CHAPTER 6

WASTE TREATMENT AND ENERGY RECOVERY FROM WASTE

Electricity generators at Burntstump Landfill Site, Calverton. This is one of 5 landfill sites in the County where landfill gas is collected and burnt to generate electricity.

INTRODUCTION

6.1 The purpose of treating waste is twofold. First, it reduces the volume of waste, thereby cutting down on the amount of disposal space required. Secondly, it can remove those properties of the waste which may cause pollution, so allowing it to be disposed of more safely. Treatment, therefore, helps to achieve a more sustainable waste management system by both reducing the need to take up land for disposal and the risk of pollution. Other advantages include recovery of materials and energy and being able to handle waste in a controlled environment. Energy recovery is considered at the end of this chapter.

6.2 The most common method of treating waste is incineration. Other methods are mostly in the experimental stage and/or are not as yet economically viable enough to merit any major schemes in the UK. These include anaerobic digestion, gasification and pyrolysis, chemical treatment and refuse derived fuel. However, some of these alternative methods of treatment may have a greater role to play during the Plan period.

6.3 The distinct waste group composed of waste water and sewage requires treatment before release back into the environment. Waste Water and sewage treatment is considered in Chapter 8.

WASTE TREATMENT OPTIONS

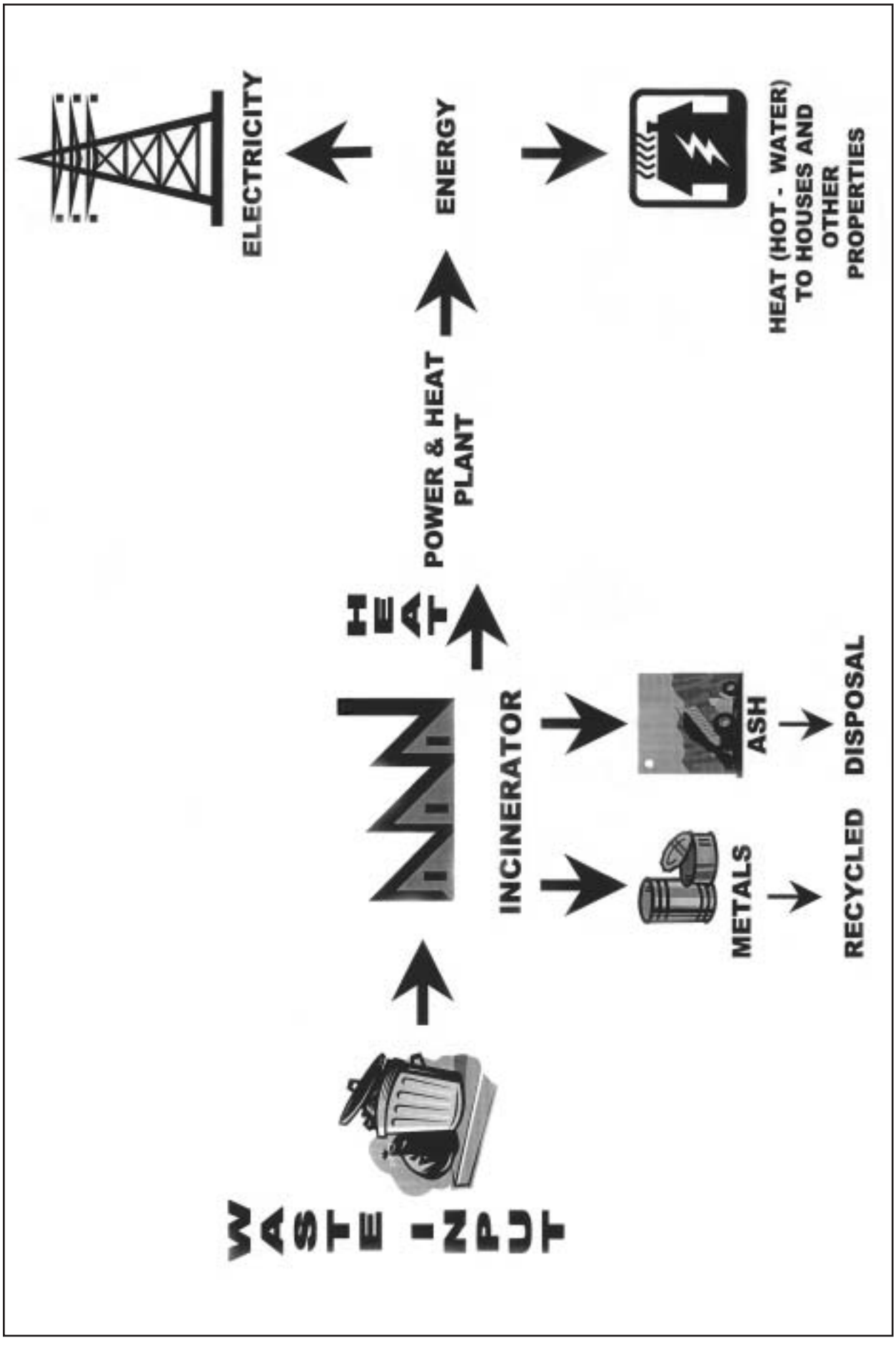
Incineration

6.4 Incineration is the most common form of treatment for a wide range of combustible wastes, in particular household, commercial, industrial, clinical and special wastes. By burning at very high temperatures, the volume of waste and its potential for causing pollution can be reduced considerably. In addition, energy may be recovered from the process. Even if recycling efforts are greatly increased (see Chapter 5) incineration is likely to represent the main opportunity for reducing the volume of waste disposed during the Plan period. This is recognised in the Government's Waste Strategy 2000 which sees incineration as a key component in meeting the overall recovery targets.

