Carbon Reduction Scenarios – Technical Report

LB Haringey

Prepared March 2007

Executive Summary

Climate change represents the most serious and pressing danger facing humanity today. Without dramatic reductions of gases arising from virtually every area of human activity the climate could enter a rapid and irreversible phase of warming, making much of the planet uninhabitable. Already some island nations are being lost to the sea, and melting the melting of polar and glacial ice threatens the water supplies of millions of people. The next ten years are possibly critical in determining whether this is avoided.

Cities like London are more sensitive to rising temperatures than the surrounding countryside due to the urban heat island effect. The capital can expect hotter, drier summers that will threaten the health of vulnerable people, more extreme weather events and an increased risk of flooding due to tidal surges.

Despite these risks, emissions globally have continued to rise. In the UK, we have seen a drop in emissions in recent years as a result of switching from coal to gas, but energy consumption continues to increase. Efficiency improvements are invariably offset by increased demand.

Action on climate change is now urgent. This report sets out what the London Borough of Haringey can do to reduce its own emissions and set an example to London and the rest of the UK.

In developing this strategy we have focussed on where we believe Haringey can best target its resources to have the greatest impact over the short to medium term.

It already has a waste strategy in partnership with neighbouring boroughs through the North London Waste Authority which should largely eliminate the methane emissions arising from disposal by landfill.

Transport policy has been set in place through Haringey's Local Implementation Plan. Transport planning is also conducted regionally through Transport for London to a much greater extent than either waste or energy. However, Haringey will need to implement a range of policies to reduce transport emissions. These will be aimed primarily at reducing car use by switching journeys to carbon free modes such as walking and cycling or lower carbon public transport. In addition, efficiency improvements will be encouraged through choice of vehicle, improved technology and the use of alternative fuels. Lastly emissions from freight transport can be reduced through efficient logistics reducing distances travelled and by a switch from road to rail.

The building sector and particularly the area of heat demand is a very significant area where carbon reductions can be achieved. Haringey's corporate buildings are responsible for a relatively small proportion of emissions in the borough. However, it can exert its influence on buildings owned both privately and by Local Strategic Partners. The borough will need to lead by example in partnership with the Primary Care Trust, Police, Housing Associations and Haringey Homes. It will also need to make bold decisions in areas such as planning, regeneration and procurement to encourage and enable local buildings to produce less emissions of carbon dioxide. The aim of the resulting policies will be to increase energy efficiency, the provision of renewable energy and improved transport efficiency. Most important of all is the provision of a community heating network supplying half of the borough's thermal demand by 2050. It is this measure that will have the biggest impact on CO_2 emissions, but it does require strong central leadership with careful planning and coordination starting as soon as is possible.

Objectives

The primary objective of this report is to calculate the carbon reduction necessary to meet a 60% reduction target and to put forward a strategy for Haringey to meet those targets, based on analysis of a range of possible scenarios. Interim targets are proposed for 2010, 2016 and 2030. This report assesses the baseline on which the target is based, accounts for emissions from expected growth in the borough, and quantifies the target in absolute terms to a longer-term time horizon (2050).

Carbon Reduction Target

Haringey has adopted a target of reducing CO_2 emissions by 60% by 2050. Data on the level of emissions for the base year 2006 is not yet available. For the purposes of this report, the first year where reliable CO_2 data is available, 2003, has been used as a starting point for action taken for 2006. It is not considered that emissions will have changed substantially within that 3 year timeframe.

A 60% reduction target by 2050 implies a reduction of some 580 ktpa on 2003 levels. Taking into account the predicted growth in emissions from new housing, non-residential floor space and increased demand for transport this target increases to 775 ktpa.

The Vision

This strategy illustrates that community heating and combined heat and power (CHP) provide the most cost-effective way for Haringey to achieve its carbon reduction targets. The vision set out in this report for Haringey is therefore of a heating network served by a number of CHP based heat sources supplying a significant proportion of the borough. This will be complemented by renewable energy systems, both building integrated and stand-alone, and a range of energy efficiency measures to the existing stock.

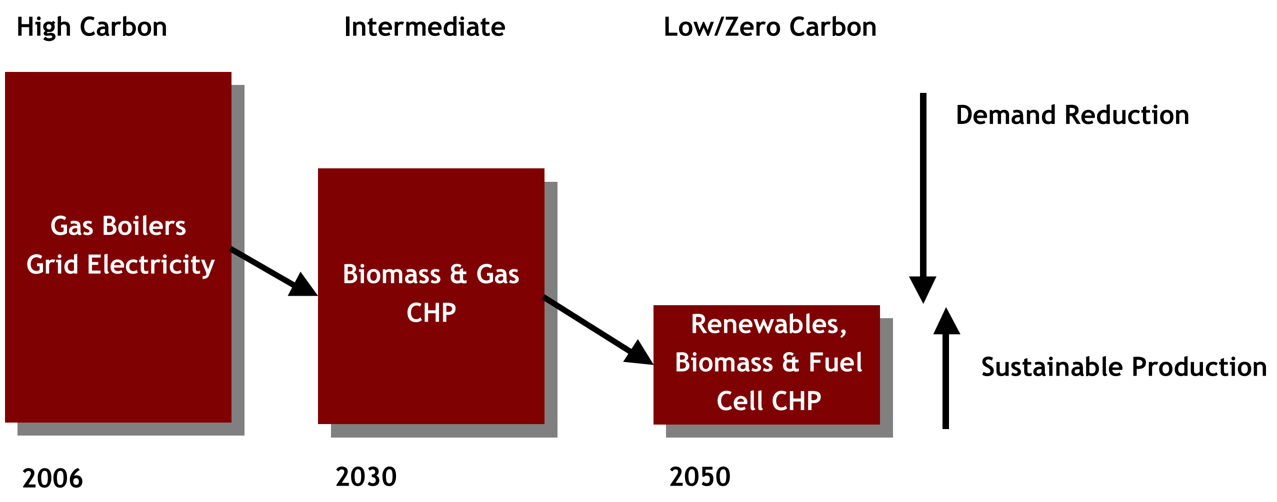

Figure 1: The Transition to a Low Carbon Future in the Building Sector

Similarly for transport, demand reduction is envisaged alongside a modal shift to more sustainable transport options. Private cars are responsible for the majority of transport emissions, and it is the aim of this strategy to reduce private car use and encourage walking, cycling and public transport. This will be complemented by reduced freight transport and efficiency improvements for all transport modes.

This vision implies a number of consequences in terms of carbon reduction targets, funding and financing, the planning framework, choices of technologies and the phasing of their implementation.

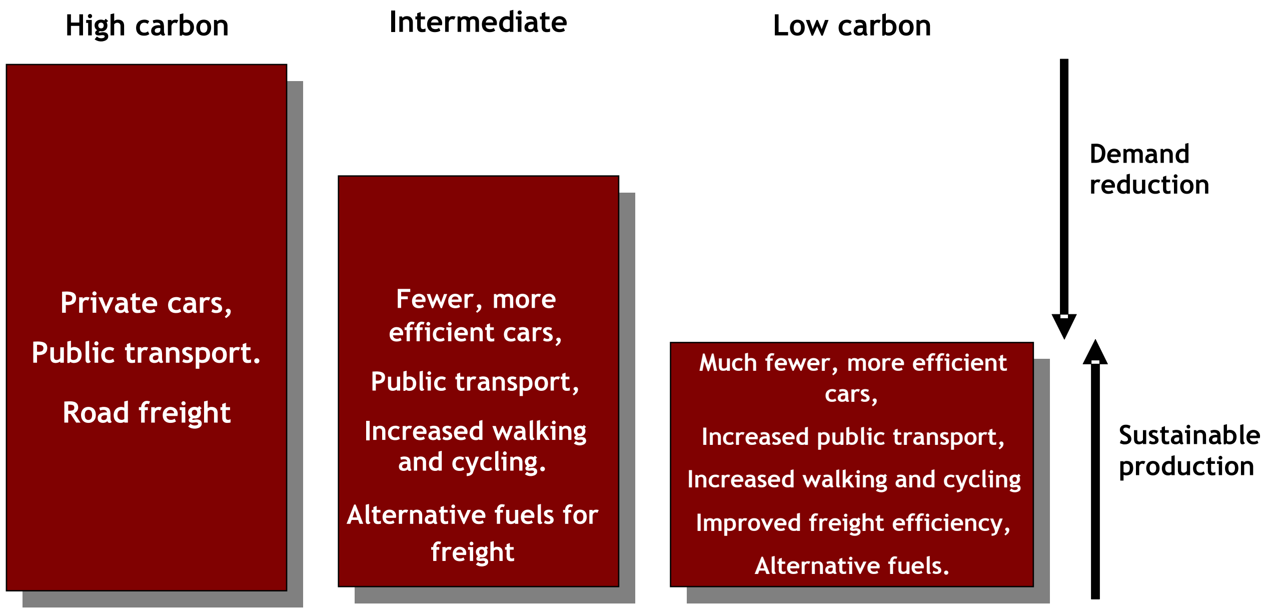

Figure 2: The Transition to a Low Carbon Future in the Transport Sector

The Planning Framework & Technology Choices

The planning framework will need to specifically reflect the adoption of a community heating network and renewable technologies. Each new building or set of buildings will need communal heating systems compatible with the wider heat network. This in turn has implications for the choice of building-integrated renewable energy systems that developers should use. We recommend that only electricity generating systems be used, i.e. solar photovoltaic or wind. To ensure that the optimum carbon outcome is achieved under the new 2006 Building Regulations we further recommend that this 10% renewables requirement be in addition to the carbon target specified within the Regulations.

The planning framework will also need to take into consideration the requirements for transport and reducing this sectors climate change impact. New developments must be properly served by public transport and facilitate cycling and walking, as well as minimising the distance people need to travel to access shops and services.

Actions

A companion document has been produced alongside this climate change strategy. *Carbon Reduction Scenarios - Action Plan* outlines the actions that should be implemented in order for the CO_2 reduction targets to be met.

List of Abbreviations

AD	Anaerobic Digestion
AHP	Aberdeen Heat and Power
BHP	Barkantine Heat and Power
BRE	Building Research Establishment
BVPI	Best Value Performance Indicator
CCGT	Combined Cycle Gas Turbine
CCL	Climate Change Levy
CFC	Chloroflourocarbons
CH	Community Heating
CHP	Combined Heat & Power
CHPA	CHP Association
CI	Carbon Index
CO_2	Carbon Dioxide
DC	Direct Current
Defra	Department for the Environment, Food and Rural Affairs
DER	Dwelling Emission Rate
DfT	Department for Transport
DSWH	Domestic Solar Water Heating
DTI	Department of Trade and Industry
EAA	Energy Action Area
EEC	Energy Efficiency Commitment
EfW	Energy from Waste
EPA	[United States] Environmental Protection Agency
EPBD	Energy Performance in Buildings Directive
ESCo	Energy Services Company
EST	Energy Saving Trust
ETS	Emissions Trading Scheme
EU	European Union
GHG	Greenhouse Gas
GIS	Geographic Information Systems
GLA	Greater London Authority
GSHP	Ground Source Heat Pump
GWh	Gigawatt hours
HA	Housing Association
HECA	Home Energy Conservation Act
IC	Internal Combustion
IRR	Internal Rate of Return
kt	kilotonnes

ktpa	Kiltonnes per annum (CO_2)
KWp	Kilowatts peak
kWth	kilowatts thermal
LA	Local Authority
LBH	London Borough of Haringey
LCBP	Low Carbon Buildings Programme
LDA	London Development Agency
LEC	Levy Exemption Certificate
LECI	London Energy and CO_2 Emissions Inventory
LEP	London Energy Partnership
LIP	Local Implementation Plan (for Transport)
LPG	Liquid Petroleum Gas
LULUCF	Land Use, Land Use Change and Forestry
m^2	Suare metres
MBT	Mechanical and Biological Treatment
mCHP	Micro CHP
MSW	Municipal Solid Waste
MT	Megatonnes
MTC	Megatonnes of Carbon
MTS	Mayor’s Transport Strategy
MW	Megawatts
MWe	Megawatts (electrical)
MWth	Megawatts thermal
NAEI	National Atmospheric Emissions Inventory
NAP	[UK] National Allocation Plan
NETA	New Electricity Trading Agreement
NGT	National Grid Transco
NHER	National Homes Energy Rating
NLWA	North London Waste Authority
NPV	Net Present Value
NRF	Neighbourhood Renewal Fund
ODPM	Office of the Deputy Prime Minister
Ofgem	Office of Gas and Electricity Markets
ONS	Office of National Statistics
O & M	Operation and Maintenance
PAFC	Phosphoric Acid Fuel Cell
PFI	Private Finance Initiative
ppm	Parts per million
PV	[Solar] Photovoltaic
RCEP	Royal Commission on Environmental Pollution

RO	Renewables Obligation
ROC	Renewables Obligation Certificate
RSL	Registered Social Landlord
SAP	Standard Assessment Procedure
SEA	Strategic Environmental Assessment
SEPN	Sustainable Energy Policy Network
SfL	Solar for London
SME	Small to Medium Enterprise
SOP	Standards of Performance
SPB	Simple Payback
SRF	Solid Recovered Fuel
TCO_2	Tonnes of carbon dioxide
TER	Target emissions rate
tpa	tonnes per annum (CO_2)
TfL	Transport for London
TRV	Thermostatic Radiator Valves
TWh	Terawatt hours
UDP	Unitary Development Plan
UNFCCC	United Nations Framework Convention on Climate Change
We	Watts electrical
W/m^2k	Watts per metre squared Kelvin
WRAP	Waste and Resources Action Programme

Table of Contents

EXECUTIVE SUMMARY 1

LIST OF ABBREVIATIONS 4

1 INTRODUCTION 15

1.1 AIMS AND OBJECTIVES 15

1.2 METHODOLOGY 16

2 POLICY AND FUNDING CONTEXT 17

2.1 CARBON TARGETS 17

2.1.1 Introduction 17

2.1.2 Measuring Carbon 17

2.1.3 Existing Targets 17

2.1.4 The New Climate Science 21

2.2 EU REGULATION 23

2.2.1 Energy Performance in Buildings Directive (2002/91/EC) 23

2.2.2 The Landfill Directive (99/31/EC) 23

2.2.3 EU Cogeneration Directive (2004/08/EC) 23

2.2.4 Renewable Transport Fuel Directive (2003/30/EC) 23

2.3 NATIONAL 23

2.3.1 Home Energy Conservation Act (HECA) 1995 23

2.3.2 UK Electricity Suppliers Licence exemption regime 24

2.3.3 Warm Homes and Energy Conservation Act 2000 24

2.3.4 Sustainable Energy Act 2003 24

2.3.5 Energy Bill 24

2.3.6 Decent Homes 25

2.3.7 Building Regulations 26

2.3.8 Code for Sustainable Homes 27

2.3.9 UK Combined Heat and Power Strategy 30

2.3.10 Transport Ten Year Plan (2000) 32

2.3.11 The Future of Transport (2004) 32

2.4 REGIONAL 32

2.4.1 London Energy Strategy 32

2.4.2 The London Plan 33

2.4.3 Mayor's Transport Strategy (MTS) 33

2.5 LOCAL 34

2.5.1 BVPI 63 34
2.5.2 Haringey HECA strategy 34
2.5.3 Planning Policies 35
2.5.4 Haringey's Local Implementation Plan (LIP) 35
2.6 SCHEMES AND FUNDING 36
2.6.1 Summary of Main Support Mechanisms 36
2.6.2 Energy Efficiency Commitment (EEC) 37
2.6.3 Climate Change Levy (CCL) - Levy Exemption Certificates 38
2.6.4 EU Emissions Trading Schemes, ETS 39
2.6.5 Low Carbon Buildings Programme 40
2.6.6 Renewables Obligation 42
2.6.7 Warm Front 44
2.6.8 Transco Affordable Warmth 44
2.6.9 European (EC) Grant Aid 44
2.6.10 Neighbourhood renewal funds (NRF) 44

3 BASELINE EMISSIONS 45
3.1 ONS HOUSEHOLD EMISSIONS REPORT 45
3.2 REGIONAL ENERGY CONSUMPTION STATISTICS, DTI 2003 46
3.3 DEFRA LOCAL AND REGIONAL CO_2 EMISSIONS ESTIMATES FOR 2003 REPORT 47
3.4 DEFRA END USER LOCAL AND REGIONAL ESTIMATES OF CARBON EMISSIONS 2004 48
3.5 LONDON ENERGY AND CO_2 EMISSIONS INVENTORY (LECI) 2003 49
3.6 LECI 2003 – MODIFIED 51
3.7 CO_2 EMISSIONS COMPARISON 53
3.8 TRANSPORT EMISSIONS BREAKDOWN 54
3.8.1 Growth in transport emissions 55
3.9 HOUSING EMISSIONS BREAKDOWN 56
3.9.1 Current Emissions 56
3.9.2 New build 56
3.10 COMMERCIAL AND INDUSTRIAL EMISSIONS 57
3.10.1 All bulk categories 57
3.10.2 New Build 58
3.11 EMISSIONS FROM WASTE 58
3.11.1 Baseline Emissions 58

4 TECHNOLOGY REVIEW 61
4.1 ENERGY EFFICIENCY 61

4.1.1 Insulation 61
4.1.2 Condensing Boilers 62
4.1.3 Heating Controls......62
4.2 RENEWABLES 63
4.2.1 Solar PV 63
4.2.2 Solar Thermal 63
4.2.3 Ground Source Heat Pumps (GSHPs) 64
4.2.4 Wind 64
4.2.5 Hydro 66
4.2.6 Biomass......66
4.3 COMBINED HEAT AND POWER (CHP) 70
4.3.1 Overview 70
4.3.2 Internal Combustion (IC) Engines......70
4.3.3 Gas Turbines......70
4.3.4 Steam Turbines 71
4.3.5 Combined Cycle Gas Turbine 72
4.3.6 Fuel Cells 72
4.3.7 Stirling Engines 73
4.4 GREEN ELECTRICITY TARIFFS 74
4.4.1 For......74
4.4.2 Against 74
4.5 TECHNOLOGY COMPATIBILITY AND SELECTION 75
4.6 DEMAND SIDE MANAGEMENT VERSUS SUPPLY 75
4.6.1 Introduction 75
4.7 IS HEAT FROM CHP REALLY CARBON FREE? 77
4.8 CONCLUSION 78
4.9 TRANSPORT TECHNOLOGIES 79
4.9.1 Reducing distance travelled by vehicles 79
4.9.2 Reducing the carbon intensity of travel 79
4.9.3 Modal shift......81

5 BIOMASS RESOURCE 82
5.1 INTRODUCTION 82
5.2 BIOMASS RESOURCE IN HARINGEY......82
5.3 BIOMASS RESOURCE IN LONDON......83
5.4 TREATMENT OF BIOMASS RESOURCE IN SCENARIO MODELLING......85

6 CARBON SCENARIOS 86

6.1 INTRODUCTION 86

6.2 BUSINESS AS USUAL 86

6.2.1 Trends in housing 86

6.2.2 Trends in Commercial & Industrial 86

6.2.3 Trends in Transport 86

6.3 A TARGET FOR 2050 TAKING INTO ACCOUNT GROWTH RATES 87

6.4 METHODOLOGY AND MODEL DESCRIPTION 87

6.5 SCENARIO CONSTRAINTS 90

6.5.1 Maximum potentials 90

6.5.2 Biomass resource 90

6.5.3 Thermal and power demand 90

6.5.4 Transport reduction and modal shift 91

6.6 POTENTIAL SCENARIO TO 2050 91

6.7 BIOMASS CONSUMPTION 96

6.8 GAS CONSUMPTION 96

7 IMPLEMENTATION 97

7.1 INTRODUCTION 97

7.2 LEADING BY EXAMPLE 98

7.3 SETTING THE PLANNING FRAMEWORK 98

7.3.1 10% renewables requirement 98

7.3.2 Low carbon buildings 99

7.4 ENCOURAGE DEVELOPMENT OF A HEAT NETWORK 99

7.5 ENCOURAGING LARGE SCALE RENEWABLE ENERGY INSTALLATIONS 99

7.6 ENERGY EFFICIENCY MEASURES 100

7.6.1 Domestic 100

7.6.2 Non-domestic 100

7.6.3 Cross cutting 100

7.7 TRANSPORT 101

7.8 OPPORTUNITIES FOR REDUCING CO_2 EMISSIONS FROM TRANSPORT IN HARINGEY 101

7.8.1 Within LBH 101

7.8.2 Within Haringey 103

8 ESCOS & DELIVERY 108

8.1 ROLES REQUIRED 108

8.1.1 Power Plant Operator 108

8.1.2 Heat Network ... 108
8.2 WHAT IS AN ESCO? ... 108
8.3 POSSIBLE MODELS FOR HARINGEY ... 109
8.3.1 Barkantine Heat and Power ... 109
8.3.2 Woking – Thameswey Ltd ... 109
8.3.3 Aberdeen Heat and Power ... 109
8.3.4 Southampton ... 110
8.3.5 Transfer of Risk ... 110
8.3.6 Other Existing ESCo Options ... 111
8.4 A HARINGEY ESCO MODEL ... 111
8.5 POSSIBLE ESCO MEMBERSHIP ... 112
8.5.1 Housing Associations ... 112
8.5.2 Industry Champions ... 113
8.5.3 Local strategic partners ... 113
8.5.4 Residents' Associations ... 113
8.6 CONCLUSION ... 113
9 FUNDING ... 114
9.1 GRANT FUNDING ... 114
9.2 OTHER MECHANISMS ... 115
10 PHASING ... 116
10.1 HEAT AND POWER MAPS ... 116
10.2 PHASING OF SCHEMES ... 122
10.3 DEVELOPING A HEAT NETWORK ... 123
10.3.1 Connecting to Edmonton ... 123
10.3.2 Regeneration schemes ... 123
10.3.3 Further development of the heat network ... 123
11 CONCLUSIONS & RECOMMENDATIONS ... 124
11.1 BASELINE EMISSIONS ... 124
11.2 CARBON SCENARIOS ... 124
11.3 THE VISION ... 125
11.4 IMPLEMENTATION ... 125

Table of Figures

Figure 1: The Transition to a Low Carbon Future in the Building Sector 2
Figure 2: The Transition to a Low Carbon Future in the Transport Sector 3
Figure 3: Implementation of a Borough-wide Energy Services Strategy 15
Figure 4: Chart showing strategy process 16
Figure 5: UK Emission Reduction Targets and Aspirations against 1990 Baseline 18
Figure 6: Sectoral Carbon dioxide (CO_2) emissions from London, 1991 and 1999 21
Figure 7: Code for Sustainable Homes Points System 30
Figure 8: Theoretical Value of ROCs 43
Figure 9: Forward ROC Values (Source: Platts website) 43
Figure 10: Breakdown of London household emissions including indirect sources 45
Figure 11: CO_2 Emissions by sector, LECI 2003 50
Figure 12: LECI 2003 Energy Consumption and CO_2 emissions for Haringey 51
Figure 13: Grid Cells included in LECI 2003 51
Figure 14: Grid squares in Haringey 52
Figure 15: CO_2 emissions for different models 53
Figure 16: Percentage of CO_2 emissions from road transport modes by region 55
Figure 17: Insulating the unfilled cavity of a wall 61
Figure 18: A Schematic of a typical urban biogas system (Copyright Rutherford-Collins Ltd 2003) 69
Figure 19: CCGT simplified diagram 72
Figure 20: CO_2 Emissions for heating and hot water systems compared – CHP 38% efficiency 77
Figure 21: CO_2 Emissions for heating and hot water systems compared - CHP 42% efficiency 78
Figure 22: Biomass resource in London and surrounding 40km 83
Figure 23: Flow diagram of the model 87
Figure 24: Estimated capital expenditure for proposed scenario 93
Figure 25: CO_2 emissions savings under proposed scenario 94
Figure 26: Biomass consumption 96
Figure 27: Gas consumption 96
Figure 28: Influence vs. Emissions 97
Figure 29: Existing ESCos on Public/Private Sector Schematic 110
Figure 30: ESCo Roles 112
Figure 31: Gas consumption densities (LECI 2003) 116
Figure 32: Non-domestic gas consumption densities (LECI 2003) 117
Figure 33: Domestic gas consumption densities (LECI 2003) 118
Figure 34: Electricity consumption densities (LECI 2003) 119

Figure 35: Non-domestic electricity consumption densities (LECI 2003) 120
Figure 36: Domestic electricity consumption densities (LECI 2003)........ 121
Figure 37: Phasing of a heat network........ 122

Table of Tables

Table 1: Minimum Targets for Renewable Energy in London (Mayor's Energy Strategy) 20
Table 2: Assumptions used for Renewable Target Calculations........20
Table 3: Standard lifetime for heating systems 25
Table 4: Summary of support mechanisms 36
Table 5: Climate Change Levy for different fuels 38
Table 6: ETS variables 39
Table 7: Actual plant operating conditions........39
Table 8: ETS benefit for large CHP plant 40
Table 9: Low Carbon Building Programme Grants for individual householders 41
Table 10: Low carbon buildings programme stream 2 grants 41
Table 11: Forward values for ROCs for this study 43
Table 12: Total Energy Consumption for Haringey, DTI 2003 46
Table 13: CO_2 emissions by fuel & sector, DTI 2003 47
Table 14: CO_2 emissions by sector (Defra 2003) 48
Table 15: CO_2 emissions by sector (Defra 2004) 48
Table 16: Sources, sectors and datasets used within LECI 2003 49
Table 17: LECI 2003 Energy Consumption and CO_2 emissions for Haringey 50
Table 18: LECI 2003 Energy Consumption and CO_2 emissions for Haringey - Modified 52
Table 19 CO_2 emissions for different models........53
Table 20: Breakdown of Ownership (April 2004)........56
Table 21: Commercial and industrial types........57
Table 22: Haringey C&I floor space (April 2005)........57
Table 23: Predicted growth in commercial and industrial floorspace 58
Table 24: Greenhouse gas flux for waste management options (European Commission). 59
Table 25: Waste treatment methods in Haringey 59
Table 26: Wind resource 64
Table 27: Technology Compatibility 75
Table 28: Thermal and electrical energy yield from biomass........84

Table 29: Electrical and thermal yield from residual biomass 85
Table 30: CO_2 Targets for 2010, 2016, 2030 and 2050 87
Table 31: Technologies analysed within the model 90
Table 32: Summary of proposed scenario 92
Table 33: Summary of results for the proposed scenario 95
Table 34: Summary of support mechanisms 114
Table 35: Carbon scenario in 2050 125

1 Introduction

1.1 Aims and Objectives

The primary objective of this report is to calculate carbon reduction targets for Haringey and to put forward a strategy for Haringey to meet those targets, based on analysis of a range of scenarios. Short-term targets (to 2010 and 2016) for these reductions have been proposed by Haringey, based on a 60% reduction by 2050. This report re-assesses the baseline on which the target is based and quantifies the target absolute terms.

Figure 3 below shows the overall process of implementing a borough wide strategy, which this report forms the start of.

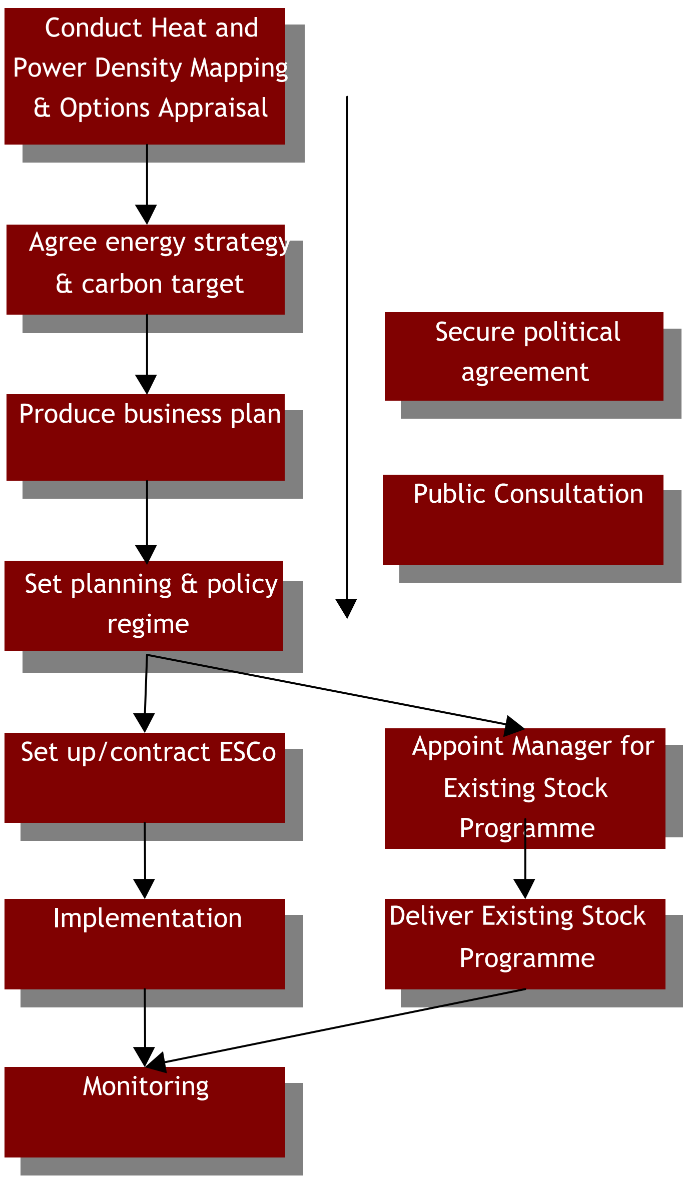

Figure 3: Implementation of a Borough-wide Energy Services Strategy

1.2 Methodology

Figure 4 below shows an overview of the process adopted to develop the strategy.

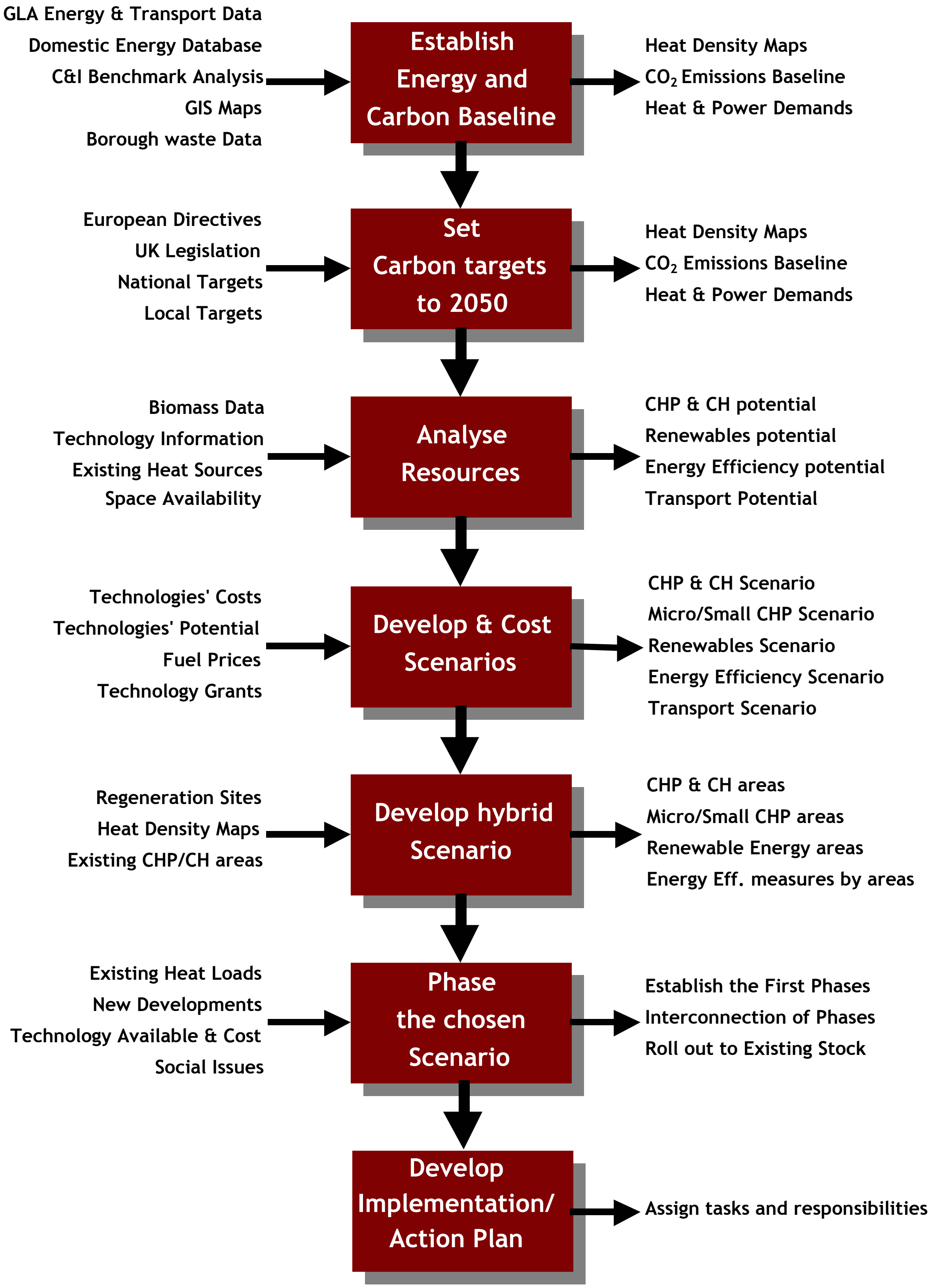

Figure 4: Chart showing strategy process

2 Policy and Funding Context

This section sets out the policy, regulatory and support programme context in which the Haringey strategy sits.

2.1 Carbon targets

2.1.1 Introduction

The section provides an overview of the carbon reduction targets that have already been set for London, including targets relating to renewable energy, energy generation, energy demand and distribution. All sectors are considered in the overview, including the transport, domestic and commercial sectors.

2.1.2 Measuring Carbon

Climate accounting is a complex area. Human-induced climate change results from a whole host of interactions between a range of different greenhouse gases and pollutants released by our activities. The emissions from aviation, for example, are not purely from the CO_2 emissions that are released through the combustion of kerosene: there are also "net radiative forcing" effects. These include the effect of the contrails and other effects produced by aircraft which are believed to increase the overall global warming impact of aviation by 2.7 times the direct CO_2 impact.[1]

Conventions for measuring carbon have tended to limit the inclusion of aviation fuel to landing and takeoff activities at airports within the city boundary. Other gases such as methane released from waste at landfill sites can also be counted towards emissions targets.

For the purposes of this study, whilst these associated impacts should be born in mind when setting a target, for clarity and simplicity, in setting a building sector target we are purely counting CO_2 released through the direct combustion of fuels either in homes, businesses or public sector buildings in London and the electricity consumed in those buildings.

Where power generation is sited within London this becomes a more complex issue. All renewables and CHP generated power, where it is sold for Renewables Obligation Certificates (ROCs) will count towards the national target. We therefore propose that, to avoid double counting emissions reductions for electricity generated within London, we adopt a position that the current Building Regulations figure for electricity generation and displaced electricity generation is used and in taking forward projections into the future this is kept constant.

