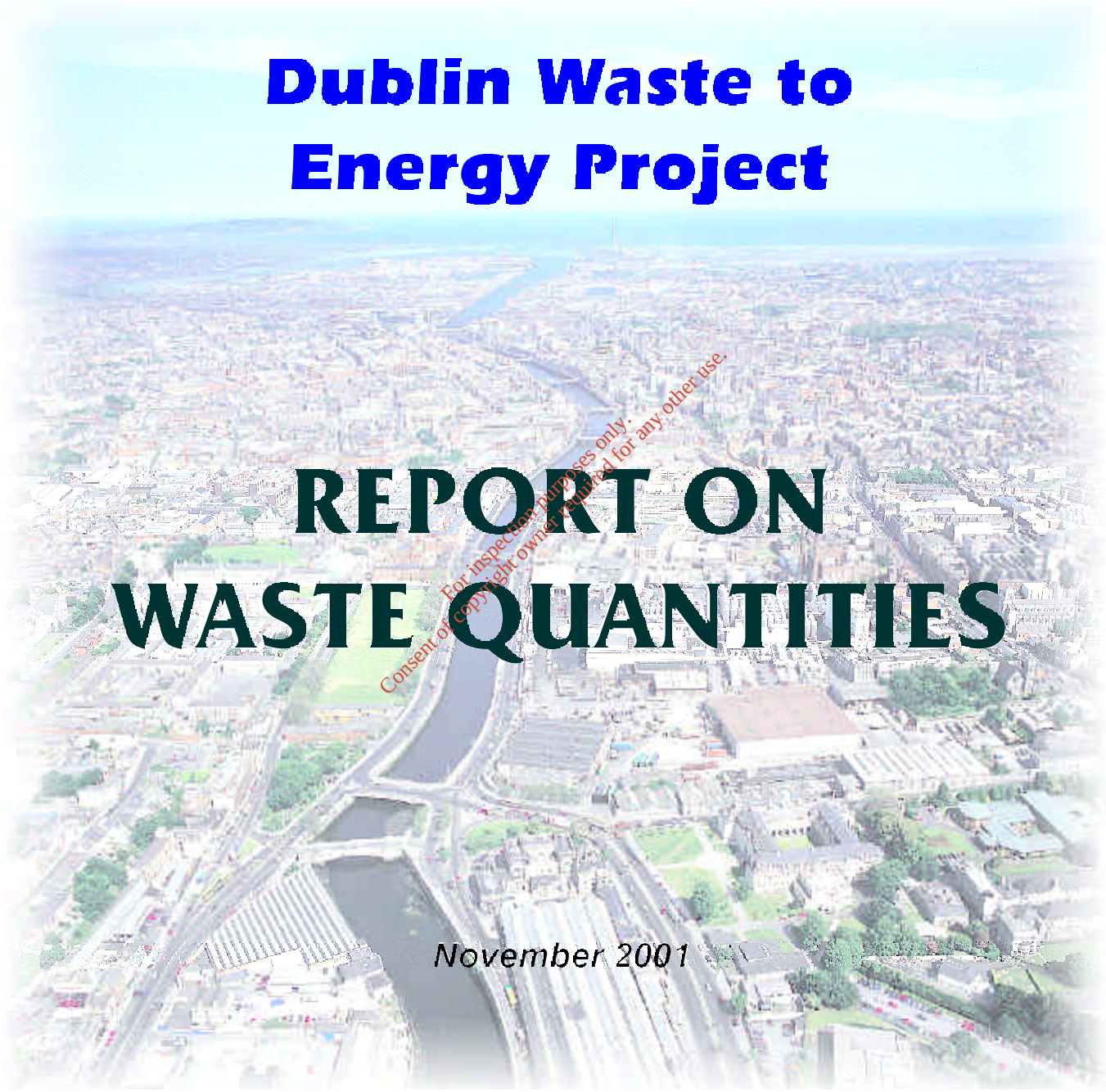
WASTE MANAGEMENT PLAN

Working for the Dublin Region

Dublin Waste to Energy Project



REPORT ON WASTE QUANTITIES

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November 2001

EC HARRIS
Capital Project and Facilities Consultants

PRICEWATERHOUSECOOPERS

McCann FitzGerald
SOLICITORS

COWI

mcos

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1 INTRODUCTION

The Dublin Waste to Energy Project is part of the implementation of the Dublin Waste Management Plan which was adopted individually by each of the four local authorities (Dublin Corporation, Dun Laoghaire Rathdown, Fingal and South Dublin County Councils). A consortium has been appointed by Dublin Corporation to plan the development of a Waste to Energy plant on their behalf. The consortium is led by M.C. O'Sullivan & Co. Ltd. in a joint venture with COWI a Danish consultancy with specialist expertise in thermal treatment. Due to the complex nature of the project and the many different elements including technical, financial, legal and public information the consortium also includes PricewaterhouseCoopers international financial advisors, McCann Fitzgerald solicitors and EC Harris, contract and project management specialists. Mary Murphy Associates, PDA International and Professor Judith Petts are providing specialist advice on public involvement.

The consortium will do the following:-

- Provide information to the public
- Identify possible environmental impacts
- Consult the public about ways to minimise impacts
- Facilitate the tendering process
- Ensure best available technology is used
- Facilitate establishment of a Public Private Partnership to design, build, operate and finance the plant

The Public Private Partnership will be between the public (represented by Dublin Corporation) and a private company where both parties share the cost, expertise, technology and responsibility for developing the plant.

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This report provides a review of the quantities of waste from the Dublin Region which will be available for thermal treatment in 2006, the expected year of opening of the plant. The report includes a review of previous data, comprehensive surveys relating to collection and disposal of waste in the Dublin Region and projections of waste quantities requiring thermal treatment in 2006 and beyond.

The objectives of this report are:

- To quantify the amounts of household, commercial and industrial wastes which will be available for thermal treatment in 2006 and beyond.
- To estimate the calorific value of the waste requiring thermal treatment from 2006.
- To provide information for the Tendering Process, in particular information necessary to form a successful Public Private Partnership between Dublin Corporation and the successful Tenderer.

In the context of this report, the Dublin Region means the four local authority areas of Dublin Corporation, Dun Laoghaire Rathdown, Fingal and South Dublin County Councils.

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2 WASTE MANAGEMENT IN THE DUBLIN REGION

2.1 OVERVIEW OF THE DUBLIN WASTE MANAGEMENT PLAN

Dublin Corporation and Fingal, South Dublin and Dun Laoghaire Rathdown County Councils jointly prepared a Waste Management Plan for the Dublin Region in 1998. Each local authority individually adopted the Plan.

The Plan contains policies and objectives to meet the requirements of Ireland's waste policy. National waste policy in Ireland is now governed by the Waste Management Act, 1996, which is being brought into law through a series of regulations. The Waste Management Act is guided by the European hierarchical approach:

- Prevention/minimisation
- Reuse/recycling
- Energy recovery
- Environmentally sustainable disposal of residual waste that cannot be prevented, recycled or recovered

The Minister for the Environment and Local Government produced a Policy Statement on Waste Management in October 1998. In the Policy Statement the Irish Government states that waste must be dealt with on a regional basis and in an integrated fashion. Waste management should be funded by the 'Polluter Pays' principle.

Policies in the Plan apply to all four local authorities and cover a 20-year time period including a review after 5 years. The Plan's principal policies are summarised below:

- **Waste minimisation policies** to implement a 'Green Region' approach, promotion of waste minimisation in industry and commerce, implementation of the packaging directive, promotion of public education and waste minimisation within Local Authorities.

- **Waste collection policies** including provision of home address source separation of recyclables and household organic waste, provision of bring banks and Waste Recycling Centres and regulation of source separation of commercial, industrial and construction and demolition waste.

- **Waste recycling and recovery policies** including provision of sorting and baling facilities, green waste depots and composting facilities, facilities for the biological treatment of kitchen organic waste, facilities to sort and recycle construction and demolition waste and facilities to deal with priority and harmful wastes (batteries, oil, paints etc). The Plan also includes an objective to provide a thermal treatment facility with energy recovery.

- **Disposal policies** to continue utilising Arthurstown Landfill, expansion of Balleally for a short term period followed by replacement and servicing of landfills using Ballymount baling/transfer station and a proposed station at Ballyogan. A new landfill for thermal treatment residues is also expected.

The Plan's five-year recycling and recovery targets are (1999-2004)

Source	Recycling	Thermal	Landfill
Households	60%	39%	1%
Commerce/Industry	41%	37%	22%
Construction/Demolition	82%	0%	18%
Total	**59%**	**25%**	**16%**

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2.2 WASTE ARISINGS (1997)

The Waste Management Plan was developed based on studies carried out for the Dublin Waste Management Strategy 1997 by the MCCK Consultancy Group of which MCOS and COWI were the main participants along with the City of Copenhagen and KPMG Consulting. The Waste Strategy Report was produced in December 1997 and presented to the Dublin Local Authorities in January 1998.

The Waste Management Strategy aimed to determine and assess the quantity and nature of current and future waste arisings in the Dublin Region.

Strategy authors MCCK quantified the existing waste arisings in the Region and described the existing waste collection, recycling and disposal arrangements. Waste quantities were estimated using landfill surveys, information provided by local authorities, ADEME surveys (household waste composition surveys) and the National Waste Database Report 1995, EPA.

The total amount of waste arising in the Dublin Region in 1997 was estimated to be 3,395,048 tonnes. Table 2.1 illustrates the municipal waste categories contributing to this total.

Table 2.1: Waste Arisings in the Dublin Region (1997)

Waste Category	Total (tonnes per annum)	% of Total
Household-collected	365,000	10.5
Household-Delivered (Bulky Waste)	18,000	0.5
Litter/Street Sweepings	45,000	1.3
Commercial	308,000	8.8
Industrial	408,000	11.7
Construction/Demolition	1,223,000	35.1
Wastewater Treatment	335,500	9.6
Agricultural	680,000	19.5
Other	100,000	2.9
Total	**3,482,500**	**100**

Source: Waste Management Plan for the Dublin Region, 1998

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Table 2.1 illustrates that the largest source of waste arising in the Dublin Region is construction and demolition waste, accounting for 35% of the total waste stream, followed by 20% agricultural waste, 12% industrial waste, 11% household waste and 10% wastewater treatment waste.

The Dublin Waste Management Plan also addressed the waste disposal situation in 1997 and is reproduced below in Table 2.2.

Table 2.2: Landfill Disposal in the Dublin Region (1997)

Waste Type	Landfill Location				Total
	Balleally	Ballyogan	Friarstown	Co. Kildare/Co. Wicklow	
Household	191,000	94,000	66,000	Nil	352,000
Commercial/ Industrial	235,000	17,000	12,000	101,000	364,000
Construction/ Demolition	820,000	-	-	403,000	1,223,000
Miscellaneous	22,000	-	-	-	22,000
Total	1,267,000	111,000	78,000	504,000	1,961,000

Source: Waste Management Plan for the Dublin Region, 1998

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2.3 RECYCLING INITIATIVES (1997)

Data from Rehab bring banks from 1996 shows there were 134 bring banks in the Region providing a distribution of 7,500 people per bring bank. In 1996 Rehab collected 10.8 tonnes of aluminium cans, 4,257 tonnes of glass and 91 tonnes of textiles, making a total of 4,369 tonnes.

During 1996, the 'Kerbside Dublin' home address collection system was operational. Kerbside collected from a total of 45,000 households in the Dublin Region and collected a total of 3,150 tonnes of recyclable material. This constituted 49% cardboard, 2% aluminium cans, 8% ferrous metals, 35% glass and 6% plastics.

St Anne's Composting Plant treated between 3,500-4,000 tonnes of green waste per annum, 50% from the Dublin Corporation Parks Department and the balance from householders.

The Dublin Waste Management Strategy noted that the capacity for recycling facilities in 1997 in the Dublin Region was limited due to constraints in finding markets for particular materials. Markets existed for glass, paper (to a limited extent), compost and metals. In 1996 Smurfit Recycling processed approx. 50,000 tonnes of cardboard. In addition, approximately 3,000-5,000 tonnes each of glass, green waste and household recyclables were diverted from landfill.