6.5 The Government has produced a leaflet[1]. to provide more information on the potential role of incineration within a sustainable waste strategy. This guidance seeks to address some of the planning and other concerns relating to incineration. Currently there are only 8 major municipal incinerators operating in the United Kingdom. These treat just 7% of the Country's municipal solid waste. In comparison to Europe this is very poor. For example, Switzerland and Belgium incinerate over 50% of their municipal solid waste, France, Sweden and Denmark over 40%, and the Netherlands and Norway over 30%.

1 *Energy from Waste, Getting More Value from Municipal Waste, DoE, November 1996.*

Figure 6.1 - Effect of Incineration on Waste.



6.6 Nottinghamshire is fortunate in having its own municipal incinerator at Eastcroft, Nottingham, which incinerates nearly 30% of the County's household waste. This is well above the national average. The incinerator takes approximately 150,000 tonnes of waste per annum from Greater Nottingham and reduces it to 45,000 tonnes of ash and 2,600 tonnes of recovered ferrous metals. In volume terms, the reduction is even more significant and averages 80-90%. The incinerator is linked to an energy recovery scheme. The Eastcroft Incinerator has already saved over 4 million m3 of disposal space since it became operative in 1973 and at current rates will save a further 5 million cubic metres over the next 20 years (see Figure 6.1). It has therefore had a major impact in reducing disposal requirements in the Greater Nottingham Area.

6.7 Nottingham also has three clinical incinerators located at Eastcroft, the Nottingham City Hospital, and the Sutton Bonington School of Agriculture. The aim of incinerating this category of waste is to remove the pollution and health risks, rather than to reduce volume. Plan 6.1 shows the locations of incinerators in the County.