2.1.3 Existing Targets

2.1.3.1 The Royal Commission 2050 Target

The Royal Commission on Environmental Pollution (RCEP) report *Energy: the Changing Climate*[2] recommends a 60% reduction in greenhouse gas emissions by 2050 for the UK. This is based on stabilising atmospheric levels of CO_2 at 550ppm (parts per million). At the time of the report (2000) they stood at 370ppm (now 381ppm). This target has been adopted by the UK government as a long term goal.

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[1] Intergovernmental Panel on Climate Change www.grida.no/climate/ipcc/aviation/064.htm

[2] www.rcep.org.uk/pdf/summary.pdf

The RCEP also recommends setting per capita reduction targets based on "contraction and convergence":

> The most promising, and just, basis for securing long-term agreement is to allocate emission rights to nations on a *per capita* basis – enshrining the idea that every human is entitled to release into the atmosphere the same quantity of greenhouse gases. But because of the very wide differences between *per capita* emission levels around the world, and because current global emissions are already above safe levels, there will have to be an adjustment period covering several decades in which nations' quotas converge on the same *per capita* level. This is the principle of contraction and convergence, which we support.

2.1.3.2 UK Emission Reduction Targets

The chart below summarises the overall targets that the UK currently aspires to. As the 2050 target is based on emission levels in 2000 rather than 1990, the overall target is actually 7% higher once set against 1990 levels[3] - a 7% reduction was achieved between 1990 and 2000.

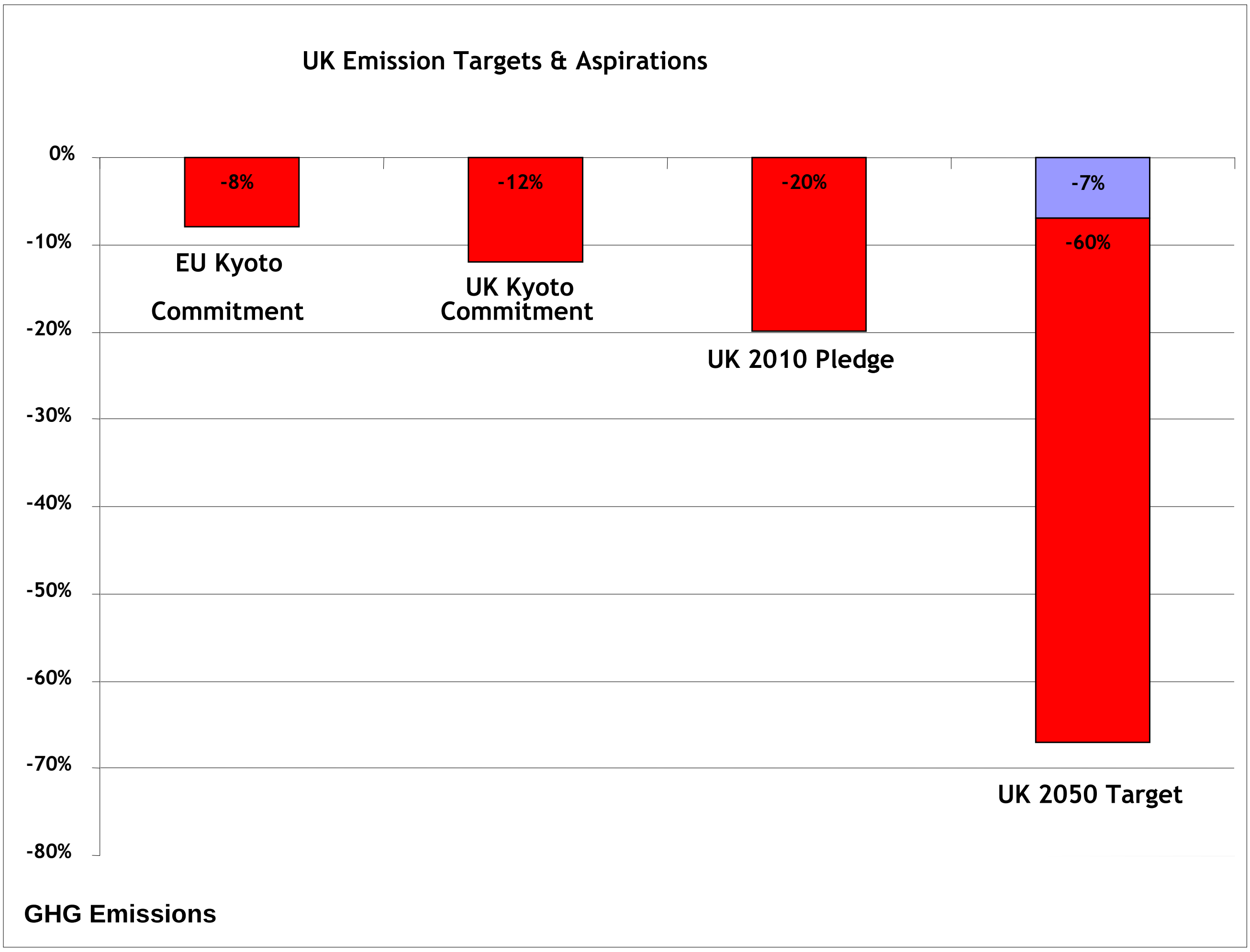

Figure 5: UK Emission Reduction Targets and Aspirations against 1990 Baseline

[3] Climate Change and Carbon Dioxide Emissions Transport Sector, Draft Discussion Document, TFL, March 2006

2.1.3.3 Targets in the Mayor's Energy Strategy

Policy 1 in the Mayor's Energy Strategy states:

> "The Mayor considers that London should take a proactive approach to ensure that it meets or exceeds its fair contribution to national targets for carbon dioxide emissions, renewable energy, combined heat and power, and eradicating fuel poverty."

Furthermore:

> "The Mayor supports the work of the Royal Commission on Environmental Pollution, and agrees with its conclusion that global atmospheric CO_2 concentration must not be allowed to exceed 550ppm. However, the choice of 550ppm as the upper limit will need to be kept under review."

The Mayor's Energy Strategy accepted the London Sustainable Development Commission's recommendations on targets. These were:

- 20% reduction on 1990 levels by 2010
- 60% reduction on 2000 levels by 2050

It is assumed that these refer to CO_2 emissions rather than the whole basket of greenhouse gas emissions which can be expressed as CO_2 equivalent.

2.1.3.4 Renewable Energy Targets

Targets were also set within the strategy for specific technologies. These are set out in Proposal 6:

> "London should generate at least 665GWh of electricity and 280GWh of heat, from up to 40,000 renewable energy schemes by 2010. This would generate enough power for the equivalent of more than 100,000 homes and heat for more than 10,000 homes.
>
> To help achieve this, London should install at least 7,000 (or 15MW peak capacity) domestic photovoltaic installations; 250 (or 12MW peak capacity) photovoltaic applications on commercial and public buildings; six large wind turbines; 500 small wind generators associated with public or private sector buildings 25,000 domestic solar water heating schemes, 2,000 solar water heating schemes associated with swimming pools, and more anaerobic digestion plants with energy recovery and biomass-fuelled combined heat and power plants. London should then at least triple these technology capacities by 2020."

Technology	Scale	2010				2020			
		Number installed	MWe	Elec GWh	Heat GWh		MWe	Elec GWh	Heat GWh
PV	Domestic	7,000	15	11		21,000	45	34	
PV	Large-scale	250	12	9		250	36	27	
Solar thermal	Domestic	25,000			35	75,000			105
Solar thermal	Swimming pool	2,000			21	6,000			63
Wind	Small	500	0.05	55		1500	0.15	493	
Wind	Large	6	2	32		18	6	284	
AD			5	40	40		15	120	120
Biomass CHP			65	520	780		195	1560	2340
Total				667	876			2517	2628
Total Target				**665**	**280**			1995	840

Table 1: Minimum Targets for Renewable Energy in London (Mayor's Energy Strategy)

As can be seen from the text from the Mayor's Strategy, not all of the targets were set out in detail for each technology but over arching targets for heat and power generation were set. We have therefore made assumptions about the contribution from each technology. An assumption that the Anaerobic Digestion (AD) and biomass CHP targets are both CHP leads to outputs higher than the heat target for an approximately correct electricity generation target. The table below summarises the assumptions made in assessing the installed capacity required to meet the overall GWh targets.

Technology	Scale	Output	Area	Load/ Capacity factor	Heat to power ratio
PV	Domestic	750kWh/kWp/yr			
PV	Large-scale	750kWh/kWp/yr			
Solar thermal	Domestic	350kWh/m2/yr	4m2		
Solar thermal	Swimming pool	350kWh/m2/yr	30m2		
Wind	Small			25%	
Wind	Large			30%	
AD				91.3%	1:1
Biomass CHP				91.3%	3:2

Table 2: Assumptions used for Renewable Target Calculations

(8000hrs of operation was selected as an approximate figure which gave the load factor of 91.3% for AD and biomass CHP.)

2.1.3.5 Baseline Estimate in Mayor's Strategy

The current target for 2010 and 2050 for emissions reductions in London were set with 1990 and 2000 levels as a baseline respectively. These were estimated in the strategy as 45million tpa CO_2 for 1990 and approximately 42million tpa CO_2 for 2000, including the transport, domestic, commercial and industrial sectors.

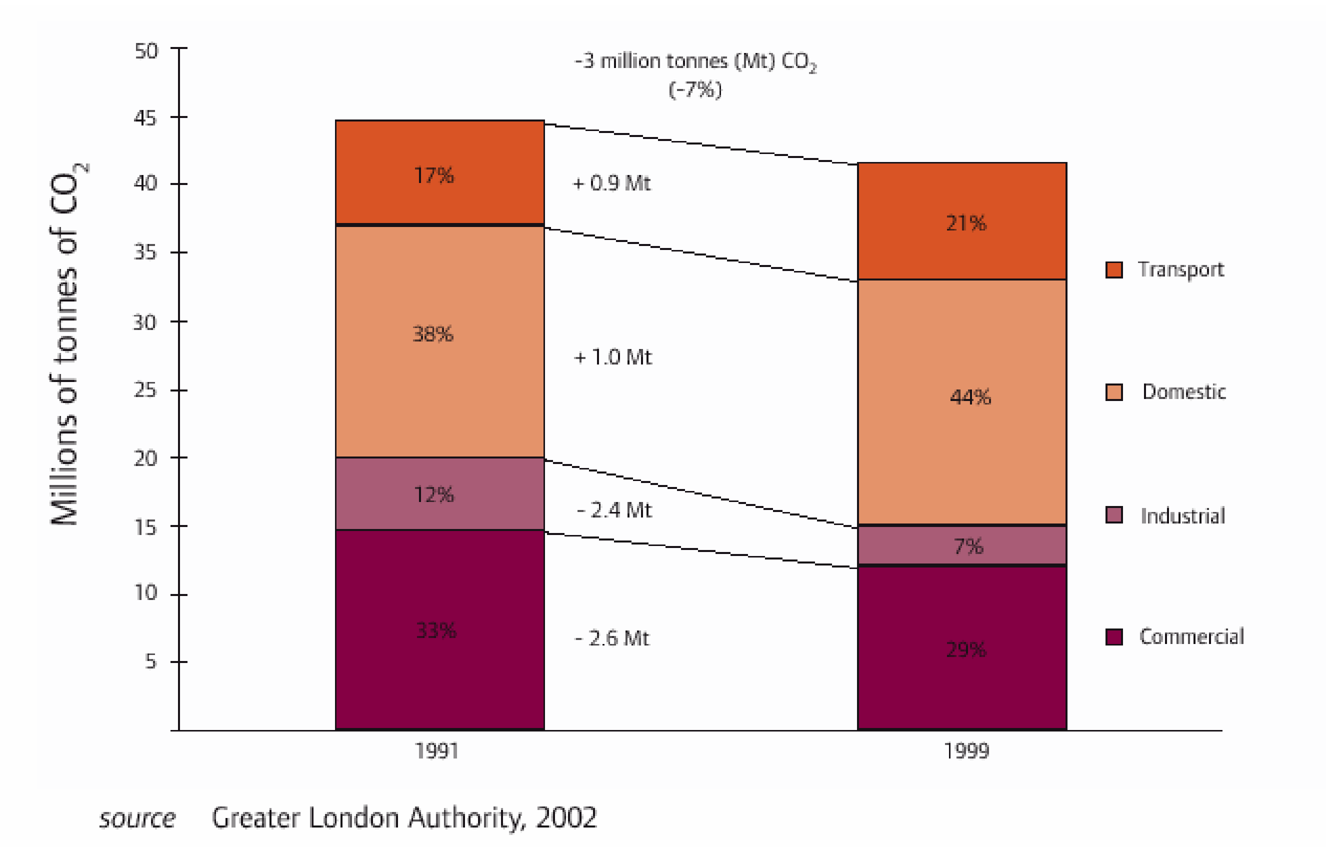

Figure 6: Sectoral Carbon dioxide (CO_2) emissions from London, 1991 and 1999[4]

2.1.4 The New Climate Science

The targets discussed above were set in a context of considerable uncertainty about the likely impact, scale and speed of climate change (the RCEP report was published in June 2000). Climate science has moved on significantly since then with many studies suggesting that the worst case scenarios are likely to have been closest to the correct predictions. There is also increasing evidence around a "tipping point" where natural feedback mechanisms will lead to uncontrollable, irreversible and accelerated climate change. There is now a developing consensus that to avoid this, global temperature rises should not exceed 2°C. This target has been adopted by the EU Council:

> "The European Council acknowledges that climate change is likely to have major negative global, environmental, economic and social implications. It confirms that, with a view to achieving the ultimate objective of the UN Framework Convention on Climate Change, the global annual mean surface temperature increase should not exceed 2ºC above pre-industrial levels."

[4] Greater London Authority, Green Light to Clean Power, The Mayor's Energy Strategy, 2004

2.1.4.1 Royal Commission Response to Calls for Higher Targets

In the light of this new evidence, the Royal Commission have recently been asked to review their 60% reduction target. In a letter to the Treasury they state that:

> "Science is showing us ever more clearly that there will be serious impacts as a result of climate change, and this has prompted some to argue for stabilising CO_2 levels below the current UK/EU goal of 550 ppm. Recent evidence suggests this may be right at the upper limit of the likely prudent level, and that climate change could cause catastrophic and irreversible impacts, which will very difficult to predict or prepare for...
>
> ....Given the current uncertainties in models we cannot confidently unscramble the different dangers associated with 450, 550 or 650 ppm CO_2, although we know that each higher level will yield more problems from gradual climate change and increase the risk of dramatic and irreversible changes. However, the differences in emission scenarios over the next decade for the three CO_2 levels are not very great, and the crucial thing is to set a course for stabilisation now, otherwise all the targets will be unattainable. Thus we believe that the 550ppm CO_2 goal remains reasonable for now, being challenging yet attainable, and reducing the climate change impact far below business as usual levels. It could be kept under review to allow a move to a lower target if this becomes necessary."

The essential point being made is that we might need a higher target but taking a 10 year view, the difference in emissions reductions are not that great. As we shall see later, the implications when taking a 20 year view to 2026 of increasing the 2050 target are quite significant for London.

2.1.4.2 What does a 2 degree limit mean?

According to the Potsdam Institute, this temperature limit leads to a requirement to stabilise atmospheric concentrations of greenhouse gases at less than 440 ppm CO_2 equivalent.

A report by Colin Forrest[5] explores the implications on targets for this level of atmospheric emissions:

> "we find that the current natural sinks for anthropogenic emissions, around 4 gigatonnes of carbon per year (or 4 GtC a^{-1}) will be reduced to around 2.7 GtC a^{-1} in 2030. 2.7 GtC a^{-1} therefore, is the amount of greenhouse gases we will be able to emit in 2030, without increasing atmospheric concentrations.
>
> When this global emission limit is shared out between the projected world population of 8.2 billion people, we get a per capita emission limit of 0.33 tonnes of carbon per year.
>
> In the UK we currently emit around 3 tonnes of carbon equivalent per person per year, so we will need to reduce our greenhouse gas emissions by 90%, compared with current levels, by 2030."

Achieving an emission level per capita of 0.33 tonnes of carbon by 2030 is clearly a very ambitious target. Whether this target is realistic will be examined once the detailed housing stock data is available for analysis. As emission level is based on a per capita level this would allow for the projected increase in population.

2.1.4.3 The Tyndall Centre Target

Irrespective of what the overall targets are set at, there are also sound arguments that the building stock must make a higher contribution to these targets. A recent Tyndall Centre study made the claim that the rest of the economy would need to be carbon neutral to allow for the likely growth in aviation emissions.

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[5] www.climate-crisis.net/downloads/THE_CUTTING_EDGE_CLIMATE_SCIENCE_TO_APRIL_05.pdf

2.2 EU regulation

2.2.1 Energy Performance in Buildings Directive (2002/91/EC)

This important directive will be implemented through the revised UK building regulations and was due to come into force in January 2006, and must be fully implemented by 2009. The directive covers:

- The establishment of a framework for a common methodology for calculating the energy performance of all buildings
- The application of minimum standards of energy performance for new buildings and existing buildings with a total surface area over 1,000 m^2 when they are renovated
- Certification schemes for new and existing buildings and the public display of these certificate
- Inspection and assessment of boilers and heating/cooling installations.

2.2.2 The Landfill Directive (99/31/EC)

This directive requires member states is to reduce the quantities of landfilled biodegradable waste to 75%, 50% and 35% of the amount produced in 1995 by 2010, 2013 and 2020 respectively. The local authorities efforts to comply with this directive and to save money on landfill gate fees will promote composting and the generation of biogas through anaerobic digestion. Biogas makes an excellent alternative to conventional natural gas as a fuel for CHP plant and boilers.

2.2.3 EU Cogeneration Directive (2004/08/EC)

This directive ensures that the member states can continue to support CHP schemes using public funds[6]. It provides a methodology for calculation of the energy efficiency of CHP. The harmonised methodology is key to the operation of the directive as public support must be based on the schemes' primary energy savings. The directive also requires member states to issue certificates of origin where such a certificate is required by the CHP operator. The Directive includes an amendment to the EU Hot Water Boilers Directive (92/42/EEC). This ensures that micro-CHP units which would not be able to comply with minimum heat efficiency thresholds required by the latter can now do so.

2.2.4 Renewable Transport Fuel Directive (2003/30/EC)

This directive obliges member states to ensure that a certain percentage of transport fuel comes from renewable sources. The targets are 2% of all petrol and diesel for transport purposes (calculated on the basis of energy content) by the end of 2005, and 5.75% by the end of 2010.

The UK has introduced the Renewable Transport Fuel Obligation that works in a similar way to the Renewables Obligation. Suppliers of transport fuel will be obliged to supply 5% renewable fuels by 2010. They will be issued with certificates to show compliance, which can be traded.

2.3 National

2.3.1 Home Energy Conservation Act (HECA) 1995

Under HECA local authorities are required to increase the energy efficiency of all domestic property within their borders by 30% over April 1996 levels by 2011. This includes all tenures. Most, if not all, of this target can be achieved by using a number of fairly simple measures including insulation, better controls and supply of condensing boilers.

2.3.2 UK Electricity Suppliers Licence exemption regime

On the 1st October 2001, the government introduced legislation which relaxes exemption criteria for licences for electricity supply, generation and distribution. The threshold above which a supply licence is required has been increased. This removes the additional administrative burden associated with becoming a licensed supplier. Clearly, this benefits CHP by encouraging small scale distribution from embedded generation - especially where energy supplies are exported direct to tenants. The new criteria increase the power output limits to include:

- Distribution of 2.5 MWe to domestic consumers, with up to a further 1 MWe from a generating station embedded in the distribution system
- Supplies of no more than 5MWe, of which 2.5 MWe could be supplied to domestic consumers (either generated on site or received from another licensed supplier)

2.3.3 Warm Homes and Energy Conservation Act 2000

As a result of this act the government produced a target for the eradication of fuel poverty. The government's stated aim is to ensure that 'no household in Britain should be living in fuel poverty by 2016-2018'. Fuel poverty in 'vulnerable' households will be ended by 2010. Vulnerable households are described as: 'older households, families with children and households who are disabled or who have a long term illness'.

2.3.4 Sustainable Energy Act 2003

The Act was passed in 2003 and has the following provisions:

- Requires the Government to report annually to Parliament on the 135 commitments in the Energy White Paper regarding reducing emissions of CO_2 and ending fuel poverty
- Requires the Government to set an energy efficiency aim for residential accommodation
- Enables the Government to set binding targets for local authorities falling short of their targets under the Home Energy Conservation Act (1995)
- Requires the Government to set a target for Combined Heat and Power (a way of using 'Waste heat' to generate electricity so reducing emissions) in Government buildings
- Requires Ofgem (the gas and electricity regulator) to publish environmental impact assessments of its actions
- Releases £60 million for developing renewable sources of energy

2.3.5 Energy Bill

This was published in 2004. The bill implements commitments made in the government's energy white paper 'Our Energy Future – Creating a Low Carbon Economy', published in February 2003. The white paper identifies three main challenges for energy policy: climate change, decline in indigenous energy supplies, the need to upgrade the UK's energy infrastructure. To meet these challenges four policy goals are identified:

- Put the UK on a path to cutting CO_2 emissions by 60% by 2050
- Maintain reliability of energy supplies
- Maintain competitive markets in the UK and beyond
- Ensure that every home is affordably and adequately heated

[6] such as exemption from Climate Change Levy on fuel inputs and power outputs

By 2020 the white paper envisages, ‘much more micro-generation, for example from CHP plant, fuel cells in buildings or photovoltaics’. The bill places a heavy reliance on CHP to deliver the required carbon savings. For example of the 3.5 Mt Carbon required to be saved by 2010, 1 Mt Carbon comes from CHP. The rest will come from energy efficient appliances and lighting, fabric insulation measures and condensing boilers.

2.3.6 Decent Homes

The ODPM requires has set a target “by 2010, to bring all social housing into decent condition, with most of the improvement taking place in deprived areas” where a “decent home is one which is wind and weather tight, warm and has modern facilities.”

There are 4 aspects to this definition:

- minimum standards for fitness
- reasonable state of repair
- reasonably modern facilities and services
- thermal comfort

2.3.6.1 Fitness Standard

The main element of this that relates to energy is that dwelling must have: have adequate provision for lighting, heating and ventilation.

2.3.6.2 Reasonable state of Repair

This states that to the meet the standard components must not be “old” where old is defined if it is older than its expected or standard lifetime. The component lifetimes given for energy related aspects are:

Building component	Houses & Bungalows	All flats in blocks of below 6 storeys	All flats in blocks of 6 or more storeys
Heating central heating gas boiler*	15	15	15
Heating central heating distribution system	40	40	40
Heating other*	30	30	30
* denotes key component			

Table 3: Standard lifetime for heating systems

“Landlords will wish to consider whether these lifetimes are appropriate within their own stock for predicting the age at which the component ceases to function effectively.”

A building component can only fail to satisfy this criterion by being old and requiring replacing or repair. A component cannot fail this criterion based on age alone.

- Components are in poor condition if they need major work, either full replacement or major repair.
- One or more key components, or two or more other components, must be both old and in poor condition to render the dwelling non-decent on grounds of disrepair.

- Components that are old but in good condition or in poor condition but not old would not, in themselves, cause the dwelling to fail the standard.
- A building component which requires replacing before it reaches its expected lifetime has failed early. Under the terms of the definition, this early failure does not render the dwelling non-decent but should be dealt with by the landlord, typically on a responsive basis.

2.3.6.3 Thermal Comfort

To meet this criterion a dwelling must have

- efficient heating and
- effective insulation

Efficient heating is defined "as any gas or oil programmable central heating or electric storage heaters or programmable LPG/solid fuel central heating or similarly efficient heating systems which are developed in the future". Heating sources which provide less energy efficient options fail the decent home standard. Programmable heating is "where the timing and the temperature of the heating can be controlled by the occupants."

Because of the differences in efficiency between gas/oil heating systems and the other heating systems listed, the level of insulation that is appropriate also differs:

- For dwellings with gas/oil programmable heating, cavity wall insulation (if there are cavity walls that can be insulated effectively) or at least 50mm loft insulation (if there is loft space) is an effective package of insulation; and
- For dwellings heated by electric storage heaters/LPG/programmable solid fuel central heating a higher specification of insulation is required: at least 200mm of loft insulation (if there is a loft) and cavity wall insulation (if there are cavity walls that can be insulated effectively).

Most communally homes don't have their own programmers, though they should have thermostatic radiator valves, yet if they are sourced from CHP the heating system is much more "efficient" in primary energy terms than a conventional gas boiler system. In the true sense of "efficient heating system" they more than meet the criterion and yet in the specific criterion they fail.

2.3.7 Building Regulations

2.3.7.1 New Dwellings

The new draft building regulations came into force on April 6th 2006. They make requirements for a Target CO_2 Emission rate (TER) expressed in kg/m^2/yr. For most dwellings (under 450m^2) the SAP method must be used and this now includes ventilation and internal fixed lighting as well as heating and hot water.

The target is set by entering the dimensions of the proposed buildings into SAP but using a standard set of reference data for U-values, boiler efficiency etc, multiplying this by a fuel factor and then adjusting this overall carbon figure by an improvement factor of 20%. The reference set of U-values are essentially the u-values set out in 2002 Building Regulations. Thus far this would therefore imply an overall 20% improvement on these values needs to be achieved.

However low or zero carbon energy supply systems such as PV, solar thermal or ground source heat pumps (GSHP) or CHP can be used to contribute towards this target. In order to prevent over use of trade offs a minimum set of U-values has been set. These are similar to the 2002 Building Regulation values.

The actual building emission rate is known as the Dwelling Emission Rate (DER). The DER is calculated using SAP using the actual proposed U-values, boiler efficiency etc. The DER obviously must meet the TER for compliance to be achieved.

Essentially the overall impact appears to be that it's possible to build to the 2002 Regulations if CHP, GSHPs, PV or other renewables are used in sufficient quantities to provide a 20% carbon reduction. This implies that under new Regulations new Buildings could be built to 2002 U-values if enough renewables or CHP were installed.

On the 13th December 2006, the Government announced a proposal to progressively tighten building regulations up to 2016, when all new homes would be "zero carbon"[7].

2.3.7.2 Existing Dwellings

Existing dwellings are subject to building regulations approval when certain works are carried out to them. Examples of such works include extensions, changes of use, loft conversions and the replacement or renovation of a *thermal element*[8].

When these works are carried out, any new building elements would have to meet the same U-value standards as for new dwellings, i.e. similar to the 2002 building regulations. They must also not make any existing building elements any worse than they were before the work was carried out.

For renovating or replacing thermal elements (excluding decorating), the thermal element should meet the relevant U-value standard where technically, functionally and economically feasible. A measure with a simple payback of 15 years or less is considered economically feasible. If it is not feasible, then the element should be improved to the best standard that is technically, functionally and economically feasible. A good example of this is cavity wall insulation, where the amount of insulation that can be installed is limited by the size of the cavity. The highest feasible standard is probably to fill the available cavity with insulating material.

2.3.8 Code for Sustainable Homes

In responding to recommendations by the Sustainable Buildings Task Group, John Prescott, Patricia Hewitt and Margaret Beckett agreed in July 2004 that a Code for Sustainable Homes be developed.

This was designed to fulfil the 2005 Labour Party manifesto commitment:

> *"From April 2006 all new homes receiving government funding will meet the new Code for Sustainable Homes and we will encourage local authorities to apply similar standards to private homes."*

Initially a consultation for the Code was launched on 6th December 2005, followed by final publication on 13th December 2006. It is based on the BRE's existing EcoHomes scheme, and is also compatible with the Energy Performance of Buildings Directive to avoid duplication. The code is a voluntary initiative, by Government and Industry, to actively promote the transformation of the building industry towards more sustainable practices by requiring buildings to use:

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[7] www.communities.gov.uk/index.asp?id=1002882&PressNoticeID=2320, accessed 3/1/2007.

[8] A thermal element is essentially a wall, floor or roof separating the inside of the building from the external environment.

- Energy resources more efficiently
- Water resources more efficiently
- Material resources more efficiently and
- Practices and materials designed to safeguard occupants' health and well being

According to the DTI, the principal objective of the code is to become the single national standard for sustainable building that all sectors of the building industry will subscribe to and consumers demand and to promote more sustainable building practices.

The Code has various essential elements. These are:

- **energy efficiency** in the fabric of the building and appliances in the building. This covers, for example, the standard of insulation or the use of solar heating. It may include ‘A’ rated kitchen appliances (where fitted) or low energy light bulbs;
- **water efficiency**, for example, fitting dual or low flush toilets and reduced flow taps;
- **surface water management**, for example sustainable drainage;
- **site waste management**, as building construction is responsible for a significant proportion of waste that currently goes to landfill;
- **household waste management**. This means providing space for bins, such as segmented kitchen bins for recycling waste;
- **use of materials**, for example, using low allergy materials;
- **ecology of the site**, which must be protected or enhanced by development.

Minimum standards would be set for each essential element and all of these must be achieved if a home is to meet Code standards. Where there is a relevant building regulation, then the minimum Code standard would at least equal or exceed it.

In addition, homes built to higher Code standards might have some of the following features:

- **Lifetime Homes -** this is about internal adaptability so that a home can be adapted for use of an elderly or disabled person;
- **additional sound insulation** which is important especially in apartment developments;
- **private external space** which may be a garden or a balcony;
- **higher daylighting standards** which is beneficial to health and reduces the need for electric lighting;
- **improved security**;
- **a home user guide** - this is a home log book and will advise purchasers on the details of the sustainability of their home.

The Code is performance-based which means that it does not prescribe how a particular standard should be achieved. Rather, it sets a standard and allows the house-builder to deliver the required level of sustainability. This is designed to encourage the house-building industry and its suppliers to become much more innovative in finding sustainable building solutions and products.

2.3.8.1 How will the Code be applied?

The Government wishes to see all new homes in England built to meet the Code. Homes we construct today should be built to last for at least 60 years. It will be a lost opportunity if house-builders fail to recognise how much the climate of the UK could change even by 2030.

The Government intends to implement its commitment set out in the Labour Party manifesto earlier this year which stated

> *"From April 2006 all new homes receiving Government funding will meet the new Code for Sustainable Buildings and we will encourage local authorities to apply similar standards to private homes".*

Ministers will deliver this commitment from the launch of the Code next year, by requiring that all new homes built by RSLs (or others) with Housing Corporation funding will comply with higher levels of the Code, together with homes developed by:

- English Partnerships;
- with the direct funding support from any of the Government's housing growth programmes, including the Thames Gateway, the Milton Keynes/South Midlands area and Ashford, together with any other growth points that are supported.

2.3.8.2 Essential Element Minimum Standard

- **Energy Efficiency** - As Building Regulations Part L1A 2006 (conservation of fuel and power)
- **Water Efficiency** - No greater than 125 litres per head per day (use of potable water) (46m^3/bedspace/year).
- **Surface Water Management** - Ensure that peak run-off rates and annual volumes of run-off will be no worse than the original conditions for the development site.
- **Site Waste Management** - Adopt and implement Site Waste Management (during construction) Plans (including monitoring of waste)
- **Household Waste Management** - At least 0.8m^3 storage for each home (during occupation and use)
- **Use of Materials** - Inventory of materials/products used.

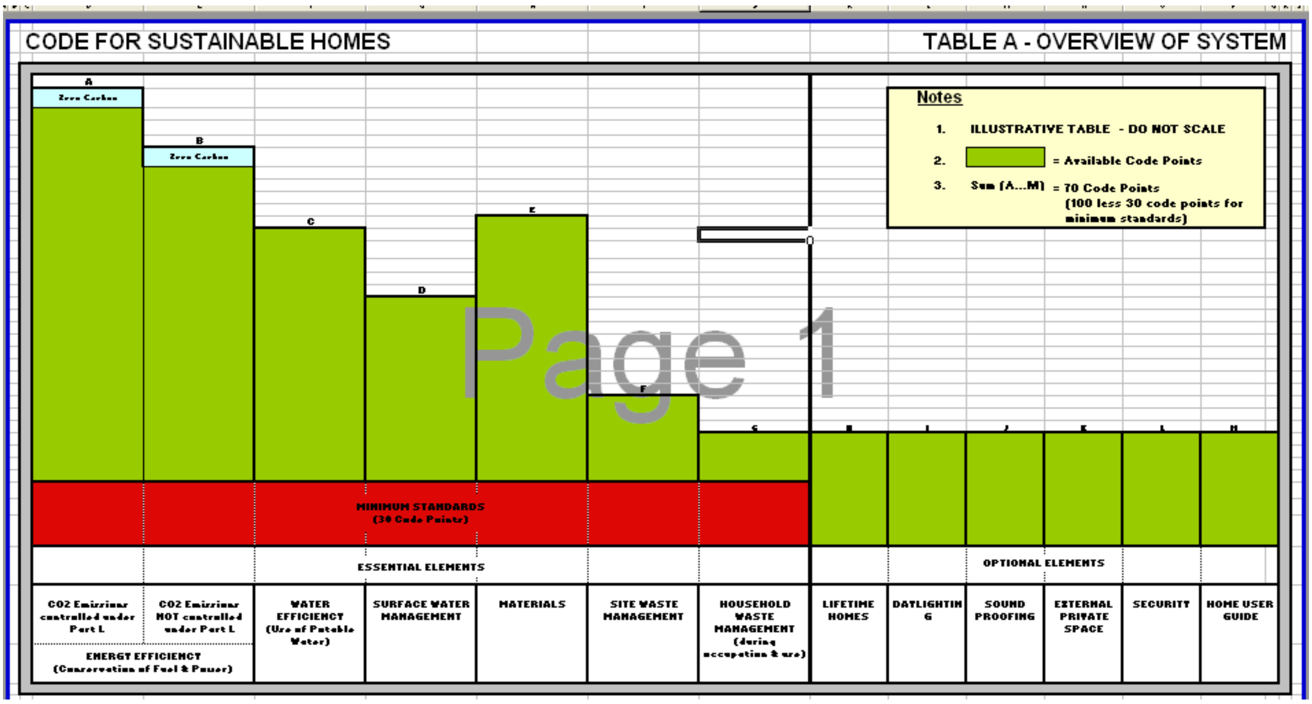

Figure 7: Code for Sustainable Homes Points System

Effectively all new homes must meet the minimum standard (level 1 - 30 points) and any new homes built with public money must meet level 3 (60 points)

2.3.8.3 Strengthening the Code

After the consultation the Government announced it would be introducing a series of revisions to the Code as well as undertaking further research into future improvements.

In addition energy efficiency ratings - which form one component of the Code - will be made mandatory for new homes and existing homes. The ratings will be included in energy performance certificates set out to EU standards.

The Government has decided to set minimum standards of energy and water efficiency for every level of the Code, rather than allowing builders to trade different kinds of improvements against each other. The lowest levels of the Code will also be raised above the level of mandatory building regulations.