2.4 THE DUBLIN WASTE MANAGEMENT MODEL

The policies in the Waste Management Plan for the Dublin Region were formulated using the outcome of a modelling exercise carried out as part of the preparation of the Dublin Waste Management Strategy.

The model was used to compare different waste management strategies by predicting future waste flows from producer to final disposal and calculating the associated costs. Waste calculations are based on 1996 data. The model covered a time span of 15 years, starting in 1997 and ending in 2011.

Population and waste projections were made and incorporated into the model. Population projections were based on population and labour force projections produced by the Central Statistics Office (CSO).

The waste quantities used in the model were derived from landfill surveys conducted by the study team, data supplied by the local authorities and the Kompass database of industrial activities.

Four scenarios were formulated to meet different waste management objectives as illustrated in Table 2.3 below.

Table 2.3: Scenario Options for Waste Modelling Exercise

Scenario	Recycling	Waste Volume Reduction/Recovery
1	Mandatory recycling according to national and EU recycling targets plus proposed landfill directive	None
2	Maximum realistic recycling	None
3	Mandatory recycling according to national and EU recycling targets plus proposed landfill directive	Thermal treatment
4	Maximum realistic recycling	Thermal treatment

Each scenario was translated into an integrated waste management system, setting out collection, recycling and recovery/disposal facilities required. The scenarios included household, commercial, industrial and construction and demolition waste as well as the priority waste streams of scrap metal, used tyres, batteries and electronic equipment.

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The resulting information was then inputted into a model to compare the selected scenarios. The model took into account the environmental, technical and financial implications of each scenario. The model was run over an implementation time-scale of 1997-2011.

Assumptions were made for some variables where uncertainties existed and a sensitivity analysis was applied to predict possible variations in the result.

Detailed analysis showed Scenario 4 to be the most favourable option. Scenario 4 produces the lowest environmental impact because it combines high levels of recycling of organic materials with thermal treatment. The cost difference between all four scenarios was only 19% over a 15-year period. Scenario 4 diverts the most waste from landfill.

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3 PRESENT QUANTITIES OF HOUSEHOLD, COMMERCIAL AND INDUSTRIAL WASTE IN THE DUBLIN REGION

3.1 QUESTIONNAIRES

To estimate the quantities of waste suitable for thermal treatment, it was necessary to determine the current quantities of household, commercial and industrial waste in the Region. Questionnaires were sent to waste collection and landfill operators in the Dublin Region for this purpose (see Chapter 4.2).

3.2 PRESENT WASTE MANAGEMENT IN THE DUBLIN REGION

Private and public operators carry out waste collection in Dublin. Local authorities collect almost all household waste in the region. Private operators are employed occasionally to collect household waste, including bulky waste and recyclables. Private operators collect the majority of commercial waste, with the remainder collected by Local Authorities (e.g. Dublin Corporation collect 15% of commercial waste). Private operators collect all industrial waste.

The total amounts of waste disposed to landfill in Dublin in 1997 & 2000 are shown in Table 3.1 below.

Table 3.1: Municipal and Industrial Waste Disposal to Landfill in Dublin (1997 & 2000)

	1997	2000	% Change
Household Waste	352,000	376,000	+ 7%
Commercial Waste	364,000	191,000	
Industrial Waste		159,000	
Total	716,000	726,000	+ 2%

(Litter is not included)

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Table 3.1 shows that household waste disposed of to landfill in Dublin has increased by approximately 7% over the three years since the plan was adopted. Commercial and industrial waste landfilled has decreased by about 4% while the overall amount of waste to landfill from the Dublin Region has increased by approximately 2%.

Household waste recycling in Dublin has traditionally been carried out by the Rehab Recycling Partnership through a network of bottle banks. Kerbside Dublin operated a pilot door to door collection of recyclables for several years. This service has now been replaced by a new service operated by Oxigen as part of the implementation of the Dublin Waste Management Plan. Table 3.2 below shows the recycling rates estimated for the year 2000 (most recently available complete data set) using the information collected for the surveys.

Table 3.2: Recycling Rates in the Dublin Region in 2000

Waste Recycled 2000		
Overall Recycling	**Type**	**Amount**
Household	3%	12,000
Commercial	17%	40,000
Industrial	26%	57,000
Total	13%	109,000

Source: Questionnaire Surveys, 2000

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The recycling rate for household waste in the Dublin Region in 1997 was 2.6% so it seems that there has only been a slight increase in recycling since 1997. However the amount of material collected by Rehab Recycling increased by about 40% over the three years from 4,400 to 6,200 tonnes. This increase is not reflected in the overall household recycling rate due to the discontinuation of the Kerbside Collection System. **It is expected that there will be a substantial increase in household recycling in the coming years due to a major expansion of a new door to door collection service which is expected to cover 75,000 households by the end of 2001.** It is estimated that approximately 130 kg of recyclables are collected per household per year from this scheme which is currently limited to paper, cardboard and metal although there are potentially more recyclable materials in the waste stream, for example plastic. It is estimated that the recycling rate for household waste in 2001 will be 4%.

Waste disposal by landfill remains the main method of waste management in the Dublin Region. Four non-hazardous waste landfills serve the Dublin Region: Balleally Landfill, Arthurstown Landfill, Ballyogan Landfill and the KTK Landfill at Kilcullen, Co. Kildare. Balleally, Arthurstown and Ballyogan landfills are owned and operated by Fingal County Council, South Dublin County Council and Dun Laoghaire Rathdown County Councils respectively. A private company operates the KTK Landfill, KTK Sand & Gravel Ltd. Balleally landfill accepts household, commercial and industrial waste from both public and private operators. It also accepts wastes that arise from local authority activities, for example street sweepings. Arthurstown landfill located near Kill in Co. Kildare accepts baled household, commercial or industrial waste only from both public and private waste collectors. Ballyogan landfill accepts household and commercial waste collected by Dun Laoghaire Rathdown County Council as well as some wastes delivered by individual householders. The KTK landfill is licensed to accept non-hazardous waste with the exception of organic wastes. This means that the KTK Landfill accepts commercial and industrial wastes only from the Dublin region and other counties.

Figure 3.1 below shows the quantities and types of waste being deposited at the landfills accepting waste generated in Dublin. It should be noted that the figures below do not include construction and demolition waste which is used for landfill rehabilitation. The figures exclude waste entering the landfills from outside the Dublin region and also make some assumptions with regard to the types of waste being deposited by private waste collectors due to the way in which the waste is categorised. Waste from local authority activities, with the exception of waste material collected from litterbins, is also excluded as most of this is unsuitable for thermal treatment.

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Table 3.3 below shows the overall amounts of waste collected in the Dublin Region and the waste types. Studying Figures 3.1 & 3.2 it is evident that there is a difference in the amounts of commercial and industrial wastes reportedly landfilled in Dublin. Figure 3.1 shows that there are 296,000 tonnes of commercial waste and 66,000 tonnes of industrial waste disposed of to landfill. Figure 3.2 shows that 191,000 tonnes of commercial waste and 159,000 tonnes of industrial waste are landfilled. This discrepancy is accounted for by the fact that two separate data sources were used in the compilation of each of the graphs. Figure 3.1 was compiled using information supplied by landfill operators while Figure 3.2 was compiled from information supplied by waste collectors. However, the overall sum of landfilled commercial and industrial waste is similar. This would imply that the discrepancy is accounted for by different classification of commercial and industrial wastes for example, waste that arrives at a landfill may appear to be commercial waste (cardboard, paper etc.) but may in fact have come from an industrial source.

Table 3.3: Management of Waste Collected in Dublin 2000 (excluding litter)

	Waste Collected	Waste Recycled	Waste Landfilled
Household	388,000	12,000	376,000
Commercial	230,000	40,000	191,000
Industrial	216,000	57,000	159,000
Total	834,000	109,000	726,000

There were also 18,500 tonnes of litter landfilled in Dublin by local authorities in 2000 which would be available for thermal treatment.

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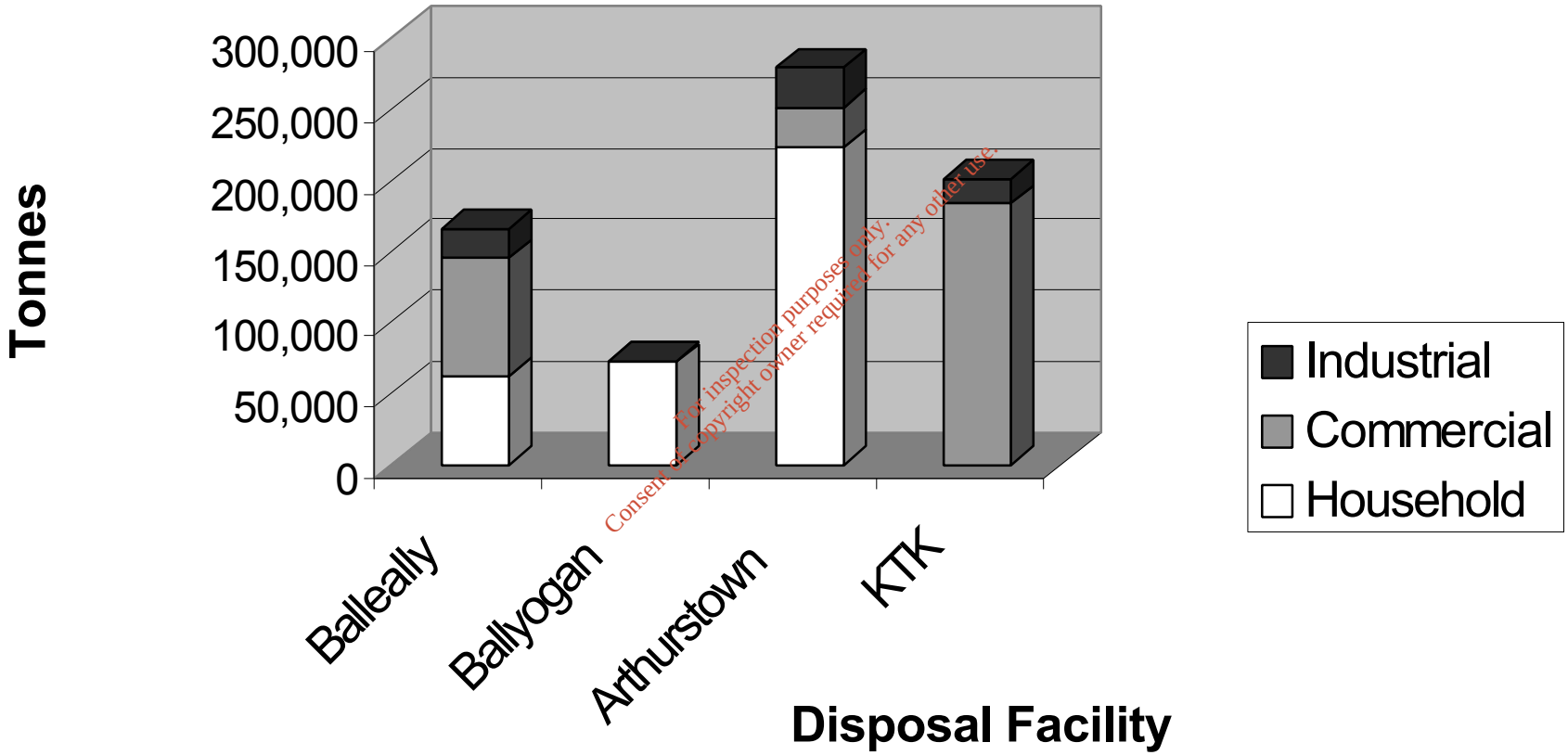
Fig 3.1 Waste Disposal Locations for Household, Commercial & Industrial Waste from County Dublin 2000



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(Source: Questionnaires completed by landfill operators)