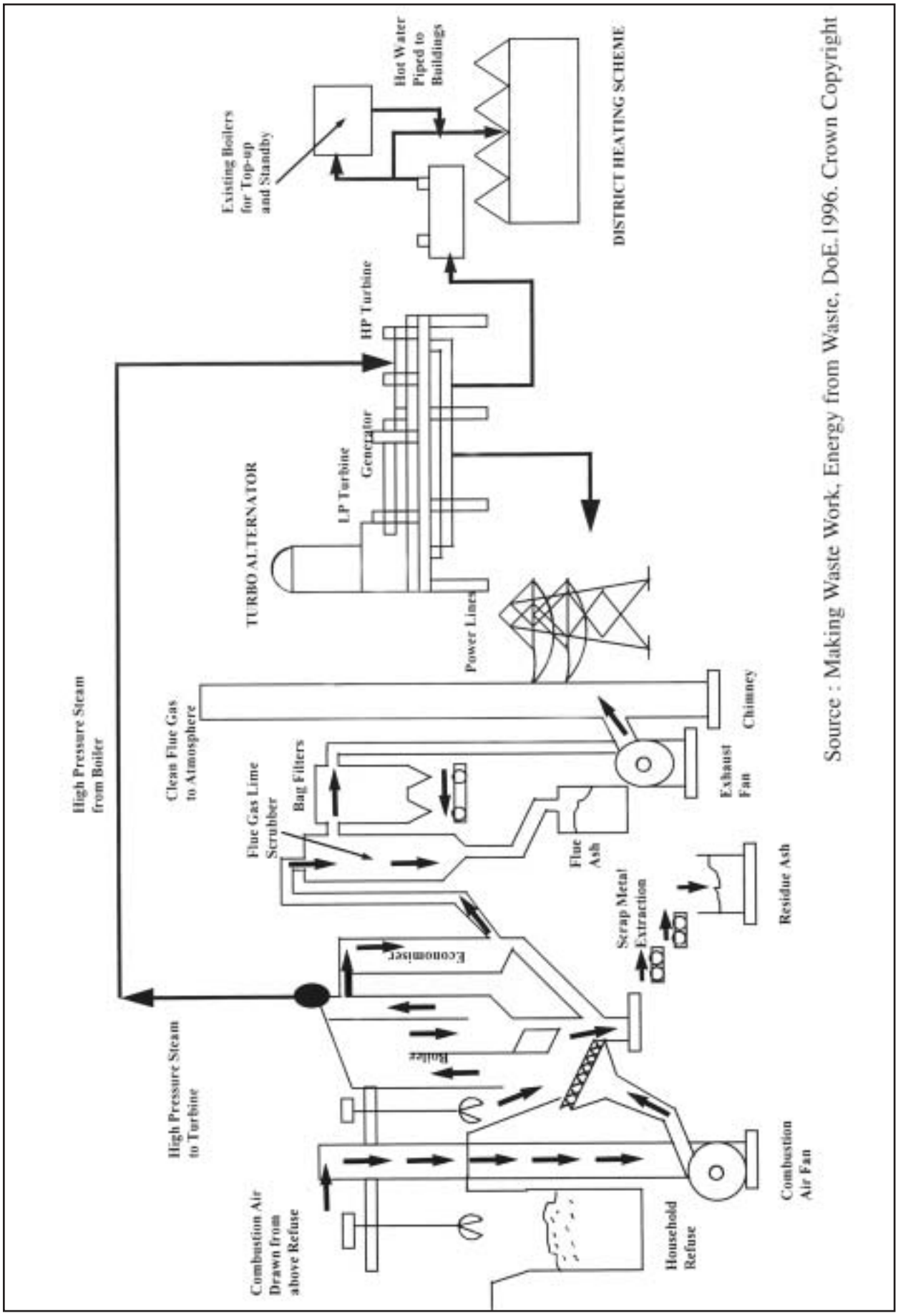
Planning Considerations of Incinerators

6.8 Municipal incinerators tend to be more visible than other waste management facilities because of their size and chimney height (see Fig. 6.2). They also tend to be sited nearer to the host communities than landfill sites (which in turn can result in greater public attention). However, this can help meet sustainable transport objectives by reducing the total mileage travelled by vehicles carrying waste. This factor is also in keeping with the proximity principle (see Chapter 2). However, this proximity can give rise to concern about local traffic movements, odour and the effects of pollution from the stack (though the latter two issues may largely arise through association with the poor image of the old generation of municipal solid waste incinerators). Concerns about emissions and other pollutant elements are controlled by environmental pollution rather than planning legislation.

6.9 Noise from an incinerator is created by vehicles manoeuvring on site and, to a lesser extent, by the combustion plant. Unpleasant odours from waste storage areas, particularly tipping bays, can also be a problem although this can be reduced by enclosure within a building. The extraction of air from the tipping area for use within the furnaces can also reduce unwanted odours. Where waste is stored prior to incineration, there is a risk that any underlying aquifer, or other water resource, may be polluted. Special or hazardous wastes pose a particular threat. Impermeable hard-standing areas may offer some protection from spillages on the site. Chapter 3 on Environmental Protection gives more detailed advice regarding these and other matters.

6.10 Although clinical and specialist waste incinerators are likely to be smaller and generate less traffic, in most other respects they are very similar to municipal incinerators.

Figure 6.2 - Diagram of a Typical, Modern, Energy from Waste Plant with combined Heat and Power



Future Provision of Municipal Incinerators

6.11 The Eastcroft Incinerator has recently been upgraded to meet the emission standards imposed by the 1990 Environmental Protection Act (EPA) and a recent European Directive[2]. This plant is therefore likely to be operative for the foreseeable future. The original design of the Eastcroft site allowed sufficient space to increase its capacity by 100,000 tonnes per annum by opening up a third line, if this became economic to do so.

6.12 The County and City Councils will look favourably on an increase in capacity at this site, as this would result in more of Nottinghamshire's waste being managed higher up the waste management hierarchy. Also, this would save considerable landfill space which is becoming in short supply in the County, particularly in the Greater Nottingham area (see Chapter 10, Para 10.8).