The Government is considering making assessment under the code mandatory in the future.

2.3.9 UK Combined Heat and Power Strategy

Published in April 2004 by RSLs, it set set a target of 10,000 MW_e of combined heat and power (CHP) by 2010 – this would meet 20% of its CO_2 reduction target. The strategy proposed a range of measures to support CHP.

Fiscal Incentives:

- Climate Change Levy exemption on fuel inputs to Good Quality CHP and on all Good Quality CHP electricity outputs
- eligibility for Enhanced Capital Allowances to stimulate investment
- Business Rates exemption for CHP power generation plant and machinery
- a reduction in VAT on certain grant-funded domestic micro-CHP installations

- a Government announcement to possibly reduce VAT more widely on micro-CHP
- Climate Change Agreements to provide an incentive for emissions reductions

Grant Support:

- the £50m Community Energy programme to encourage CHP in community heating schemes

Regulatory Framework:

- the EU Emissions Trading Scheme, from which CHP should benefit as a form of low-carbon generation. A portion of the free new entrant reserve will be ring-fenced for CHP. The impact of the Scheme on CHP capacity is difficult to quantify and will partly depend on decisions yet to be taken on the implementation of the Scheme, but could be in the range of 100–400 MWe by 2010;
- introduction of the EU Directive on the promotion of cogeneration (CHP) based on useful heat demand in the internal energy market;
- changes to the licensing regime, benefiting smaller generators;
- continued work with Ofgem to ensure a level playing field under NETA for smaller generators, including CHP;
- continued emphasis of the benefits of CHP and community heating whenever Planning Policy Guidance, Regional Planning Guidance or Sustainable Development Guidance is introduced or reviewed;
- review of the existing guidance on information required to accompany power station consent applications to ensure full consideration of all options for CHP and community heating;
- explore the opportunities to incentivise CHP technologies in an expanded household Energy Efficiency Commitment from 2005, and any wider Commitment;
- encouraging the take-up of CHP through the Building Regulations; and
- addressing the administrative burdens placed on smaller generators and incentivising the utilisation of distributed generation.

Promotion of Innovation:

- instigation of field trials to evaluate the benefits of micro-CHP;
- promotion and support by the Carbon Trust, in non-domestic markets, and the Energy Savings Trust, in domestic markets, for the development of energy efficiency and low-carbon technologies including CHP;
- reviews by the Energy Saving Trust and the Carbon Trust of their current and future programmes to ensure they reinforce delivery of the Government's CHP target; and
- improvements to existing CHP schemes through development of a Quality Improvement programme.

Government Leadership:

- adoption of a 15% target for Government Departments to use CHP generated electricity and the encouragement of other parts of the public sector to consider doing the same.

2.3.10 Transport Ten Year Plan (2000)

This document laid out the Government's strategy for improving transport over a ten year period. It set out the Government's aim to improve all forms of transport in ways which increase choice and the levels of public and private investment needed. Eleven key transport challenges for the ten years to 2010 are set out one of which is climate change. One section of the Ten Year Plan specifically addresses London and sets out the most important transport improvements needed in the capital:

- "delivering increased public transport capacity and efficiency to cater for London's growing economy and to reduce overcrowding;
- tackling road congestion with improved public transport and congestion charging in central London to encourage motorists to transfer to other modes of transport;
- improving access to jobs, regeneration areas and key local facilities to promote social inclusion;
- reducing road accidents and improving the environment through town centre and local area improvements; and
- providing a better door-to-door journey for all - including cyclists and pedestrians - for example through measures to improve safety, personal security, accessibility, integration and information."

2.3.11 The Future of Transport (2004)

The most recent White Paper 'The Future of Transport' builds on the Ten Year Plan for Transport and addresses the transport system for the country over in the period up to 2030. The role of the Mayor and Transport for London is expanded giving more control over the railway network in London. The White Paper acknowledges both the benefits and costs of travel and stresses that as the economy grows the demand for travel will also continue to grow. The White Paper gives three main themes for transport strategy: sustained long term investment; improvements in transport management and planning for the future. The importance of transport in reducing the emissions of greenhouse gases, in particular CO2 is acknowledged. The White Paper gives the most cost effective ways of reducing the climate change impact from transport as raising the cost of fuel, reducing the cost of energy efficient vehicles and increasing the efficiency of road haulage. However it states that the Energy White Paper found that measures in other sectors were generally more cost effective than transport initiatives.

2.4 Regional

2.4.1 London Energy Strategy

The Mayor of London's Energy Strategy *A Green Light to Clean Power* was published in 2004. It contains a vast array of policies and proposals. These are the key statements on CHP:

- Combined heat and power (CHP), whereby heat and electricity are produced and utilised simultaneously, is almost twice as efficient as separate production. Increased use of CHP would effectively reduce carbon dioxide emissions. The Mayor considers that London should maximise its contribution to meeting the national target by at least doubling its 2000 combined heat and power capacity by 2010.

- The heat generated from CHP plants can be used in industrial processes, in commercial premises or to provide heat for homes through community heating systems, which can provide affordable warmth to large numbers of homes, helping to tackle fuel poverty.

- The Mayor will use his planning powers to help to deliver significant increases in CHP capacity and community heating in London, by requiring their inclusion in planning applications referable to him wherever possible. The Mayor will encourage the boroughs and the London Development Agency to follow this lead.

- The Mayor wants to increase the use of community heating in London, and has recently led a successful application to the Government's Community Energy Programme for a London community heating development study.

On ESCos:

- Greater efficiency in energy use can be gained by a different approach to buying and selling energy. Energy Service Companies (ESCos) would deliver the services that people require - such as warmth, heat and light. They would be obliged to work towards the reduction of greenhouse gases and to improve the condition of customers' homes. This could include helping to install energy-saving technology to reduce the energy bills of the homes they serve and providing the homeowner with a single bill covering all aspects of energy services, from fuel and electricity supply to boiler maintenance.
- A small number of these energy services companies are already operating in London. The Mayor will encourage these to expand and new ones to be set up.

2.4.2 The London Plan

The Mayor of London published the London Plan in February 2004. Policy 4B.6 Sustainable design and construction states that:

> The Mayor will, and boroughs should, ensure future developments meet the highest standards of sustainable design and construction and reflect this principle in UDP policies. These will include measures to:
>
> - re-use land and buildings
> - conserve energy, materials, water and other resources
> - ensure designs make the most of natural systems both within and around the building
> - reduce the impacts of noise, pollution, flooding and micro-climatic effects
> - ensure developments are comfortable and secure for users
> - conserve and enhance the natural environment, particularly in relation to biodiversity
> - promote sustainable waste behaviour in new and existing developments, including support for local integrated recycling schemes, CHP schemes and other treatment options (subject to Policy 4A.1 and 4A.2)

Applications for strategic developments should include a statement showing how sustainability principles will be met in terms of demolition, construction and long-term management.

Boroughs should ensure that, where appropriate, the same sustainability principles are used to assess planning applications.

2.4.3 Mayor's Transport Strategy (MTS)

The Mayor of London has more responsibility for transport than any other region of England, having overall control over London Underground, buses, taxis, the strategic road network, light rail and river services - all overseen by Transport for London. In 1999 the Greater London Authority Act required the London Mayor to produce a transport strategy. This was produced in 2001 and looked at transport in London up to 2011. The strategy was written with reference to National Policy, in particular the 1998 Transport White Paper and the Ten Year Plan produced in 2000. Ten key transport priorities for London are outlined:

- Reducing traffic congestion
- Improvements to the underground
- Improving the bus network
- Integrating the National Rail network more fully into London's transport network
- Increasing the capacity of London's transport network
- Improving journey time reliability for car users
- Supporting local transport initiatives
- Making the distribution of goods and services more efficient
- Improving the accessibility of London's transport network
- Transport integration initiatives – including fares.

Implementation of the strategy is largely down to Transport for London and the London Boroughs who are required to produce a Business Plan and Local Implementation Plans respectively to show how they will implement the strategy locally. A range of targets are set including measures regarding: passenger numbers and capacity for public transport networks; traffic growth with different targets set for central, inner and outer London; walking; cycling and road safety. Detailed guidance on how to implement the MTS through LIPS is issued to London Boroughs.

2.5 Local

2.5.1 BVPI 63

Best Value Performance Inidicator 63 is a measure of the average SAP of a local authority's housing stock.

The Standard Assessment Procedure (SAP) is an index of the annual cost of heating a dwelling to achieve a standard heating regime and runs from 1 (highly inefficient) to 120 (highly efficient). It is a measure of a dwelling's overall energy efficiency, it is dependent on both the heat loss from the dwelling and the performance of the heating system.

An energy survey needs to be conducted to set the baseline position. The survey should be carried out in accordance with the ODPM's local house condition survey guidance. This data should then be updated annually to account for works carried out each year.

If a formal decision has been made to demolish dwellings, they should not be included in the calculations.

Periodically, new surveys should be used to form a new baseline to update

2.5.2 Haringey HECA strategy

The key aims of Haringey's Home Energy Strategy are:

- **Energy Efficiency** - To increase the energy efficiency of homes in Haringey
- **Energy Consumption** - To reduce overall energy consumption in Haringey and to encourage householders to use energy wisely
- **Carbon Dioxide Emissions** - To reduce carbon dioxide emissions due to energy use in homes in Haringey

- **Renewable Energy -** To increase the proportion of electricity generated from renewable sources and encourage greater self-sufficiency amongst Haringey residents
- **Affordable Warmth** - To eradicate fuel poverty in Haringey Council homes by 2010 and to assist the reduction of fuel poverty in the private sector
- **Community Energy/Community Ownership** - To encourage and facilitate the extension of community heating/combined heat and power to all housing tenures and local ownership of electricity and heat generation.

2.5.3 Planning Policies

The Haringey UDP requires all major developments to supply an energy assessment with planning applications and to supply 10% of their energy from on-site renewables where feasible.

The energy assessments should demonstrate that:

> the proposed heating and cooling systems have been selected in accordance with the following order of preference: passive design; solar water heating; combined heat and power, for heating and cooling, preferably fuelled by renewables; community heating for heating and cooling; heat pumps; gas condensing boilers and gas central heating.

Energy assessments and 10% renewable provision will be encouraged for non-major developments.

The UDP also calls for one large wind power scheme in the borough (no date is put forward for this) and one zero carbon development in the borough by 2010.

2.5.4 Haringey's Local Implementation Plan (LIP)

Haringey's LIP was submitted to Transport for London for approval in September 2006. It covers the period up to 2009 with indicative proposals up to 2011. Thirty-four transport strategy policies are set out in the LIP. Five key objectives are taken from the UDP:

- To support and promote transport improvements where it would improve safety for all road users, including pedestrians and cyclists, enhance residential amenity and complement land development and regeneration strategies
- Discourage the use of the car and promote other forms of travel
- Improve freight movement whilst minimising the environmental impact
- To balance the need for parking and the environmental impact of traffic movement and parked cars
- To encourage developments which, through their design, reduce the need to travel, especially by car

With the exception of the targets set as part of the Mayor's Transport Strategy few specific targets are set in the LIP. LBH commits to meeting most of the MTS targets, but aims to limit traffic growth to 2.5% between 2001 and 2011 rather than the zero growth target for inner London boroughs set in the MTS. This is due to the level of planned development in the borough and the fact that three neighbouring boroughs are defined as outer London and therefore have a target to restrict traffic growth to 6% rather than halt it altogether.

The majority of the LIP details how Haringey will meet its MTS targets and in particular improve road safety and reduce congestion. There is limited mention of the climate change impacts of transport in the main body of the LIP although the environmental, social and health benefits of reducing car use and increasing walking, cycling and public transport use is acknowledged. Environmental aspects of the LIP are considered in Chapter 9 and the LIP underwent a Strategic Environmental Assessment (SEA) carried out by external consultants.

The Environmental Statement produced as part of the SEA process acknowledges that the impacts of the LIP may be relatively small in comparison to the impact of transport strategy decisions made by the Mayor and TfL and the statement focuses on those proposals where the LIP may have significant environmental impacts. Of the 53 measures in the LIP nine were assessed as having a negative environmental impact and these were considered to be fairly minor. The SEA identified a number of broad alternatives which could have been considered in the LIP although it was acknowledged that broadly speaking these were an increase in the quantity of the measures in the existing LIP rather than new measures. The alternatives were:

- Measures which reduce the need for travel
- Measures which reduce or discourage motor vehicle traffic
- Measures which increase the capacity for motor vehicle traffic and/or improve conditions for motor vehicle users
- Measures which improve public transport
- Measures which improve conditions for walking and cycling

The Environmental Statement states that one of the major potential impacts of the LIP proposals is climate change, but does not examine this further due to the difficulty in monitoring CO_2 emissions locally. Instead the SEA concentrates on other environmental impacts such as noise, air quality and land take.

2.6 Schemes and Funding

2.6.1 Summary of Main Support Mechanisms

Mechanism	Acronym	Summary	Value	Future variation	Total Value	Lifetime
Energy Efficiency Commitment	EEC	Subsidy to domestic energy saving	0.7-.9p/kWh	Unknown beyond 2008	£148m for EEC1	EEC2 2005-8
Levy Exemption Certificates	LECs	CHP & renewable elec can claim	0.43p/kWh	Increase with RPI	Unlimited	
EU Emissions Trading Scheme	EU ETS	Cap & trade system on 20MWth plant	Current price £6/tonne CO_2	Market instrument - value of carbon	Limited by	Phase II to 2012
Low Carbon Buildings Programme	LCBP	Capital support for building integrated renewables and CHP	Varies depending on technology	Unknown beyond 2009	£80m	2006-9
Renewable Obligation Certificates	ROCs	Awarded to generators	4.5p/kWh	Market instrument	Limited by % obligation	2016

Table 4: Summary of support mechanisms

None of the above programmes are fixed and are subject to continual review. New schemes could radically alter the framework.

2.6.2 Energy Efficiency Commitment (EEC)

EEC is funded from a levy placed on all domestic electricity and gas customers. The programme (EEC2) for 2005-8 has a target of 130TWh savings. The scheme has been running since the mid 90s in one form or another – formally as SOP (Standards of Performance).

Electricity and gas suppliers control the administration of the scheme, which is regulated by Ofgem. Centrica holds the largest funds. The targets placed on the obligation holders (the energy companies) are based on an agreed reduction in emissions so there is an incentive to deliver the highest emissions reductions at the lowest cost. The cost is based on the capital cost of the project divided by the kWh reduction discounted at a Treasury rate of 6% per annum over 15 years. Therefore grants will be most attractive to the obligation holders at the lowest cost per kWh. As a guide, the level of cost to be attractive to the obligation holders is around 0.7 to 1p/kWh.

Within EEC, an obligation holder will offer a grant based upon the potential carbon savings from a project.

The carbon savings can be offered to the any national obligation holders/suppliers either by making a direct approach or via the Energy Saving Trust (EST) as a broker.

EEC is “technology blind”; it will fund any type of energy saving measure that is accepted by EST. The measure must, however, provide additionality to the Building Regulations. Simply installing double glazing will not allow EEC funding to be used, the window must be above Building Regulations standards to qualify.

At least 50 per cent of the energy efficiency target has to be met in the “Priority Group”, i.e. households in receipt of at least one of a number of benefits.

Under EEC 2005-8, suppliers are provided with an incentive to deliver energy services. Suppliers will receive an increased energy saving if their energy service package involves an audit of the dwelling, measures to improve the household's energy efficiency by 13 per cent and the option of a deferred payment for those measures.

DEFRA has also introduced an incentive for suppliers to offer more for 'innovative' energy efficiency measures. Micro combined heat and power (mCHP) has been labelled innovative and will qualify for additional energy savings.

Those measures not used under the current EEC, and which have significantly greater savings than a similar product under the current programme, will also be considered ‘innovative’. Ofgem plans to consult on this definition in the near future to provide further guidance to suppliers.

The assumptions made in this report are taken from the value of EEC during EEC1. The total expenditure by utilities was £148m achieving a saving of 0.37MTC *per year*. (DEFRA Assessment of EEC 2002-5, Carbon, Energy and Cost Savings). This equates to a cost per tonne of CO_2 of £109. However this is savings per year. Assuming a 25yr lifetime of the measure the cost reduces to £4.36 per tonne of CO_2.

2.6.3 Climate Change Levy (CCL) - Levy Exemption Certificates

The CCL is a tax on the use of energy in industry, commerce, agriculture and the public sector, with offsetting cuts in employers' National Insurance Contributions (0.3 percentage points) and additional support for energy efficiency schemes and renewable sources of energy. The levy was introduced on 1st April 2001 on the following fuels:

Commodity	Rate of levy	Notes
Electricity	0.43 p/kWh	Higher rate as it includes a factor for fossil fuels burned to produce electricity.
Natural Gas	0.15 p/kWh	Supplied by a gas utility.
Solid Fuel	1.17 p/kg (equivalent to 0.15p/kWh)	Coal and lignite, coke and semi coke of coal or lignite, petroleum coke
Liquefied Petroleum Gas (LPG)	0.96 p/kg (equivalent to 0.07p/kWh)	For heating purposes, or any other gaseous hydrocarbon supplied in a liquid state.

Table 5: Climate Change Levy for different fuels

In the March 2006 budget, the Chancellor stated that the Levy would be indexed link to inflation.

2.6.3.1 Exemptions and Reliefs from the levy

Only supplies classed as taxable commodities attract the levy. The levy does not apply to domestic or non-business use, customers outside the UK and exempt /excluded supplies such as:

- Fuel oil or fuel used in some forms of transport
- Supplies to electricity producers (other than self-supplies)
- Electricity from renewable sources
- Supplies to CHP schemes (good quality CHP)
- Supplies of small quantities of fuel and power
- Supplies not used as fuel
- And others

The main impact for the analysis in this report is that good quality CHP and renewable generated electricity is exempt from the Levy and Levy Exemption Certificates can be obtained which therefore provide a subsidy to these forms of electricity generation. For the purposes of this study it has been assumed that LECs are available in full to CHP and at a value increasing with inflation at 2.5% per annum.

2.6.4 EU Emissions Trading Schemes, ETS

The members of the European Union signed the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC). This means that the EU has to reduce Greenhouse Gas (GHG) emissions by 8% during the 2008-2012 period, using 1990 emissions as a baseline.

The EU ETS, which covers 25 countries in the EU (or 27 including Switzerland and Norway), started in 2005, having been adopted by European Commission on 22nd July 2003. This has been introduced in order to help the EU members achieve their targets.

Member States have accepted caps on their emissions of GHGs (cap and trade), starting with carbon dioxide during the first phase (2005-2007), and possibly expanding to cover other gases in the second phase (2008-2012).

The main difference with the UK ETS is that the EU ETS would be a legal requirement under the European Directive 2003/87/EC and will include power generation.

The UK National Allocation Plan (NAP) for phase II (2008-12) of EU ETS has recently been put out to consultation so even in this phase II could be subject to further change.

The following assumptions have been made for the purposes of this report:

- As the EU ETS only applies to plant of over 20MW thermal input, that the scheme only impacts upon large scale CHP.
- The benefit to large scale CHP has been calculated on the following basis:

Traded value of CO_2	6 £/tCO_2
CHP Allocation	100%
Power only Allocation	90%
CHP load factor allocation	72%
CCGT load factor allocation	62.2%

Table 6: ETS variables

The value of £6/tCO_2 has been calculated from €31.50 per tonne of Carbon at exchange rates of 1.44. €31.50 is the value given by Bloombergs for forward price of carbon for 2007 and 2008.[9]

Fuel input (MW)	500
Effiency	50%
Mwin	1000
Load factor	75%

Table 7: Actual plant operating conditions

[9] www.bloombergs.com Accessed April 18th, 2006

Barking Power Station operated at a load factor of 75.5% in 2003. This was the highest of any gas fired station in that year. New plant should operate at best practice conditions, so assuming a load factor of 75% is reasonable.

MWh/yr Gas used	Elec Produced MWh/yr	tpa CO_2 Produced	CO_2 tpa Allocation if CCGT	CO_2 tpa Allocation if CHP	Annual Carbon Cost if CHP	Annual Carbon Cost if power only	Value of being CHP per MWh elec produced
6,570,000	3,285,000	1,274,580	951,347	1,223,597	£ 305,899	£ 1,939,401	£ 0.50

Table 8: ETS benefit for large CHP plant

As can be seen from the table above analysis the value of ETS to large scale CCGT based CHP is very small compared to the actual carbon savings and to other support programmes. £0.50 per MWh of electricity produced by the plant is the overall saving when compared to CCGT power only plant. For comparison ROCs would offer a £40 per MWh benefit. In the long term this may change but these are the values as proposed in the current draft NAP. The benefits derive from the fact that CHP is awarded an allocation of 100% of its emissions whereas power only plant is awarded 90% of its emission allowances free of charge. Furthermore CHP plant is awarded allowances based on an assumed load factor of 72%, whereas CCGT power only plant is awarded only 62.2%. Power only plant may either buy allowances from other plant operators who have managed to reduce emissions, reduce emissions themselves or pay a penalty.

There may be further benefits that accrue to CHP plant in terms of the heat offtake whereby either existing large-scale boiler plant over 20MWth is displaced or where that plant would have had to have been built. However we have conservatively estimated that this is not the case as the majority of boilers displaced will be household boilers which do not fall under ETS.

2.6.5 Low Carbon Buildings Programme[10]

The Low Carbon Buildings Programme was launched in April 2006, with a value of £80m over 3 years. It replaced the previous DTI Clear Skies and Solar PV grant programmes, and is divided into two streams.

2.6.5.1 Stream 1- Individual householder

Grant levels will be as follows and will be regularly reviewed as the market for each technology develops.

Technology	% Grant available
Solar photovoltaics	Maximum £3,000 per kWp installed, up to a maximum of £15,000 subject to an overall 50% limit of the installed cost (exclusive of VAT)
Wind turbines	Maximum £1,000 per kW installed, up to a maximum of £5,000 subject to an overall 30% limit of the installed cost (exclusive of VAT)
Small hydro	Maximum £1,000 per kW installed, up to a maximum of £5,000 subject to an overall 30% limit of the installed cost (exclusive of VAT)
Solar thermal hot water	Maximum £400 regardless of size subject to an overall 30% limit (exclusive of VAT)

[10] Source: www.est.org.uk/housingbuildings/funding/lowcarbonbuildings/faq/

Heat pumps Ground/water/air source	Maximum £1,200 regardless of size subject to an overall 30% limit (exclusive of VAT)
Bio-energy 1.Room Heater/Stoves automated wood pellet feed 2. Wood fuelled boiler systems	Maximum £600 regardless of size subject to an overall 20% limit (exclusive of VAT) Maximum £1,500 regardless of size subject to an overall 30% limit (exclusive of VAT)
Renewable CHP	Grant levels to be defined
MicroCHP	Grant levels to be defined
Fuel cells	Grant levels to be defined

Table 9: Low Carbon Building Programme Grants for individual householders

2.6.5.2 Stream 1 - Community

Grants will be up to 50% of the capital and installation cost of the microgeneration technologies installed and is currently set at a maximum of £30,000. These grants will be awarded competitively.

2.6.5.3 Stream 2

Stream 2 grants are open to community organisations, local authorities, public bodies, charitable organisations and to private businesses.

It is further divided into Stream 2A and Stream 2B:

> **Stream 2A** is for simple retrofit projects, and can be for up to 40% of the total cost subject to a maximum of £100,000.
>
> **Stream 2B** is for new build or major refurbishment projects and can be for up to 40% of the total cost subject to a maximum of £1 million.

SMEs are entitled to a 10% uplift and can apply for up to 50% of the costs of their projects, with the same maximum grants of £100,000 or £1 million.

2.6.5.4 Phase 2 – Public and charitable sectors.

Phase 2 grants are open to the public and charitable sectors and are subject to State Aid requirements. These grants are divided into "pots" of money for each technology, with a specified maximum funding limit for each expressed as a percentage of the installed cost, as shown in Table 10.

Technology	Total available "pot" (£ millions)	Maximum grant per project (% of installed cost)
Solar PV	17.5	50%
Solar thermal hot water	7	30%
Wind turbines	12	30%
Ground source heat pumps	7.5	35%
Biomass	4	35%

Table 10: Low carbon buildings programme stream 2 grants

Phase 2 grants are available up to £1 million and can be for multiple technologies across multiple sites, subject to a limit of three technologies per site.

2.6.5.5 Impact in London

This £80m is to be spread across a range of technologies. This means that around £26m per year is available. Assuming perhaps optimistically that 25% of this programme is available for London, this gives a total of around £6.5m per year for London, or £197,000 per borough.

In our scenario, the capital expenditure on technologies that would be eligible under LCBP is £15.8 million by 2010. The LCBP funding could be in the region of 3.7% of this total.

These contributions are unlikely to affect the overall picture significantly and the contributions from the programme have therefore not been included here.

2.6.6 Renewables Obligation

The Renewables Obligation Order is a legal obligation and requires all electricity suppliers in England and Wales to supply a specific proportion of their electricity from eligible renewable sources. The RO order came into force on 1st March 2002. The Obligation will remain in place until 2027 and targets have been set for each year up to 2015 (15.4% by 2015/6).

Each electricity supplier has to sell a target proportion of their sales from renewable sources. At the end of each compliance period (12 months from 1 April to 31 March), suppliers can

- Present Renewable Obligation Certificates (ROCs), they can be purchased from accredited generators, and they can be sold with or without the electricity they relate
- 'Buy out' the Obligation. The buy out price is currently set at £30.51 per MWh
- Or a combination of both

The Office of Gas and Electricity Markets (OFGEM) is responsible for monitoring the suppliers' compliance.

ROCs are issued in units of 1 MWh within the month of generation. Ofgem is responsible for accrediting the generators, issuing ROCs and registering transfer of ROCs. Generators are the registered holders of ROCs when issued to them, but they can be transferred (sold) to another entity (supplier, trader, etc).

ROCs can be traded separately from the electricity or sold in conjunction with it. It is an open market, which is not regulated by OFGEM or the DTI.

Ofgem returns the buying out in proportion to the amount of ROCs that each supplier presents compared to the total amount of ROCs presented by all suppliers. Suppliers receive recycling only for the ROCs presented, not for the buy-out purchased. Recycling provides an incentive to purchase ROCs. Ofgem adjusts the buy-out price, receives and recycles the buy-out, and reports the annual operation.

The ROC value is given by the open market, and Recycle Buyout is only known at the end of each year after the compliance period has ended. When negotiations are taking place, the recycle buyout is unknown, which adds some uncertainty to the process. The economics of the value of a ROC in any year are therefore dependent on the cost of the buyout and the degree to which the national target has been achieved. The figure below shows the theoretical value of ROCs which is a function of the amount of compliance. For example, if only half of the renewable electricity is available, the price of ROCs could be worth £61.02. In practice the trading process is much more complex than this.

This is a market with some uncertainties, specially the value of ROCs. It is difficult to predict their future value, as it would depend on the renewable energy generated at the time, the amount of ROCs traded on the market and therefore the recycle payment expected. The following figure shows “The Platts Renewable Obligation Certificate Marker” which is a five-year projection of theoretical values of ROCs in Great Britain.

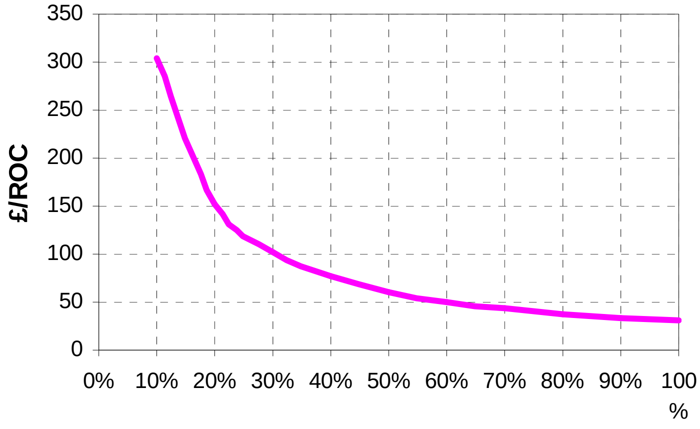

Figure 8: Theoretical Value of ROCs

There are many factors that actually influence the renewable energy generation and therefore the future value of ROCs, such as market issues, transmissions constraints, planning permissions, technology developments, funding available, policy changes, project timescales, seasonality of generation, etc.

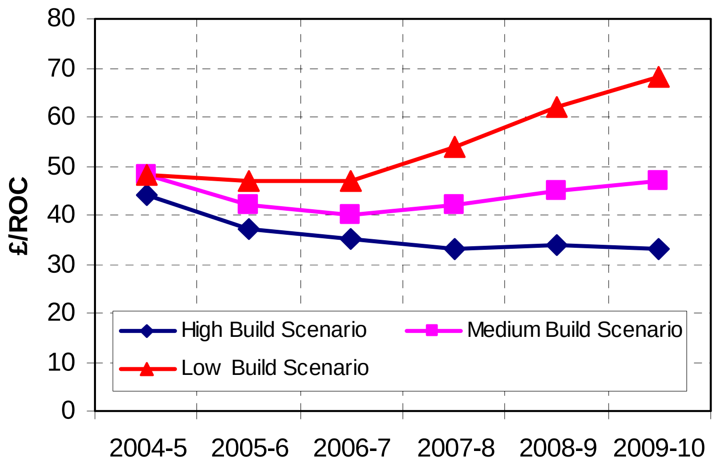

Figure 9: Forward ROC Values (Source: Platts website)

For the purposes of this study we have assumed the following forward values for ROCs:

		2006-10	2011-15	2016-20	2021-26
ROCs	£/MWh	45	40	35	35

Table 11: Forward values for ROCs for this study

2.6.7 Warm Front

Warm Front (formally called HEES) is a Government funded scheme through DEFRA for a range of options including new heating systems and connection to community heating. Grants for qualifying applicants are up to £2000 per connection.

The scheme targets the most vulnerable people. Those receiving an income related benefit or disability benefit might qualify for assistance whether they are young, old, homeowners, or those who rent.

However Warm Front is aimed at private dwellings and excludes local authority or Housing Association owned dwellings.

2.6.8 Transco Affordable Warmth

The Transco Affordable Warmth programme is available to provide finance for elements of community heating. Under the programme, Transco underwrites a (SSAP21 Compliant) operating lease over a fixed number of years that enables Transco to take advantage of the Enhanced Capital Allowance Scheme recently introduced by the Government. Transco will also underwrite the 10% residual value of the lease at the end of the term.

The programme allows for refurbishment and development of both existing and new schemes with or without CHP. However only items that are removable can be financed through this scheme ie CHP, condensing boilers and internals – not heat mains. According to the Co-operative Bank the cost of capital through this scheme is just 3.9%.

2.6.9 European (EC) Grant Aid

Grants are available through the EU for certain classes of projects in the UK through the Sixth Framework Programme.

There are a range of different programmes. All require European partners. Generally the level of support for capital projects is set at 35%.

2.6.10 Neighbourhood renewal funds (NRF)

This Government-backed fund is aimed at the most deprived areas of the UK with the aim of arresting the decline of deprived neighbourhoods, to reverse it, and to prevent it from recurring. The success of the scheme will be measured against a simple goal – to narrow the gap between deprived areas and the rest of the community by dramatically improving outcomes with more jobs, better educational attainment, less crime and better health.

The amounts granted under the fund are relatively low. Assistance could be requested from the NRF to help fund trips for residents to visit other similar schemes in other cities or for support for developing ESCos.

3 Baseline Emissions

There are many different ways of assessing the baseline emissions and a range of different gases that could be included. This section provides a comparison of a number of different attempts to establish the baseline of greenhouse gas emissions for the London Borough of Haringey and puts forward the best to be used for the year 2003 – the last year in which utility data was made available by the DTI. Figures below are expressed in carbon dioxide (CO_2) emissions rather than carbon (C) emissions and are generally stated in tonnes per annum (tpa).

3.1 ONS Household Emissions Report

An Office of National Statistics Report produced in 2004 examined the generation of greenhouse gases by UK households in 2001and attributes them to the use of energy products, the use of transport and to the demand for goods and services. They include within the study remit carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride – so a larger range of greenhouse gases than the studies outlined below. Emissions from final demand for other goods and services include emissions embedded in imports of goods and services. Effectively this represents an "embodied" emissions approach seem from the household perspective.

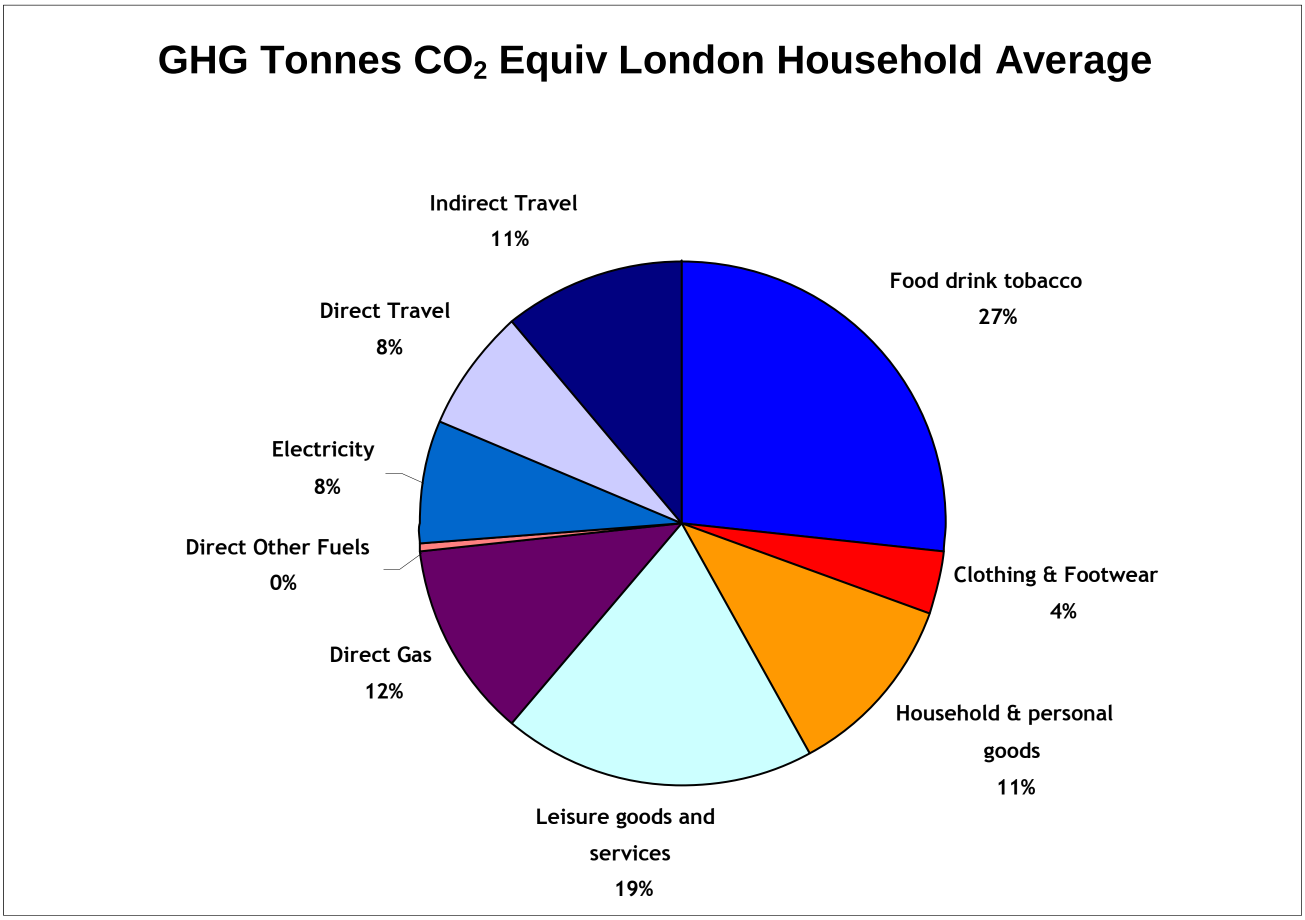

Figure 10: Breakdown of London household emissions including indirect sources

The report breaks down the figures regionally but not to the local authority so we have assumed the London figures are broadly representative of Haringey. It can be seen that indirect emissions from goods and services accounts for some 60% of household emissions. This approach significantly increases the overall emissions that Haringey is responsible for. This is because it includes transport outside of the borough (for instance air travel by residents) and the emissions associated with the import of goods and services.