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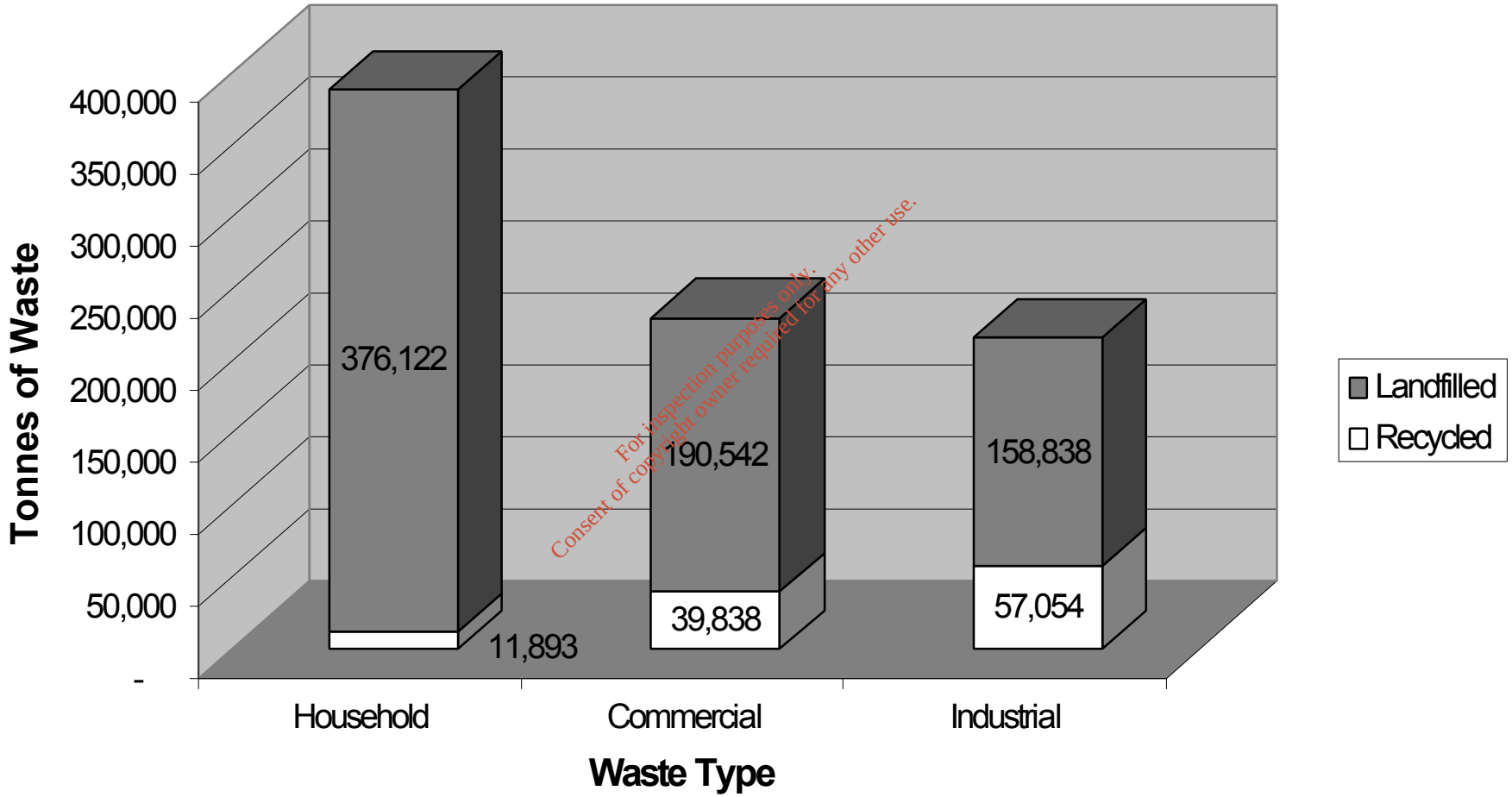
Fig 3.2 Management of Collected Waste in the Dublin Region 2000



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(Source: Questionnaires completed by waste collectors)

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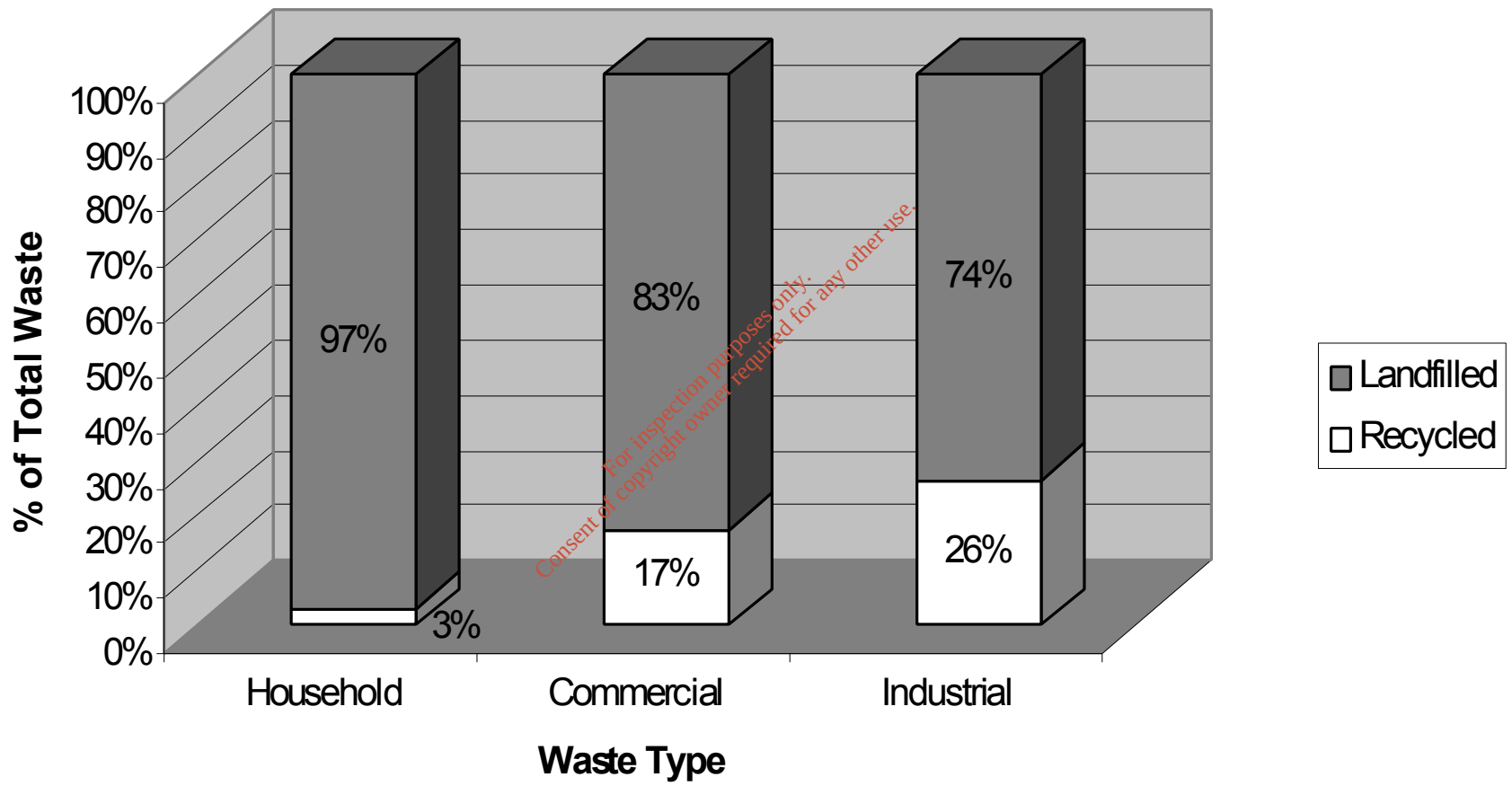
Fig 3.3 Percentage Waste Management in the Dublin Region, 2000



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(Source: Questionnaires completed by waste collectors)

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4 METHODOLOGY TO PREDICT WASTE REQUIRING THERMAL TREATMENT

In order to estimate a capacity for the proposed thermal treatment plant it is necessary to predict the amount of waste that will be available for thermal treatment in the future.

The results of the existing Dublin Waste Model require updating to:

- Take account of economic growth and changes in population
- Take account of changes in waste arisings between 1996 and 2000
- Take account of the effect of the provision of new waste management facilities.

MCOS and COWI devised a new 'Dublin Waste to Energy Calculation 2001' to take into consideration the factors above and with the specific objective of determining the quantity and type of waste available for thermal treatment in 2006, the expected year of opening the Waste to Energy Plant.

An important difference between the Dublin Waste Model and the Dublin Waste to Energy Calculation is the amount of garden waste included. The Dublin Waste Model includes all garden waste generated, whereas the calculation only includes garden waste collected with dual and ordinary collection i.e. garden waste collected at recycling centres. Home composting is not included.

4.1 DESIGN AND IMPLEMENTATION OF DUBLIN WASTE TO ENERGY CALCULATION

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The Dublin Waste to Energy Calculation 2001 was set up using Excel spread sheets. The initial sheets in the calculation are used to record information necessary to calculate the amount of waste available for thermal treatment. This information includes:

- Information derived from the questionnaires, i.e. waste amounts, type of waste (paper, plastic), source of waste (e.g. household, commercial), waste destinations.
- Household, commercial and industrial waste composition.
- Information to calculate waste producer growth, including population figures and commercial and industrial employment growth figures.
- Information to calculate waste growth per producer.
- Information about waste management facilities and their intake
- Information about current waste recycling levels

The remainder of the sheets in the Calculation contain formulae that use the information from the initial sheets to calculate the amount of waste for thermal treatment.

The calculation includes the following steps in order to make predictions on waste quantities available for thermal treatment in 2006 and beyond:

1. Calculate the amount of waste collected in 2000. This is calculated from information derived from the questionnaires and waste composition information.

2. Forecast how this waste will grow over the coming years.

3. Predict the levels of recycling which will be achieved over the coming years and calculate the predicted actual amount of waste which will be recycled.

4. Calculate the amount of waste which will be available for thermal treatment by removing these amounts recycled and the amounts of waste not suitable for thermal treatment from the total waste collected.

5. Calculate the calorific value of waste for thermal treatment.

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Two future waste management forecasts were developed which determine the levels of recycling that will be achieved in 2006. The first forecast is based on the levels of recycling that will be achieved if all of the measures adopted in the Dublin Waste Management Plan are implemented. The second forecast assumes that more conservative recycling rates are achieved based on the current level of implementation of the plan. These levels, although lower than those proposed in the plan, are high when compared to recycling rates in other cities.

4.2 COLLECTION OF NEW DATA

Information was collected to estimate the current waste quantities via questionnaires. Additional information was needed to predict future waste quantities including population and economic growth figures.

Questionnaires

MCOS/COWI devised and sent out questionnaires to 26 waste collectors in the Region and to 14 organisations operating landfills receiving waste from the Dublin Region. Organisations were asked to return information about waste quantities in 2000, specifically:

Collectors	Landfill Operators
• Total amount of waste collected	• Total amount of waste received
• Total amount collected from the Dublin Region	• Total amount received from the Dublin Region
• % recycled and % landfilled	• Amount of waste received from each source (e.g. households)
• Amount of waste collected from each source (e.g. households)	• Amount of and type of waste received from each collector
• Amount of each waste fraction collected (e.g. paper, plastic, organic)	
• Destination for disposal	

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Fourteen waste collector questionnaires and twelve landfill operator questionnaires were returned. Many of the questionnaires required follow up phone calls in order to gain further information. For example, where a questionnaire result showed that the sum of the material recycled and landfilled by a company did not compare with the amount of waste collected by that company, a telephone call was made in order to identify where the discrepancy lay.

Population and Economic Growth Figures

The surveys allowed estimation of the amount of waste generated in 2001. Prediction of the amount of waste generated in 2006 is required, the proposed year of opening of the plant. Two factors were considered which might cause an increase in the amount of waste being produced in these years, waste producer growth and economic growth. An increase in population for example would indicate that the number of waste producers in a region would increase and hence the amount of waste would increase. The rate of economic growth was used to indicate the amount that waste produced by individual waste producers may increase over time. Each of these factors have been applied to household, commercial and industrial waste. Table 4.1 below shows the waste producer growth rates which were used to estimate the waste quantities from 2001-2016.