POLICY W6.1

PROPOSALS TO INCREASE CAPACITY AT THE EASTCROFT INCINERATOR WILL BE PERMITTED SUBJECT TO ADEQUATE ENVIRONMENTAL SAFEGUARDS.

Future Provision of Clinical Incineration

6.13 The raising of emission standards by the EPA and the lifting of crown immunity from NHS hospital incinerators has resulted in the closure of two of the three hospital incinerators. These were located at the Queens Medical Centre in Nottingham, and Kings Mill Hospital in Mansfield. However, despite this, the resultant current Countywide shortfall was a relatively insignificant 264 tonnes per annum. Planning permission has since been granted for a new high performance clinical incinerator within the existing Municipal incinerator site at Eastcroft. The maximum capacity of this facility is 5,000 tonnes per annum. The Eastcroft site became operational in 1998.

6.14 The County now has a surplus clinical waste incineration capacity of over 4,500 tonnes per annum. The County is therefore exceeding the Government's requirements in terms of being self sufficient. Indeed, it may become a major importer of this category of waste. It is therefore not considered necessary or desirable for the Plan to provide for the development of any more clinical waste incinerators. Furthermore, the health service should seek to minimise the amount of clinical waste produced in support of the overall objectives of the Plan and the principle of the waste hierarchy.

POLICY W6.2

PROPOSALS FOR CLINICAL WASTE INCINERATORS WILL NOT BE PERMITTED.

[2] *European Directive 89/429/EEC*

OTHER TECHNOLOGIES

6.15 There are a variety of other methods of treating waste. These include anaerobic digestion, gasification and pyrolysis, bioremediation, and refuse derived fuel. At present, however, no significant quantities of waste are treated by these methods in the UK. Government research and experience abroad suggests that such facilities may have a greater role to play in the future.

(a) Anaerobic Digestion

6.16 The term "anaerobic digestion" (AD), when describing a process for managing waste, refers to the break down of organic materials in the waste by bacteria in the absence of oxygen. A compost heap provides a similar bacterial break-down, but in an oxygen-rich or "aerobic" atmosphere.

6.17 Despite the fact that the same process takes place naturally within a landfill, the term anaerobic digestion is normally used to describe the anaerobic process when artificially accelerated in closed vessels. AD has been used as a method of handling certain special wastes, like sewage sludge and animal slurry, for many years, but as a treatment for municipal wastes it is relatively new.

6.18 Wastes are digested anaerobically in a closed fabricated container such as a drum. This accelerates natural degradation and all of the gas generated can be collected for use as a fuel. The remaining waste is both reduced in volume and made inert. Small quantities of compost may also be produced.

6.19 Only biodegradable wastes, that is those with an organic or vegetable origin, can be processed in anaerobic digestion plants. However, since such wastes typically make up 30 - 60% of household waste, there is considerable opportunity to either divert wastes from landfill or to pre-treat them before landfilling.

(b) Gasification and Pyrolysis

6.20 These are related techniques for the thermal breakdown of organic material through incineration. Historically both have been employed to generate town gas, coke and other products from coal. Both require the use of an engineered vessel. Whilst gasification employs oxygen enriched air, pyrolysis relies on an inert atmosphere devoid of oxygen. Gasification produces a virtually inert residue and a gas which can be used as a heating fuel. Pyrolysis produces a char which can be processed into a liquid with a heat value in the range of 50-80% of mineral fuel oil. Neither method has as yet been developed beyond a pilot state for municipal waste, but the DTLR expect significantly more research and development in the future.

POLICY W6.3

PROPOSALS FOR PILOT PLANTS FOR NEW AND EMERGING ENERGY RECOVERY TECHNOLOGIES WILL BE PERMITTED PROVIDED THEY DO NOT LEAD TO ANY UNACCEPTABLE ENVIRONMENTAL IMPACT.

(c) Refuse Derived Fuel

6.21 Refuse-derived fuel, (RDF), is made by refining municipal solid waste in a series of mechanical sorting and shredding stages to separate the combustible portion of the waste. Either a loose fuel, known as fluff, floc or coarse RDF (c-RDF), or a densified pellet or briquette (d-RDF) is produced.

6.22 RDF production can complement materials recycling schemes (see Chapter 5, Para 5.19). Glass, clean paper, metals and any other materials for which there are secondary markets are removed from the waste stream for recycling, before it is delivered to the plant. Further materials recovery is conducted at the RDF production sites, as many plants incorporate some degree of manual sorting and metal recovery schemes.