The report states that London emits 77.2 million tonnes of CO_2, or 26.6 tonnes per household per year. At this rate, Haringey's 93,638 households would be responsible for 2493 ktpa, at least double the emissions predicted by the other models outlined below.

3.2 Regional Energy Consumption Statistics, DTI 2003

Estimates of total final energy consumption in 2003 published by the DTI for the first time in the December 2005 edition of Energy Trends. It includes gas consumption, road transport fuel and other fuel statistics at regional (NUTS1) and local (NUTS4) levels for 2003[11]. The information published for Haringey by DTI is shown in Table 12.

Fuel	Sector	Energy Consumption GWh
Coal	Industry & Commercial	0
	Domestic	2.3
	Total	2.3
Manufactured fuels	Industry & Commercial	0
	Domestic	6.2
	Total	6.2
Petroleum products	Industry & Commercial	39.47
	Domestic	21.62
	Road transport	1031.60
	Rail	2.98
	Total	1095.67
Natural gas	Industry & Commercial	633.65
	Domestic	1795.71
	Total	2429.36
Electricity	Industry & Commercial	439.50
	Domestic	424.46
	Total	863.96
Renewables & Waste	Total	1.4
Total		**4,398.9**

Table 12: Total Energy Consumption for Haringey, DTI 2003

The data provided for electricity consumption is classified as experimental and it was first released last year for 2003 and 2004. The transport figures were provided for the DTI by Netcen. Netcen runs the National Atmospheric Emissions Inventory (NAEI) which is used by government departments, local authorities, regulators and industry.

By using the above data in conjunction with CO_2 emission factors for the different fuels, it was possible to estimate the CO_2 emissions for the Borough, as shown in the next table.

Fuel / Sector	Domestic ktpa	Industry & Commercial ktpa	Transport ktpa	Total ktpa
Coal	0.79	0	0	0.79
Petroleum Products	6.27	11.45	300.02	317.74
Gas	341.18	120.39	0	461.58
Electricity	182.52	188.99	0	371.5
Total	**530.76**	**320.83**	**300.02**	**1,151.61**

Table 13: CO_2 emissions by fuel & sector, DTI 2003

3.3 Defra Local and Regional CO_2 Emissions Estimates for 2003 Report

Published in 2005 and produced by NETCEN, part of AEA Technology, which is an extension of the National Atmospheric Emissions Inventory (NAEI).

This work was made possible following the publication of new local gas, electricity and road transport fuel consumption estimates by DTI. The DTI electricity consumption data enabled Netcen to map for the first time carbon dioxide emissions from electricity generation to the point of consumption. This is a key difference to the data previously published by the NAEI where emissions have traditionally been attributed to the location of emission (e.g. at the power station locations).

The emissions from electricity consumption were estimated using an average UK factor in terms of kt CO_2 per GWh. This average allocates equal shares of coal, gas, oil and renewable powered generation to the electricity consumers and is derived from the UK inventory for 2003. The local CO_2 estimates presented in the report are split into three categories: domestic (including electricity use), industrial and commercial (not including power stations) and road transport. Natural (e.g. soils) and land use change emissions are also included in the Local Authority data. The remainder of the UK emissions such as off shore emissions from oil and gas extraction, fishing and coastal shipping, are reported as unallocated because these could not be spatially disaggregated to LA level.

This reporting structure is different from that used for reporting the UK total CO_2 emissions for Defra commitments under the UN Framework Convention on Climate Change (in the National Communication Format). The simplified structure has been adopted because of the aggregated nature of the data available from the DTI.

[11] www.dti.gov.uk/energy/statistics/regional/index.html accessed on June 2006

Sector	CO_2 Emissions ktpa
Domestic	599
Industry & Commercial	375
Road Transport	252
Land Use Change	0
Total	**1,226**

Table 14: CO_2 emissions by sector (Defra 2003)

The DTI electricity consumption data used in this work is an experimental dataset published for the first time (DTI, 2004a). Electricity used by railways is included in the Industrial and Commercial dataset from DTI. Because it is not possible to separate rail use of electricity from this data both diesel and electric emissions from the rail sector are allocated to commercial and industrial sector.

The gas data published by DTI provides estimates of gas consumption by the domestic sector and the industrial and commercial sector for each Local Authority in Great Britain (DTI 2004a), has been used for this report. The estimates have been compiled by DTI using data provided by National Grid Transco (NGT) at postcode sector level. DTI have allocated each postcode sector in the NGT dataset to one or more Local Authority (LA) area.

3.4 Defra End User Local and Regional Estimates of Carbon Emissions 2004

Defra have recently (November 2006) published updated estimates of carbon dioxide emissions at Local Authority level. These are described as experimental, and not directly comparable with the 2003 data described above due to improvements in the raw data and modelling methods used.

The main changes over the 2003 dataset are:

- Energy sector emissions are re-allocated to end users. In 2003 this was only done for the electricity sector.
- Improved DTI electricity consumption data means that only 1.5% is unallocated to a Local Authority compared to 8% previously. Meter point locations have been more accurately allocated to LAs.
- Improved estimates of the distribution of solid and liquid fuels in the domestic sector.
- Improved estimates of emissions and removal of CO_2 due to land use, land use change and forestry (LULUCF).

The Defra 2004 figures for Haringey are actually quite close to the 2003 figures, despite these changes.

Sector	CO_2 emissions (ktpa)
Commercial and Industrial	378
Domestic	567
Road Transport	290
LULUCF	1
Total	**1237**

Table 15: CO_2 emissions by sector (Defra 2004)

3.5 London Energy and CO_2 Emissions Inventory (LECI) 2003

Published by Mayor of London in June 2006, the LECI 2003 is an annually updated database of related electronic files that hold geographically referenced datasets of energy consumption (in kWh) and the resulting CO_2 emissions (in tonnes/year) for the Greater London area in 2003. The LECI 2003 was compiled and is maintained by the Greater London Authority (GLA) as part of the implementation of the London Mayor's Energy Strategy.

The LECI 2003 provides energy consumption and CO_2 emission estimates at both London borough and 1km^2 levels for various energy/fuel categories and sectors. The energy consumption and CO_2 emissions were split into three broad sectors: domestic, commercial and industrial, and transport. The database was also divided in energy/fuel sources. The following table shows different sources for the datasets used within the LECI 2003.

Energy/Fuel Source	Energy Fuel/Sector	Data Source
Electricity	Domestic / C&I	NAEI 2003/NETCEN and DTI
Gas	Domestic / C&I	LAEI 2003 (GLA 2006)
Oil	Domestic / C&I	NAEI 2003/NETCEN and DTI
Coal	Domestic / C&I	NAEI 2003/NETCEN and DTI
Renewables & Wastes	Domestic / C&I	NAEI 2003/NETCEN and DTI
CHP	Domestic / C&I	LAEI 2003 (GLA 2006)
Rails	Transport	LAEI 2003 (GLA 2006)
Road Transport	Transport	LAEI 2003 (GLA 2006)
Shipping	Transport	LAEI 2003 (GLA 2006)
Aviation	Transport	LAEI 2003 (GLA 2006)

Table 16: Sources, sectors and datasets used within LECI 2003

The LECI 2003 was provided in a database form (Microsoft Access) by the Environment Group's Energy Team (GLA). Most of the data can be exported to Microsoft Excel and linked to GIS software. For more information about the methodology used, please refer to the LECI 2003 report.

The following table shows the energy consumption and CO_2 emissions extracted from the LECI 2003 database. According to this database, the 2003 CO_2 emissions for Greater London were 43,665 ktpa while for Haringey were 1,009 ktpa.

	Domestic		Commercial & Industrial		Total	
Energy/Fuel Source	Energy GWh	CO_2 ktpa	Energy GWh	CO_2 Ktpa	Energy GWh	CO_2 ktpa
Gas	1609	302	551	102	2160	404
Electricity	436	187	453	209	889	396
Oil	22	6	65	17	86	23
Coal	2	1	0	0	2	1
Wastes & Renewables	0	0	6	0.0	6	0
Rail					37	22
Roads					627	163
Aviation					0	0
Shipping					0	0
Totals	**2069**	**496**	**1075**	**328**	**3808**	**1009**

Table 17: LECI 2003 Energy Consumption and CO_2 emissions for Haringey

It can be seen from the previous table and the following figures that the domestic sector is responsible for nearly 50% of the CO_2 emissions and uses more the 50% of the Borough's energy.

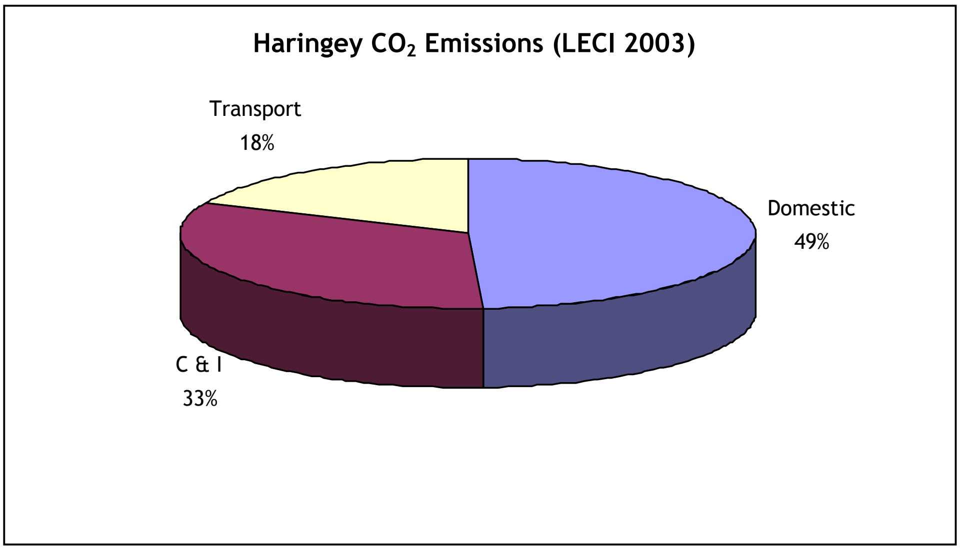

Figure 11: CO_2 Emissions by sector, LECI 2003

In terms of energy/fuel sources, Figure 12 shows that highest proportion of CO_2 emissions comes from electricity consumption, followed by gas and road transport. The emissions from coal, oil and rail represent a very small fraction of the Borough's total emissions.

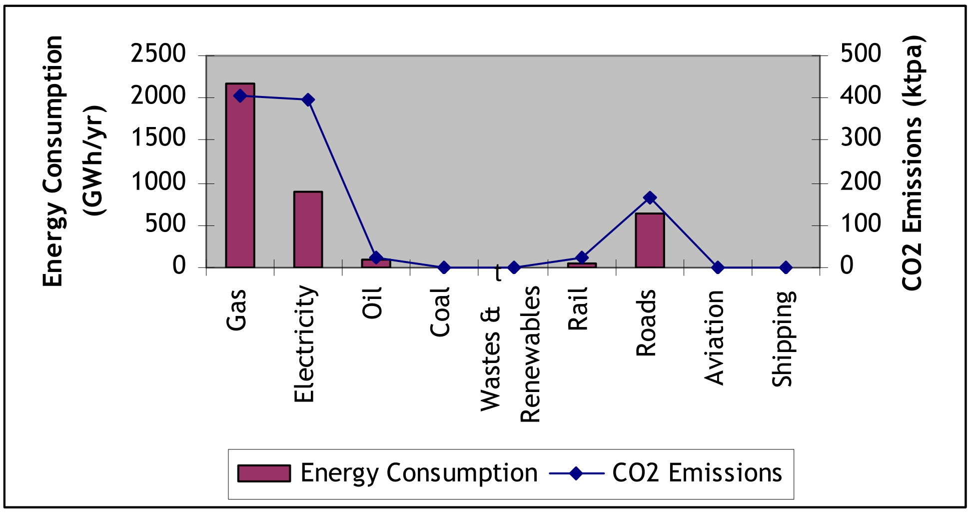

Figure 12: LECI 2003 Energy Consumption and CO_2 emissions for Haringey

The energy consumption and CO_2 emissions shown in the LECI 2003 are classed as experimental by the GLA. However, this database seems to be the most comprehensive and refined to date for the Greater London area. This version corresponds to an improved version of the previous LECI 2000 database.

3.6 LECI 2003 - Modified

After analysing in detail the data obtained from LECI 2003, it was found that the way of assigning emissions to each Borough contains some inaccuracies. As mentioned earlier, London was divided in 1km^2 areas and each square was assigned to only one Borough. When a square falls between 2 Boroughs, the one that has the largest area of the square gets assigned all the energy use within that 1km^2. The grid squares included in LECI 2003 for Haringey are shown green in Figure 13.

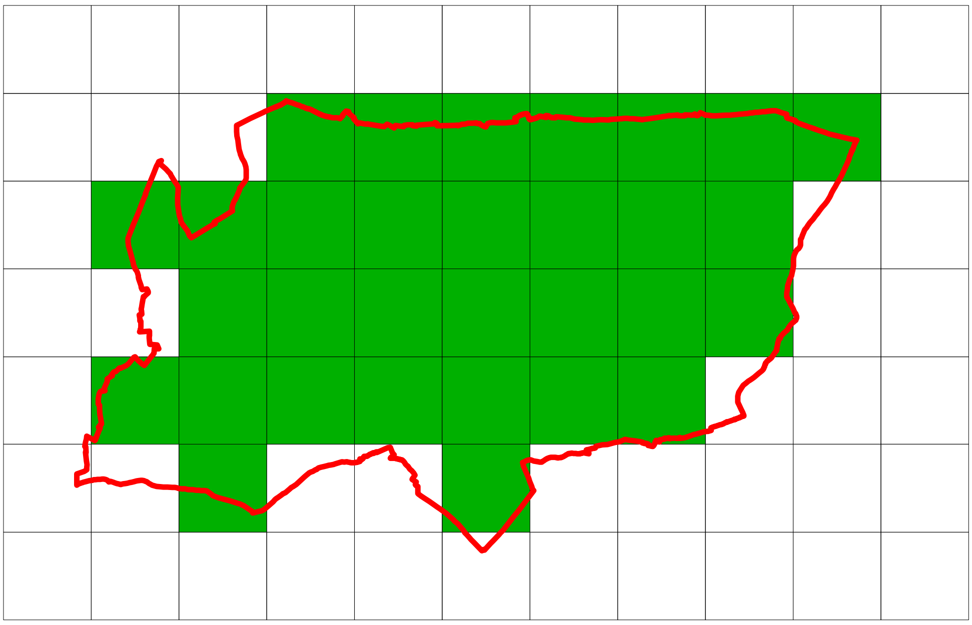

Figure 13: Grid Cells included in LECI 2003

Clearly some of the grid squares included as part of Haringey cover large areas outside the borough, and several areas that are within Haringey's boundary are excluded. Figure 14 shows those parts of the grid squares that are actually within the borough.

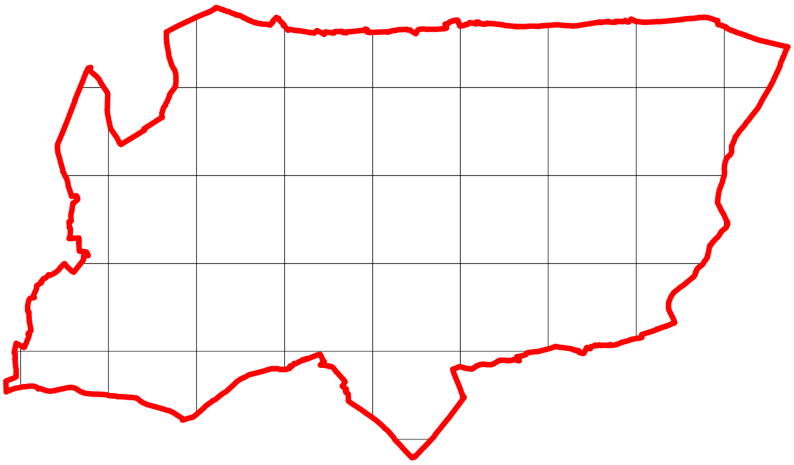

Figure 14: Grid squares in Haringey

By calculating the area of each grid square within the Haringey boundary and the CO_2 emissions from each grid square according to LECI 2003, it is possible to assign CO_2 emissions to each grid square shown in Figure 14 proportional to the area within Haringey. Adding these values gives a more accurate estimate of the total emissions for Haringey.

Furthermore, it was found that an out of date emissions factor for electricity was used for calculating train emissions. The current grid emissions factor was substituted and the CO_2 emissions recalculated for rail.

	Domestic		Commercial & Industrial		Total	
Energy/Fuel Source	Energy GWh	CO_2 ktpa	Energy GWh	CO_2 ktpa	Energy GWh	CO_2 ktpa
Gas	1579	296	514	95	2093	391
Electricity	422	182	436	201	858	383
Oil	21	6	60	16	81	22
Coal	2	1	0	0	2	1
Wastes & Renewables			4	0	4	0
CHP			2	1	2	1
Rail					36	15
Roads					600	156
Aviation					0	0
Shipping					0	0
Totals	**2,024**	**485**	**1,016**	**313**	**3,676**	**968**

Table 18: LECI 2003 Energy Consumption and CO_2 emissions for Haringey - Modified

The new estimation for total CO_2 emissions for Haringey is slightly lower than the emissions obtained from the LECI 2003 database.

3.7 CO_2 Emissions Comparison

Table 19 and Figure 15 show a comparison between the different models analysed in this section.

Models / CO_2 Emissions	Domestic	Commercial & Industrial	Transport	Total Emissions
	ktpa	ktpa	ktpa	Ktpa
DTI 2003	531	321	300	1151
Defra 2003	599	375	252	1226
DEFRA 2004	567	378	290	1237
LECI 2003	496	328	185	1009
LECI 2003 Modified	485	313	171	968
ONS "Embodied" 2001	499	1,521	474	2,493

Table 19 CO_2 emissions for different models

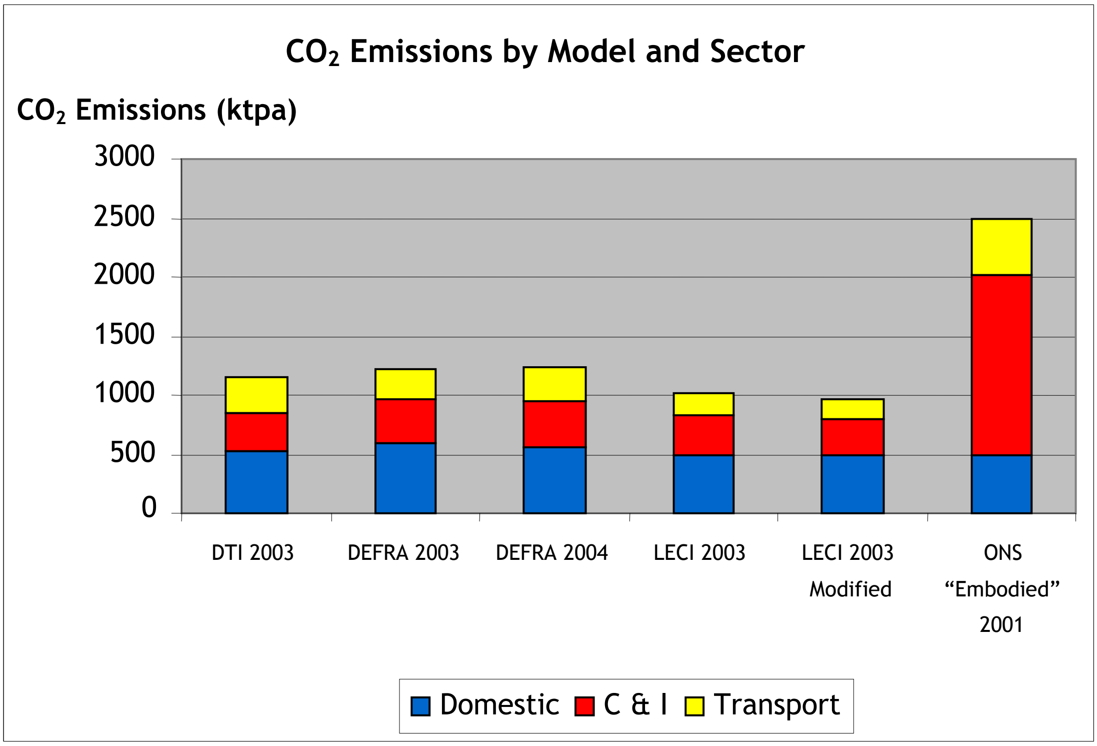

Figure 15: CO_2 emissions for different models

From Figure 15 it can be seen that the various models show reasonable agreement for the domestic and commercial and Industrial sectors. The greatest variation is in the transport sector, where the LECI data shows the lowest values. The ONS report shows much higher commercial and industrial and transport emissions because it includes indirect emissions and emissions from outside the borough that residents are responsible for.

Transport emissions are based on models of transport within the borough boundaries. A journey could start and end outside Haringey, and the emissions allocated to Haringey would be based on an estimate of the part of the journey within the borough. Clearly there is considerable uncertainty in such a modelling process.

The Defra 2004 figures include a proportion of refineries emissions to end users and show a 40 ktpa increase over 2003.

The LECI 2003 is a comprehensive and accurate study at London level, but not at borough level. This is why it was decided to analyse its data in more detail and to recalculate the emissions based on the data held in the database. It was felt that London specific data was best suited to estimating the emissions from a London borough.

3.8 Transport emissions breakdown

According to the London Energy and Carbon dioxide emissions Inventory (LECI) transport generates 171 ktpa of carbon dioxide in Haringey. The vast majority of this was generated by road traffic (91%) with the remainder coming from railways and no recorded contributions from shipping and aviation. The road traffic carbon dioxide emissions are split as follows: 63% cars, 14% HGVs, 12% LGVs, 6% buses and coaches, 3% taxis and 1% motorcycles. CO_2 emissions from transport within Haringey can also be broken down into what is produced internally by the council fleet (not including the use of private vehicles for work) (3.22ktpa), public transport (buses, trains, taxis) (31.37ktpa) and private transport (cars, motorcycles, vans and freight) (138.28ktpa). These figures show that private transport and in particular private cars are the major generator of CO_2 emissions from transport in the borough.

As shown in Figure 16 below, Haringey's emissions from different types of road transport fall between the average emissions for inner and outer London. This is not surprising as although Haringey is defined as an inner London borough by the GLA it is one of the outermost of the inner London boroughs and has many characteristics of an outer London borough.

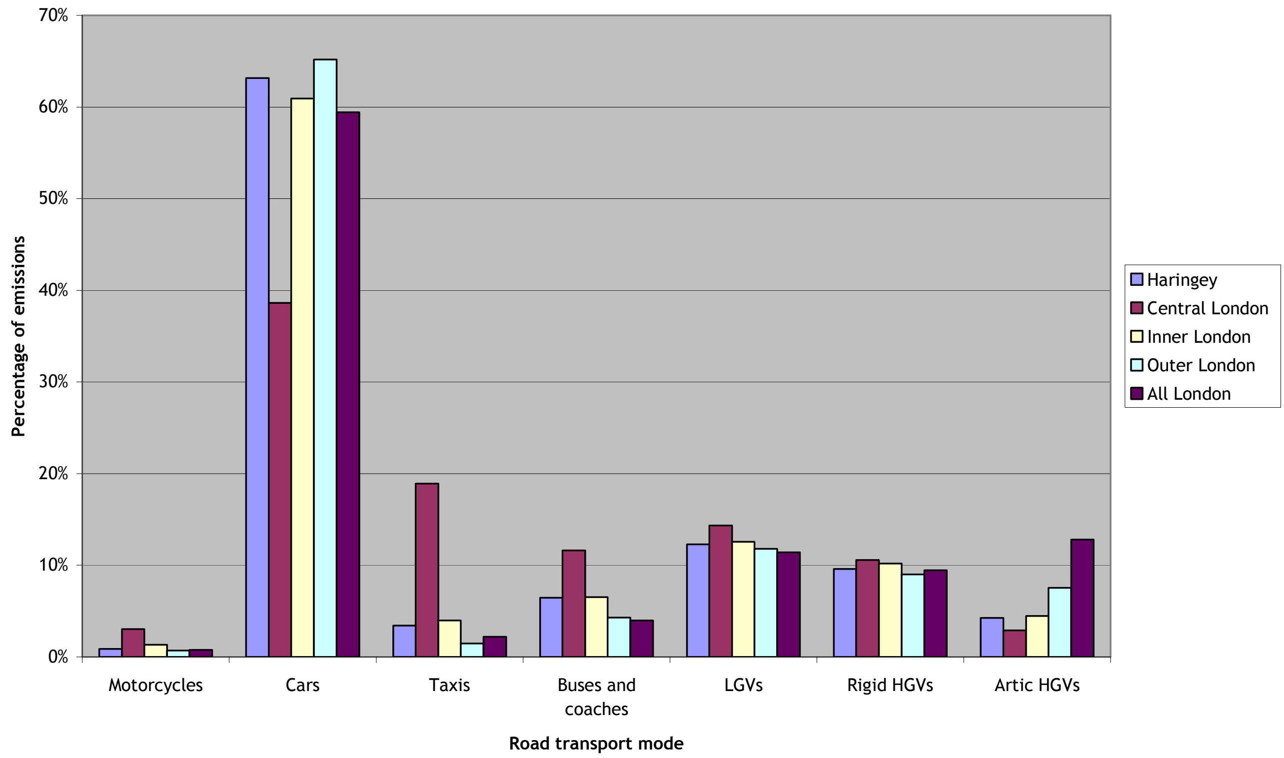

Figure 16: Percentage of CO_2 emissions from road transport modes by region

The carbon dioxide generated by transport in Haringey is 2% of the total carbon dioxide emissions from transport in London and 18% of the total carbon dioxide emissions in Haringey. This is a lower proportion of the total than for London overall where transport emissions make up 22% of total carbon dioxide emissions.

3.8.1 Growth in transport emissions

The population of the North London region is expected to grow by 15% by 2016[12]. This is equivalent to an annual increase of 0.94%. If it is assumed that this rate of population increase continues to 2050, and that emissions due to transport grow at the same rate in an unconstrained scenario, then the CO_2 emissions from transport would increase by 90,519 tpa by 2050.

In its LIP Haringey estimate that if unconstrained vehicle km will grow by 14% by 2011 although their target is 2.5% growth. In contrast the Department for Transport predict that traffic will grow by between 18-26% by 2010, 22-34% by 2015 and 30-50% by 2025. However due to improvements in vehicle efficiency its corresponding predictions for CO_2 emissions were 5-7% growth by 2010, 0-4% growth by 2015 and a 1-6% decrease by 2025.

[12] The London Plan Sub Regional Development Framework North London, Mayor of London, May 2006

3.9 Housing emissions breakdown

3.9.1 Current Emissions

Currently housing in the borough is responsible for half the total emissions of nearly one million tonnes CO_2 (for 2003). It could therefore play a major role in reducing carbon emissions.

	%	Number
Haringey Homes	17.9	16,761
Registered Social Landlords	10.7	10,019
Privately Owned/Rented	71.4	66,858
Total		**93, 638**

Table 20: Breakdown of Ownership (April 2004)[13]

Haringey no longer has direct control over the housing stock. However, it has considerable influence over Haringey Homes, its ALMO running the former LA stock. It can also influence private housing through planning and building control.

3.9.2 New build

The London Plan[14] suggests that 680 new homes will need to be built per year in Haringey to 2016. This includes the regeneration areas at Tottenham Hale and Haringey Heartlands. Assuming 95% of these are built to 2006 building regulations standard and 5% to best practice standards, and assuming 70 demolitions per year, each year's additional houses will contribute a further 1.5 ktpa to Haringey's emissions.

If these rates continue until 2050, they will result in an extra 68 ktpa emissions by this time.

[13] Source: National Statistics, http://neighbourhood.statistics.gov.uk/dissemination/LeadKeyFigures.do;jsessionid=ac1f930cce6dc74111d0cfe4d5a9999f94550a21870.e38Qa3mPbh4Kai0Lb3yKc34NahyTe6fznA5Pp7ftolbGmkTy?a=3&b=276756&c=Haringey&d=13&e=7&g=335694&i=1001x1003x1004&m=0&enc=1&bhcp=1, accessed 30/11/2006.

[14] The London Plan Sub Regional Development Framework North London, Mayor of London, May 2006

3.10 Commercial and Industrial emissions

The commercial and industrial sector is responsible for 33% of Haringey's CO_2 emissions from energy use in non-domestic buildings. It is more difficult to provide a more detailed breakdown of emissions in this sector because of the wide variety of building types and their different patterns of energy use.

3.10.1 All bulk categories

Floor space statistics for Haringey for April 2005 were taken from the National Statistics website[15]. Table 21 shows the definition used for the different sectors.

Type	Description
Retail premises	Premises that provide 'off-street' goods and services to the public. They include supermarkets, corner shops, local post offices, restaurant, cafes, launderettes and many others. Pubs are classed as non-bulk.
Offices	These include purpose-built office buildings, offices over shops, light storage facilities and light industrial activities. Larger banks, building societies and post offices containing substantial office space may be included in this class, rather than in the retail bulk class.
Factories	These range from small workshops to very large manufacturing units. Some industrial hereditaments where the rateable value is not primarily derived from floorspace (for example iron and steel plants) are classed as non-bulk.
Warehouses	These range from small storage units and depots to very large distribution warehouses.

Table 21: Commercial and industrial types

Table 22 shows a summary of the commercial and industrial floor space by sector type for Haringey as of April 2005. The most complex sector is that classed as "Non-bulk". This covers a whole range of building types from schools, leisure centres, libraries to pubs. Exact floor area is not given by ODPM for this sector and only total numbers of buildings are known for London. The average floor area changes from year to year in this sector therefore produces quite a strong variation in total floorspace.

Sector	Floorspace (thousands m^2)
Retail	393
Offices	249
Factories	330
Warehouses	481
Other bulk classes	43
Total	**1495**

Table 22: Haringey C&I floor space (April 2005)

[15] Neighbourhood Statistics (NeSS) on http://www.neighbourhood.statistics.gov.uk

3.10.2 New Build

The London Plan[16] suggests the following growth in Commercial and Industrial floorspace by 2016:

Type	Floorspace growth by 2016 (m^2)	Floorspace growth per year (m^2)
Convenience goods	8500	850
Comparison goods	24000	2400
Offices	52145	5215

Table 23: Predicted growth in commercial and industrial floorspace

Using benchmarks for building types in these categories, it is estimated that the new growth each year will add 0.83 ktpa to Haringey's emissions. If this rate continues to 2050 then Haringey will emit a further 36 ktpa by this time.

3.11 Emissions from waste

This section outlines a model to assess the baseline carbon emissions due to waste management in Haringey, and the likely emissions from this sector into the future.

3.11.1 Baseline Emissions

3.11.1.1 Emissions by waste management option

There have been three important studies estimating the carbon equivalent emissions due to waste management in recent years, commissioned by the United States Environmental Protection Agency (EPA), the European Union (EU) and the Waste and Resources Action Programme (WRAP). It is important to note that these are *carbon equivalents*, i.e. a mixture of greenhouse gases expressed as carbon dioxide. In the case of waste management the dominant greenhouse gas is methane from landfill sites, which has a climate change impact some 21 times stronger than carbon dioxide[17]. Waste management also results in emissions of CO_2, nitrous oxides and CFC's and their replacements, all with different climate change impacts.

Municipal waste management is an area where good data is available on the quantities of different types of waste going to each waste management option, because Local Authorities are required to report this information. Estimating waste arisings other than from households is more challenging, because the quantities and composition vary considerably for different types of business. However, commercial waste is similar in composition and quantity to municipal waste nationally.

A further problem is that the studies mentioned above assess greenhouse gas emissions from a waste generation standpoint. This means that emissions are zero at the point of waste generation, and emissions from that products life cycle prior to it becoming waste are ignored. Since some waste management options, especially those involving materials recycling or energy recovery, displace materials or energy they can have a negative greenhouse gas flux. That is, there is a net emissions reduction from these options. This is shown in Table 24 below.

[16] The London Plan Sub Regional Development Framework North London, Mayor of London, May 2006

[17] AEA Technology for the European Commission, *Waste Management Options and Climate Change*, July 2001.

Waste Management Option		Greenhouse gas flux (kg CO_2 equivalent per tonne of waste)
Landfill	Best practice	250
	EU average	699
Incineration	Electricity only	-10
	CHP	-348
MBT	With landfill of rejects	-366
	With incineration of rejects	-258
Organics	Windrow composting	-12
	In Vessel Composting	-10
	Home Composting	-18
	Anaerobic Digestion electricity only	-33
	Anaerobic Digestion CHP	-58
Recycling	Glass	-30
	High Density Polyethylene	-41
	Ferrous metal	-63
	Textiles	-60
	Aluminium	-95
	Paper	-177
	All materials	-467

Table 24: Greenhouse gas flux for waste management options (European Commission).

3.11.1.2 Municipal Solid Waste

Using data describing waste arisings and treatment methods for waste from the North London Waste Authority[18] (NLWA), emissions for each material can be added up to produce the total greenhouse gas emissions due to waste management in the borough. Municipal waste in Haringey amounts to around 104,000 tonnes. The waste treatment methods are shown in Table 25.

Treatment method	Percentage of waste treated (%)
Recycling	15.27
Composting	5.62
Energy recovery	34.35
Landfill	44.75

Table 25: Waste treatment methods in Haringey[19]

[18] It is assumed that the waste generated per capita and the rates of recycling, composting, energy recovery and landfill are the same for Haringey as for the NLWA as a whole.