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Table 4.1: Growth Rates of Waste Producers for Various Waste Types

Waste Type	2000-2005	2006-2010	2011 - 2015
Household	1.1%	1.1%	0.6%
Commercial	2.2%	2.2%	2.2%
Industrial	2.1%	1.6%	0.7%

Source: Analysis of the Economic, Employment and Social Profile of the Greater Dublin Region, ESRI
Population and Labour Force Projections, 2001-2031, CSO
Medium-Term Review 1999-2005, October 1999, ESRI

The Analysis of the Economic, Employment and Social Profile of the Greater Dublin Region Report (Tables 2.7 & 2.8) project average populations for County Dublin of 1,119,261 and 1,181,801 for 2001 and 2006 respectively. These figures forecast a population increase of 5.59% over five years, equivalent to 1.1% per annum. These growth rates are assumed to continue over the period 2006-2010 and to level off to approximately half of this level of growth (0.6%) over 2011-2015. These assumptions were made based on the trends of national population forecasts in the CSO Report, Population and Labour Force Projections, 2001-2031.

The ESRI report Medium Term Review 1999-2005, October 1999 (Table 5.10) forecasts growth rates for Industry and Commerce to the year 2015. The average of these commercial sector figures is calculated to be 2.2%. The industrial growth was assumed to be a reflection of the Total Employment for which forecasts of 2.1%, 1.6% & 0.7% have been calculated for the intervals 2000-2005, 2005-2010 & 2010-2015 respectively.

The growth in waste accounted for by economic growth was assumed to be similar to that assumed for the original Dublin Waste Model in 1998 (see Table 4.2 below).

Table 4.2: Waste Growth Rates for Various Waste Types

Waste Type	2000-2002	2003-2006	2007-2010	2011-2015
Household	2.0%	1.0%	0.5%	0%
Commercial	1.0%	0.5%	0.5%	0%
Industrial	1.5%	1.0%	0.5%	0%

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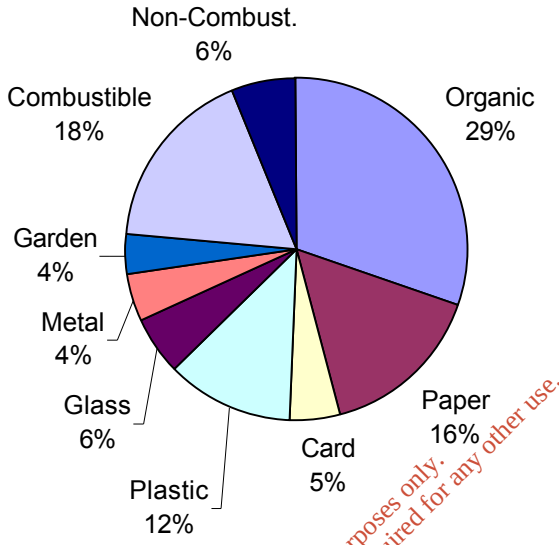
4.3 COMPOSITION OF WASTE

To quantify the amounts of household, commercial and industrial wastes available for thermal treatment in 2000 it is necessary to assess the composition of the different types of waste. The composition of the waste collected is shown below.

Fig 4.1 Household Waste Composition 2000



Source: Dublin Waste Model 1997 (based on ADEME (1995))

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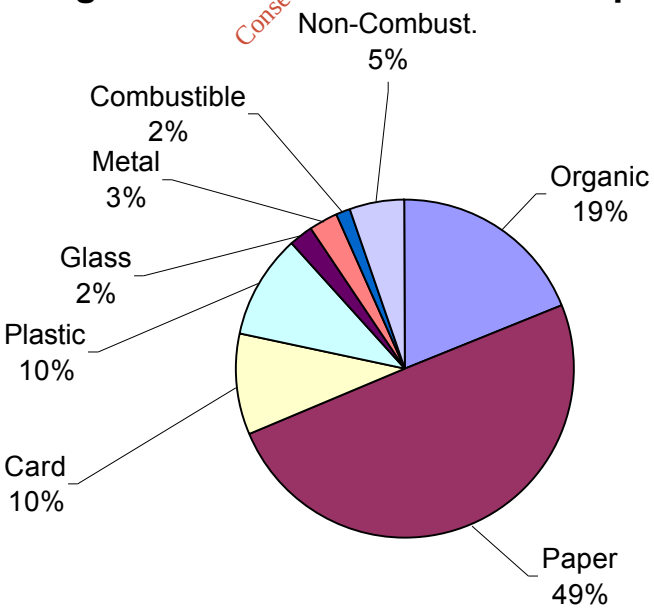
Fig 4.2 Commercial Waste Composition 2000



Source: Dublin Waste Model 1997

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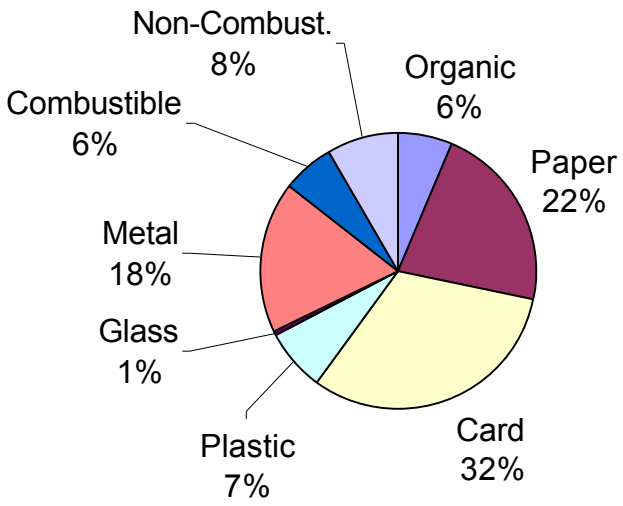
Fig 4.3 Industrial Waste Composition 2000



Source: Dublin Waste Model 1997

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4.4 WASTE QUANTITIES 2000-2016

The waste quantities predicted for 2001-2016 were calculated using waste growth rates and waste producer growth rates as described above and the current waste quantities in 2000 (see Table 4.3 below).

Table 4.3: Waste Quantities 2000-2016

	2000	2001	2002	2003	2004	2005	*2006*	2007	2008
Household	388,000	400,000	413,000	426,000	434,000	444,000	***453,000***	463,000	470,000
Commercial	230,000	238,000	245,000	253,000	260,000	267,000	***275,000***	282,000	290,000
Industrial	216,000	224,000	232,000	240,000	248,000	256,000	***263,000***	270,000	276,000
Litter	19,000	19,000	20,000	20,000	21,000	21,000	***22,000***	22,000	22,000
Total waste Collected	853,000	881,000	910,000	939,000	963,000	988,000	***1,013,000***	1,037,000	1,058,000

	2009	2010	2011	2012	2013	2014	2015	2016
Household	478,000	485,000	493,000	496,000	499,000	502,000	505,000	508,000
Commercial	297,000	306,000	314,000	321,000	328,000	335,000	342,000	350,000
Industrial	282,000	288,000	294,000	296,000	298,000	300,000	302,000	304,000
Litter	23,000	23,000	24,000	24,000	24,000	24,000	24,000	24,000
Total waste Collected	1,080,000	1,102,000	1,124,000	1,136,000	1,149,000	1,161,000	1,174,000	1,186,000

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The highlighted quantity above of 1,013,000 tonnes of waste is the predicted amount of waste that will be collected for recycling, thermal treatment and landfill in 2006, the year that the thermal treatment plant is planned to be taken into operation.

Household waste available for thermal treatment is collected in dual collection (residual fraction only), ordinary collection and non-recyclable waste fractions suitable for thermal treatment collected at recycling centres.

Commercial and industrial waste available for thermal treatment is a proportion of this waste collected via ordinary container collection that is suitable for thermal treatment. All recyclable materials collected separately, at source are assumed to be recycled.

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5 FORECASTING WASTE FOR THERMAL TREATMENT 2006

As described in Section 4.2, two alternatives were considered with regard to predicting the amount of waste that will require thermal treatment in 2006. Forecast 1 represents a scenario based on levels of recycling that will be achieved if all measures contained in the Waste Management Plan are implemented. Forecast 2 represents a scenario based on more conservative levels of recycling predicted if current levels of plan implementation continue. These alternatives, and the assumptions, upon which they are based, are described below.

5.1 FORECAST 1 MAXIMUM RECYCLING

5.1.1 Assumptions

The assumptions made for Forecast 1 are based on the levels of recycling that will be achieved if all the measures in the Dublin Waste Management Plan are implemented. The list below is a summary of the assumptions made for this forecast:-

- A home address collection system for recyclable materials will be in place, which will collect 27% of the waste generated by the households served (assuming a coverage level of 90% is reached).
- An intensive bring banks scheme will be implemented for households which cannot avail of the home address collection system. This scheme is assumed to achieve 4% of the overall household waste stream.
- A network of 10 recycling centres will be implemented which will accept 9% of all household wastes.
- A dual collection for organic and residual materials will operate which will cover 90% of households in the Dublin Region. Domestic waste from the remaining 10% of households will be collected via ordinary collection. It is assumed that dual collection will collect 47% of waste, of which 40% will be organic material sent to biological treatment.
- Ordinary collection will collect the remaining 13% of household waste.
- Recycling rates of 35% and 46% of commercial and industrial waste respectively are achieved.

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These assumptions, when applied to the waste stream lead to the following predicted recycling rates:

Table 5.1: Waste Management Targets 2006 – Forecast 1 Maximum Recycling

	Household	Commercial	Industrial
Recycled	55%*	35%	46%
Thermal treatment	44%	55%	21%
Landfilled	1%	10%	32%
Total	100%	100%	100%

* The household recycling rate is slightly lower here than is in the adopted Waste Management Plan (60% recycling). This is because the Dublin Model includes all garden waste generated, while the calculation undertaken for this report only includes garden waste that is collected via dual and ordinary collection (23%). It is assumed that the majority (77%) of garden waste generated is composted centrally or home composted.

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When broken down into the various waste fractions the percentages above yield the following:

Table 5.2: Waste Fractions for Recycling, Thermal Treatment and Landfill - Forecast 1

Household	Organic	Paper	Card	Plastic	Glass	Metal	Garden	Combust.	Non-combust.	Total
Recycled	62%	87%	89%	78%	93%	89%	0%*	0%	1%	55%
Thermal Treatment	38%	13%	11%	22%	6%	8%	100%*	100%	88%	44%
Landfill	0%	0%	0%	0%	1%	4%	0%	0%	10%	1%

* Assumption: All garden waste collected via dual and ordinary collection will be thermally treated. This represents 23% of the total garden waste generated, the rest of which is centrally composted and home composted.

Commercial	Organic	Paper	Card	Plastic	Glass	Metal	Combust.	Non-combust.	Total
Recycled	0%	47%	57%	3%	38%	76%	47%	47%	35%
Thermal Treatment	85%	45%	37%	83%	53%	21%	45%	45%	55%
Landfill	15%	8%	6%	15%	9%	4%	8%	8%	10%

Industrial	Organic	Paper	Card	Plastic	Glass	Metal	Combust.	Non-combust.	Total
Recycled	0%	40%	60%	3%	40%	79%	0%	50%	46%
Thermal Treatment	40%	24%	16%	39%	24%	8%	40%	20%	21%
Landfill	60%	36%	24%	58%	36%	13%	60%	30%	32%

Source: Dublin Waste Model, 1997

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5.1.2 Waste Requiring Thermal Treatment in 2006

When the recycling, thermal treatment and landfill rates are multiplied by the total amounts of material to be managed, the tonnage is shown in Table 5.3.