6.23 The RDF production also permits a level of flexibility, so that if, for example, no markets were available for low-grade waste paper, it could instead be temporarily re-directed to the fuel process rather than being wastefully landfilled.

6.24 Typically, the refuse is discharged either onto a tipping floor or into a bunker with an overhead grabber. Subsequently, the material is passed through a cylindrical screen (trommel) which sorts it into fine material (fines), heavy (stones and bricks) and oversized materials (large sheets of plastic etc) from the small, lighter pieces like paper and plastic film which form the fuel product. The fine fraction, containing the smaller high moisture content organics and ash is usually landfilled. The oversized fraction can be shredded and partially returned to the fuel stream or landfilled, depending on its composition, while the fuel fraction is conveyed to a shredder. Further separation takes place in an air classifier, although this would not be essential for c-RDF manufacture. For d-RDF, the light fuel fraction is subjected to secondary shredding, then dried and pelletised.

6.25 The recent controls in atmospheric emissions imposed by the 1990 Environmental Protection Act may have an impact upon the market demand for this RDF. Whilst there are no examples in Nottinghamshire, RDF plants have proved successful in some parts of the UK. The County and City Councils wish to encourage such schemes provided they do not have an adverse environmental impact. Suitable sites are likely to be within existing employment sites or those designated in the City and District Councils' Local Plans where it can be demonstrated that there is no unacceptable environmental impact.

POLICY W6.4

PROPOSALS FOR WASTE DERIVED FUEL FACILITIES WILL BE PERMITTED IN EXISTING EMPLOYMENT SITES OR THOSE DESIGNATED WITHIN THE CITY AND DISTRICT COUNCILS' LOCAL PLANS PROVIDED THERE IS NO UNACCEPTABLE ENVIRONMENTAL IMPACT.

(d) Bioremediation

6.26 Many pollutants can be converted to harmless or less harmful substances by bacteriological action. Indeed, this is the orthodox method for sewage treatment (see Chapter 8). It has also proved particularly useful for treating contaminated land. This method is known as "bioremediation". The main advantage is that the treatment can be carried out in-situ and therefore haulage costs are avoided. However, as long as low cost landfill is available at a reasonable distance, bioremediation will be an expensive option. It is however, a more sustainable option and although planning permission is unlikely to be required, the County Council wishes to encourage such schemes.

ENERGY RECOVERY

6.27 All combustible and organic waste contains potential energy which can be recovered by burning or biological (anaerobic) action. This reduces demand for finite fossil fuels and therefore helps contribute towards a more sustainable system of waste management.

6.28 The Government has produced a leaflet[3] considering more fully the benefits of energy recovery from waste than that given in the main strategy document, Making Waste Work[4]. This leaflet includes examples of technological and operational best practice and also seeks to address some of the important concerns relating to energy from waste. Additionally, the Government commissioned a study of all potential renewable energy sources, (including those relating to waste management) within the East Midlands Region[5]. Structure Plan Review Policy 10/3 and paragraphs 10.15 to 10.18 and 10.43 to 10.45) and Nottingham Local Plan Policy ENV 1 set out the approach to renewable energy proposals.

6.29 A number of waste treatment and disposal sites in the County generate energy. These comprise of one major municipal household waste incinerator, two clinical incinerators and three waste disposal sites with gas recovery (see Plan 6.1). Additionally, the operators of Dorket Head Landfill Site intend to install a gas recovery scheme to run new brick kilns.

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3 *Energy from waste, Getting More Value From Municipal Waste, DoE, November 1996.*

4 *Making Waste Work, A Strategy for Sustainable Waste Management in England and Wales, 1995.*

5 *East Midlands Renewable Energy Study, ETSU, 1998.*

(a) Energy Recovery from Incineration

6.30 Recovering energy from incinerating waste is a long established method of obtaining added value before final disposal. It may also represent the best practicable environmental option (BPEO) for certain wastes, especially where the environmental and economic costs of recycling are high (see Chapter 2 Paras 2.20-2.21).

6.31 Incinerators burn waste at high temperatures and the heat is used to generate steam. Steam can then drive electric turbines and/or heat water for a district heating scheme. Where both forms of energy are produced, this is known as a combined heat and power (CHP) scheme. These processes have undergone major technical improvements in recent years and now have to achieve very high environmental standards in terms of reduced emissions to air[6].