[19] NLWA Best Value Performance Plan 2006, www.nlondon-waste.gov.uk/docs/BVPP%202006-2007.pdf, accessed 31/12/2006.

This analysis suggests that the landfilling of municipal waste results in the emission of 32,600 tpa (carbon equivalents), reducing to approximately 24,700 tpa when recycling and incineration benefits are included.

The NLWA are proposing a strategy[20] whereby recycling rates will increase to 35% by 2010 and 45% by 2015. Edmonton incinerator will close in 2015, to be replaced by a new Energy from Waste (EfW) plant and a Mechanical and Biological (MBT) plant. As Table 24 shows, these treatment methods result in a negative net GHG flux mainly due to carbon sequestration and avoided energy and materials from the recycling and energy recovery elements of the processes. If these targets are met, the calculated carbon emissions from waste management would be negative. As mentioned above, it would be reasonable to count these negative emissions, or carbon savings, if the carbon emissions from the lifecycle of the products that make up the waste were also counted (see Section 3.1).

There is a danger of double counting when undertaking these analyses. For example, incineration results in a net carbon benefit due to the displacement of conventional sources of energy. However, this strategy proposes the use of some of that energy from Edmonton, with associated reductions in carbon emissions. In the case of recycling, there is an energy saving from using recycled materials in place of virgin materials to manufacture new products resulting in a negative GHG flux for recycling options shown in Table 24. However, the baseline carbon emissions calculated in this strategy already account for energy used in the borough. If the recycling were taking place here in Haringey, these energy savings would already have been counted. If the recycling takes place outside the borough's boundaries (as is probably the case) then a consistent approach would allow another local authority to count these carbon savings in their own area.

For these reasons, we recommend taking the landfill emissions figure of 32,600 tpa as a baseline. This represents approximately 3.4% of emissions from the borough. The quantity of waste landfilled and the resultant emissions can easily be monitored over time. In practice, Haringey's waste strategy targets combined with the Landfill Directive (see section 2.2.2) and the reducing landfill capacity in the South East and East of England will almost certainly mean that emissions associated with the landfilling of waste will be close to zero by 2050.

3.11.1.3 Other forms of waste

Nationally, commercial waste consists of similar materials and is produced in similar quantities to municipal waste[21]. London produces 17 million tonnes of waste in total, made up of 4.4 million tonnes municipal waste, 6.4 million tonnes commercial and industrial and 6.1 million tonnes from construction and demolition[22].

The disposal of these other types of waste tends to be market led, and is generally not subject to statutory recycling rates except in the case of certain specific waste streams such as packaging, electrical equipment and end of life vehicles. However reduced landfill capacity, increased disposal cost, improved recycling technologies and corporate environmental responsibility concerns are likely to lead to a reduction in landfill rates in future years.

Furthermore, many of these waste streams do not contain putrescible waste that would result in methane emissions from landfill.

It is very difficult to determine figures for the exact quantities, composition and disposal methods for non-municipal wastes. However, we believe that it would be reasonable to assume that commercial waste in the borough contributes similar carbon emissions to municipal waste, 32,000 tpa, and that this will be close to zero by 2050.

[20] North London Joint Waste Strategy, www.nlondon-waste.gov.uk/jointwastestrategy/, accessed 31/12/2006.

[21] www.wasteonline.org.uk/resources/InformationSheets/WasteAtWork.htm

[22] Rethinking Rubbish in London, GLA, 2003.

4 Technology Review

In this section we include a brief overview of the various measures available to reduce carbon emissions.

4.1 Energy Efficiency

4.1.1 Insulation

Cavity wall and loft insulation measures are the most cost-effective per tonne of carbon saved. Other insulation measures such as double glazing, solid wall insulation, flat roof insulation and floor insulation are uneconomic given current capital costs unless they are being done as part of the replacement of a failing element (e.g. double glazing where the window frame has rotted).

Cavity wall insulation is injected into the cavity between the inner and outer leaves of brickwork that make up the external wall of a property. There are a variety of different insulating materials, but they all work in the same way: by combining with the still captive air, the insulation acts as a barrier to heat loss. Cavity Wall Insulation is a simple process by which insulation is injected into this cavity through a carefully designed pattern of holes, as shown in Figure 17.

The insulation system is designed so that any water that does enter the cavity can drain away, whilst the insulation reduces the heat loss through the wall. There are a number of different products, or systems, each of which must pass stringent technical requirements laid down by the British Board of Agrement or alternative independent approvals body. The systems don't require servicing, maintenance or adjustment. Cavity all insulation can reduce the heat loss through cavity walls by up to 40%. Payback savings (against costs) is estimated at between 3 and 4 years. Cavity wall insulation can also lead to reduced heating costs and improved comfort levels. An average grant aided installation for a dwelling could cost around £260.

The vast majority of cavity wall installations are carried out using mineral wool systems (either rock or glass mineral wool).The remaining installations use mainly systems based on expanded polystyrene beads or granules, with less than 1 per cent using urea-formaldehyde (UF) foam. For a cavity wall with two brick leaves of 105mm, internal plaster and a cavity of 65mm the U-value could be around 1.44 W/m2K. By filling the cavity with suitable insulation material a final U-value of 0.54 W/m2K could be achieved.

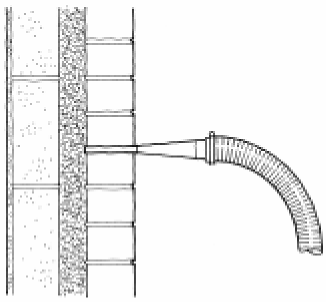

Figure 17: Insulating the unfilled cavity of a wall

As much as a third of the space heating costs could be lost through the roof. Energy and money can be saved by simply by insulating the loft of a property to the recommended depth of 270mm. An uninsulated loft space would have a U-value in the region of 2.5 W/m2K. Adding 100mm of insulation could improve this value to 0.4 W/m2K. By insulating (or topping up) with two layers, covering the joists, a U-value of 0.16 W/m2K could be achieved. DIY loft insulation could costs between £140-£170, or £200-£250 if a contractor is used.

4.1.2 Condensing Boilers

High efficiency condensing boilers convert more than 88% of their fuel into heat, compared to 78% for conventional types. A high efficiency condensing boiler works on the principle of recovering as much as possible of the waste heat which is normally rejected to the atmosphere from the flue of a conventional (non-condensing) boiler.

This is accomplished by using an extra heat exchanger within the boiler which maximises heat transfer from the burner as well as recovering useful heat which would normally be lost with the flue gases. When in condensing mode (for condensing boilers do not condense all the time) the flue gases give up their 'latent heat' which is then recovered by the heat exchanger within the boiler. As a result the temperature of the gases exiting the flue of a condensing boiler is typically 50-60°C compared with 120-180°C in a current non-condensing boiler. At the same time an amount of water or 'condensate' is produced. A condensing boiler will always have a better operating efficiency than a conventional non-condensing one, due to its larger and more efficient heat exchanger.

By law most new gas boilers fitted in England and Wales must now be high efficiency condensing boilers (with a few exceptions depending on suitability).

4.1.3 Heating Controls

Heating controls help to determine when a dwelling is heated, making it warm when it is required. A properly controlled system for a dwelling should include:

- **A Programmer** - It allows setting the on/off time periods for the heating and domestic hot water systems.
- **A Room thermostat** - It simply switches the heating system on and off as necessary. It works by sensing the air temperature, switching on the heating when the air temperature falls below the thermostat setting and switching it off once this set temperature has been reached.
- **A Programmable room thermostat** (instead of separate programmer and room thermostat).
- **A Cylinder thermostat** - It switches on and off the heat supply from the boiler to the hot-water cylinder, if there is one. It works by sensing the temperature of the water inside the cylinder, switching on the water heating when the temperature falls below the thermostat setting, and switching it off once the setting has been reached.
- **Thermostatic Radiator Valves (TRVs)** - TRV's sense the air temperature around them and regulate the flow of the water through the radiator. They help improve comfort in your home by allowing you to set different temperatures in different rooms.

More advanced controls for commercial premises, such as boiler energy managers, are also available. Using heating controls adequately will bring financial benefits and help to reduce energy wastage.

4.2 Renewables

4.2.1 Solar PV

PV remains an expensive technology. However it is relatively simple, largely maintenance free and well suited to the urban environment. Though the simple payback period for PV without subsidy is around 100 years, with the range of grants and availability of Renewable Obligation Certificates (ROCs) this is reduced to 47yrs. The government is currently reviewing the grant support system.

The ideal situation for this technology is mounting on large unshaded flat roofed blocks where all of the electricity could be used to offset electricity consumed by tenants at 10.5p/kWh. Economies of scale should reduce the capital cost. In this situation payback periods of 21 years could be obtained.

The price of PV is expected to fall in the future, and this technology is expected to be cost effective by 2030.

4.2.2 Solar Thermal

Solar thermal systems are a proven technology, which again suffer from relatively long payback periods. However, a report for ETSU in 1990 found solar thermal was most cost-effective when applied to large communally heated schemes fed by boilers.

The main problem here is that most of the heat from solar thermal is provided at a time in the summer when demand for heat is at its lowest and when the CHP easily meets this demand. CHP achieves carbon emission savings even when all its heat is not being used in summer because central power stations are rejecting heat during the summer and winter, and reducing electricity from central power stations by generating locally reduces the amount they waste.

Environmentally, the most favourable combination might be to run CHP during the winter and in the summer to use PV for electricity to displace the central generation and solar thermal for hot water. This would substantially reduce the need for gas use in the summer for both heat and power.

Looking at it from a financial viewpoint however, this means that the capital intensive CHP plant stands idle in the summer months, which doesn't help the economics of the scheme, and it is also not the optimum use of the investment in solar thermal, which is better applied to systems using boilers or electricity as their heat source.

Solar thermal has an advantage for communal heating in that the heat losses from distribution pipework remain relatively constant all year round i.e. they are not dependent on the rates of heat flow through the pipe; they are purely a function of temperature differences. This means that heat losses as a proportion of total heat demand are much higher in the summer months rising to as much as 30% of the total heat flows with the fuel loss depending on the fuel or carbon content of the heat transmitted. If as an example the heat came from renewable CHP running on vegetable oil the heat losses would be 30%, the fuel loss would be zero (no change in renewable fuel burn in the engine producing power) and zero carbon for the heat supplied and the losses. There is therefore no benefit under these conditions for further capital expenditure on solar thermal.

Therefore local solar thermal systems supplying heat directly into heat stores within blocks can eliminate the need for distribution of heat at a time when much of it is lost in the pipework. This has proved successful in some combined solar thermal and CHP schemes in Denmark. If the CHP is not economic to run in summer due to very low electricity values, or is down for maintenance, then since heat would otherwise have to be sourced from boilers, solar thermal can give carbon savings.

However the central problem still remains that the economics of CHP depend on running the plant for as long as possible and so spending more money on another technology, which reduces the running hours, worsens the viability of both technologies. Nor will it produce any additional carbon savings as it is replacing what is effectively carbon free heat or low carbon heat unless PV is used simultaneously.

In a more rational world where the externalities of fossil fuel use are included in the price, it would probably make economic sense in the long term as these technologies mature and reduce in cost to include solar thermal and PV. But even if this is not possible now, the advantage of building up larger heat networks such as the one proposed, particularly if it proves practical to move towards condensing operation, is that it enables future-proofing. Investment in a low grade heat distribution infrastructure will allow other technologies to be added in, such as solar thermal, biomass and renewably produced hydrogen.

4.2.3 Ground Source Heat Pumps (GSHPs)

Ground source heat pumps are strictly speaking a low-carbon technology rather than genuinely renewable energy, since they use electricity as a fuel.

Ground source heat pumps transfer heat from the ground to heat water for space heating. The technology is essentially the same as a refrigerator or air conditioning unit, and uses electricity as an input fuel. The system consists of a *groundloop* (lengths of pipe containing water and antifreeze buried in the ground) and a *heat pump*. The water and antifreeze is circulated through the ground loop, extracting heat from the ground. The heat pump extracts this heat energy from the fluid and transfers it to low temperature hot water for space heating. This technology is interesting because it can deliver 3 to 4 units of thermal energy for every unit of input electrical energy.

The fact that more units of heat are given out than electrical units put in effectively offsets the energy wasted at power stations and in distribution. This means that GSHPs can compete with gas in price and offer carbon savings. In addition, heat pumps require very little maintenance and only require an electrical connection with no other fuel deliveries or storage.

They are ideally suited to rural properties where space is available to lay the groundloop and where there is no gas connection. Obviously this is not a typical inner London dwelling. However, groundloops can be sunk vertically (at greater expense but saving space), and could be applicable to a limited number of new buildings where the groundloop can be installed on the site before the building is constructed.

4.2.4 Wind

4.2.4.1 Wind resource

The UK has 40% of Europe's total wind resource. This is more than any other European country, and theoretically enough to meet UK electricity needs 8 times over. Denmark, with a lower wind resource than ours, generates 18% of its electricity from wind.

The average wind speed at 10m above ground level has been estimated by the DTI at about 4.5 to 5 m/s across most of Haringey. Wind speeds increase with height above ground level.

Average wind speed (m/s)	Maximum energy available from 1m^2 swept area (kWh/yr)
4.9	1180
5.6	1750

Table 26: Wind resource

Table 26 shows the energy available from 1m^2 swept area for two wind speeds that might typically be found at 10m and at 25m above ground level in London. This compares to the solar resource of around 1000 kWh/m^2 horizontal surface. Wind turbines are typically 20% to 30% efficient, compared to 10% to 20% for solar PV.

However, there is some doubt that these wind speeds can be achieved in London. A study in Edinburgh found that while the DTI database was reasonably accurate in surrounding rural areas, measured wind speeds on rooftops in the city were less than half those predicted by the DTI.

Furthermore, wind turbines perform best in conditions where the wind is not turbulent, which occurs when the turbine is sited in an area with few obstacles for the wind to pass over or where the turbine is at a significant height above any surrounding obstacles. This is rarely achieved by building mounted turbines in an urban environment, where the wind is likely to be turbulent.

4.2.4.2 Building mounted wind turbines

Building mounted wind turbines are small turbines that convert the kinetic energy in the wind to electrical energy. The wind causes the blades to rotate, which drives a generator that produces power. The DC power generated by the wind turbine array is supplied to an inverter where it is conditioned (converted to AC power) for standard use. From the inverter the electrical energy is connected to the buildings electrical distribution panels from where it can be used by standard electrical appliances and devices within the building or supplied to the national electricity grid. There are two types of wind turbine, as shown below:

- **Horizontal axis wind turbines** are the most common type, and are so called because the rotating shaft is aligned horizontally. They consist of two or more blades, the most common configuration being three blades. The turbines are usually mounted on a pole fixed to a vertical surface such as a wall or gable end, such that the turbine itself is as high as possible above the roofline to minimise turbulence. The turbine is able to rotate so that it generates power regardless of wind direction.
- **Vertical axis wind turbines** are less common, but are of interest in building mounted applications. The rotating shaft is aligned vertically on these devices. It has been claimed that a vertical axis designs are less sensitive to turbulence as they do not have to rotate to track the wind, and that the produce less noise and vibrations in operation.

4.2.4.3 Medium scale free standing wind turbines

This technology describes larger turbines mounted on free standing towers fixed to the ground. They would usually be horizontal axis designs rated at several kW to perhaps 0.5 MW. They would be located in open land such as parks or the edge of areas of water, and be taller than building mounted wind turbines to take advantage of higher wind speeds. They could be used to supply local buildings, connected to the national grid, or both.

4.2.4.4 Large scale wind turbines

Large scale wind turbines are also usually horizontal axis machines. The size of wind turbines has increased dramatically in recent years. The first UK wind farms used wind turbines rated at 300 to 400 kW. Turbines installed today are often 2 to 3 MW. The scale envisaged for large scale wind in Haringey would be at least 1 MW turbines.

The first large scale wind development in the UK is at the Ford Motor Company's site in Dagenham. The development consists of two 1.8 MW turbines. These have a hub height of 85m and a rotor diameter of 70m. The load factor[23] for such turbines is in the region of 20% to 30%.

4.2.5 Hydro

Hydroelectric power is generated by passing water through a turbine that turns a generator. Power is proportional to the water flow rate (i.e. the quantity of water passing through the turbine) and the *head* (the distance the water drops before passing through the turbine). The scale can range from huge plant over 1000 MW by damming rivers to micro-hydro schemes of a few kW using small streams. Micro-hydro schemes are particularly well suited to hilly, wet regions.

It is possible to generate electricity from undershot water wheels and some old mills have been converted around the UK, but the available power is limited. The DTI have estimated that the potential capacity of small scale hydropower in the UK is about 320 MW, which would provide about 1300 GWh/yr[24]. 60% of the sites and 90% of the capacity is in Scotland.

It is unlikely that hydropower could make a significant contribution in Haringey, and it is therefore not included in the scenario modelling.

4.2.6 Biomass

Biomass energy technologies are discussed in this report under the following main headings:

- Heat from combustion of biomass
- Electricity generation from combustion of biomass
- Electricity generation from advanced thermal technologies
- Anaerobic digestion
- Combined heat and power from biomass

4.2.6.1 Heat from combustion of biomass

Biomass heat plant refers to combustion plant whose sole output is heat energy in the form of hot water or steam for use in domestic or industrial applications. Heat plant dealing with combustion of contaminated biomass is regarded for regulation purposes as waste incineration plant. Biomass heat plant as discussed here refers to dedicated boilers where the fuel is uncontaminated biomass as exempted from the provisions of the Waste Incineration Directive.

Biomass boilers running on clean biomass fuels range in size of output from 10 kW pellet fired boilers up to 5 MW multi fuel combustion systems. Modern automated heat plant has undergone considerable development in recent years, particularly in the design and production of wood fuelled boilers for the European market. The best of these boilers have efficiency levels in excess of 90% and flue gas emissions compliant with the provisions of the Clean Air Act. The requirement for fuel handling and storage systems for biomass boilers results in increased capital cost, and a larger on site footprint by comparison with oil or gas fuelled plant. High fossil fuel prices, the low cost and local availability of certain types of woodfuel and various fiscal incentives have led to a recent continuing rapid increase in the number of installations of dedicated biomass boilers in the UK.

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[23] This is the ratio of actual energy generation to the energy generation that would be achieved if the turbine ran at maximum capacity continuously.

[24] Geoffrey Boyle (Ed.), *Renewable Energy - Power for a Sustainable Future*, Oxford University Press, 2002.

The most commonly used types of biomass fuel are:

- Woodchips
- Pellets
- Bales or shredded dry plant material

Woodchip is chipped woody material and most often produced to a particle size specification for delivery into the combustion chamber by screw feed delivery mechanism. Moisture content may vary from 10-15% for post consumer wood up to 55% for fresh felled timber. Woodchip is derived from:

- Forestry produce
- Arboricultural arisings
- Dedicated energy crops including short rotation coppice (SRC) and short rotation forestry
- Primary processing residues from saw milling and joinery
- Waste wood from uncontaminated sources including e.g. packaging and woody garden materials

Pellets are most usually manufactured by compression of dry sawdust into pellets. The lignin in the wood melts in the high temperatures resulting from pressurisation and re-solidifies on extrusion to retain the pellet form. They can also be manufactured from shredded straw, miscanthus, chaff and other suitable agricultural products. A binding agent may be included, e.g. vegetable oil, in the absence of lignin. The feedstock for pellets can be in the form of:

- Sawdust from saw milling and joinery industries
- Wood dust from wood recycling (shredding) processes
- Straw, chaff, etc
- Dedicated energy crops, principally miscanthus

Biomass boilers have also been developed to run on shredded straw and miscanthus. These agricultural products can be delivered to site as bales or as chopped material, depending on the method of harvesting.

4.2.6.2 Electricity from combustion of biomass

Generation of electricity is most commonly achieved by combustion of a variety of forms of biomass. The heat produced is used to generate steam, which in turn drives a steam turbine to produce heat.

Biomass combustion for electricity generation is usually carried out on a large scale, with plant sizes ranging upwards to 70 MW installations. Plant is relatively inefficient in terms of electrical output with figures for existing incinerators of 20% electrical efficiency but increasing to 32% for drier biomass sources. If contaminated waste is used as the main fuel, including biomass, the plant becomes an incineration plant. If fossil fuels and biomass are burned together, this is known as co-firing.

Large scale combustion of biomass would normally require expensive flue gas clean up and monitoring equipment. Using waste as a fuel often offsets the high capital cost of combustion plant for electricity generation when the cost of disposal is taken into account.

Sources of uncontaminated biomass fuel could be:

- Forestry produce
- Arboricultural arisings
- Dedicated energy crops including short rotation coppice (SRC) and short rotation forestry
- Primary processing residues from saw milling and joinery
- Waste wood from uncontaminated sources including e.g. packaging and woody garden materials

Incineration plants use biomass from the following sources:

- Municipal waste
- Commercial and industrial waste
- Sewage sludge

4.2.6.3 Electricity from advanced thermal technologies

Gasification and pyrolysis are briefly discussed here as advanced thermal technologies. They use high temperatures to break down any waste containing carbon. Gasification is the process where biomass is heated in a restricted air flow to produce a gas containing hydrogen and methane, and a carbon char residue. The proportions of the gases obtained depend on the fuel type, temperature and residence times. Pyrolysis involves the further restriction of air and lower temperature in the reactor vessel to maximise production of a bio-oil.

Most gasification and pyrolysis processes have four stages:

- Pre-treating the waste, which usually involves sterilising it and separating out some of the recyclables, especially glass, grit and metal (which have no calorific value)
- Heating the remaining waste, mainly organic pulp, to produce gas, oils and char (ash)
- 'Scrubbing' (cleaning) the gas to remove some of the particulates, hydrocarbons and soluble matter
- Using the scrubbed gas to generate electricity and, in some cases, heat (through combined heat and power – CHP)

Pyrolysis oil can be used to produce heat and electricity or further refined and mixed with diesel for use as a transport fuel.

Gasification and pyrolysis technologies are sometimes capable of higher levels of efficiency of electricity generation than combustion technologies, with cleaner flue gases and residues.

The gasification process can be used for all types of solid biomass, including contaminated waste and sewage sludge. Plastics present in municipal or commercial wastes will yield energy in the gasification process, along with the biomass material also present.

4.2.6.4 Anaerobic digestion (AD)

AD is the degradation of organic wastes or green crops by bacterial action in the absence of oxygen to produce a methane rich gas, biogas. AD entails placing wet organic material with specific classes of bacteria in a temperature controlled digester vessel to maximise bacterial activity and the yield of methane. Following digestion, an inert, odourless organic material remains, which can be returned to the land as a fertiliser.

The biogas produced contains between 50-80% methane, which can be used to generate electricity. With additional clean up the biogas can also be used as a transport fuel or in domestic gas supply networks.

The design of the digester vessel and infrastructure are specific to the types of organic wastes used. Anaerobic digesters are available in a wide range of sizes and types. Household scale plant designed to produce methane from animal wastes for use as domestic gas is now widely used in developing countries. Commercial scaled plant is in use throughout Europe, generating gas for electricity, heat, transport fuel and modified domestic gas networks

AD plant is most usually used on wet organic waste materials requiring treatment prior to returning to the land. Feedstocks in the UK include:

- Animal wastes
- Food wastes
- Sewage sludge
- Agricultural products, as solids in solution

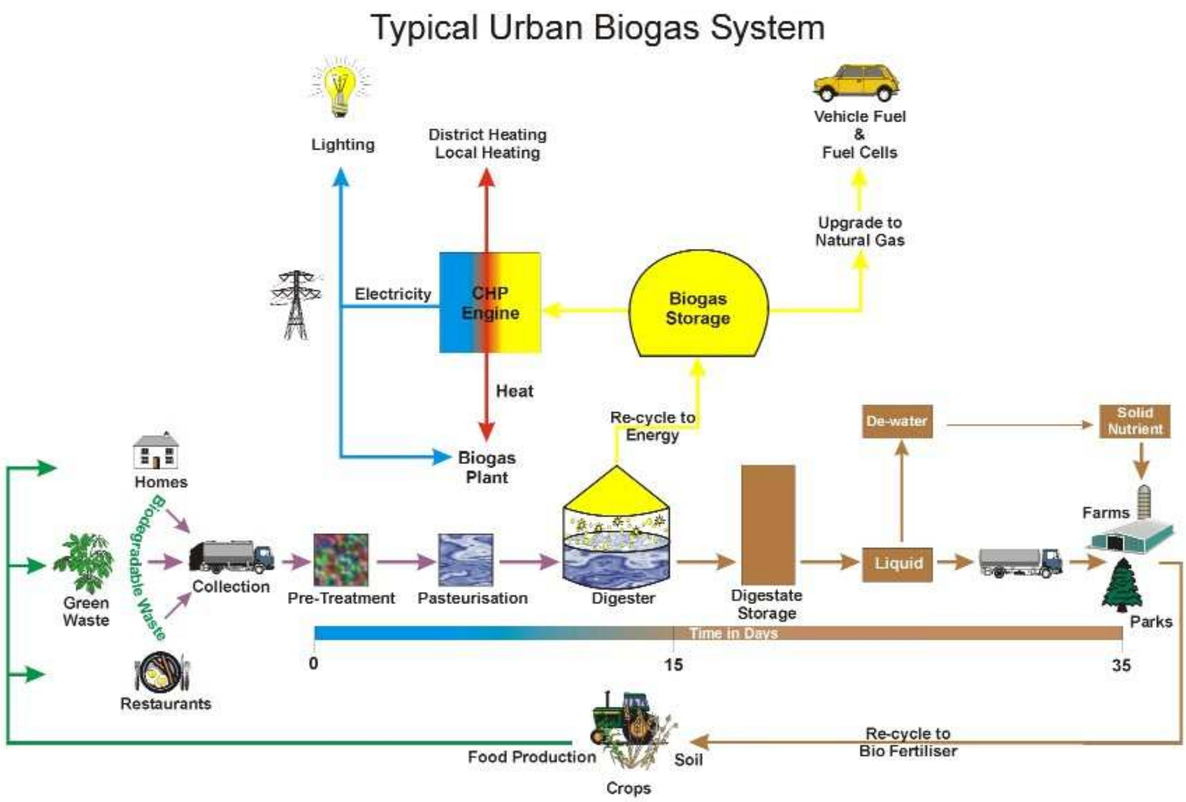


Figure 18: A Schematic of a typical urban biogas system (Copyright Rutherford-Collins Ltd 2003)

4.2.6.5 Combined heat and power from biomass

Heat is always produced when biomass is used as a fuel to generate electricity and it is desirable to utilise the heat energy in order to maximise offset of fossil carbon emissions and the overall efficiency of the plant. The ability to market this heat is often a determining factor in the commercial success of biomass plant. Biomass electricity plant where the heat is also used is known as combined heat and power (CHP) plant.

Heat energy from biomass processes is most often available as hot water or steam. The ideal location for the CHP plant is in proximity to a continuous heat load that matches or is greater than the heat output of the CHP plant.

Heat from the CHP plant can also be distributed via heat mains for use as domestic and space heating. While it is practically possible to distribute the through heat mains over distances in excess of 1 km it is desirable to use the heat locally for maximum efficiency.

4.3 Combined Heat and Power (CHP)

4.3.1 Overview

Combined heat and power (CHP) technologies produce electricity or mechanical power and recover waste heat for process use. Conventional centralised power systems average less than 40% delivered efficiency for electricity in the UK. CHP systems can deliver energy with efficiencies exceeding 90%, while significantly reducing CO_2 and other emissions per delivered MWh. CHP systems can provide cost savings for industrial and commercial users and substantial emissions reductions for the Borough. This section describes some of the leading CHP technologies, their efficiency, size, cost to install and maintain, fuels, and emission characteristics.

4.3.2 Internal Combustion (IC) Engines

Among the most widely used and most efficient prime movers are internal combustion engines. Several types of IC engines are commercially available, however, two designs are of most significance to stationary power applications and include four cycle- spark-ignited (Otto cycle) and compression-ignited (diesel cycle) engines. They can range in size from small fractional portable petrol engines to large 50,000 HP diesels for ship propulsion. In addition to CHP applications, diesel engines are widely used to provide standby or emergency power to hospitals, and commercial and industrial facilities for critical power requirements.

IC engines have electric efficiencies of 25-50% and are among the most efficient of any commercially available prime mover. Overall efficiencies range from 60 to 85% depending on the type of technology and use. CHP projects using IC engines are typically installed between £600-£1,600/kW. The high end of this range is typical for small capacity projects that are sensitive to other costs associated with constructing a facility, such as fuel supply, engine enclosures, engineering costs, and permitting fees.

IC engines have proven performance and reliability. With proper maintenance and a good preventative maintenance program, availability is over 95%. Improper maintenance can have major impacts on availability and reliability. Engine maintenance is comprised of routine inspections/adjustments and periodic replacement of engine oil, coolant and spark plugs. The time interval for overhauls is recommended by the manufacturer but is generally between 12,000-15,000 hours of operation for a top-end overhaul and 24,000-30,000 for a major overhaul. A major overhaul involves piston/ring replacement and crankshaft bearings and seals. Typical maintenance costs including an allowance for major overhauls could range from 0.5 to 1.6p/kWh.

4.3.3 Gas Turbines

Over the last two decades, the gas turbine has seen tremendous development and market expansion. Gas turbines have been long used by utilities for peaking capacity, however, with changes in the power industry and increased efficiency, the gas turbine is now being used for base load power. Much of this growth can be accredited to large (>50 MW_e) combined cycle plants that exhibit low capital cost and high thermal efficiency. Manufacturers are offering new and larger capacity machines that operate at higher efficiencies.

The thermodynamic cycle associated with the majority of gas turbine systems is the Brayton cycle, which passes atmospheric air, the working fluid, through the turbine only once. The thermodynamic steps of the Brayton cycle include compression of atmospheric air, introduction and ignition of fuel, and expansion of the heated combustion gases through the gas producing and power turbines. The developed power is used to drive the compressor and the electric generator. Industrial gas turbines are approaching simple cycle efficiencies of approximately 40% and in combined cycles are approaching 60%.

The capital cost of a gas turbine power plant on a kW basis (£/kW) can vary significantly depending on the capacity of the facility. Typical estimates vary between £300-£900/kW. The lower end applies to large industrial frame turbines in combined cycle. Estimated availability of gas turbines operating on clean gaseous fuels like natural gas is in excess of 95%. Use of distillate fuels and other fuels with contaminants require more frequent shutdowns for preventative maintenance that reduce availability.

Although gas turbines can be cycled, maintenance costs can triple for a turbine that is cycled every hour versus a turbine that is operated for intervals of 1,000 hours. Operating the turbine over the rated design capacity for significant time periods will also dramatically increase the number of hot path inspections and overhauls.

Maintenance costs of a turbine operating on fuel oil can be approximately three times that as compared to natural gas. Typical maintenance costs for a gas turbine fired by natural gas is 0.3 - 0.5 p/kWh.

4.3.4 Steam Turbines

Steam turbines are one of the most versatile and oldest prime mover technologies used to drive a generator or mechanical machinery. Steam turbines are widely used for CHP applications in Europe and the U.S. where special designs have been developed to maximize efficient steam utilization. The capacity of steam turbines can range from several kW to more than 1,300 MW for large utility power plants.

The thermodynamic cycle for the steam turbine is the Rankine cycle. The cycle is the basis for conventional power generating stations and consists of a heat source (boiler) that converts water to high pressure steam. The steam flows through the turbine to produce power. The steam exiting the turbine is condensed and returned to the boiler to repeat the process.

Steam turbines used for CHP can be classified into two main types:

- The **non-condensing turbine** (also referred to as a back-pressure turbine) exhausts steam at a pressure suitable for a downstream process requirement. The term refers to turbines that exhaust steam at atmospheric pressures and above.
- The **extraction turbine** has opening(s) in its casing for extraction of steam either for process or feedwater heating. The extraction pressure may or may not be automatically regulated depending on the turbine design. Regulated extraction permits more steam to flow through the turbine to generate additional electricity during periods of low thermal demand by the CHP system. In utility type steam turbines, there may be several extraction points each at a different pressure.

Modern large condensing steam turbine plants have efficiencies approaching 40-45%, however, efficiencies of smaller industrial or backpressure turbines can range from 15-35%. Boiler/ steam turbines installation costs are between £400-£800/kW or greater depending on environmental requirements.

A maintenance issue with steam turbines is solids carry over from the boiler that deposit on turbine nozzles and degrades power output. The oil lubrication system must be clean and at the correct operating temperature and level to maintain proper performance.

Other items include inspecting auxiliaries such as lubricating-oil pumps, coolers and oil strainers and check safety devices such as the operation of over speed trips. Steam turbine maintenance costs are typically less than £0.02 per kWh.

4.3.5 Combined Cycle Gas Turbine

The term combined cycle is used for systems consisting of two thermodynamic cycles, which are connected with a working fluid and operate at different temperature levels. The high temperature cycle (topping cycle) rejects heat, which is recovered and used by the low temperature cycle (bottoming cycle) to produce additional electrical (or mechanical) energy, thus increasing the electrical efficiency.

The most widely used combined cycle systems are those of gas turbine and steam turbine. A simplified diagram of such a system with the main components only is given in Figure 19.

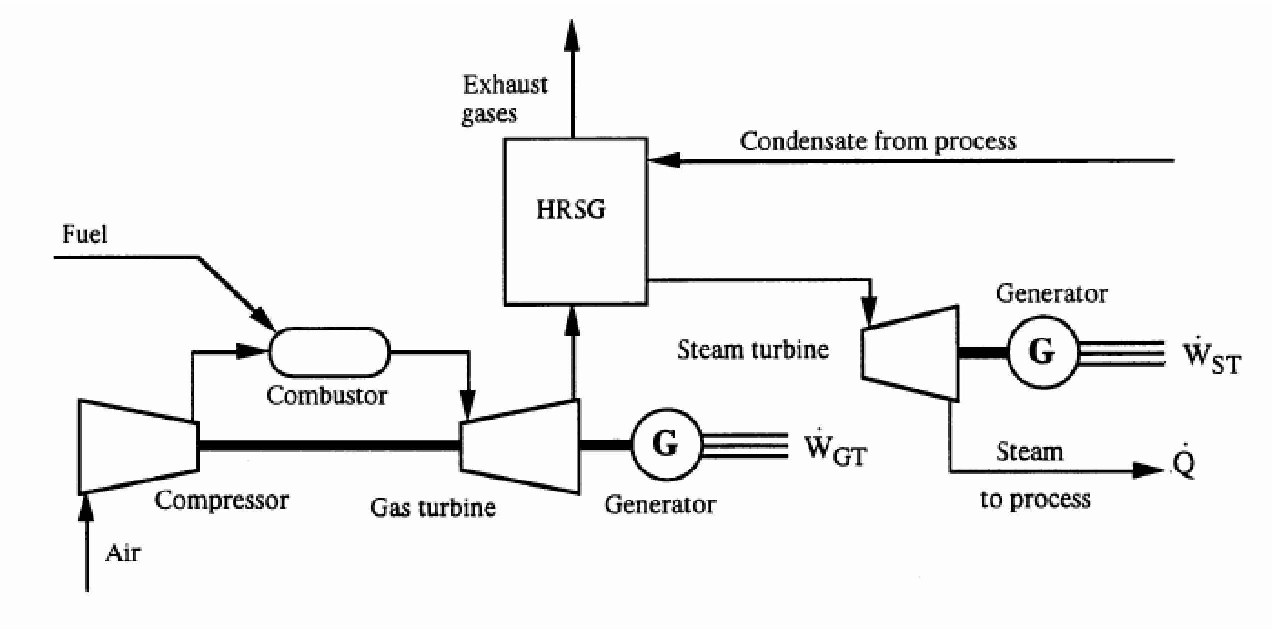


Figure 19: CCGT simplified diagram

The electric efficiency could range from 35 to 45% and the total efficiency from 70 to 90%. The power to heat ratio could range from 0.6 to 2.0. The electric efficiency can be improved further; in fact, contemporary combined cycle systems producing electric power only (no heat to process) can have efficiencies approaching 60%. However, these systems do not qualify as cogeneration systems.