Table 5.3: Amounts Available for Waste for Thermal Treatment – Forecast 1

	Household	Commercial	Industrial	Total
Recycled	248,000	97,000	122,000	467,000
Thermal treatment*	***201,000***	***151,000***	***56,000***	***408,000***
Landfilled	4,000	27,000	85,000	116,000
Total Collected	453,000	275,000	263,000	991,000

*Litter collected (22,000 tonnes) is also sent to thermal treatment

Litter will be taken directly to the plant and hence can be added to the total amount of household, commercial and industrial wastes to be thermally treated. This means that if the recycling levels predicted for Forecast 1 and the Dublin Waste Management Plan are achieved, then approximately 430,000 tonnes of waste will available for thermal treatment in 2006.

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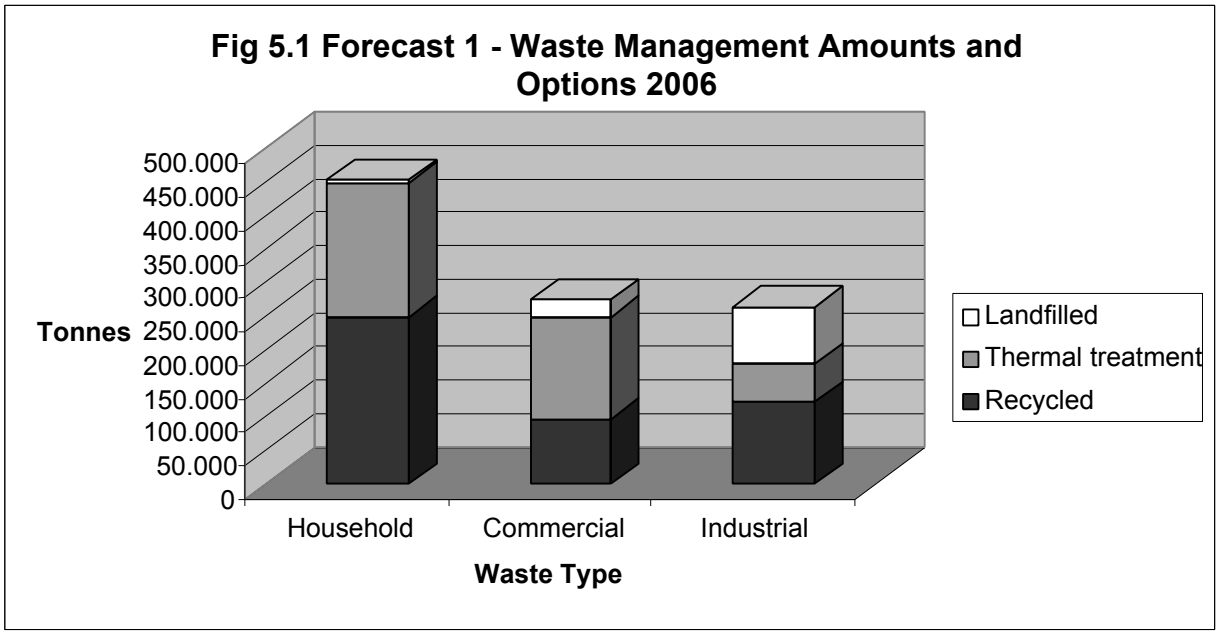

Taking the amount of waste available for thermal treatment in 2006, to the year 2016, using the growth rates discussed earlier and assuming that the same levels of recycling are maintained, then the wastes available for thermal treatment will increase as shown in Fig 5.2

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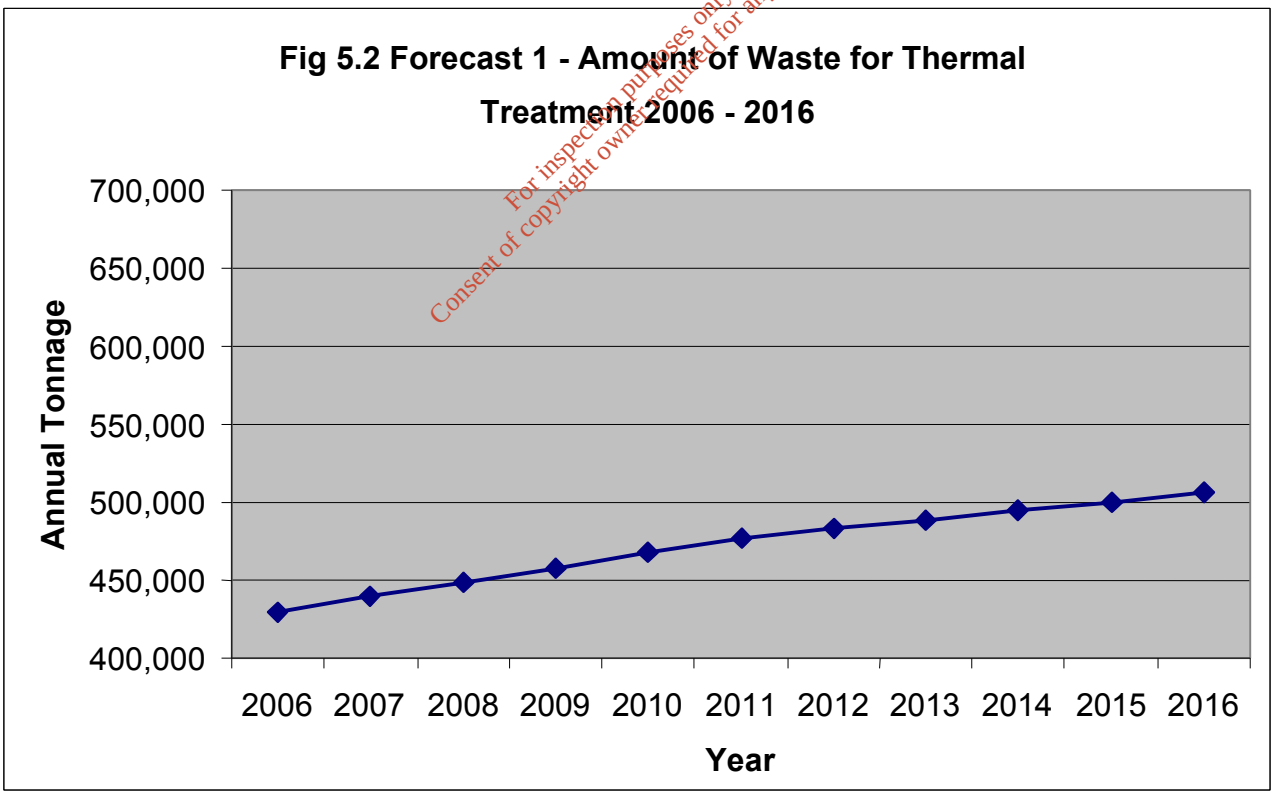

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5.2 FORECAST 2 HIGH RECYCLING

5.2.1 Assumptions

The assumptions made for Forecast 2 are based on a slower rate of implementation of the initiatives in the Dublin Waste Management Plan than is proposed in the Plan. In other words, more conservative recycling rates will be achieved than those outlined in the plan by 2006.

- Home address collection system– instead of achieving 90% coverage, just 250,000 of the 392,157 households in Dublin will receive this service. 19% of the waste generated by these households will be collected by this system.
- Bring Banks – instead of achieving a 4% collection rate for all household waste, just 2% is achieved.
- Recycling centres – It is assumed that four such centres are introduced, which collect 6% of the overall household waste stream.
- Dual collection system– instead of achieving 90% coverage, 45% coverage is achieved and 23% of the waste is collected in this system.
- Ordinary Collection – The households that are not served by dual collection are served by ordinary collection, which accounts for the remaining 50% of household waste.
- Recycling rates of 28% and 34% are achieved for commercial and industrial wastes respectively.

These assumptions, when applied to the waste stream lead us to the conclusion that the following recycling rates will be achieved:

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Table 5.4: Waste Management Targets 2006 – Forecast 2 High Recycling

	Household	Commercial	Industrial
Recycled	34%	28%	34%
Thermal treatment	66%	63%	30%
Landfilled	1%	10%	37%

When broken down further these rates yield the following recycling rates for individual materials.

Table 5.5: Waste Fractions for Recycling, Thermal Treatment and Landfill – Forecast 2

Household	Organic	Paper	Card	Plastic	Glass	Metal	Garden	Combust.	Non-combust.	*Total*
Recycled	30%	59%	60%	54%	62%	58%	0%	0%	1%	34%
Thermal Treatment	70%	41%	40%	46%	38%	40%	100%	100%	92%	66%
Waste to Landfill	0%	0%	0%	0%	1%	2%	0%	0%	7%	1%

* Assumption: All garden waste collected via dual and ordinary collection will be thermally treated. This represents 23% of the total garden waste generated, the rest of which is centrally composted and home composted.

Commercial	Organic	Paper	Card	Plastic	Glass	Metal	Combust.	Non-combust.	*Total*
Recycled	0%	37%	45%	2%	30%	60%	37%	37%	28%
Thermal Treatment	85%	55%	49%	83%	61%	36%	55%	55%	63%
Waste to Landfill	15%	8%	6%	15%	9%	4%	8%	8%	10%

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Industrial	Organic	Paper	Card	Plastic	Glass	Metal	Combust.	Non-combust.	*Total*
Recycled	0%	29%	43%	2%	29%	57%	0%	36%	34%
Thermal Treatment	40%	35%	33%	40%	35%	10%	40%	24%	30%
Waste to Landfill	60%	36%	24%	58%	36%	33%	60%	40%	37%

5.2.2 Waste Available for Thermal Treatment in 2006

With the recycling levels predicted for Forecast 2, approximately 572,000 tonnes of waste will require thermal treatment in 2006 (including litter).

Table 5.6: Amounts of Waste for Thermal Treatment – Forecast 2

	Household	Commercial	Industrial	TOTAL
Recycled	152,000	75,000	88,000	316,000
Thermal treatment*	***298,000***	***172,000***	***79,000***	***550,000***
Landfilled	3,000	27,000	96,000	126,000
Total Collected	453,000	275,000	263,000	991,000

* Litter collected (22,000 tonnes) is also sent to thermal treatment

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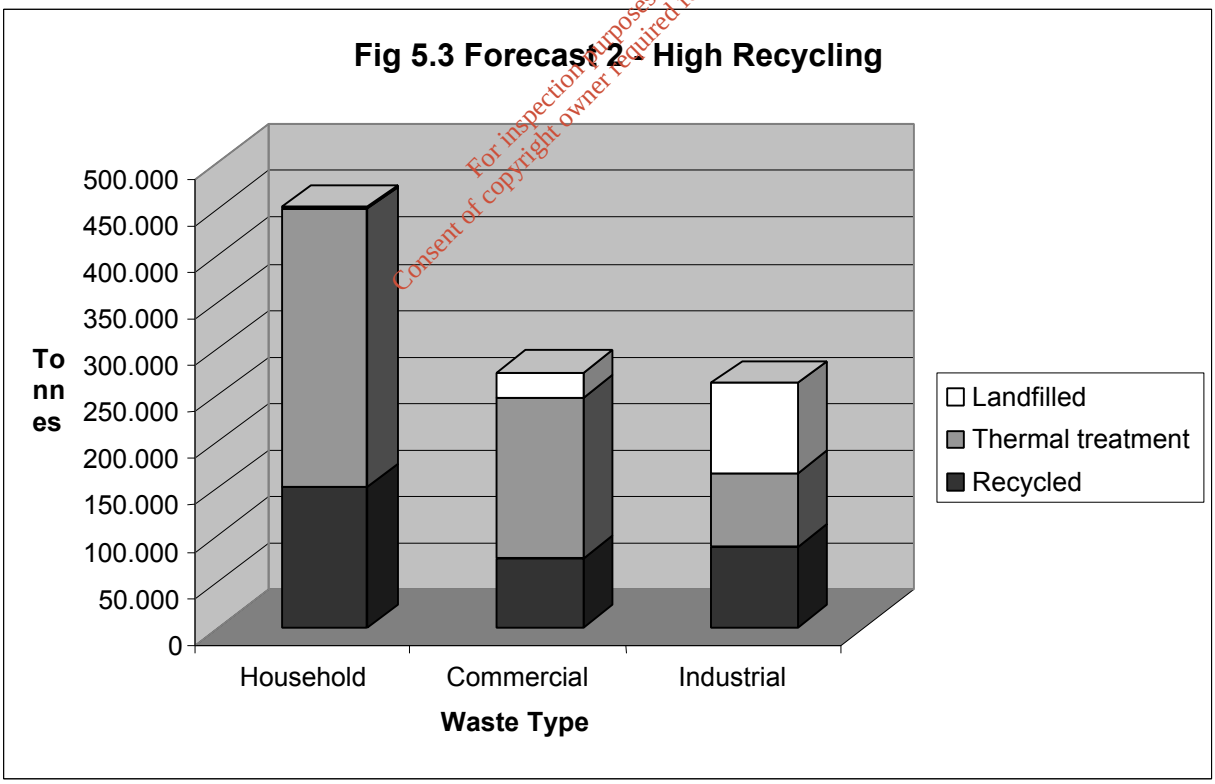

If we project the amount of waste requiring thermal treatment in 2006, 572,000 tonnes, to the year 2016, using the growth rates discussed earlier and assuming that the same levels of recycling are maintained, then the wastes requiring thermal treatment will increase as shown in Fig 5.4.