6.32 The Eastcroft Incinerator in Nottingham burns around 150,000 tonnes of household and commercial waste every year and the heat recovered is used to produce steam which drives turbo-alternators at the London Road Heat Station. The electricity produced is fed into the National Grid and the water heated by steam is pumped through miles of insulated pipes to two large shopping centres, major public buildings, industrial premises and council house estates. It is the only city-wide combined heat and power scheme in the UK. Plan 6.2 shows the location of these developments which benefit from the district heating scheme.

6.33 Clinical incinerators, although much smaller scale, can also recover useful quantities of energy. For example the existing plant at the Nottingham City Hospital generates hot water and electricity.

Planning Considerations and Future Provisions – Energy Recovery from Incineration

6.34 The main issues regarding the environmental impact and future provision of incinerators are covered in paragraphs 6.8-6.14. With regards to the additional machinery required to convert heat from the incineration process to energy, this is incorporated within the structure of the main plant. Whilst energy conversion plant will normally require planning permission, it is not likely to result in significant additional environmental impact. In order to comply with the overall strategy set out in Policy W2.1, all incinerators should therefore incorporate energy recovery schemes where it is economic to do so.

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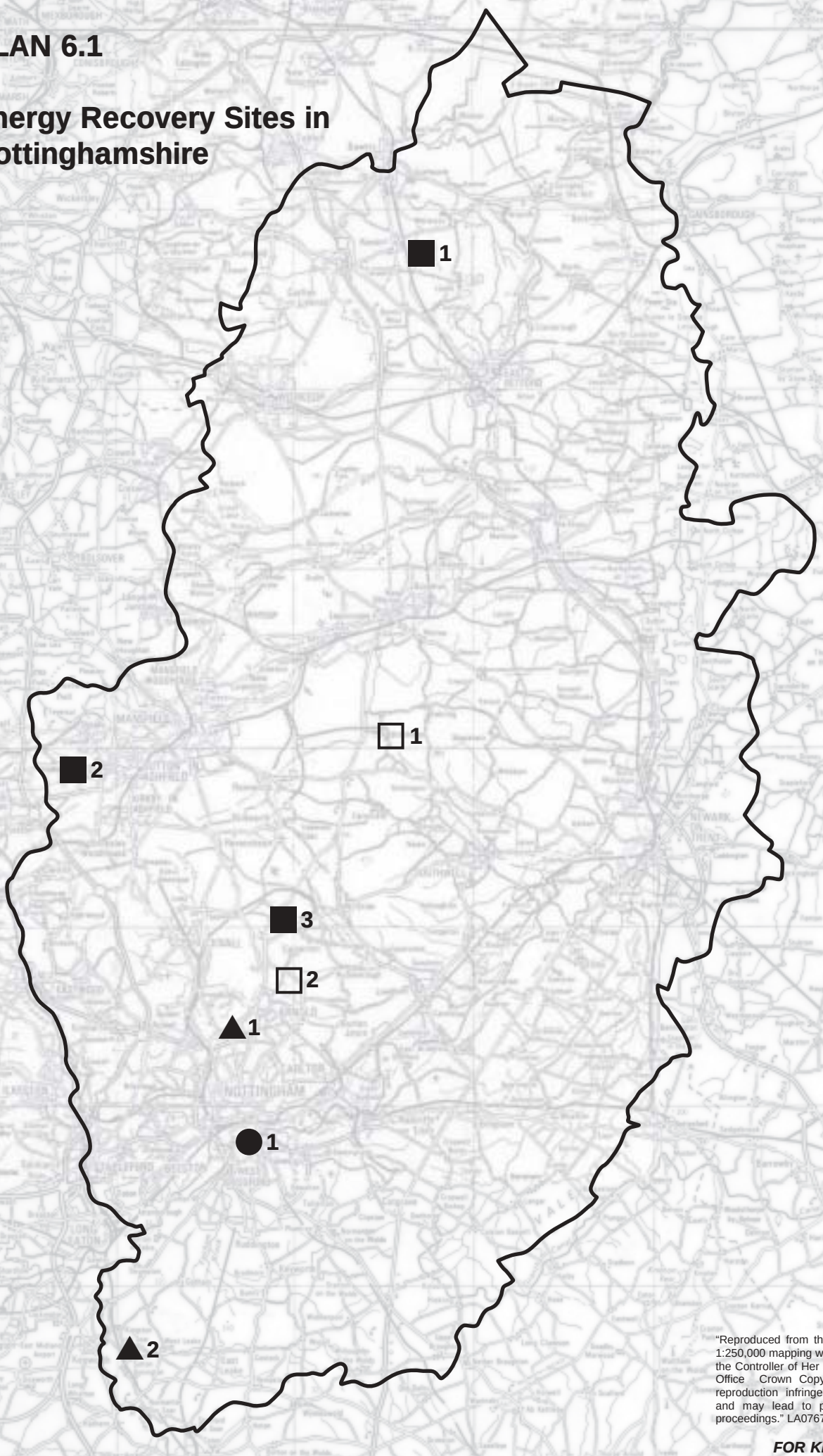
6 *Directive on Prevention of Air Pollution from New Municipal Waste Incineration Plants (89/369/EEC) and Directive on Reduction of Air Pollution from existing Municipal Incinerator Plants (89/429/EEC). Implemented in the UK under the Environmental Protection Act 1990 and Regulations made under it.*