The capital cost of CCGTs on a kW basis (£/kW) can vary significantly depending on the capacity of the facility. Typical estimates would be a combination of the gas and steam turbine capital costs.

4.3.6 Fuel Cells

Fuel cells offer the potential for clean, quiet, and very efficient power generation, benefits that have driven their development in the past two decades. Fuel cells offer the ability to operate at electrical efficiencies of 40-60% and up to 85% in CHP. Development of fuel cells for commercial use began in earnest in the 1970s for stationary power and transportation applications.

Although several fuel cell designs are under development, only the phosphoric acid fuel cell (PAFC) is commercially available. The price of the most competitive PAFC is still around £3000/kW which is still too high for most industrial and commercial applications. The fuel cell requires continued research and development before it becomes a serious contender in the CHP market.

Fuel cells are similar to batteries in that they both produce a direct current (DC) through an electrochemical process without direct combustion of a fuel source. However, whereas a battery delivers power from a finite amount of stored energy, fuel cells can operate indefinitely provided that a fuel source is continuously supplied. Two electrodes (a cathode and anode) pass charged ions in an electrolyte to generate electricity and heat. A catalyst is used to enhance the process.

The electric efficiency of fuel cells is dramatically higher than combustion-based power plants. The current efficiency of PAFC is 40% with a target of 40-60% estimated. With the recovery of the thermal by-product, overall fuel utilisation could approach 85%. Fuel cells retain their efficiency at part load.

The capital cost of fuel cells is currently much higher than competing distributed resources. The commercial PAFC currently costs approximately £3,000/kW. Fuel cell prices are expected to drop to £500-£1500/kW in the next decade with further advancements and increased manufacturing volumes. Theoretically, fuel cells should have higher availability and reliability than gas turbines or reciprocating engines since they have fewer moving parts. PAFC have run continuously for more than 5,500 hours which is comparable to other power plants. Limited test results for PAFC have demonstrated availability at 96% and 2,500 hours between forced outages.

The electrodes within a fuel cell that comprise the “stack” degrade over time reducing the efficiency of the unit. Fuel cells are designed such that the “stack” can be removed. It is estimated that “stack” replacement is required between four and six years when the fuel cell is operated under continuous conditions. The maintenance cost for PAFC (200 kW) including an allowance for periodic stack replacements has been in the range of £0.02- £5 kWh. Improvements and mass production should bring the service cost down over the next decades.

4.3.7 Stirling Engines

The Stirling engine is an external combustion device and therefore differs substantially from conventional combustion plant where the fuel burns inside the machine. Heat is supplied to the Stirling engine by an external source, such as burning gas, and this makes a working fluid, e.g. helium, expand and cause one of the two pistons to move inside a cylinder. This is known as the working piston. A second piston, known as a displacer, then transfers the gas to a cool zone where it is recompressed by the working piston. The displacer then transfers the compressed gas or air to the hot region and the cycle continues. The Stirling engine has fewer moving parts than conventional engines, and no valves, tappets, fuel injectors or spark ignition systems. It is therefore quieter than normal engines, a feature also resulting from the continuous, rather than pulsed, combustion of the fuel. Stirling engines also require little maintenance and emissions of particulates, nitrogen oxides, and unburned hydrocarbons are low. The efficiency of these machines is potentially greater than that of internal combustion or gas turbine devices.

There is a more that 60 years experience with this technology, what is newer is its use for micro-cogeneration boilers. For this type of boilers, there is a need for small engines with a capacity between 0.2 and 4 kWe. Gas turbines and even gas engines are unsuited for this kind of size (although the current smallest spark-ignition engine is 3 kWe), while the Stirling engine offers a good alternative. The advantages of the Stirling engine are: less moving parts with low friction, no need for an extra boiler, no internal burner chamber, high theoretical efficiency and very suited for mass production. The external burner allows a very clean exhaust and gives the possibility of controlling the electrical output of the engine by reducing the temperature of the hot side. So there is the possibility of varying the electricity production regardless the need of thermal heat demand.

There are some low capacity Stirling engines in development or in the market. The electrical efficiency is still not very high and in the range of 10% (350 W_e); 12.5% (800 W_e) up to 25% (3 kW_e), but it should be possible to design then with at least 25% electrical efficiency and total efficiency of 90%.

4.4 Green Electricity Tariffs

We have not included green electricity as part of the list of measures analysed. There are good arguments for and against green tariff schemes but on balance we have decided that they do not constitute a measure that we should analyse or that we should propose policies to support their uptake.

There are two types of green tariff. For the purposes of this we are referring to green tariff whereby the supplier aims to match the electricity consumed with renewably sourced electricity.

4.4.1 For

- Buying green electricity creates a demand for green electricity. Even if this is not strictly speaking additional (see against) it sends a message to government that people care about the environment and support renewable electricity.
- All of the money going to green electricity companies, where that is their core business, is going to support green electricity companies. As in any consumer choice this is an inherently more ethical decision than supporting companies producing “brown” electricity.
- The additional revenue that is provided to green electricity suppliers through green tariffs could be critical in the development of green schemes i.e. the Renewable Obligation is not sufficient.

4.4.2 Against

- The Renewables Obligation puts an onus on suppliers to source an increasing percentage of their electricity from renewables. Green tariffs must ensure that any green electricity supplied is over and above the RO, otherwise the tariff has no impact on renewable electricity supplies.
- Ecotricity have changed their policy from providing 100% green to part green and brown. This was apparently because there was too much demand for green electricity. It would seem from this example that the reality is that growing demand for green electricity did not lead to a growth in capacity to match it. Instead, it simply led to green electricity companies cutting back their supply of green and substituting brown.
- Perhaps more importantly there is a tendency to believe that electricity is carbon neutral because it is sourced from a green supply. Rather like carbon offset schemes for flying, this could lead to a continuation of current practices of electricity consumption or that it is better to use electricity for low grade uses such as heat. However, the carbon content of electricity has to be measured according to the grid generating mix at the time, and choice of fuel should be based on carbon content if climate change is to be mitigated.
- If the decision by consumers to support green tariffs assists in the development of renewables then green consumers are simply helping to subsidise costs which would have been passed on to all electricity consumers anyway.
- In the absence of a CHP obligation we will need customers to sign up to a CHP based tariff in Haringey.

4.5 Technology Compatibility and Selection

A key factor in selecting a mix of technologies is how these different systems will work together as a whole and provide the optimum carbon reduction.

The table below gives a guide to the compatibility of different supply technologies, or more accurately how they well they work together. It is perfectly possible that solar thermal can be installed together with CHP and community heating, but they both provide carbon free heat simultaneously, meaning that no additional carbon savings are achieved by installing solar thermal if CHP has already been selected.

Technology	CHP/CH	Ground source heat pumps	Solar thermal	Solar PV	Wind	Micro-CHP
CHP/ community heating (CH)		X	X	✓	✓	X
Ground source heat pumps	X		✓	✓	✓	X
Solar thermal	X	✓		✓	✓	X
PV	✓	✓	✓		✓	✓
Wind	✓	✓	✓	✓		✓
Micro-CHP	X	X	X	✓	✓	

Table 27: Technology Compatibility

4.6 Demand Side Management versus Supply

4.6.1 Introduction

There has for a long time been an automatic assumption that saving energy is better than producing it. It is assumed in the GLA's Energy Hierarchy (similar to the Waste Hierarchy). In fact it is repeated over and over in various formulations.

As a general principle this sounds like common sense but in practice things are little more complex.

Energy saving isn't a goal in itself or at least not a primary one. The problem with energy use is primarily that the CO_2 emissions associated with it are causing climate change. Carbon should be our key criteria.

Let's imagine a situation where you have a limited amount to spend on reducing your carbon dioxide emissions. This is, of course, the situation that we're already in.

Imagine that an analysis of the available options shows that installing a wind turbine is cheaper per tonne of CO_2 saved than buying a load of new electrical appliances that use less energy than those they replace. Our limited budget shows that we can afford to do only one of those items. Is it a problem that we choose the supply side option rather than the demand side measure because the latter will save less carbon for the same amount of money? The answer is no. Unless we need to consider other associated problems i.e. space taken up by wind turbines or the waste disposal problem caused by replacing appliances or we have a strategic view that we need to develop the market for a specific technology which is likely to considerably reduce in cost etc.

Of course in an ideal world we might do both but the reality is we have a limited amount of money to spend on this so we often have to make these choices.

Exactly the same is true of say CHP and insulation or CHP and heat meters. If CHP reduces carbon emissions in a more cost-effective way than insulation or heat meters then there is no problem in only implementing just the CHP. The argument that residents leave their windows open isn't the point. We may not like what we see as waste but the use of boiler plant rather than CHP is arguably just as wasteful as leaving windows open. We are confronted with a variety of options and we need to select the right mix.

Furthermore in this case there is an extremely complex interplay between supply and demand. It is entirely possible that by doing both you will reduce the financial viability of either project.

This is complicated by the following factors:

- **CHP generates both heat and electricity in a set ratio depending on the type of engine eg internal combustion engine, fuel cell, turbine etc.** This means that when we generate electricity from CHP a set amount of heat is produced. Once we've chosen the engine that's it. (though we can turn both down)
- **There is a national electricity grid but no heat grid.** This means that if you save electricity from a zero carbon or low carbon supply it can be used elsewhere and it's not wasted. However if you save heat from a low or zero carbon source it may just go to waste (unless you store it or expand the grid)

4.7 Is heat from CHP really carbon free?

This is clearly a very complicated question. The complication relies on the simple fact that we can't predict the future pattern of electricity generation (or consumption) in the UK. When we install CHP in Haringey we generate electricity and somewhere else in the UK (or France) some power station reduces its output by a corresponding amount. Whether the heat produced from CHP is carbon free depends to a very great extent to what type of power station it displaces elsewhere, its efficiency and the fuel that it uses. The table below shows a range of heat producing technologies and their carbon content.

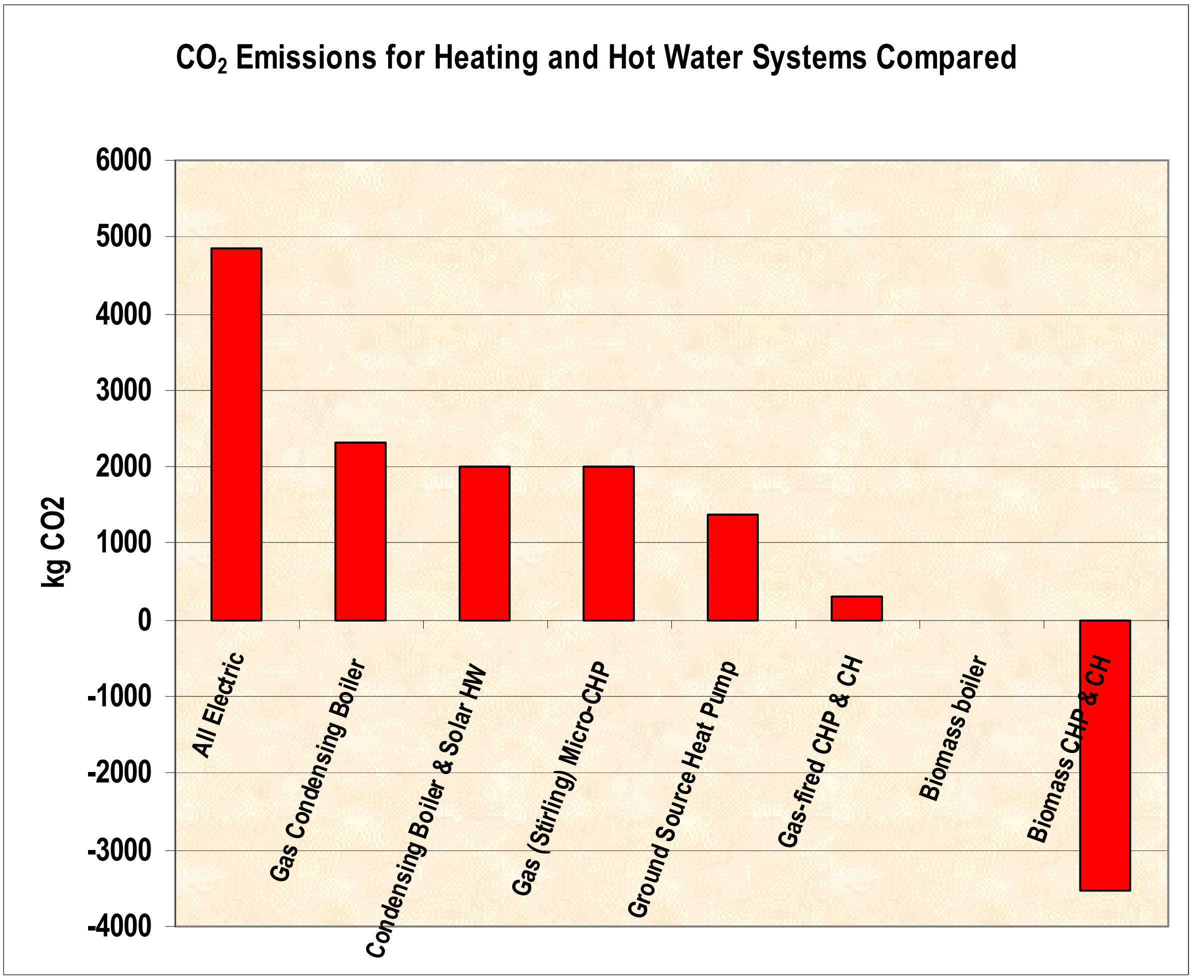


Figure 20: CO_2 Emissions for heating and hot water systems compared – CHP 38% efficiency

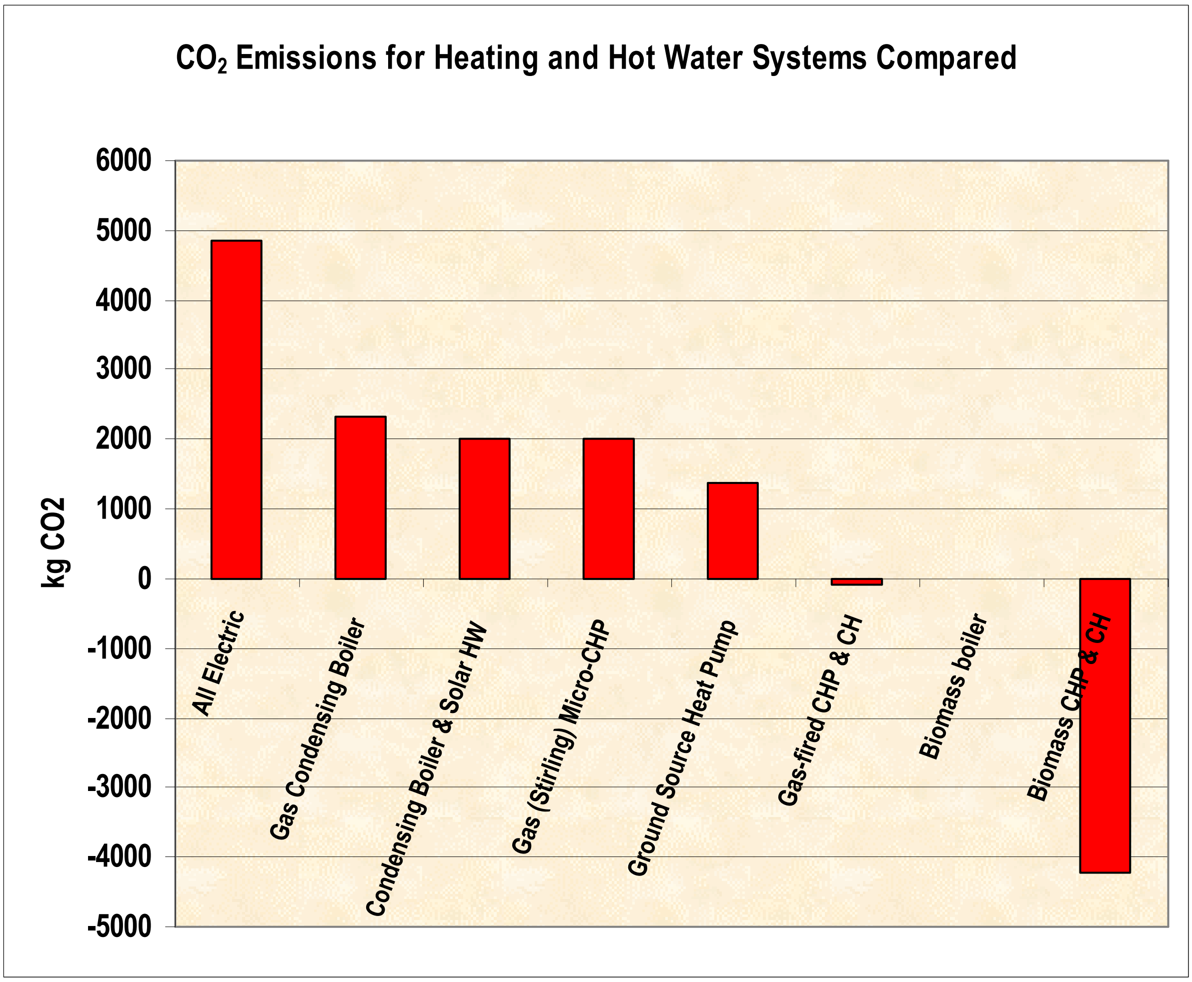


Figure 21: CO_2 Emissions for heating and hot water systems compared - CHP 42% efficiency

The assumption in the above scenario is that the CHP has 42% electrical efficiency as opposed to 38% in the previous chart. In this case the heat from the CHP has negative CO_2 emissions - i.e. it makes carbon dioxide savings through replacing other electricity generating plant as well displacing boiler heat. This means that if we install heat meters we actually increase carbon emissions by reducing the amount of time that the CHP can run.

4.8 Conclusion

The point of all this is that we shouldn't make the decision to spend money on heat meters or other demand side reduction because "it will save energy". Saving energy shouldn't be the primary goal. Saving carbon should be the goal. Technologies choices should have to pass this test.

4.9 Transport technologies

4.9.1 Reducing distance travelled by vehicles

This group of transport technologies describes means by which the total number of vehicle kilometres travelled can be reduced. The reduction is for private road vehicles (passenger cars and freight), as these are the highest carbon emitters.

4.9.1.1 Switch to walking and cycling

A reduction in private car use can be achieved by encouraging a switch to carbon free travel modes such as walking and cycling. A significant proportion of journeys in London are less than two miles, a distance that can easily be travelled without a car for most people.

Cycling and walking can be encouraged in many ways, for example by provision of cycle lanes and bicycle storage, improved signage and punitive taxes on the parking or driving of cars.

Travel plans for workplaces and schools can be used to encourage more walking and cycling.

4.9.1.2 Reducing the number of car journeys

Some journeys can be reduced by replacing necessary travel. For example, home working means that a commute is no longer necessary. Deliveries from shops reduce the need for personal travel for shopping.

4.9.1.3 Car clubs

Car clubs can reduce the number of car kilometres travelled if members have stopped using their own private car by using pool cars in its place. Because each journey has to be paid for individually, car club members are likely to make fewer journeys than car owners.

However, if someone who previously did not own a car joins a car club, then the travel by this person is in fact additional car use.

Nevertheless, it is the case that car club members generally cover less distance annually in club cars than car owners do in private cars.

4.9.1.4 Reducing freight travel

The distance travelled by road freight vehicles can be reduced, although the potential here within Haringey is probably less than for personal travel.

At a national level, encouraging consumers to purchase local products, especially food, could reduce the amount of freight on the roads. At a borough level, the impact of this is less clear because most food delivery journeys probably cover a distance longer than a borough dimension even if the food is relatively local.

Significant journey savings can be made for freight by improving logistics.

4.9.2 Reducing the carbon intensity of travel

This group describes technologies that reduce the amount of CO_2 emitted per kilometre travelled. These could apply to private and public transport and freight. Savings can be made for road, rail, shipping and aviation. Since the baseline emissions for Haringey do not include any shipping or aviation emissions, these are considered outside the scope of this study.

4.9.2.1 Efficiency improvements

Improving the efficiency of existing vehicle and engine designs results in improved fuel economy and therefore reduced carbon emissions. The greatest savings can be made for private cars, but efficiency improvements could also be made to freight vehicles, buses and trains.

The efficiency of engines has increased over time, and this might be expected to continue. At present, vehicle buyers are free to choose less efficient versions, for example with bigger engines, for reasons of performance. In the future choice could be limited to the most efficient models. Diesel engines are also less carbon intensive than petrol equivalents, so a switch to this technology could improve the overall efficiency of the fleet.

Light-weighting can improve efficiency for all vehicle types. This could be as simple as driving smaller cars, which tend to use less fuel. In the case of trains and larger vehicles it might involve the use of more advance materials. Cars have become bigger and heavier in recent years, offsetting improvements in engine efficiency.

Finally, vehicles have increasing amounts of extra equipment, especially electronic systems such as satellite navigation, air conditioning and automatic doors on trains. All these take energy to run, so improving their efficiency or removing them altogether would improve overall efficiency.

4.9.2.2 Maximise the use of each vehicle

Empty vehicles do not use significantly less energy than full ones. Ensuring that vehicles carry as many people or tonnes of freight as possible would reduce the CO_2 emissions per passenger-kilometre or per tonne-kilometre.

In the case of freight this is a logistics issue. For public transport clearly there are times when a service has to be offered for a few people, and vehicles have to have enough capacity for busy periods so there will be times when they cannot operate at full capacity. However, it might be possible to choose a wider variety of vehicles for specific routes and times or to alter price structures to smooth out peaks in demand.

Again private cars are significant here. Cars carrying just one person are inefficient and add to congestion. Car share lanes are one way to discourage this behaviour. Lift share schemes should also be encouraged.

4.9.2.3 Hybrid technology

Hybrid vehicles are attracting a lot of attention at the moment. They combine an internal combustion engine (ICE) with batteries and electric drive. This enables energy wasted in braking to be recovered and can allow the ICE to run under optimum conditions for longer. This can result in efficiency gains. Several cars are commercially available using this technology, and a hybrid bus is being trialled in London at present.

There is some doubt as to whether the official economy figures for hybrid cars are actually achieved under normal driving conditions, although this is likely to be the case for conventional cars too. It might be that a small, efficient conventional car can match the economy of a hybrid mode, although hybrid technology is likely to continue to improve.

4.9.2.4 Alternative fuels

Another way to reduce the carbon intensity of vehicles is to substitute fuel for a lower carbon alternative. Some of these are described here.

4.9.2.4.1 Biodiesel

Biodiesel is a diesel substitute made from renewable oils and fats, for example waste cooking oils or new vegetable oils. Biodiesel can already be used in all diesel vehicles in a 5% blend with mineral diesel. Vegetable oils can be burned directly in modified engines. Alternatively, the oils can undergo *transesterification* and be processed into a fuel similar to mineral diesel that can be used in unmodified engines and can be mixed in any quantities with mineral diesel. Some manufacturers are offering guarantees for their engines to run on blends higher than 5%.

The carbon content of the fuel will depend on how it is produced and processed. Using waste cooking oil is likely to result in a much lower carbon content than mineral diesel, but the resource is limited. There is concern that palm oil will be imported from Asia, where rainforest and peat wetlands are being cleared for oil production. This threatens wildlife and can release significant quantities of greenhouse gases, offsetting any gains from substituting for fossil fuels.

4.9.2.4.2 Bioethanol

Bioethanol is a petrol substitute made by fermentation from plant materials. Ethanol can already be used in a 5% blend with petrol. Ethanol made from sugar cane is widely used in Brazil, and much of the ethanol currently used in the UK is imported from here. A facility is under construction in Somerset that will produce fuel from grain. Cars can be modified to run on blends of up to 85% ethanol, and there are two models currently available that can use this fuel.

Like biodiesel, the carbon content of bioethanol fuel is variable depending on its origin. In some cases bioethanol can be as carbon intensive as petrol, but in others it can offer reductions of up to 70%.

4.9.2.4.3 Electric vehicles

Electric vehicles use batteries and an electric motor to drive the vehicle. Some electric vehicles are commercially available. These are usually charged from a conventional mains socket.

Obviously there are still carbon emissions associated with the electricity used by the vehicle. However, official CO_2 emissions for electric cars are typically around 100 g/km, compared to a fleet average (for new cars) of 171 g/km and 104 g/km for the best hybrid. Therefore they could help reduce carbon emissions. However, these electric cars have only two seats so a conventional car carrying four people could have a lower emission per passenger-kilometre. Hybrid or conventional cars might yet equal or better the performance of electric cars in terms of CO_2 emissions. On the other hand, if renewable energy makes a significant contribution to grid electricity in the future then electric cars could be preferable.

The principal barriers to the take up of electric vehicles are the limited range and the availability of charging points. The short range means that they are not suitable for everyone, although they are ideal for city use. Improving battery technology should improve the range in the future. It might also be possible to use “plug-in hybrids” so that they can effectively become electric vehicles over short distances and then use liquid fuels for longer journeys. Many people in cities use on-street parking, making it impossible to charge vehicles at home. Public charging points would have to be provided for mass take up of electric vehicles.

4.9.3 Modal shift

This describes a shift from one mode of transport to another. For the purposes of this report we are interested in a shift from cars to public transport and from road freight to rail. This means that there is a decrease in the higher carbon road transport and a simultaneous and equal increase in lower carbon public transport and rail freight.

This might be achieved by a range of policies aimed at simultaneously discouraging the use of private personal transport and road freight and encouraging the use of buses and trains for passengers and rail for freight.

5 Biomass Resource

5.1 Introduction

Biomass is one of the renewable technologies that are perhaps closest to commercial viability for the urban environment, particularly where waste sources can be utilised. Waste sources may be a fuel that you are actually paid to use. Biomass also has the advantage that it is relatively flexible with the ability to transform it into a solid, liquid or gas and, in contrast to wind and solar, the ability to store it and use when required.

For the purposes of this study, the broadest definition of biomass has been used. This is also the definition adopted by the UK Biomass Task Force:

> literally, any biological mass derived from plant or animal matter. This includes material from forests, crop-derived biomass including timber crops, short rotation forestry, straw, chicken litter and waste material.

5.2 Biomass resource in Haringey

A certain amount of biomass is produced in Haringey, from sources such as waste materials, arboricultural waste and used cooking oils. The exact quantity is not known.

It should be noted that the potential resource is effectively much larger than this if imported biomass is included. An international trade in wood pellets already exists and arguably there is no reason why biomass could not be imported from much further afield. Of course there would be an impact from the transportation of these materials, but generally the carbon released in transportation is insignificant compared to the carbon offset by burning biomass materials in place of fossil fuels. For example, it has been calculated that willow could be transported 11,785 km before the transport CO_2 emissions matched the emissions saved if the willow replaced gas.

An indication of this can be seen from Figure 22, showing the total biomass resource from London and including biomass from the 40km surrounding London. If Haringey were awarded a share of this proportional to its population, the total energy content would be 376 GWh.

However, not all of this resource is available as a fuel. In particular, Municipal Solid Waste (MSW) undergoes various treatments including recycling and energy recovery (see Section 3).

Energy recovery obviously uses waste as fuel already. Recycling also saves CO_2 emissions (often more than energy recovery, although usually not within the borough). The North London Waste Strategy aims to reduce landfill use, so the vast majority of MSW will be either recycled or incinerated in the future. If MSW is excluded, the biomass resource falls to 135 GWh/yr.

Table 28 shows the total energy consumption in Haringey used to calculate the baseline emissions is 3676 GWh. Therefore the available biomass resource represents just 3.7% of the borough’s energy demand.

5.3 Biomass resource in London

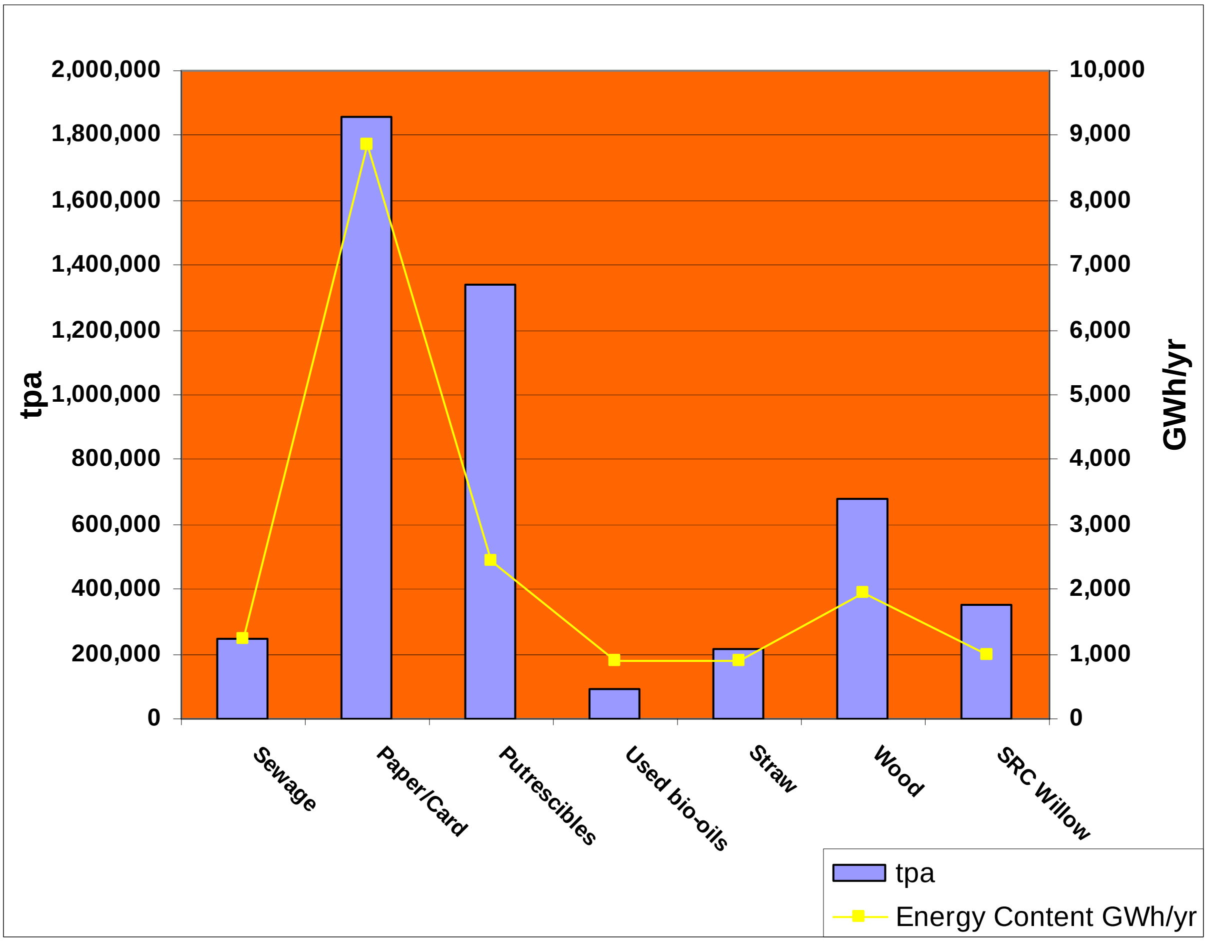


Figure 22: Biomass resource in London and surrounding 40km

Table 28 shows the potential electrical and thermal yields from London's biomass using incineration, gasification and digestion technologies.

		Potential Electrical Energy Yield GWh			Potential Thermal Energy Yield GWh		
Sector	Material	Incineration	Gasification	Digestion	Incineration	Gasification	Digestion
Sewage	Sludge	691	959	47	2,379	2,111	52
MSW	Paper/Card	1,214	1,687	0	4,183	3,710	-
	Putrescibles	360	500	447	1,239	1,099	495
	Misc Combustible	207	288	0	714	633	-
	Wood	120	166	0	413	366	-
Commercial & Industrial Waste	Paper/Card	380	528	0	1,311	1,163	-
	Putrescibles	72	100	90	247	219	99
	Wood	32	44	0	110	97	-
	Used cooking oil	141	93	0	155	204	-
	Animal fats	201	133	0	223	292	-
Construction Waste	Wood	38	52	0	130	115	-
Aboricultural	Wood	93	129	0	319	283	-
Woodland	Wood	2	3	0	8	7	-
Farms in GL	Straw	163	226	0	560	497	-
	Vegetable/Cereal Residu	7	10	8	25	22	9
	Manure	0	0	0	0	0	-
SRC Potential in London	Willow	0	0	0	0	0	-
SRC Potential in 40km Radius	Willow	175	243	0	602	534	-
Forestry in 40km radius	Wood	63	88	0	219	194	-
Total		**3,959**	**5,248**	**593**	**12,836**	**11,546**	**655**
		3%	3%	0%	8%	7%	0%

Table 28: Thermal and electrical energy yield from biomass

There is potential for conflict between local authority strategies when using biomass as a fuel, particularly waste strategies where material would be diverted from recycling. On the other hand, the London Waste Strategy has committed to processing 85% of London’s waste within London. Using waste as a fuel within London instead of transporting it to landfill sites in surrounding counties could contribute to this target. Table 29 below shows the potential thermal and electrical yield from residual biomass, the proportion currently sent to landfill.