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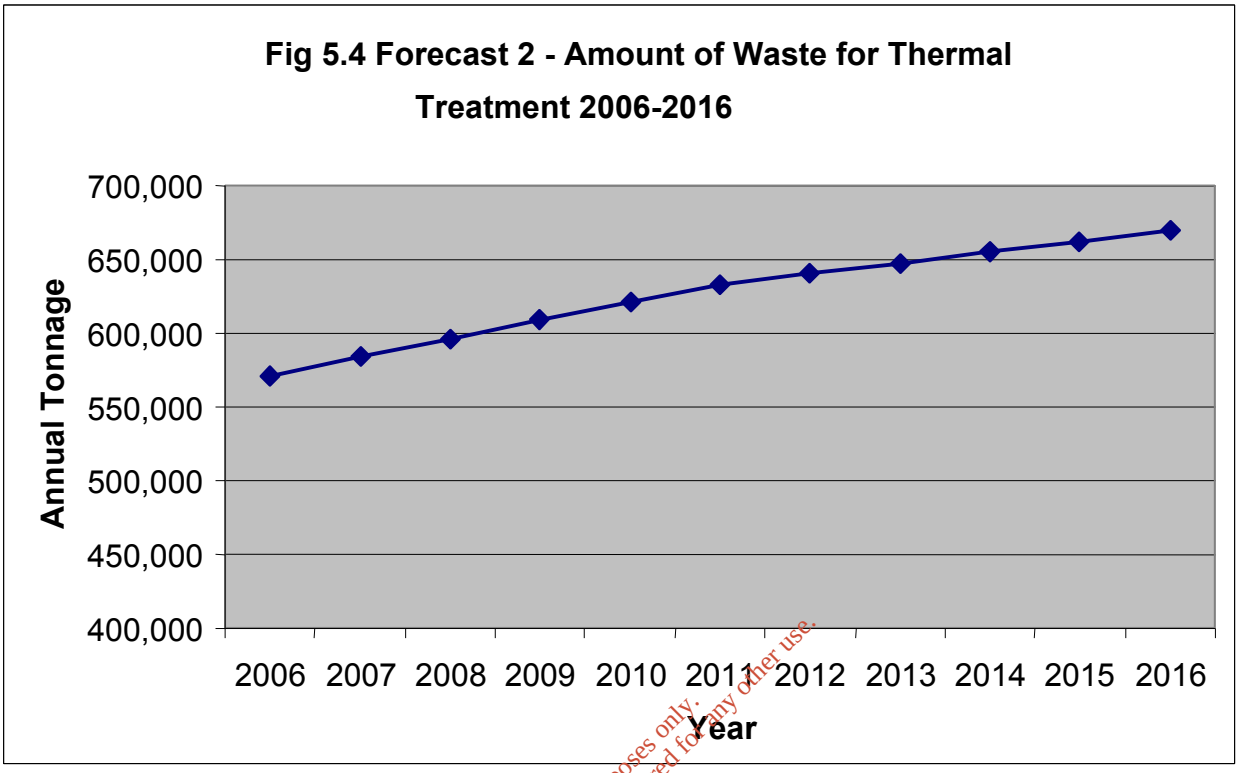

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5.3 CALORIFIC VALUE

In order to design a thermal treatment plant, the net calorific value of the waste material to be treated must be estimated. The net calorific value is calculated by taking the calorific value of each material in the waste e.g. paper, plastic, glass, cardboard and calculating a weighted average based on the relative amounts of the materials in the waste i.e. waste composition. Table 5.7 shows the values used for the different waste fractions.

Table 5.7: Net Calorific Values of Waste Fractions

	Organic	Garden	Paper	Card	Plastic	Glass	Metal	Combust.	Non-combust.
LHV	3.8	14.4	15.5	15.5	32.8	0	0	12	0

Source: Volund in Denmark, University of Technology in Vienna & Christiansen (1998) & Kjell Jenslev (COWI).

Waste to Energy Plants are designed to deal with a range of heat values. An increase in the calorific value of waste reduces the capacity of the plant i.e. fewer tonnes can be treated per hour.

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5.3.1 Forecast 1

The waste entering the proposed thermal treatment plant will have the following composition if the provisions of Forecast 1 are met.

Table 5.8: Composition of Waste for Thermal Treatment – Forecast 1

Composition	Organic	Paper	Card	Plastic	Glass	Metal	Garden	Combust.	Non-combust.
Household	23%	4%	1%	5%	1%	1%	8%	46%	11%
Commercial	29%	41%	6%	15%	2%	1%	0%	1%	4%
Industrial	12%	25%	24%	13%	1%	7%	0%	12%	8%
Total	24%	20%	6%	10%	1%	2%	4%	26%	8%

Litter is included as combustible household waste.

Comparing this composition to the individual calorific values of the different waste fractions yields the following overall calorific values for household, commercial and industrial waste.

Table 5.9: Calorific Values of Waste Types – Forecast 1

	Calorific Value
Household	10.1
Commercial	13.4
Industrial	13.6
Total	11.7

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5.3.2 Forecast 2

The waste entering the proposed thermal treatment plant will have the following composition if the provisions of Forecast 2 are met.

Table 5.10: Composition of Waste for Thermal Treatment – Forecast 2

Composition	Organic	Paper	Card	Plastic	Glass	Metal	Garden	Combust.	Non-combust.
Household	30%	9%	3%	8%	3%	2%	5%	32%	8%
Commercial	26%	44%	8%	13%	2%	2%	0%	1%	5%
Industrial	9%	26%	34%	10%	1%	6%	0%	8%	7%
Total	26%	22%	9%	10%	2%	3%	3%	19%	7%

Litter is included as combustible household waste.

Comparing this composition to the individual calorific values of the different waste fractions yields the following overall calorific values for household, commercial and industrial waste.

Table 5.11: Calorific Values of Waste Types – Forecast 2

	Calorific Value
Household	10.1
Commercial	13.4
Industrial	13.8
Total	11.6

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5.4 SENSITIVITY ANALYSIS

A sensitivity analysis was carried out to assess the implications of varying the recycling rates and waste quantities on the amount and net calorific value of waste available for thermal treatment. Forecasts 1 and 2 allowed different waste collection systems and recycling rates to be considered, which influences the waste composition and calorific value of waste available for thermal treatment (see Table 5.12). Projecting waste quantities beyond 2006 predicted an increase in the quantity of waste available for thermal treatment.

The influence of the waste types available for thermal treatment were also considered. In the event that the local authorities in the Dublin Region are legally entitled to assign only household and commercial waste and not industrial waste to thermal treatment, the amount and calorific value of waste sent to the plant will vary as shown in Table 5.12.

Table 5.12: Net Calorific Values and Waste Quantities in 2006 - Forecasts 1 and 2

	Forecast 1		Forecast 2	
	GJ/tonne	Tonnes	GJ/tonne	Tonnes
Household	10.1	222,000	10.1	320,000
Commercial	13.4	151,000	13.4	172,000
Household + Commercial	***11.5***	***373,000***	***11.3***	***492,000***
Industrial	13.6	56,000	13.8	79,000
Total	11.7	429,000	11.6	571,000

Litter (22,000 tonnes) is included together with household waste

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Two variations of Forecast 2 were considered to determine the influence of the organic and plastic fractions of household waste. The first variation was a scenario without the collection of the organic fraction for biological treatment (dual collection). The introduction of dual collection removes a large amount of the organic fraction from the household waste stream requiring thermal treatment and hence increases the calorific value. The results are shown in Table 5.13 below.

Table 5.13: Net Calorific Values and Waste Quantities – Forecast 2 Sensitivity Analysis

	Forecast 2		Forecast 2 - No Dual Collection	
	GJ/tonne	Tonnes	GJ/tonne	Tonnes
Household	10.1	320,000	9.4	362,000
Commercial	13.4	172,000	13.4	172,000
Household + Commercial	***11.3***	***492,000***	***10.7***	***533,000***
Industrial	13.8	79,000	13.8	79,000
Total	11.6	571,000	11.1	612,000

Litter (22,000 tonnes) is included together with household waste

The second variation of Forecast 2 involved changing the recycling rate of household plastic, a waste fraction with a particularly high calorific value. Changing the recycling rate for plastic in Forecast 2 by ± 50% caused the net calorific value of household waste to vary from 9.2 to 11.0 GJ/tonne.

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6 CONCLUSIONS

The amount of waste available for thermal treatment and the net calorific value of this waste depends on the recycling initiatives that are in place by 2006, the expected year of opening of the thermal treatment plant. The amount of waste available and the net calorific value is also influenced by the type of waste (household, commercial and industrial) that the Dublin local authorities can assign to thermal treatment.

The main results of this report are as follows:

- There are currently 834,000 tonnes of municipal and industrial waste collected in the Dublin Region of which 109,000 tonnes are recycled and 726,000 tonnes are disposed of to landfill. A further 19,000 tonnes of litter are landfilled.

- Despite the high recycling targets in the Dublin Waste Management Plan, approximately 430,000 tonnes of household, commercial and industrial waste would be suitable for energy recovery by thermal treatment in 2006 (Forecast 1).

- If the maximum recycling targets set in the Dublin Waste Management Plan are not met, but high levels of recycling are still achieved, almost 572,000 tonnes of household, commercial and industrial waste would be suitable for thermal treatment in 2006 (Forecast 2).

- The net calorific value of the waste to be thermally treated is of the order of 9-14 GJ/tonne.

It is therefore recommended that Dublin Corporation procure a plant capable of treating at least 400,000 tonnes of waste per year commencing in 2006.

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APPENDIX A

Note on Calorific Value of Waste

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NOTE ON CALORIFIC VALUE OF WASTE

The net calorific value of waste (also know as the lower heat value) to be sent to thermal treatment needs to be estimated to design the plant.

However, even small variations in the composition of waste to be treated can affect the net calorific value, so it is important to design the plant to treat waste in a satisfactory way within a relatively broad range of values.

DEFINITION

The calorific value is defined as the heat energy evolved by the combustion of waste, and is given in MJ/kg waste or GJ/tonne. In practice two types of calorific value may be determined: *gross calorific value and net calorific value.* The gross calorific value, or higher heat value, is the heat evolved when all the products of combustion are cooled to atmospheric temperature and pressure. The gross calorific value therefore includes the latent heat of vaporisation and the sensible heat of the water in the combustion products. The net calorific value, or lower heat value (LHV), is the heat evolved when the products of combustion are cooled so that the water remains as a gas. It is therefore equal to the gross calorific value less the sensible heat and latent heat of vaporisation of water. The magnitude of this deduction is 2.45 MJ/kg water condensed.

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PHYSICAL AND CHEMICAL COMPOSITION

The net calorific value of waste can be determined based on an estimate of the quantities and composition of waste sent to thermal treatment.

Waste available for thermal treatment is primarily generated by households, and commercial activities, although some industrial (non-hazardous) waste may also be treated at the plant. The quantities available in the Dublin Region in 2006 were estimated assuming two different forecasts with varying percentages of waste sent to recycling, thermal treatment and landfill.