PLAN 6.1

Energy Recovery Sites in Nottinghamshire



FOR KEY SEE OVER

KEY TO PLAN 6.1

Energy Recovery Sites in Nottinghamshire

● Municipal Incinerator

1. Eastcroft Incinerator

▲ Clinical Incinerator

1. Nottingham City Hospital
2. Sutton Bonnington School of Agriculture

■ Landfill Gas Energy Recovery Scheme

1. Daneshill
2. Sutton
3. Burntstump

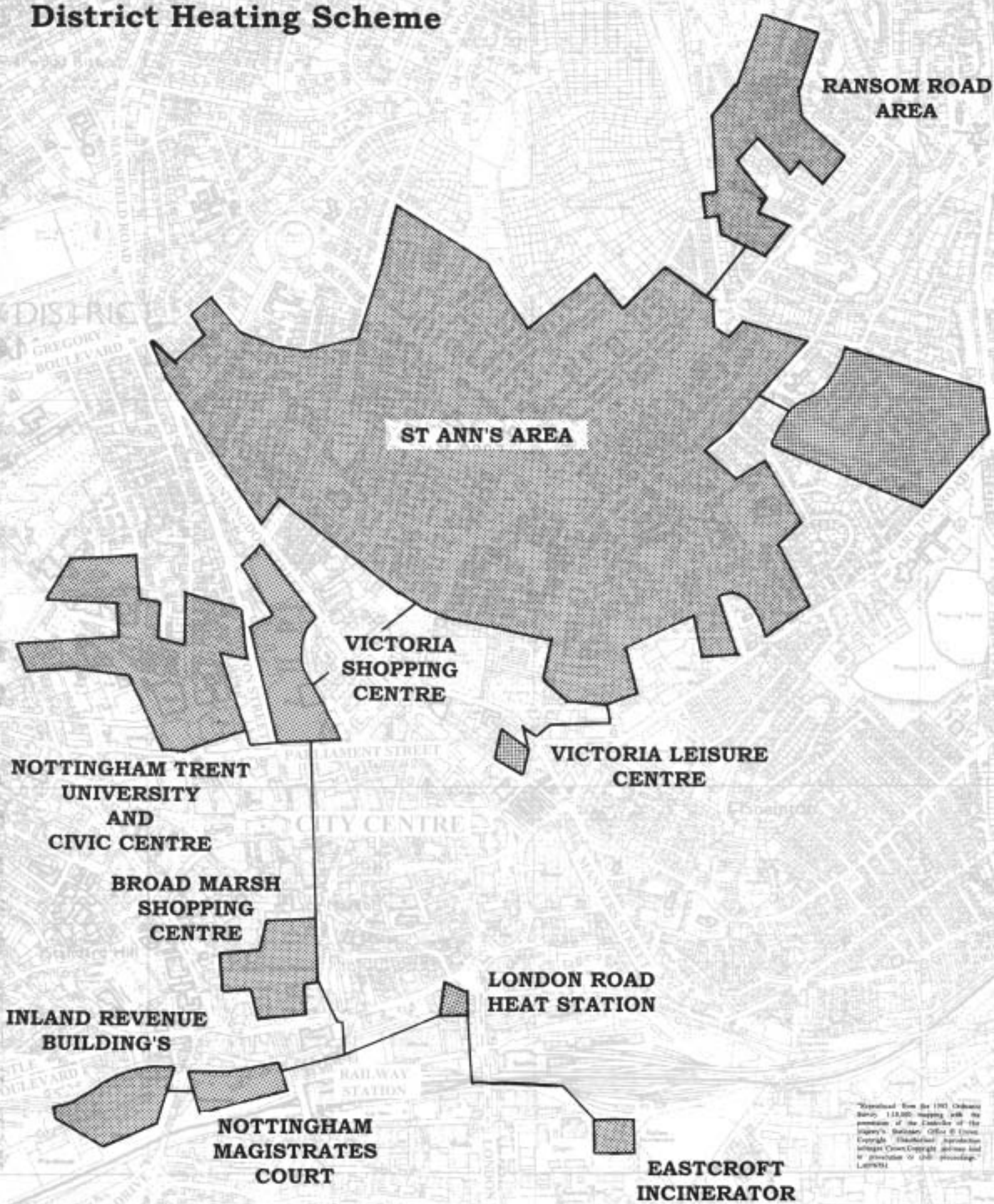
□ Proposed Landfill Gas Energy Recovery Scheme