Sector	Material	Potential Electrical Energy Yield GWh			Potential Thermal Energy Yield GWh		
		Incineration	Gasification	Digestion	Incineratio n	Gasificatio n	Digestion
Sewage	Sludge	0	0	0	0	0	-
MSW	Paper/Card	886	1,231	0	3,053	2,709	-
	Putrescibles	263	365	327	904	802	361
	Misc Combustible	151	210	0	521	462	-
	Wood	87	121	0	301	267	-
Commercial & Industrial Waste	Paper/Card	247	343	0	852	756	-
	Putrescibles	47	65	59	161	143	65
	Wood	12	17	0	41	37	-
	Used cooking oil	134	88	0	148	193	-
	Animal fats	191	126	0	211	277	-
Construction Waste	Wood	19	27	0	67	59	-
Aboricultural	Wood	47	66	0	163	144	-
Woodland	Wood	2	3	0	8	7	-
Farms in GL	Straw	0	0	0	0	0	-
	Vegetable/Cereal Residu	7	10	8	25	22	9
	Manure	0	0	0	0	0	-
SRC Potential in London	Willow	0	0	0	0	0	-
SRC Potential in 40km Radius	Willow	0	0	0	0	0	-
Forestry in 40km radius	Wood	63	88	0	219	194	-
Total		**2,158**	**2,760**	**394**	**6,674**	**6,072**	**435**
		1%	2%	0%	4%	4%	0%

Table 29: Electrical and thermal yield from residual biomass

5.4 Treatment of biomass resource in scenario modelling

The SEA model calculates the estimated biomass fuel input for each scenario, and compares it to the resource. A warning is given if the resource is exceeded. A scenario using more biomass can still be modelled, for example if biomass imports were envisaged from other areas such as Scandinavia, but for the purposes of this report the scenario keeps within the 135 GWh/yr total.

6 Carbon Scenarios

6.1 Introduction

The section of the report outlines the preferred energy scenario, which illustrates a mix of sustainable energy measures that could meet the target for carbon savings by 2050, e.g. a mix of energy efficiency, CHP & community heating, micro CHP, renewables and transport measures. Associated costs and carbon savings for each measure are set out.

6.2 Business as usual

The first part of this work examines the likely changes to carbon emissions in the absence of any intervention, based on the growth of floor space in both the housing and non-residential sectors and growth in transport.

Note that predictions are not available to 2050, and the expected growth here has been extrapolated to 2050 based on shorter term predictions. Some of these figures might seem quite high. While there is a danger that high growth predictions could induce despair and make the costs of avoidance higher, it does serve to highlight the importance of managing growth. Furthermore, if these levels of growth turn out to be lower, the targets will be easier to meet. Therefore if a worst case scenario is planned for, the difficulty of meeting the challenges can only get easier.

6.2.1 Trends in housing

Demolition and new build rates for housing are critical to this work. Carbon emissions of new homes will vary in a non-interventionist business usual scenario according to the Building Regulations. For the purposes of this study the new 2006 Regulations have been used. Whilst it is known that the government intends to strengthen these regulations at regular intervals, Building Regulations currently exclude the majority of electricity use from their remit. Electricity can easily represent more than 50% of emissions. As appliance use is growing the assumption has been made that overall emissions remain unchanged to 2050.

Taking a typical new build property to be a mid floor flat of 87m^2 gives CO_2 emissions of 2.3 tpa. The average household in Haringey is estimated to be responsible for 5.6 tpa of CO_2. The net effect in terms of household emissions is that, in the absence of a more interventionist approach and without improvements beyond the 2006 Building Regulations, new build housing could add up to 67,748 tpa of CO_2 by 2050.

6.2.2 Trends in Commercial & Industrial

It has been estimated that more approximately 52,145 m^2 of new office and 32,500 m^2 of new retail floorspace in Haringey would be required by 2016. Using emission benchmarks for gas and grid electricity it was estimated from the above figures (extrapolated on linear basis from 2016 to 2050) that the net impact of commercial and industrial premises (bulk) could add in excess of 36,000 tpa of CO_2 by 2050.

6.2.3 Trends in Transport

The population of the North London region is expected to grow by 15% by 2016[25]. This is equivalent to an annual increase of 0.94%. If it is assumed that this rate of population increase continues to 2050, and that emissions due to transport grow at the same rate in an unconstrained scenario, then the emissions from transport would increase by 90,519 tpa by 2050.

[25] The London Plan Sub Regional Development Framework North London, Mayor of London, May 2006

6.3 A Target for 2050 Taking into Account Growth Rates

The preceding sections estimated the impact of growth in housing, non-residential buildings and transport to 2050. The final column in Table 30 below shows the impact of factoring in that growth. Assuming a 60% reduction by 2050 means that the reduction target will be in excess of 775 ktpa. This figure forms the target of all the energy scenarios work that follows. The table below shows the reduction targets for different years, according to borough's own targets.

	CO_2 Emission Reduction Required		
Year	%	Excluding growth (ktpa)	Including growth (ktpa)
2010	5.5%	52.8	68.8
2016	13.6%	132.0	173.0
2030	32.7%	316.7	418.7
2050	60%	580.7	775.7

Table 30: CO_2 Targets for 2010, 2016, 2030 and 2050

6.4 Methodology and Model Description

In order to analyse the different scenarios, a model was devised in Microsoft Excel. Figure 23 shows a simplified flow diagram of the model. Once a scenario has been selected, the model estimates the heat and power displaced and calculates CO_2 savings. Using this information an economic analysis is carried out in order to estimate yearly cash flows which then allow the calculation of simple payback, net present value and internal rate of return.

Technical and financial parameters can be easily adjusted, which include CO_2 emission factors, fuel and electricity prices and financial incentives, among others. The information used for different technologies can a

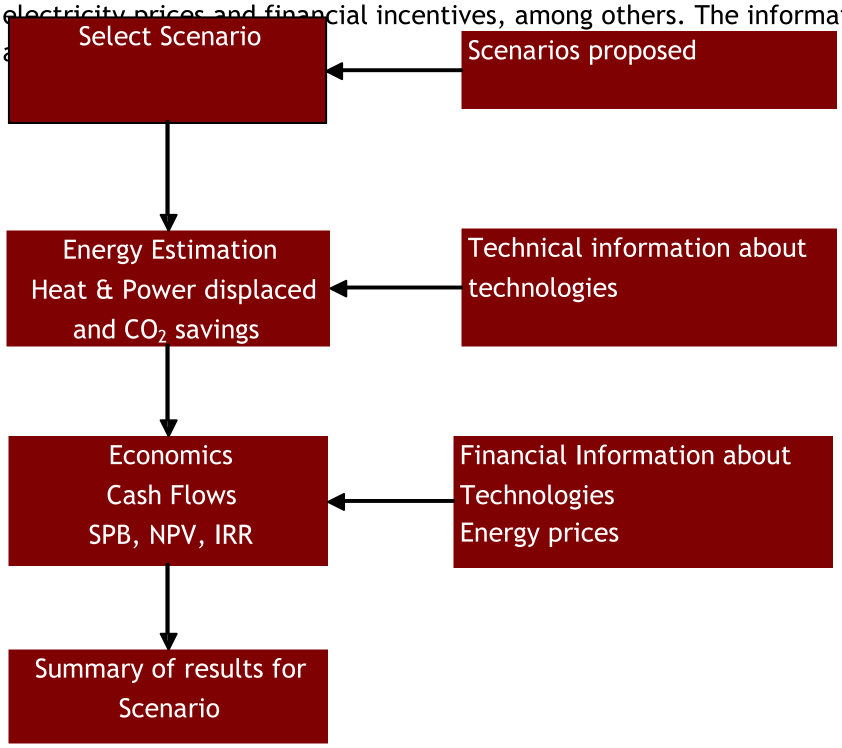


Figure 23: Flow diagram of the model

The following table shows the technologies that are included within the model and some comments about their potential in London and Haringey.

Technology	Description	Potential
Renewable CHP	Includes a mixture of different biomass technologies, such as anaerobic digestion, gasification, steam turbines, biodiesel. This technology is measured in number of MW_e installed.	It has been estimated that 200MWe of biomass CHP are required in London to comply with the Mayor's Energy Strategy
Large Gas CHP	Large CHP plant that could be built within London, and connected to heating networks. This technology is measured in number of MW_e installed.	The Carbon Trust estimates the UK CHP capacity at 18GWe, CHPA suggests 12GWe by 2020
Gas CHP – building	These are smaller CHP engines that would be building integrated. This technology is measured in number of MW_e installed.	As above
Heat from existing Power Stations	There are a number of power stations within London that reject heat to the atmosphere. This heat could be potentially used for heating and DHW purposes.	It has been estimated that the potential heat that could be exported from Edmonton power station is in the order of 25 MW_{th}.
PV - domestic	Domestic systems of 2.5kWp are assumed per dwelling. This technology is measured in number of systems installed.	Mayor's Energy Strategy proposes no less than 100MWp for London
PV- large	Commercial & industrial systems are measured in number of MW_e installed.	As above
Wind – large	Large systems are measured in number of MW_e installed.	Mayor's Energy Strategy proposes no less than 6MWe
Wind - domestic	Domestic systems of 1 kW_e are assumed per dwelling. This technology is measured in number of systems installed.	Mayor's Energy Strategy proposes no less than 0.5MWe
Solar thermal	Domestic systems of 2.8kW_{th} are assumed per dwelling. This technology is measured in number of systems installed.	Mayor's Energy Strategy proposes no less than 75,000 domestic systems
Biomass boilers Large	Commercial & industrial systems are measured in number of MW_{th} installed.	There are no real targets for biomass boilers in London.
Biomass boilers domestic	Domestic systems of 20kW_{th} are assumed per dwelling. This technology is measured in number of systems installed.	As above, but in this case they would be applicable to houses with space for fuel storage.
Ground Source Heat Pumps	Domestic systems of 5kW_{th} are assumed per dwelling. This technology is measured in number of systems installed.	This is not considered to be a very cost effective measure and it would applicable only to new houses.
Micro-CHP stirling	Domestic systems of 1.2kW_e are assumed per dwelling. This technology is measured in number of systems installed. This	Defra proposes 0.5GWe and EST 3.2Gwe by 2020 for the UK. CHPA estimates

Technology	Description	Potential
	technology is more appropriate for those areas where larger CHP systems are not favourable.	1.5GWe by 2020.
Micro-CHP fuel cell	Domestic systems of $1kW_e$ are assumed per dwelling. This technology is measured in number of systems installed.	As above
Cavity wall insulation	This is measured as the number of dwellings that could insulate the unfilled cavity wall.	It has been estimated that more than 36,000 homes have unfilled cavity walls in Haringey.
Loft insulation	This is measured as the number of dwellings that could insulate or increase the levels of insulation of the loft.	It has been estimated that more than 25,000 homes have low levels of loft insulation in Haringey.
Double glazing	This is measured as the number of dwellings that could replace single for double glazing.	It has been estimated that more than 40,000 homes could install double glazing in Haringey.
Solid wall insulation	This is measured as the number of dwellings that could insulate their solid walls.	It has been estimated that more than 36,000 homes have solid walls in Haringey.
Energy Efficient lighting for non-domestic premises	Energy efficient lighting could save between 10 and 30 kWh/m2, depending on the type of lighting and type of premise.	It has been estimated that there are than 1,495,000 m2 of commercial & industrial premises. This figure does not include the non-bulk premises.
Street lighting - efficient lamps	Replacing a 150W lamp with a 120W lamp could save approximately 100 kWh/yr	It has been estimated that there are around 14,000 street lights in Haringey
Reduce car passenger-km	Reduction measured in millions of passenger-kilometres	It has been estimated that nearly 900 million passenger-kilometres are travelled annually in cars in Haringey
Reduce road freight tonne-km	Reduction measured in millions of tonne-kilometres	It has been estimated that more than 280 million tonne-kilometres are travelled annually in Haringey
Reduce CO_2 emissions of fleet - cars	Reduction measured in gCO_2/pass-km	Current average is 110 gCO_2/pass-km
Reduce CO_2 emissions of fleet - freight	Reduction measured in gCO_2/t-km	Current average is 144 gCO_2/t-km
Reduce CO_2 emissions of fleet - buses	Reduction measured in gCO_2/pass-km	Current average is 80 gCO_2/pass-km
Reduce CO_2 emissions of fleet - trains	Reduction measured in gCO_2/pass-km	Current average is 45 gCO_2/pass-km

Technology	Description	Potential
Modal shift, cars to public transport	Measured in millions of passenger-kilometres. This assumes that the number of car passenger kilometres is reduced, and the same number of passenger-kilometres is added to the total for public transport, divided between trains and buses.	It has been estimated that nearly 900 million passenger-kilometres are travelled annually in cars in Haringey
Modal shift, freight road to rail	Measured in millions of tonne-kilometres. This assumes that the number of road freight tonne-kilometres is reduced, and the same number of tonne-kilometres is added to the total for rail freight.	It has been estimated that more than 280 million tonne-kilometres are travelled annually in Haringey

Table 31: Technologies analysed within the model

To model a scenario, the user has to enter the amount of technology that would be deployed by 2050. It is possible to model installing these technologies at different rates over time by entering installed capacities for the key interim years 2010, 2016 and 2030. Between these years, it is assumed that installed capacity increases yearly in a linear fashion. For example if 10MWe of CHP are proposed by 2010, 2.5MWe would be implemented every year (from 2006 to 2010). Detailed assumptions for the different technologies can be found in the appendix. The following sections detail the scenario analysed and the results obtained.

The model also includes subsidies for certain technologies as a further option, such as ROCs, LECs, EECs, ETS and Social Cost of Carbon, which were described earlier in this report.

6.5 Scenario constraints

When generating potential scenarios, there are numerous constraints that affect the capacities of each technology that can be installed. The SEA model has automatic checks for these each time a scenario is analysed. The need to hit the target and keep within these constraints significantly limits the range of possible scenarios.

6.5.1 Maximum potentials

For each technology, a maximum potential has been identified and this maximum cannot be exceeded.

6.5.2 Biomass resource

As described in Chapter 5, the total biomass consumption for the biomass technologies (CHP and boilers) cannot exceed the available resource.

6.5.3 Thermal and power demand

The total thermal and power demands for Haringey have been estimated at 1.521 GWh/yr and 858 GWh/yr respectively. The model calculates the total heat and power displaced by all the technologies in each scenario.

Power export is allowed, since the national grid system means that excess electricity can be sold to users outside the borough.

Heat export is not allowed, i.e. the heat displaced under any given scenario must not exceed the total thermal demand. This is because at present there is no way to export this heat out of the borough. Heat export might become possible in the future if neighbouring boroughs implement heat networks and these networks can be connected up.

6.5.4 Transport reduction and modal shift

The transport options include reductions in car passenger-kilometres and freight tonne-kilometres, and modal shifts from cars to public transport and from road freight to rail freight. The sum of the reduction and the modal shift cannot be greater than the total number of passenger-kilometres or tonne-kilometres travelled.

6.6 Potential Scenario to 2050

Table 32 below shows the proposed scenario to 2050. This scenario envisages adopting high levels of wind coupled with small scale CHP initially. Individual boilers and CHP units are phased out in favour of large CHP plant as community heating networks develop. Between 2030 and 2050, PV is expected to become economical and is encouraged aggressively in this scenario. Energy efficiency measures are introduced steadily over the four periods. Similarly the transport measures are changed steadily with time.

		Total capacity installed by			
Technology	Units	2010	2016	2030	2050
Renewable CHP	MWe	0.0	0.0	5.0	5.0
Gas CHP - Large	MWe	0.0	0.0	80.0	141.0
Gas CHP - building	MWe	12.0	30.0	8.0	0.0
Heat from power station	MWth	0.0	5.0	20.0	25.0
PV - Domestic	Dwellings	200	2,000	10,000	33,000
PV- Large	MWe	0.5	3.0	4.0	150.0
Wind - large	MWe	6.0	8.0	8.0	10.0
Wind - small	Dwellings	50	150	500	5,000
Solar thermal	Dwellings	100	200	1,000	5,000
Biomass boilers large	MWth	1.0	2.0	0.0	0.0
Biomass boilers small	Dwellings	200	300	100	0
GSHP	Dwellings	50	100	50	0
Micro-CHP stirling	Dwellings	1,000	2,000	3,000	0
Micro-CHP fuel cell	Dwellings	0	50	3,000	0
Cavity wall ins	Dwellings	5,000	15,000	20,000	36,000
Loft insulation	Dwellings	5,000	10,000	15,000	25,000
Double glazing	Dwellings	2,000	5,000	15,000	30,000

		Total capacity installed by			
Technology	**Units**	**2010**	**2016**	**2030**	**2050**
Solid wall insulation	Dwellings	20	200	2,000	5,000
Energy Efficient Lighting	000's m2	50.0	300.0	800.0	1,500.0
Double Glazing - Commercial	000's m2	1.0	2.0	5.0	20.0
Street Lighting - Efficient Lamps	Lamps	5,000	10,000	14,000	14,000
Reduce car passenger-km	million pass-km	12	20	40	130
Reduce road freight tonne-km	million t-km	3	7	18	35
Reduce CO_2 emissions of fleet - cars	gCO_2/pass-km	5	15	30	60
Reduce CO_2 emissions of fleet - freight	gCO_2/t-km	2	4	10	30
Reduce CO_2 emissions of fleet - buses	gCO_2/pass-km	2	4	10	20
Reduce CO_2 emissions of fleet - trains	gCO_2/pass-km	1	2	5	9
Modal shift, cars to public transport	million pass-km	15	30	90	200
Modal shift, freight road to rail	million t-km	3	6	15	25

Table 32: Summary of proposed scenario

Figure 24 shows the estimated capital expenditure for the proposed scenario. A more even distribution of expenditure between the various options can be seen up to 2030. After 2030, large scale gas CHP dominates in order to meet the 60% CO_2 reduction target. Domestic double glazing and large PV systems also have high capital expenditure.

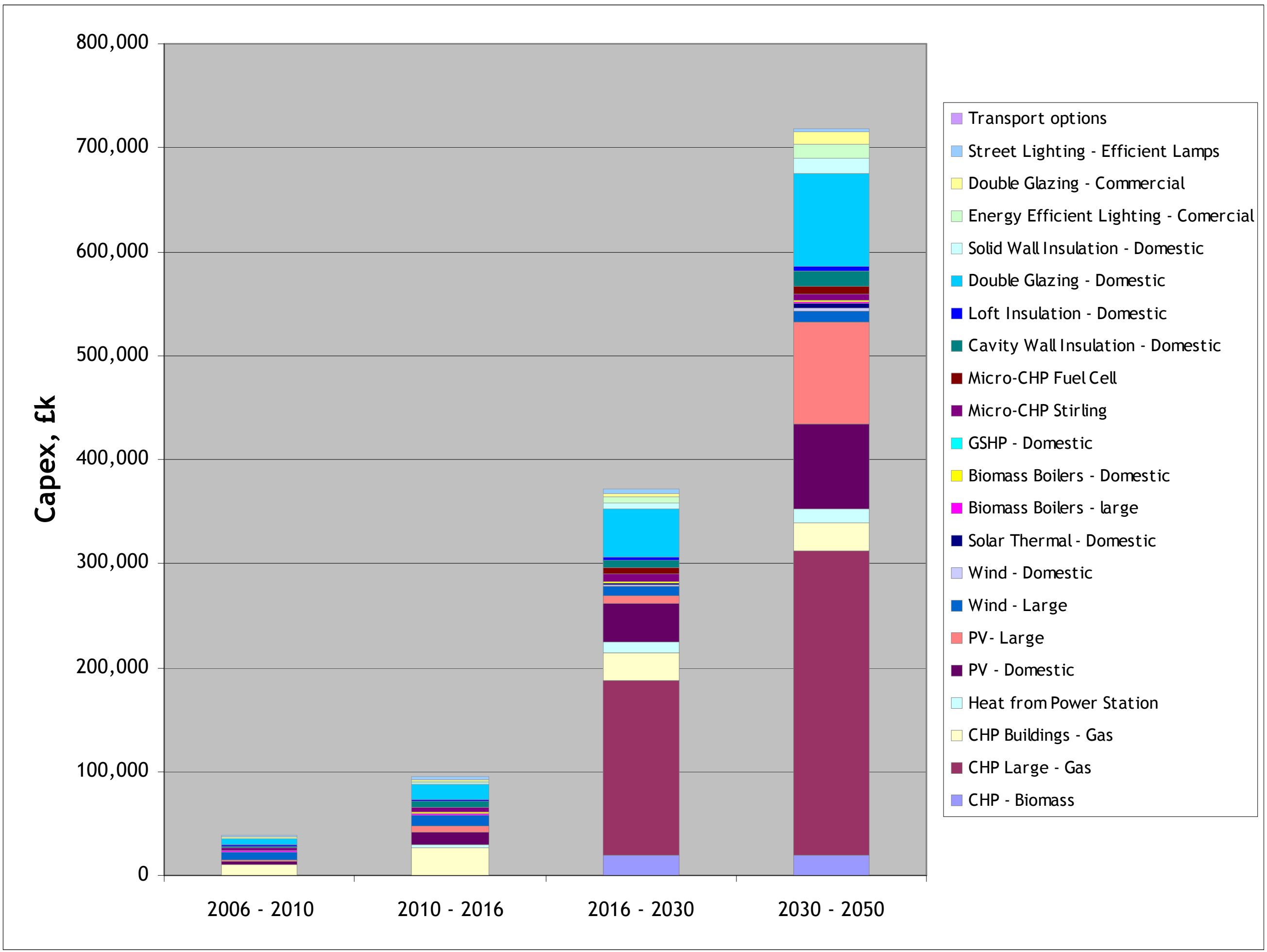


Figure 24: Estimated capital expenditure for proposed scenario

Figure 25 shows the CO_2 emissions saved by the measures adopted in the proposed scenario. Large CHP clearly dominates in later years, with significant contributions from large PV, waste heat from existing power stations, the transport options and the energy efficiency measures.

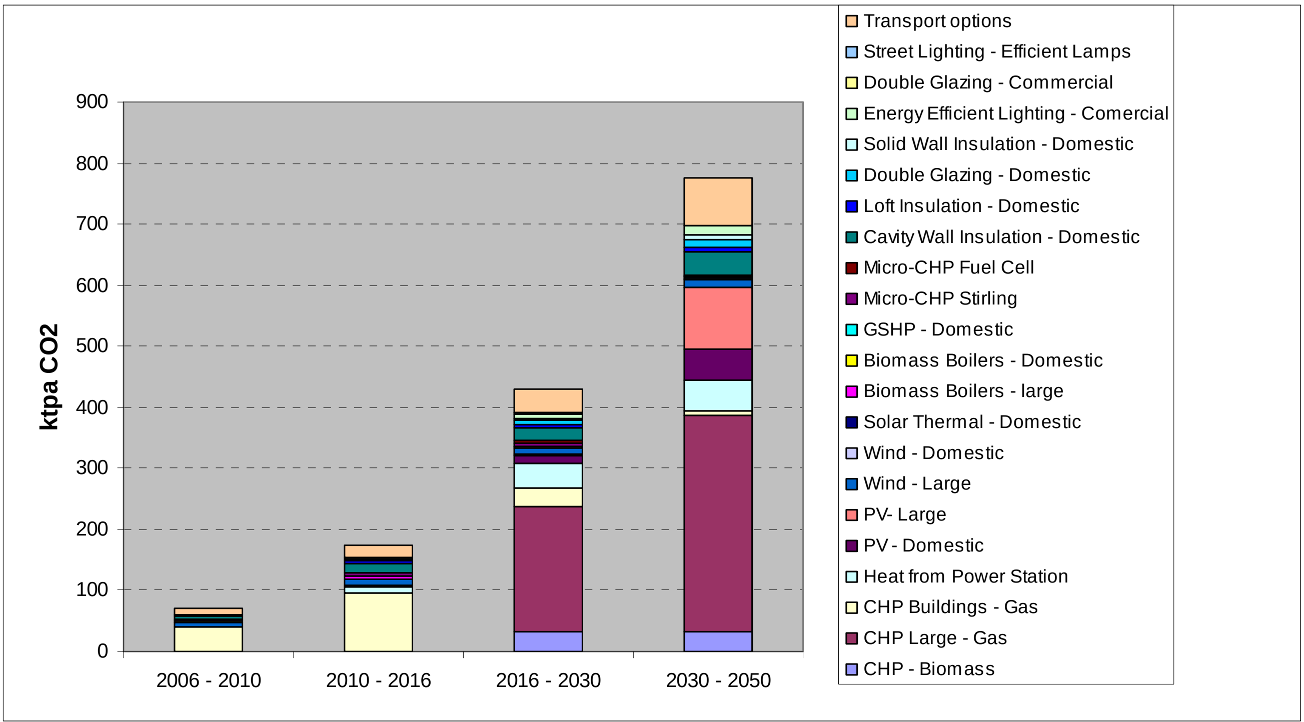


Figure 25: CO_2 emissions savings under proposed scenario

Table 33 shows that many of the measures have a positive NPV, as does the scenario overall. The CHP, wind, cavity wall insulation and transport measures are particularly good financially. Environmentally the CHP, PV, and insulation options all contribute significantly. The transport measures are not broken down individually due to the modelling methods, but between them make a significant contribution to CO_2 savings.

Technology	Units	Installed capacity	Heat	Power	CO_2 savings	Capital cost	NPV
		By 2050	GWh/y	GWh/y	Ktpa	£m	£m
Renewable CHP	MWe	5.0	59	32	32.2	19	10
Gas CHP - Large	MWe	141.0	968	926	355.5	293	125
Gas CHP - building	MWe	0.0	0	0	7.8	27	68
Heat from power station	MWth	25.0	208	0	50.5	13	-3
PV - Dom	Dwellings	33,000	0	88	49.7	82	1
PV- Large	MWe	150.0	0	179	101.5	98	8
Wind - large	MWe	10.0	0	22	12.5	11	17
Wind - small	Dwellings	5,000	0	6	3.1	3	1
Solar thermal	Dwellings	5,000	8	0	1.8	5	-3
Biomass boilers large	MWth	0.0	0	0	0.3	0	-1
Biomass boilers small	Dwellings	0	0	0	0.1	1	-2

Technology	Units	Installed capacity	Heat	Power	CO_2 savings	Capital cost	NPV
		By 2050	GWh/y	GWh/y	Ktpa	£m	£m
GSHP	Dwellings	0	0	0	0.0	0	-1
Micro-CHP stirling	Dwellings	0	0	0	1.8	7	-4
Micro-CHP fuel cell	Dwellings	0	0	0	0.2	6	-4
Cavity wall ins	Dwellings	36,000	148	0	36.4	14	28
Loft insulation	Dwellings	25,000	31	0	7.6	5	5
Double glazing	Dwellings	30,000	62	0	14.8	90	-46
Solid wall insulation	Dwellings	5,000	31	0	7.3	15	-2
Energy Efficient Lighting	000's m2	1,500.0	0	24	13.6	12	1
Double Glazing - Commercial	000's m2	20.0	3	0	0.6	12	-6
Street Lighting - Efficient Lamps	Lamps	14,000	0	2	0.9	4	-2
Reduce car passenger-km	million pass-km	130	0	0	77.7	0	294
Reduce road freight tonne-km	million t-km	35					
Reduce CO_2 emissions of fleet - cars	gCO_2/pass-km	60					
Reduce CO_2 emissions of fleet - freight	gCO_2/t-km	30					
Reduce CO_2 emissions of fleet - buses	gCO_2/pass-km	20					
Reduce CO_2 emissions of fleet - trains	gCO_2/pass-km	9					
Modal shift, cars to public transport	million pass-km	200					
Modal shift, freight road to rail	million t-km	25					
Totals			**1,517**	**1,277**	**776**	**719**	**484**

Table 33: Summary of results for the proposed scenario

6.7 Biomass consumption

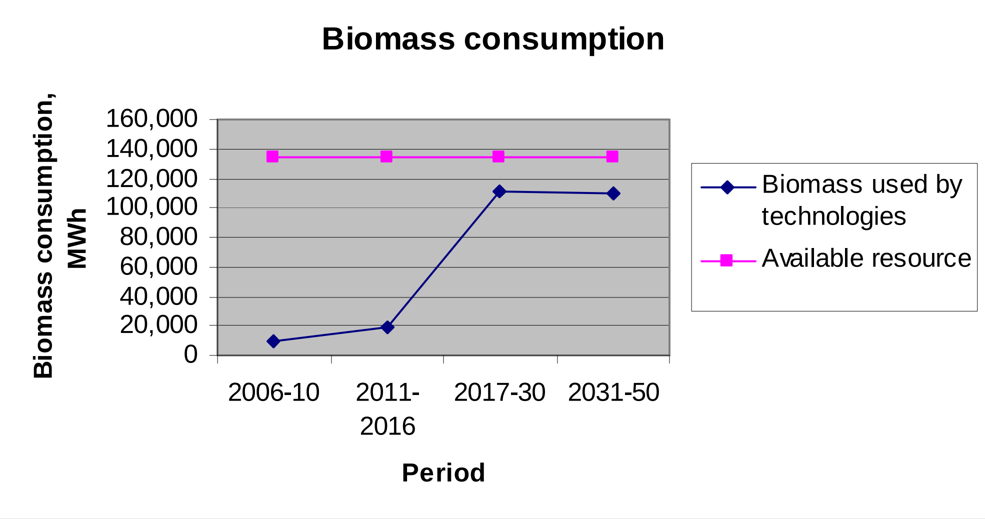


Figure 26: Biomass consumption

Figure 26 shows the annual biomass consumption under the proposed scenario, which is less than the available resource. It increases sharply between 2016 and 2030 as renewable CHP is put in place.

6.8 Gas consumption

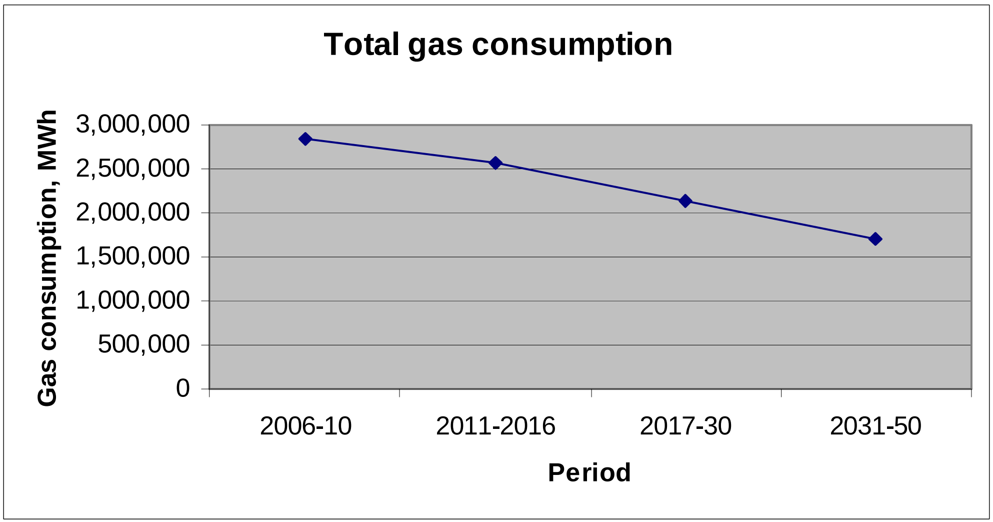


Figure 27: Gas consumption

Figure 27 shows the total annual gas consumption expected under the proposed scenario. This includes the gas consumed by the technologies installed under the scenario, the gas required to provide the remaining heat for the borough, and the gas used in generating the electricity bought in from the grid.

This shows that despite the introduction of gas fired CHP in the borough, overall gas consumption is actually reduced in this scenario because the CHP displaces the less efficient combination of individual boilers and grid electricity.

7 Implementation

7.1 Introduction

This chapter outlines some of the measures that Haringey can take to achieve its CO_2 emission reduction targets. Obviously not all the actions that need to happen are entirely within the control of the local authority. However, there is still a lot that LBH can achieve.

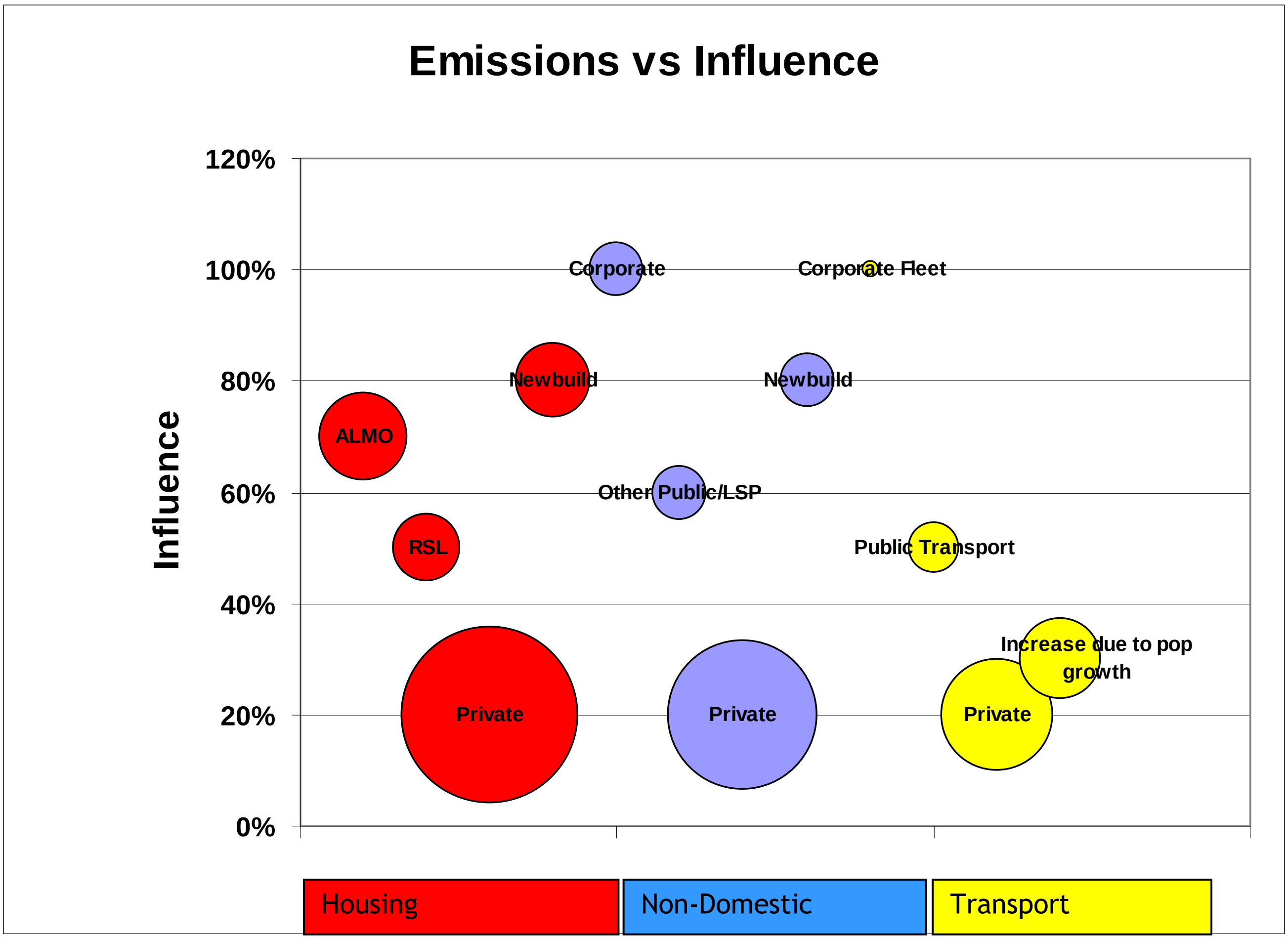


Figure 28: Influence vs. Emissions

Figure 28 indicates the amount of influence the borough has over various sectors, measured on a percentage scale. The size of the circles is proportional to the annual emissions produced by that sector.