From an estimate of the composition of waste, the calorific value of each fraction can be used to estimate the overall calorific value of the waste sent to thermal treatment. The calorific values of waste fractions were calculated based on data from Vølund in Denmark, the University of Technology in Vienna, Christensen (1998)[1], and Kjell Jenslev (COWI). The Schwanecke formula was used, together with estimates of the chemical composition of dry material (%C, %N, %S etc.) and the amount of water and ash in each waste fraction.

The table below shows the calorific values estimated for the different waste fractions in the Dublin Region in 2001-2016.

	Organic	Paper	Card	Plastic	Glass	Metal	Garden	Combust.	Non combust.
LHV (MJ/kg)	3.8	15.5	15.5	32.8	0	0	14.4	12	0

CALORIFIC VALUE OF WASTE IN THE DUBLIN REGION

Two forecasts were considered to estimate the net calorific value of waste available for thermal treatment in 2006 in the Dublin Region. Forecast 1 assumes that all the recycling initiatives in the Dublin Waste Management Plan are implemented by 2006 as planned, i.e. maximum realistic recycling. Forecast 2 assumes that the recycling initiatives are implemented at a slower rate than planned. The resulting calorific values are shown in the table below (see spreadsheet and assumptions document for further information).

[1] Table 2.1.9 in: Christensen, T.H (ed.) (1998) "Affaldsteknologi", Teknisk Forlag A/S, Copenhagen.

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Net calorific values for waste from Dublin Region in 2006	Forecast 1 (MJ/kg)	Forecast 2 (MJ/kg)
Household	10.1	10.1
Commercial	13.4	13.4
Industrial	13.6	13.8
Total	11.7	11.6
(Household + Commercial)	(11.5)	(11.3)

PRACTICAL EXPERIENCE IN DENMARK

In Denmark, the net calorific value of waste sent to incineration has been steadily increasing over the last decade and future lower heat values will be assumed to be approx. 12 MJ/kg.

Amagerforbrænding

Amagerforbrænding manages waste from approx. 500,000 inhabitants in Copenhagen and some of the surrounding municipalities. In addition, waste is managed from about 36,000 enterprises, shops and institutions. The combustible waste that is collected is incinerated and used to generate electricity and provides central heating for 100,000 households.

The increase in net calorific value over the past 5 years is shown in the table below. In 2000, 2.16 MWh electricity and heat was recovered for each tonne of combustible waste incinerated. The mean calorific value of 1 kg waste was approx. 10.5 MJ (2,500 kcal)[2].

Vestforbrænding

Vestforbrænding, in the Greater Copenhagen area, has 5 oven lines with a total capacity of 500,000 tonnes/year. Line 5, which was commissioned in 1999, is a one of the most modern in Scandinavia. It was designed for waste with a net calorific value of 2,850 kcal/kg (12 MJ/kg) and has a capacity of 210,000 tonnes/year.

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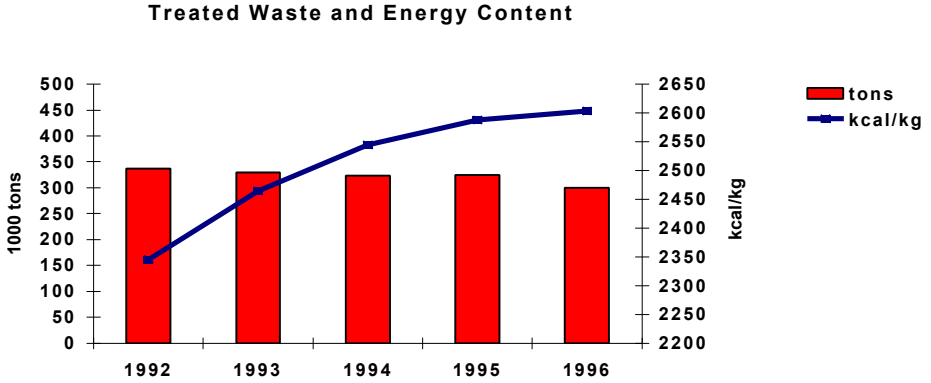
Lines 1 to 4 were built in the 1970s and were designed for waste with a calorific value of 2,200 kcal/kg (9.2 MJ/kg). However, the calorific value has increased up to 2,600 kcal/kg in 1997 (10.9 MJ/kg), mainly as a result of the higher amount of plastic in waste, increased recycling rates for the organic fraction, and higher recycling rates for non-combustible fractions. The increased calorific value has reduced the plant's overall capacity from 360,000 tonnes/year to 300,000 tonnes/year. Line 4 was rebuilt in 1997[3] and lines 1 to 3 will be rebuilt in the next few years.

The graph below illustrates the increase in calorific value of waste incinerated at Vestforbrænding.



[2] 1 kcal = 4.19 J ($J=m^2kg/s^2$)

[3] Rebuilding line 4 to account for the increase in the calorific value of waste has also optimised operating conditions and lowered emissions to air, particularly CO emissions.

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APPENDIX B

Note on Assumptions in the Dublin Waste Calculation 2001

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NOTE ON EXPLANATION OF ASSUMPTIONS IN THE DUBLIN WASTE CALCULATION 2001, FORECASTS 1 AND 2, AND IN THE DUBLIN WASTE MODEL (1997)

Dublin Region = Dublin Corporation (DC), Fingal County (FC), South Dublin County (SD) and Dun Laoghaire-Rathdown County (DL)

Household waste = domestic + garden + bulky

ASSUMPTIONS IN FORECAST 1

HOUSEHOLD WASTE

The Waste Management System in 2006

Assuming all the initiatives in the Dublin WM Plan are implemented (maximum realistic recycling), the following collection methods will be in place:

- Home address collection[1] (90% coverage)
- Bring banks scheme (10% coverage)
- Dual collection (90% coverage)
- Ordinary collection (10% coverage)
- Recycling centres (100% coverage).

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Household waste that is sent to thermal treatment is collected via dual collection (residual fraction to thermal treatment), ordinary collection and recycling centres. In addition, it is assumed that litter is sent to thermal treatment.

In contrast to the Dublin Waste Model (1997), upon which the Dublin Waste Management Plan is based, only garden waste that is collected together with residual waste in dual collection and ordinary collection is considered here, i.e. garden waste collected at recycling centres and home composted is not included.

Composition of Household Waste Collected

The household waste composition used in the Dublin Waste Calculation to estimate quantities of household waste by fraction is shown below, and includes all domestic and bulky waste and 23% of the total garden waste, which is collected together with the domestic waste (in dual and ordinary collection).

	Organic	Paper	Card	Plastics	Glass	Metal	Garden waste	Combustible	Non combust	Total
TOTAL	30%	16%	5%	12%	6%	4%	4%	18%	6%	100%

The quantity and composition of household waste collected is not quite the same as for household waste generated; garden waste that is collected at recycling centres and home composted is not considered.

[1] home address collection (or kerbside collection of recyclables) in all four counties is supplemented by bring banks in areas that cannot be served by home address collection.

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Home Address Collection

Most households (approx. 90%) in the Dublin Region are covered by home address collection of recyclables.

27% of all household waste is collected via this scheme and is all sent to a sorting facility.

The collection efficiencies that are assumed for the materials (domestic waste) collected are:

	Paper	Card	Plastics	Glass	Metal
DC	60%	60%	60%	60%	60%
FIN	79%	79%	79%	79%	79%
DL	79%	79%	79%	79%	79%
SD	73%	73%	73%	73%	73%

Bring Banks Scheme

The Bring Banks Scheme covers households in the Dublin Region that cannot be served by home address collection of recyclables.

4% of all household waste is collected via this scheme and is all sent to a sorting facility.

The collection efficiencies that are assumed for the materials (domestic waste) collected are:

	Paper	Card	Plastics	Glass	Metal
DC	60%	60%	60%	60%	60%
FIN	70%	70%	70%	70%	70%
DL	70%	70%	70%	70%	70%
SD	70%	70%	70%	70%	70%

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Dual and Ordinary Collection

Domestic waste is collected from all households in the Dublin Region by either dual collection (90% of all households) or ordinary collection (10% of all households).

60% of all household waste is collected via these schemes, including 47% via dual collection and 13% via ordinary collection.

All waste collected via ordinary collection is sent to thermal treatment. The percent of each household waste fraction collected via ordinary collection and sent to thermal treatment is:

Organic	Paper	Card	Plastics	Glass	Metal	Combustible	Non combust.
18%	3%	2%	3%	3%	2%	9%	9%

40% of waste collected via dual collection is organic material that is sent to biological treatment (not included in the tables). The remaining 60% of waste is residual waste sent to thermal treatment. The percent of each household waste fraction collected with the residual fraction is:

Organic	Paper	Card	Plastics	Glass	Metal	Combustible	Non combust.
20%	8%	6%	13%	2%	2%	81%	80%

In addition to the fractions in the tables above, garden waste is collected via dual (residual fraction) and ordinary collection. It is assumed 23% of all garden waste generated is collected in this way (70% is composted at the central composting plant and 7% is home composted, see below), which is equivalent to 9% of all the waste collected via dual (residual fraction) and ordinary collection.

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Recycling Centres

All households in the Dublin Region have access to a recycling centre.

9% of all household waste is collected via recycling centres, including all bulky waste, 19% of all domestic waste (only recyclable fractions).

All garden waste collected via recycling centres, which is sent to a central composting plant, is NOT included.

Domestic and bulky waste collected at recycling centres is recycled (35%); the rest is sent to thermal treatment (56%) and landfill (9%). The percent of each fraction of domestic and bulky waste collected at recycling centres that is recycled, incinerated and landfilled is:

	Organic	Paper	Card	Plastics	Glass	Metal	Combust	Non combust.
Recycled	0%	80%	90%	15%	90%	80%	0%	10%
Incinerated	0%	20%	10%	85%	5%	10%	100%	0%
Landfilled	0%	0%	0%	0%	5%	10%	0%	90%

Home Composting

Some households in the Dublin Region practice home composting of garden waste. Home composting of garden waste is NOT included.

Household Waste - SUMMARY FOR FORECAST 1

The following table shows the percent of household waste collected (excl. garden waste collected at recycling centres and home composted).

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Collection Method	Organic	Paper	Card	Plastics	Glass	Metal	Garden	Combust	Non Combust	TOTAL
Home Address Collection	0%	66%	56%	67%	68%	52%	0%	0%	0%	27%
Bring Banks	0%	9%	8%	10%	10%	7%	0%	0%	0%	4%
Dual + Ordinary Collection	100%	11%	8%	16%	5%	4%	100%	90%	89%	60%
Recycling Centres	0%	14%	28%	7%	17%	37%	0%	10%	12%	9%
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

The following table shows how household waste fractions are treated (garden waste that is collected at recycling centres and home composted is not included):

	Organic	Paper	Card	Plastics	Glass	Metal	Garden	Combust	Non combust	Total
Recycled	62%	87%	89%	78%	93%	89%	0%	0%	1%	55%
Incinerated	38%	13%	11%	22%	6%	8%	100%	100%	88%	44%
Landfilled	0%	0%	0%	0%	1%	4%	0%	0%	10%	1%

COMMERCIAL WASTE

According to Dublin WM Plan, commercial waste will be collected in the following two ways in 2006:

- Ordinary container collection - 65% of commercial waste will be collected via ordinary container collection. This waste will be sent to thermal treatment (85%) and landfill (15%).

- Source separation - 35% of all commercial waste is collected separately and recycled.

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The following table shows how commercial waste fractions are treated:

	Organic	Paper	Card	Plastics	Glass	Metal	Combust	Non combust	Total
Recycled	0%	47%	57%	3%	38%	76%	47%	47%	35%
Incinerated	85%	45%	37%	83%	53%	21%	45%	45%	55%
Landfilled	15%	8%	6%	15%	9%	4%	8%	8%	10%

The composition of all commercial waste collected is:

Organic	Paper	Card	Plastics	Glass	Metal	Combust	Non combust
19%	50%	10%	10%	2%	3%	2%	5%

INDUSTRIAL WASTE

According to the Dublin WM Plan, industrial waste will be collected in the following two ways in 2006:

- Ordinary container collection - 54% of industrial waste will be collected via ordinary container collection. This waste will be sent to thermal treatment (40%) and landfill (60%).
- Source separation - 46% of all industrial waste is collected separately and recycled.