1. Bilsthorpe
2. Dorket Head

Scale: 1:312,500 (1” to 5 miles) 1cm = 3.125km

PLAN 6.2

Eastcroft Incinerator and Developments which benefit from the London Road District Heating Scheme



POLICY W6.5

PROPOSALS FOR ENERGY RECOVERY SCHEMES AT INCINERATOR SITES WILL BE PERMITTED PROVIDED THERE IS NO UNACCEPTABLE IMPACT.

POLICY W6.6

PROPOSALS FOR INCINERATION OF WASTE WHICH LEAD TO THE GENERATION OF ECONOMICALLY RECOVERABLE QUANTITIES OF ENERGY WILL ONLY BE PERMITTED WHERE THEY INCORPORATE ENERGY RECOVERY SCHEMES.

(b) Energy Recovery from Waste Disposal

6.35 Disposal sites containing organic waste, can generate large quantities of landfill gas, which mainly comprises the flammable gas methane. Landfill gas can be collected, burnt and the heat used to generate electricity. It therefore represents a means of deriving residual value from landfilled waste.

6.36 Energy recovery from landfill produces only one fifth of the energy per tonne of waste than incineration with energy recovery and does not achieve volume reduction. It may also take 15 years or more to recover the methane from a landfill site, whereas the energy from incineration is recovered rapidly. Set against this, landfill gas is a cleaner fuel and requires less pollution abatement measures than incineration. Normally, landfill waste to energy plants are sited further from centres of population than is the case for incinerators.

6.37 Nationally, landfill gas generates around 80 megawatts of electricity per annum. The Government is seeking to increase the number of landfill sites that generate energy, and technological improvements should increase the proportion of landfill gas which can be collected from sites.

6.38 In addition to the wider environmental advantages of energy recovery from landfill discussed in Para 6.1, such schemes also help to avoid local dangers of explosion, asphyxiation and crop damage. Burning landfill gas also minimises atmospheric pollution, as methane is one of the most potent 'greenhouse' gases.

6.39 Of the ten non-inert waste disposal sites currently operating in Nottinghamshire five sites at Daneshill, Sutton, Dorket Head, Bilsthorpe and Burntstump, incorporate energy recovery schemes (see Plan 6.1). If the remaining sites included such schemes, the energy savings and environmental gains would be significant.

Planning Considerations and Future Provisions – Energy Recovery from Waste Disposal

6.40 Planning permission for the electricity generating plant is required, but this does not generally apply to the collection pipework. However retention of pipework post closure of the disposal site may require permission.

6.41 The electricity generating plant is usually enclosed within a building and its appearance is comparable to that of a small compact industrial unit. Whilst this development is unlikely to add significantly to the environmental impact of the waste disposal site, the plant is likely to remain on site for many years after the disposal site has been reclaimed. When siting the plant, account should therefore be taken of the longer term environmental implications. This also applies to the associated collection pipework.

6.42 Chapter 10, which considers waste disposal, indicates there is likely to be further demand for non-inert waste disposal capacity. Where future proposals are likely to lead to economically recoverable quantities of landfill gas, energy recovery schemes should be included. Such schemes accord with the overall strategy set out in Policy W2.1.

POLICY W6.7

PROPOSALS FOR WASTE DISPOSAL WHICH WOULD LEAD TO THE GENERATION OF ECONOMICALLY RECOVERABLE QUANTITIES OF LANDFILL GAS, WILL ONLY BE PERMITTED WHERE THEY INCORPORATE ENERGY RECOVERY SCHEMES.

6.43 It may also be economic to recover energy at some of the County's existing sites. The County and City Councils wish to encourage the installation of energy recovery equipment, where this does not lead to any unacceptable environmental impact.

POLICY W6.8

PROPOSALS FOR THE INSTALLATION OF ENERGY RECOVERY EQUIPMENT AT EXISTING LANDFILL SITES WILL BE PERMITTED, PROVIDED THERE IS NO UNACCEPTABLE ENVIRONMENTAL IMPACT.