The following table shows how industrial waste fractions are treated:

	Organic	Paper	Card	Plastics	Glass	Metal	Combust	Non combust	Total
Recycled	0%	40%	60%	3%	40%	79%	0%	50%	46%
Incinerated	40%	24%	16%	39%	24%	8%	40%	20%	21%
Landfilled	60%	36%	24%	58%	36%	13%	60%	30%	32%

The composition of all industrial waste collected is:

Organic	Paper	Card	Plastics	Glass	Metal	Combust	Non combust
6%	22%	32%	7%	1%	18%	6%	8%

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WASTE TO THERMAL TREATMENT

From all of the information above, the composition of household, commercial and industrial waste available for thermal treatment in 2006 is estimated as shown in the table below.

	Organic	Paper	Card	Plastics	Glass	Metal	Garden	Combust	Non combust.
Household	23%	4%	1%	5%	1%	1%	8%	46%	11%
Commercial	29%	41%	6%	15%	2%	1%	0%	1%	4%
Industrial	12%	25%	24%	13%	1%	7%	0%	12%	8%
Total	24%	19%	6%	10%	1%	2%	4%	26%	8%

The resulting calorific value of this waste is:

	LHV (MJ/kg)	Tonnes
Household	10.1	222,000
Commercial	13.4	151,000
Industrial	13.6	56,000
Total	11.7	429,000

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ASSUMPTIONS IN FORECAST 2

HOUSEHOLD WASTE

The Waste Management System in 2006

The assumptions made for Forecast 2 are based on a slower rate of implementation of the initiatives in the Dublin Waste Management Plan. In other words, more conservative recycling rates are achieved by 2006 than those outlined in the plan and Forecast 1. The following collection methods are assumed to be in place in Forecast 2:

- Home address collection (64% coverage)
- Bring banks scheme (50% reduction in waste quantity collected compared to Forecast 1)
- Dual collection (45% coverage)
- Ordinary collection (55% coverage)
- Recycling centres (4 stations exist by 2006 as opposed to the 10 planned in Forecast 1).

The table below summarises the main differences between Forecasts 1 and 2, in terms of the household waste collected via each collection method.

Collection Method	Forecast 1	Forecast 2
Home address	27 %	19 %
Bring banks	4 %	2 %
Dual collection	47 %	23 %
Ordinary collection	13 %	50 %
Recycling centres	9 %	6 %

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Composition of Household Waste

The composition of household waste is assumed to be the same as described in Forecast 1.

Home Address Collection

It is assumed that instead of achieving 90% coverage, just 250,000 of the 392,157 households in Dublin will receive this service i.e. 64% of households will be served by this system.

19% of all household waste is collected via this scheme and is all sent to a sorting facility.

The collection efficiencies that are assumed for the materials (recyclable domestic waste) collected are the same as in Forecast 1.

Bring Banks Scheme

Instead of assuming a 4% collection rate for all household waste via bring banks, as in Forecast 1, just

2% of all household waste is collected via this scheme. (Approximately 6,800 tonnes were collected via bring banks in 2000, and it is estimated that a realistic level of collection for 2006 might be 10,000 tonnes i.e. 2% of all household waste).

The collection efficiencies that are assumed for the materials (domestic waste) collected are the same as in Forecast 1.

Dual and Ordinary Collection

Domestic waste is collected from all households in the Dublin Region by either dual or ordinary collection. 73% of all household waste is collected via these schemes.

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Instead of achieving 90% coverage, 45% coverage is achieved for dual collection and 23% of all household waste is collected in this way. As in Forecast 1, 40% of waste collected via dual collection is organic material that is sent to biological treatment. The remaining 60% is residual waste sent to thermal treatment.

The households that are not served by dual collection are served by ordinary collection, which accounts for 50% of all household waste. All waste collected via ordinary collection is sent to thermal treatment.

It is assumed that 23% of all garden waste generated is collected via dual and ordinary collection and is sent to thermal treatment (as in Forecast 1).

Recycling Centres

It is assumed that four recycling centres are introduced, as opposed to the 10 planned in Forecast 1. 6% of all household waste is collected via recycling centres, including all bulky waste, and some domestic waste (only recyclable fractions).

70% of all garden waste is also collected via recycling centres and sent to a central composting plant. This garden waste is NOT included.

Domestic and bulky waste collected at recycling centres is recycled (35%); the rest is sent to thermal treatment (56%) and landfill (9%). The percent of each fraction of domestic and bulky waste collected at recycling centres that is recycled, incinerated and landfilled is assumed to be the same as in Forecast 1.

Home Composting

Some households in the Dublin Region practice home composting of garden waste. Home composting of garden waste is NOT included.

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Household Waste - SUMMARY FOR FORECAST 2

The following table shows the percent of household waste collected via each collection method:

Collection Method	Organic	Paper	Card	Plastics	Glass	Metal	Garden	Combust	Non combust	TOTAL
Home Address Collection	0%	47%	40%	48%	47%	35%	0%	0%	0%	19%
Bring Banks	0%	5%	4%	5%	5%	4%	0%	0%	0%	2%
Dual + Ordinary Collection	100%	40%	39%	42%	37%	37%	100%	94%	92%	73%
Recycling Centres	0%	9%	18%	5%	11%	24%	0%	6%	8%	6%

The following table shows how household waste fractions are treated (garden waste that is collected at recycling centres and home composted is not included):

	Organic	Paper	Card	Plastics	Glass	Metal	Garden	Combust	Non combust	TOTAL
Recycled	30%	59%	60%	54%	62%	58%	0%	0%	1%	34%
Incinerated	70%	41%	40%	46%	38%	40%	100%	100%	92%	66%
Landfilled	0%	0%	0%	0%	1%	2%	0%	0%	7%	1%

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COMMERCIAL WASTE

Lower recycling rates are achieved for commercial waste compared to Forecast 1.

Commercial waste will be collected in the following two ways in 2006:

- Ordinary container collection - 74% of commercial waste will be collected via ordinary container collection. This waste will be sent to thermal treatment (85%) and landfill (15%).
- Source separation - 26% of all commercial waste is collected separately and recycled.

The following table shows how commercial waste fractions are treated:

	Organic	Paper	Card	Plastics	Glass	Metal	Combust	Non combust	TOTAL
Recycled	0%	37%	45%	2%	30%	60%	37%	37%	28%
Incinerated	85%	55%	49%	83%	61%	36%	55%	55%	63%
Landfilled	15%	8%	6%	15%	9%	4%	8%	8%	10%

The composition of all commercial waste collected is assumed to be the same as for Forecast 1.

INDUSTRIAL WASTE

Lower recycling rates are achieved for industrial waste compared to Forecast 1. Industrial waste will be collected in the following two ways in 2006:

- Ordinary container collection - 75% of industrial waste will be collected via ordinary container collection. This waste will be sent to thermal treatment (40%) and landfill (60%).
- Source separation - 25% of all industrial waste is collected separately and recycled.

The following table shows how industrial waste fractions are treated:

	Organic	Paper	Card	Plastics	Glass	Metal	Combust	Non combust	TOTAL
Recycled	0%	29%	43%	2%	29%	57%	0%	36%	34%
Incinerated	40%	35%	33%	40%	35%	10%	40%	24%	30%
Landfilled	60%	36%	24%	58%	36%	33%	60%	40%	37%

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The composition of all industrial waste collected is assumed to be the same as for Forecast 1.

WASTE TO THERMAL TREATMENT

From all of the information above, the composition of household, commercial and industrial waste available for thermal treatment in 2006 is:

	Organic	Paper	Card	Plastics	Glass	Metal	Garden	Combust	Non combust.
Household	30%	9%	3%	8%	3%	2%	5%	32%	8%
Commercial	26%	44%	8%	13%	2%	2%	0%	1%	5%
Industrial	9%	26%	34%	10%	1%	6%	0%	8%	7%
Total	26%	22%	9%	10%	2%	3%	3%	19%	7%

The resulting calorific value of this waste is:

	LHV (MJ/kg)	Tonnes
Household	10.1	320,000
Commercial	13.4	172,000
Industrial	13.8	79,000
Total	11.6	571,000

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APPENDIX C

Questionaires sent to Waste Collectors and Landfill Operators

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Dublin Waste to Energy Project

Questionnaire to Waste Collectors/Recyclers

(1) Name of Company: _____

(2) Address of Company: _____

(3) Contact Name: _____

(6) Telephone No./Fax No.: _____

(7) Please complete the table overleaf as accurately as possible.

To be completed and returned by Wednesday 23rd May, 2001.

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Overview

Total amount of waste collected	_____tonnes in 1999
	_____tonnes in 2000

Waste collected from Dublin Region*	_____tonnes in 1999
	_____tonnes in 2000
Percent of waste from Dublin Region that is recycled	_____ %
Percent of waste from Dublin Region that is landfilled	_____ %
	Σ = 100 %

* Dublin Corporation, Fingal, South Dublin and Dun Laoghaire-Rathdown local authority areas.

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Company Name: _____

Dublin Waste to Energy Project

Questionnaire to Waste Collectors (Recyclers)

Collection Information:

Waste Collected	Quantity Collected (tonnes per annum) Total 1999	Dublin Region* 1999	Total 2000	Dublin Region* 2000	No. of collection points (households, enterprises etc.)
Waste collected from households					
Waste collected from commerce					
Waste collected from industry					
Waste collected from construction/ demolition companies					

*Dublin Corporation, Fingal, South Dublin and Dun Laoghaire-Rathdown

Recycling Information:

Waste Collected	Quantity Recycled (tonnes per annum) Total 1999	Dublin Region 1999	Total 2000	Dublin Region 2000
Paper				
Cardboard				
Wood waste				
Garden waste				
Organic material/food				
Plastic				
Textiles				
Metal				
Glass				
Other				

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Disposal Information:

Waste Collected from County Dublin*	Landfill Name	Contact Person	Tonnage to landfill (tonnes per annum) 1999	2000
Landfill 1				
Landfill 2				
Landfill 3				
Total landfilled (tonnes/annum)				

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Dublin Waste to Energy Project

Questionnaire to Landfill Operators

(1) Name of Company/Local Authority: _____

(2) Address of Company: _____

(3) Contact Name: _____

(6) Telephone No./Fax No.: _____

(7) Please complete the table overleaf as accurately as possible.

To be completed and returned by Friday 25th May, 2001.

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Overview

Total amount of waste received	_____tonnes in 1999
	_____tonnes in 2000
Percent of total waste from households	_____ %
Percent of total waste from commerce	_____ %
Percent of total waste from industry	_____ %
Percent of total waste from construction/demolition companies	_____ %

Waste received from Dublin Region**	_____tonnes in 1999
	_____tonnes in 2000
Percent of waste received from Dublin Region from households	_____ %
Percent of waste received from Dublin Region from commerce	_____ %
Percent of waste received from Dublin Region from industry	_____ %
Percent of waste received from Dublin Region from construction/demolition companies	_____ %

** Dublin Corporation, Fingal, South Dublin and Dun Laoghaire-Rathdown.

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Company Name: _____

Dublin Waste to Energy Project

Questionnaire to Landfill Operators

Collector	Company Name*	Contact Person	Waste type (Tonnes / annum)				Total waste received (tonnes/annum)	
			Household	Commercial	Industrial	C & D**	1999	2000
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
Others								
Total								

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Please make an estimate % of how much waste that is landfilled at your facility comes from The Dublin Region

_____ % Collected inside Dublin Region***

_____ % Collected outside Dublin Region

Total = 100%

* - Please enter information for the 12 collectors who deposit the largest amounts of waste to your facility
** - Construction and Demolition Waste
*** Dublin Corporation, Fingal, South Dublin and Dun Laoghaire-Rathdown.

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