At first glance it might be noted that there appears to be an inverse relationship between emissions and influence. However, there is no sector that LBH cannot exert at least some influence on. Those sectors where influence is estimated at 50% or above do represent a significant proportion of the total emissions.

This also illustrates the importance of leading by example and partnership working. By engaging partners in each of the sectors shown here, their influence can be added to the mix and more can be achieved. If the borough can achieve significant reductions in its own corporate emissions, then even though these emissions are relatively small, it will set an example that will filter down to other businesses and residents in the borough. Local Authorities can also set an example upwards, to central government. This is important, because central government can exert a significant influence on all sectors.

7.2 Leading by example

LBH must reduce its own corporate emissions as part of implementing this strategy. For transport, the recommended measures are outlined in the transport section below. Similarly, many of the building sector measures apply to the council stock.

The key measures for LBH building sector corporate emissions are:

- Undertake an energy audit of the council stock and implement any feasible energy efficiency measures.
- Install at least one visible renewable energy installation on a council building or council land soon after the adoption of the strategy. A medium scale wind turbine or large PV array would be suitable technologies.
- Advertise the work that the council is doing on its buildings and transport to reduce emissions.

7.3 Setting the Planning Framework

A few years ago, the idea that the planning system could be used to determine the energy performance of buildings would have seemed improbable. Tentative wording in planning guidance to “encourage” developers to orientate buildings to maximise winter solar gains or to “consider” higher energy efficiency standards were widespread but had limited effect. The national Building Regulations set the framework for the energy standards and developers tended to build to meet the minimum standards.

Then the introduction by the London Borough of Merton of a requirement for 10% of energy requirements to be supplied by on-site renewables opened up a whole possibility of using the planning. Now 25% of UK local authorities have a 10% on site renewables requirement and this is also included in the London Plan.

In implementing this strategy Haringey needs to think carefully about how the planning system will interact with, regional planning frameworks, national Building Regulations and the use of combined heat and power and community heating.

7.3.1 10% renewables requirement

Haringey has in its draft UDP a policy of requiring all major developments in the borough to supply 10% of their energy from on-site renewables. This strategy envisages a heat network supplying about half of the boroughs thermal demand and therefore connecting to a large number of the buildings in Haringey. As discussed in Section 4.5, it does not make sense to supply renewable heat where community heating is available. It is therefore recommended that in areas where a heat network will be developed, the 10% requirement should be restricted to electricity generating technologies.

The 10% requirement could be improved to encourage electrical technologies by changing the requirement to a carbon based rule. That is, renewables should be installed such that carbon dioxide emissions are reduced by 10% (as opposed to supplying 10% of the energy). This is because electricity has a higher carbon emission factor than heat from gas. Therefore to reduce CO_2 emissions by 10% using a renewable electricity installation would require a smaller installed capacity than meeting 10% of the energy requirement.

At present, the 10% rule applies only to major developments. It should be made mandatory for all developments to increase the uptake of renewables.

Finally, the percentage required should be increased over time. There should not be a long delay in increasing to 20% and beyond.

7.3.2 Low carbon buildings

Haringey should adopt a policy requiring all building work subject to building regulations to exceed building regulations carbon targets by 40%.

In areas where a heat network will be available, new buildings and major refurbishments should be required to be made ready for community heating connection.

7.4 Encourage development of a heat network

This strategy illustrates that a community heating network supplied by CHP will be essential for Haringey to meet its targets in a cost effective way. This will deliver over 60% of the CO_2 reduction necessary. An outline of how this might be started is given in this report. The next steps are:

- Commission a study to investigate the setting up of a community heating network and associated CHP power station(s). This will need to look at phasing and pipe routes. It will also need to determine the appropriate size, type and location of power stations
- Work with partners including the existing local power stations, particularly Edmonton, and neighbouring boroughs to establish connections to these
- Identify businesses and local strategic partner sites (such as hospitals) with high heat loads and involve them in the scheme
- Set up an ESCo as a vehicle for supplying the infrastructure for the community heating scheme
- Begin development of the network, especially where regeneration is happening anyway

7.5 Encouraging large scale renewable energy installations

This strategy has identified three important renewable energy technologies that will operate on a larger scale than individual buildings. These are biomass CHP (using the heat network), wind turbines and solar PV.

Wind is currently the most cost-effective renewable electricity generating technology, and a few large wind turbines in the borough are critical to meet the early interim targets before large infrastructure projects are completed (e.g. heat network) and before other renewables become economic (e.g. PV). This reflects the national picture.

Biomass CHP represents the most efficient means of using a limited biomass resource, and is a useful lower carbon supplement to the main gas CHP generation.

Solar PV is expensive at the moment, but is expected to fall in price in the future, particularly in the last period analysed here (2030 to 2050). It is a technology that is long lasting with low maintenance. It is also unobtrusive and there are a lot of existing surfaces especially roofs where it could be easily fitted.

Steps Haringey can take to enable the development of these technologies are:

- Identify suitable sites in the borough for wind, PV and biomass generation. These could be council or privately owned
- Identify transport routes for biomass imports into the borough. Preference should be given to water or rail transport over roads
- Establish an energy crop consortium, perhaps in the neighbouring counties of Buckinghamshire, Hertfordshire and Essex to secure supplies

7.6 Energy efficiency measures

7.6.1 Domestic

The existing housing stock represents a large proportion of emissions. Many existing houses are very inefficient, and much of the housing standing today will still be in use in 2050. This can be improved by changing the supply of energy as mentioned above. However it will also be necessary to improve the efficiency of the existing stock.

This strategy envisages that by 2050 nearly all feasible efficiency measures will have been carried out on the existing housing stock. This work has already started, but could be increased. Measures that could help include:

- Maintaining an effective database of housing stock condition to target energy efficiency measures. This should include all dwellings (Haringey Homes, RSL stock and private houses)
- Offering additional grants or local tax incentives to householders for energy efficiency work
- Use influence to encourage Haringey Homes, RSLs and private householders to implement energy efficiency measures and to supply data. This could be through tax systems, procurement contracts for ALMO, preferred lists for RSLs, the planning system etc

7.6.2 Non-domestic

As with housing, it is important to tackle energy efficiency in the non-domestic sector. Although the borough possibly has less influence on this sector, there are many measures that can easily be implemented and Haringey must do all it can to encourage them to happen.

- A database should be developed and maintained of non-domestic building stock condition in order to target measures effectively.
- Businesses should be encouraged to complete energy audits. This could be a requirement under procurement rules for companies supplying the council. The borough could also facilitate audits of whole industrial estates.
- Local tax incentives could be used to encourage businesses to improve energy efficiency.
- The council and local strategic partners should lead by example and publicise the work they are doing.
- An EPBD early implementation scheme could be encouraged, which requires energy auditing.

7.6.3 Cross cutting

It is recommended that a voluntary carbon trading scheme be introduced for householders and businesses in the borough. This would have several advantages:

- It would impose reduction targets (albeit voluntary) on scheme members, in line with (or exceeding) the strategy targets.
- It would enable useful monitoring of emissions from local businesses and residents.
- It would set a useful example for others to follow, and provide valuable information on the best ways to run such schemes.
- It would prepare members for the possible future implementation of national trading schemes

7.7 Transport

Reducing carbon dioxide emissions from transport in Haringey will require a partnership approach with neighbouring boroughs, Transport for London and the rail companies. The figures for transport given in this chapter are those produced within the borough, but many of these emissions will be from vehicles which pass through the borough without stopping and are therefore less likely to be influenced by any measures put in place in Haringey alone. Conversely many of the journeys made by Haringey residents and workers will take place largely outside the borough and people within the borough will also generate considerable freight traffic both in the UK and overseas through their purchasing behaviour (see section 3.1).

Whilst most of the actions listed in the Action Plan are designed to be implemented by LBH they will be much more effective if similar measures are implemented in neighbouring boroughs and working closely with TfL and groups such as the North London Transport Forum will be crucial. It should also be remembered that reducing CO_2 emissions from transport is likely to bring other benefits such as reduced noise, improved air quality, better health (from more walking and cycling), social benefits (making streets a more pleasant place to be), safety improvements (less road casualties, reduced fear of crime) and local economic benefits (revitalising town centres and local shops).

7.8 Opportunities for reducing CO_2 emissions from transport in Haringey

7.8.1 Within LBH

7.8.1.1 Fleet

The majority of LBH's fleet refuels centrally at the Ashley Road depot and used 1,223,000 litres of diesel in the year from 1st October 2005 to 30th September 2006. This equates to 3.2kt of CO_2 emissions from the fleet - 2% of Haringey's total transport emissions. As at the end of October 2006 the fleet comprised of 365 permanent vehicles and an additional 149 vehicles on short or longer-term hire. There are also small number of vehicles have been purchased directly by departments. Fuel for these vehicles and any other fuel purchased away from Ashley Road depot is not included in the figures above.

LBH's fleet has recently started using a 5% biodiesel blend for all vehicles which will save the borough approximately 0.096 ktpa of CO_2 (3% of fleet emissions). There is also one electric vehicle in the borough.

There are various ways in which carbon emissions from LBH's fleet can be further reduced (carbon savings are given in brackets):

- **Use a higher biodiesel blend**, by 2009 most diesel sold in the UK will contain 5% biodiesel anyway and higher blends give better CO_2 savings (a 20% blend in the whole fleet would save approx 0.39ktpa CO_2)
- **Use more alternatively fuelled vehicles** (the impact of this depends on the type of vehicle and the numbers used, but for example an electric car will produce CO_2 emissions of 100g/km, compared to 171g/km for the average new car).
- **Driver training** – improvements in driving technique have been shown to reduce fuel consumption by 5-25%.
- **Fleet review** – the most effective way to reduce CO_2 emissions from the fleet is to reduce the number of vehicles in the fleet. By regularly reviewing the number of and use of vehicles it may be possible to identify areas where vehicle usage can be reduced. The Energy Saving Trust can provide free advice to help start this process.

- **Always choose best in class vehicles** for CO_2 emissions (those with the lowest g/km CO_2 emissions or with higher mpg), if this is implemented across all vehicles as they are replaced in the fleet this could produce considerable CO_2 emission reductions.

It is suggested that LBH sets a target for reduction of CO_2 emissions from its fleet. This could be set as a reduction in diesel consumption which may be easier for the fleet manager to monitor. However it is important to ensure that fuel purchased away from the depot is also monitored.

7.8.1.2 Travel for work

The high levels of casual and essential car use for council business was mentioned several times during meetings with LBH staff. It appears that many staff use their car for work purposes when other alternatives are available. It is suggested that ways of minimising personal car use for work purposes is addressed through measures such as:

- **Provision of electric pool cars** – for use for work journeys rather than personal cars which will produce more CO_2
- **Provision of pool bikes** – for use for work journeys. Cycle training, secure cycle parking and maps will also need to be provided.
- **Promotion of the essential bike users allowance** – Haringey provides a cycle allowance of £20.83 per month, but there is low awareness of this with only 9 employees currently claiming this allowance. This should be promoted more heavily in conjunction with the availability of cycle training and improved cycling facilities (parking, lockers, showers etc).
- **Walking and cycling routes between Council sites** – several members of Haringey staff mentioned that walking between different offices was feasible and could be as quick as driving and parking. It is suggested that a map giving suggested routes and walking/cycling times between offices is produced.
- **Oyster cards for departments** – claiming expenses for work journeys by public transport appears to be more time consuming than claiming for car usage. It is therefore suggested that to encourage public transport use each department stocks several pre-loaded Oyster cards which staff can sign out to use for work journeys.

7.8.1.3 Travel Plan

LBH is in the process of implementing a staff travel plan which will look to set a baseline for staff travel to work. As part of the travel plan process measures to reduce single occupancy car use will be addressed. The last staff travel survey was conducted in 1997 and 10% of staff responded, this showed that 55% of staff drove to work, 20% travelled by bus, 15% walked, 11% travelled as car passengers, 9% came by train and 5% cycled. This shows that a higher percentage of LBH employees travel to work by car than people in Haringey as a whole, although the percentage travelling by bus and walking was also higher.

The 2001 census results gave the following modes of transport to work by Haringey residents: underground 35%, driving 25%, bus 13%, work from home 9%, train 6%, walk 6%, Bicycle 3%, car passenger 2% and motorbike 1%.

The travel plan process will help the council to implement measures to reduce the CO_2 emissions from its employees travel to work through measures such as:

- A car sharing scheme
- Flexi-time/home working

- Reduced staff car parking
- Improved cycling facilities, secure parking, lockers and showers
- Information provision on transport options
- Interest-free loans for season tickets and bicycles
- Improvements to the streetscape and pedestrian links to public transport
- Recruiting staff who live locally when possible

The travel plan should also cover travel for work as detailed in section 7.8.1.2 and should address deliveries and travel to council premises by visitors.

7.8.2 Within Haringey

This section addresses how LBH can help reduce CO_2 emissions from other transport in the borough for which it is not directly responsible. The actions are listed under the following hierarchy:

- Reduce travel
- Modal Shift
- More efficient vehicles
- Alternative fuels

Behaviour change through reduced travel and modal shift is more effective than more efficient vehicles and alternative fuels. This can be shown in the UK by the fact that cars have become considerably more efficient since the early 1990s, but the CO_2 savings made have been wiped out by the increased numbers of cars used and the distance driven. It is important to remember that whilst some of these actions will have small individual impacts on CO_2 emissions in the borough cumulatively they could lead to a real change in the way people travel in Haringey.

Additionally any improvements to alternative modes of transport to the car will benefit the large number of Haringey households without a car and help promote social inclusion.

7.8.2.1 Reduce travel

Reducing people's need to travel without impacting on their standards of living, can be done through a range of methods including:

- integrating developments so people can shop and work locally
- promoting home deliveries
- improving local shopping centres and promoting these above 'out of town' style developments
- ensuring most people live within a short distance of schools, health care facilities, banks, post offices and other services.
- ensuring local employment opportunities
- consolidating freight deliveries
- promoting local entertainment and leisure facilities
- Travel plans for schools, residents and businesses can be useful in helping people identify areas where they can reduce travel

7.8.2.2 Modal shift

When trying to encourage modal shift it is important to remember that most people will only change their travel behaviour if the alternatives give them some benefit over private car use such as a time or cost saving or health benefits. However as nearly half of Haringey's households do not have access to a car any improvements to alternative modes will benefit them too and promote social inclusion. Actions for promoting specific alternative modes are given below, but some general actions to encourage people to change from the car to another mode include:

- **Awareness raising campaigns** can be very effective, especially if they promote the benefits of alternative modes (time or cost savings, health benefits etc) rather than the disadvantages of car use. TfL's good going campaign team can help with such campaigns.
- **New developments** should be planned so that alternative modes are embedded from the start and are more attractive than private car use. Information on transport options could be supplied to all new households as changing transport behaviour is most easily achieved in conjunction with other changes in lifestyle. Section 106 money can be obtained from developers to fund transport measures within new developments. In addition it is important to follow up and ensure that developers have provided all the transport facilities promised.
- **Travel plans** have an important role in promoting modal shift whether they are implemented for residents, schools or businesses.
- **Improving existing town centres** so they have good access by all alternative forms of transport and ensuring that any new developments are fully accessible by public transport, walking and cycling is also critical.

7.8.2.3 Promote walking

Walking is the cheapest and most environmentally friendly form of transport and is possible over at least short distances for almost everyone. Improving the pedestrian environment and increasing footfall provides a wide range of social and health benefits as well as reduced emissions of CO_2 and other pollutants. When looking at ways to promote walking it is important to realise the reasons why people do not currently walk for short journeys. These might include perceived danger, unpleasant street environment, having to carry heavy shopping, lack of awareness of the time taken to walk short distances or a lack of fitness. Improvements can then be tailored to address these reasons.

The Mayor's Transport Strategy sets a target to increase walking trips by 10% per person/per year by 2015 and there is great potential to achieve this and more in Haringey as there are 5 million car journeys a year under 1km in the borough. 1km is a distance that most people will be able to walk in under 15 minutes, if 10% of these journeys can be shifted from the car to foot this could save 0.85ktpa CO_2.

Some ways in which walking can be promoted include:

- **Providing walking signs** to common destinations, these should give a walking time in minutes as most people find this easier to understand than distances.
- **Physical changes to the street** can help make walking a more pleasant environment, this includes pedestrian crossings in areas where people want to cross the road and well maintained pavements and street lighting. Home Zones and Naked Streets where road markings, bollards and railings are removed can help reduce traffic speeds and make pedestrians feel more secure.
- **Street audits** can be useful to look at the streetscape from a pedestrians point of view and identify improvements to crossings and street furniture to make the street more pleasant to navigate. Street

audits are particularly useful if carried out in conjunction with local businesses and residents so the views of those most likely to walk in the area are taken into account.

- **Guided walks** whether done for local history, leisure or health reasons can be a useful first step to encourage people to get out and explore their local area and they may help people realise how quick walking can be as a mode of transport.

7.8.2.4 Promote cycling

Cycling is a quick and efficient carbon-free form of transport, but numerous barriers most be overcome before many people feel confident to take up cycling. Fear of traffic and safety concerns are probably the most common reasons cited for not cycling, but other problems include lack of access to a bike, lack of secure storage both at home, work/school and at shops and leisure facilities, concerns about getting wet or hot and sweaty can also put people off. However if these and other issues can be addressed cycling could become an important mode of transport in Haringey.

The MTS sets a target of increasing cycling in London by 200% per person per year by 2020, again there is great potential to achieve this in Haringey with 13 million car journeys a year of less than 3km. 3km is a distance that most people will be able to cycle in under 20 minutes, although certain parts of the borough such as Muswell Hill may be more challenging to some people. If Haringey can achieve this increase in cycling by 2020, assuming that most journeys are transferred from the car, the CO_2 savings will be approximately 2.47ktpa. Like walking cycling also brings health, air quality, noise and social benefits.

Cycling can be facilitated in many ways including:

- **Improving cycling infrastructure** – this includes signposting routes, cycle priority crossings and cycle racks in public places. There is considerable debate about what sort of cycle facilities are most useful in promoting cycling and any infrastructure improvements should be discussed with Haringey Cycling Campaign and implemented in coordination with TfL's cycling centre of excellence and the LCN+ network.

- **Cycle training** – Haringey already offers subsidised cycle training to residents and this should be continued and expanded where possible. Cycle training is particularly useful to nervous cyclists or those who have not ridden a bike for many years.

- **Cycle parking and bike security** is an important and often overlooked issue. Simple Sheffield type stands in public locations where bikes are only left for short times are relatively cheap to install and are suitable outside shops and services. For workplaces, public transport hubs and homes more secure parking is more appropriate. Good examples include the bike park at Finsbury Park station and secure cycle parking facilities Hackney Cycle Campaign has installed adjacent to some local authority flats. Cycle parking for households (especially flats) is particularly important as people won't go to the expense of purchasing a bike unless they have somewhere secure to store it. Secure cycle parking can easily be installed in new developments and should be a requirement of planning permission.

- **Promoting the benefits of cycling** and having free 'Dr Bikes' (where people can get their bikes fixed) and maps at community events is a straightforward way of encouraging cycling. The good going campaign and Haringey Cycling Campaign can assist with this.

- **City bike clubs** have been successfully implemented in several European countries, these range from distinctive free bikes to cheap short term bike hire. These schemes can be expensive to implement particularly with regard to maintaining the bike and preventing theft. However they do provide an opportunity for people without bikes to have a go at cycling before purchasing a bike.

7.8.2.5 Promote public transport

Haringey has good public transport links particularly into central London, although east-west routes are less frequent. Public transport is the responsibility of TfL and the rail operating companies, but LBH can work with these bodies to ensure existing public transport is well utilised and can lobby for improved service levels and additional routes. Some specific actions which LBH can lead on to promote public transport use include:

- **Promotional campaigns** for existing public transport services, particularly those with spare capacity for example at off-peak times. This can be done in conjunction with TfL/rail operators and the good going campaign.
- **Lobby TfL** and the rail operators for improved services for example increased frequencies or new routes. In particular a need for more east-west bus routes in the borough was identified and could be a key way to reduce car use.
- **Ensure that buses are given priority** and bus lanes provided wherever possible; improve the waiting environment around bus stops and ensure correct information is available at bus stops. This will need to be done in conjunction with TfL.

7.8.2.6 Reduce car ownership/use

Private cars are the biggest transport contributors to CO_2 emissions in Haringey. Whilst they do not emit CO_2 unless they are in use, reducing car ownership can help reduce car use as people who own cars tend to use them for the majority of journeys even if alternatives are available. Reducing car ownership can also help ease congestion problems caused by parking on the street and help make the streetscape more attractive.

54% of households in Haringey have at least one car, whilst this is lower than in the country as a whole (73% of households in England and Wales have at least one car) and the London average (63% of London households have at least one car), it has been steadily growing (from 48.7% in 1991). As well as promoting alternative modes of transport as detailed above, LBH can influence levels of car ownership/use through the following actions:

As well as promoting alternative modes of transport as detailed above, LBH can influence levels of car ownership/use through the following actions:

- **Encouraging car clubs -** Car clubs can be a useful way to reduce car ownership, whilst some car club members will not have previously owned a car it may dissuade people from buying a car or replacing a second car. LBH can assist car club development by allocating on street parking spaces for car club vehicles and encouraging their inclusion in new developments.
- **Setting up car sharing schemes -** whilst many journeys in Haringey can be replaced by other modes of transport for those which are still most easily completed by car increasing the number of occupants is the simplest way to reduce the carbon emissions per person. There are already a range of car sharing schemes on the internet such as www.liftshare.org. Personal safety is a frequent concern of people regarding car sharing, which can be overcome by creating private groups for employers or groups of employers or for neighbourhoods and schools. These can be set up via the liftshare website and LBH could help facilitate the start up of such groups.

7.8.2.7 Improve vehicle efficiency

As discussed in Section 5.9.2.1 there are various ways in which the fuel efficiency of vehicles could be improved. Obviously the take up of more fuel efficient vehicles is largely influenced by fuel prices, vehicle manufacturers and national government policy, but there are some ways in which LBH can influence this at a local level:

- One direct method of incentivising people to use more fuel efficient vehicles is to **base the price of residents parking permits on the CO_2 emissions of their vehicles**. This is currently being consulted on by the London Borough of Richmond upon Thames where the scheme is based on the VED bands with the least polluting vehicles getting free or reduced permits and the vehicles with highest emissions and second cars facing large increases in parking permit charges. Richmond estimate that this could reduce CO_2 emissions from private cars by as much as 15%.
- **Businesses with fleets tend to be more sensitive to fuel costs** than individuals and would be a good place to start when promoting more fuel efficient vehicles. There is a big difference in CO_2 emissions between similar size vehicles which often is not realised by purchasers. A publicity and awareness raising campaign could be run around this issue targeted at businesses first and then individuals.
- **Improved driving techniques can also considerably reduce CO_2 emissions**, LBH could help influence this by running an awareness campaign encouraging people to take steps such as switching off their engines when stationery or checking their tyre pressure regularly. If funding can be obtained training to fleet drivers could be offered. Additionally LBH could lobby for fuel efficient driving to be included in the driving test to ensure all drivers are aware of the impacts of their driving style.
- **For freight vehicles increased delivery efficiency can greatly reduce CO_2 permission**, this could entail encouraging local businesses to coordinate their deliveries (perhaps as part of a local travel plan group). Alternatively LBH and neighbouring boroughs could look into setting up a scheme similar to the London Construction Consolidation Centre in Bermondsey which has reduced CO_2 emissions from construction traffic by 73% and has also increased delivery accuracy.

7.8.2.8 Alternative fuels/vehicle technologies

Alternative fuels/engine technologies for vehicles can reduce their CO_2 emissions, but this greatly depends on the fuel or technology used. Generally speaking diesel vehicles have lower CO_2 emissions than petrol and some alternative fuels/vehicle technologies currently available have similar CO_2 emissions to diesel and have lower CO_2 emissions than equivalent petrol cars. These include Bioethanol, LPG and petrol hybrids although these do all bring some air quality benefits.

Biodiesel, CNG and electric vehicles are considered to have lower CO_2 emissions than diesel vehicles. In the case of biofuels the source of the fuel is critical to the CO_2 savings, biofuels made from waste products being better than biofuels from virgin feedstock. Biodiesel made from palm oil grown on cleared rainforest land could even have higher CO_2 emissions than diesel and obviously brings other environmental and sustainability concerns.

The role LBH can play in promoting alternative fuels is fairly limited and largely revolves around promotion campaigns, encouraging petrol stations to stock alternative fuels and encouraging fleet managers and individuals to consider different fuels and vehicles. One step LBH could take to encourage the take up of electric vehicles would be to provide electric recharging points for vehicles both on street and in car parks. Currently people can only use electric vehicles if they have off street parking, so by providing on street charging points LBH could encourage the take up of these vehicles.

8 ESCOs & Delivery

This section of the report examines what organisational structures and mechanisms might be used to develop the strategy, drawing on examples from elsewhere in the UK. It proposes establishing an ESCo to design build finance and operate the community heating network in Haringey.

8.1 Roles Required

The central element of the strategy is that a community heating network and a power station is required. The proposed scenario suggests that this would be a combination of new heat and power plant fed from gas and some biomass supplemented by heat from an existing power plant (e.g. Edmonton or Brimsdown). There will also be a significant proportion of renewable energy systems required to meet the 10% requirement and there will be considerable activity in terms of retrofitting energy efficiency measures to existing stock.

8.1.1 Power Plant Operator

There are various options considered for power plant in Haringey, including:

- Biomass Power
- SRF-fuelled Plant
- A large CCGT power station

Whatever combination of technologies is eventually chosen, it is probable that partner organisations with experience of implementing these technologies will be required. These are likely to include manufacturers of these technologies.

8.1.2 Heat Network

A plant of the scale envisaged is a specialist operation and is it not envisaged that the power plant operator would be vertically integrated i.e. that they would engage in selling heat (or power) directly to consumers. It is likely that a separate company will be required to operate and maintain a heat distribution network and sell heat onto consumers. This network will also need to be financed. This is the most complex area of development as there is so little UK experience of this on the scale envisaged here. It is here that is an ESCo will be required. The following sections explain the principles of an ESCo and put forward a possible model for Haringey.

8.2 What is an ESCo?

The term ESCo (Energy Services Company) is used to describe a wide range of different energy supply and energy efficiency arrangements, but essentially an ESCo does not supply just gas and electricity, but rather the services that energy provides, i.e. heat, light and ultimately comfort.

This is part of a general approach that has been put forward as a way of using market systems to achieve more resource efficient outcomes. When a company provides a service rather than a manufactured product, this gives the service provider an incentive to reduce the costs associated with the use of the product. For instance some lift manufacturers now sell a vertical transport service, charging for each metre travelled by the lift rather than simply charging for supply of the lift itself. This incentivises the company to manufacture for longevity and energy efficiency and maintain the lift to a high standard. Similarly some companies now sell floor covering services, rather than carpet. Rather than replacing the whole carpet they simply replace tiles that are worn and have an incentive to produce a durable product rather than a shortlived one.

In the case of energy, a company supplying fuel has little interest in the efficiency of the boiler, in fact arguably has an interest in the efficiency being low to maximise sales of fuel. An ESCo supplying heat or comfort has an incentive to minimise the cost of the heat provision therefore the efficiency and longevity.

Inherent in all of this is the assumption that the service provider will be better placed to optimise the efficiency of the service - either through better access to finance, knowledge or the institutional capacity to deliver. In the case of combined heat and power an individual householder simply does not have the capacity to deliver a communal heat network, let alone the knowledge or finance.

8.3 Possible Models for Haringey

There are a range of possible options which Haringey could follow. Some of these are explored below.

8.3.1 Barkantine Heat and Power

Barkantine Heat and Power (BHP) was set up through a Pathfinder PFI to serve 530 homes on the Barkantine Estate with heat from a 1.4MWe CHP plant in the London Borough of Tower Hamlets. Barkantine Heat and Power is owned by London Heat and Power which is in turn a subsidiary of EDF Energy. It started operation in March 2001.

BHP is responsible for managing the energy centre which houses the CHP, boiler plant and thermal store for a period of 25 years. At the end of the 25-year term, the Energy Centre reverts to Tower Hamlets Council's ownership, at which time the plant will be refurbished.

Whilst Tower Hamlets are reportedly very satisfied with BHP's management of the scheme, it seems the new parent company EDF Energy have shown little desire to develop further schemes (until the recent announcement of partnership with the Climate Change Agency). According to Tower Hamlets, negotiating the PFI was a tortuous process and later schemes have been done in-house. A separate company, Dalkia, are responsible for maintenance of the plant. A tenant liaison officer is employed by EDF Energy on site.

8.3.2 Woking – Thameswey Ltd

Woking set up a wholly owned company who then own a minority share in another company along with a Danish investment company who own the remaining 81%. The company is called Thameswey Ltd. The Woking Council Energy Manager is the director of the company. The Danish company has recently withdrawn from the arrangement and the ESCo is now wholly owned by Woking Council.

Woking have developed a number of CHP schemes using this model, believed to total around 5MWe. Finance has come in part from Danish investors and in part from the ability to keep a proportion of savings made.

8.3.3 Aberdeen Heat and Power

Aberdeen Heat and Power (AHP) were set up as a separate not-for-profit company by Aberdeen City Council. AHP is a company limited by guarantee and the board is made of local community representatives, and chaired by Mike King from the Combined Heat and Power Association. Ownership of heating components within the properties remains the property of the council leaseholder or RSL, but the heat network, CHP and energy centre is owned by Aberdeen Heat and Power.

The rationale behind setting up a special purpose vehicle was to maintain independence and control. Any surpluses made are either ploughed back into scheme or be used to lower fuel bills. The company currently employs no staff but effectively uses a combination of a consultant (Bill Rowe), financial services from council and the time of the Council's HECA officer. In the longer term it is their intention to employ dedicated staff.

AHP uses a company known as a consolidator to deal with electricity sales and the sale of electricity direct to tenants has recently been initiated. The council charges for heat with rent on a flat rate basis. The council then collects heating payments and in turn pays AHP.

Aberdeen Heat and Power provides heat to just over 1000 homes, as well as a swimming pool and sheltered housing, and further expansion is envisaged.

8.3.4 Southampton

Southampton City Council has now developed 2 separate CHP based ESCos. The first was a straightforward design, build, finance and operate model using an existing company called Utilicom. The scheme developed from a geothermal heat source in the centre of Southampton and heat network was developed from there to Southampton's own offices and other customers in the city centre. A 5.6MWe CHP plant has also been added to the scheme.

The second more recent Southampton development at Southampton Millbrook area has followed a similar model to the Aberdeen scheme. A company limited by guarantee has been established to oversee the development of a much larger heat network and the development of a 25MWe biomass fuelled CHP plant.

8.3.5 Transfer of Risk

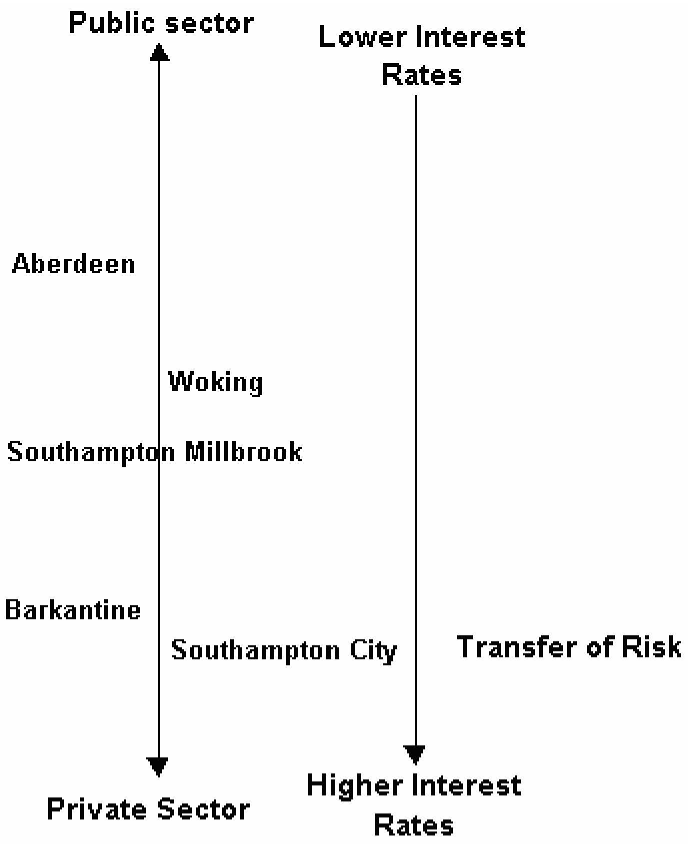


Figure 29: Existing ESCos on Public/Private Sector Schematic

The above figure attempts to map out the case studies described above in terms of the extent of which the public sector involvement. Generally speaking there is a trade off between the transfer of risk and cost of capital. The business plan assumptions have been made on the basis of 3.5% discount factor. A fully private sector ESCo would expect to see returns of around 10%.

8.3.6 Other Existing ESCo Options

8.3.6.1 Carbon Trust Pipelines

The Carbon Trust has a new initiative called Carbon Trust Pipelines. Carbon Trust Pipelines is a 100% owned subsidiary of the Carbon Trust. It has been set up to finance, own and operate connections between existing heat sources and existing heat loads. They would do this on the basis of 10% return on investment. They are a new venture and as yet have no schemes in the ground. This is a source of higher cost finance than public sector finance at 3.5%.

8.3.6.2 Climate Change Agency

The Climate Change Agency has an emerging role in the field of sustainable energy in London. The Agency was set up through the London Development Agency. The business plan for the Agency has not yet been announced. The agency currently favours small gas CHP private wire arrangements, which might be used initially in Haringey.

8.3.6.3 Utilities

EDF Energy have historically been involved in CHP at the Barkantine scheme as outlined below but have shown little appetite to develop further schemes as yet, though their recent alliance with the Climate Change Agency may herald a different approach.

8.3.6.4 ESCos

A number of private sector ESCos exist such as Utilicom, Vital Energi, EcoCentraGen who might be willing to take forward such as scheme. These would design, build, finance and operate a scheme.

8.4 A Haringey ESCo Model

The diagram below sets out the possible structure and role of a Haringey ESCo. Essentially it would purchase heat from one or more possible heat utility companies. This could either be done directly or through a separate company in charge of operating a transmission network. In Copenhagen a consortium of boroughs and the city council have formed a company for this purpose. Heat would be sold on to local residents and businesses. Many of the ESCo responsibilities could be subcontracted in the short term but in the longer term the company could develop in house capabilities to deliver project management, operation and maintenance and metering and billing. The ESCo would be responsible for the operation and maintenance of the local standby and peak load plant.

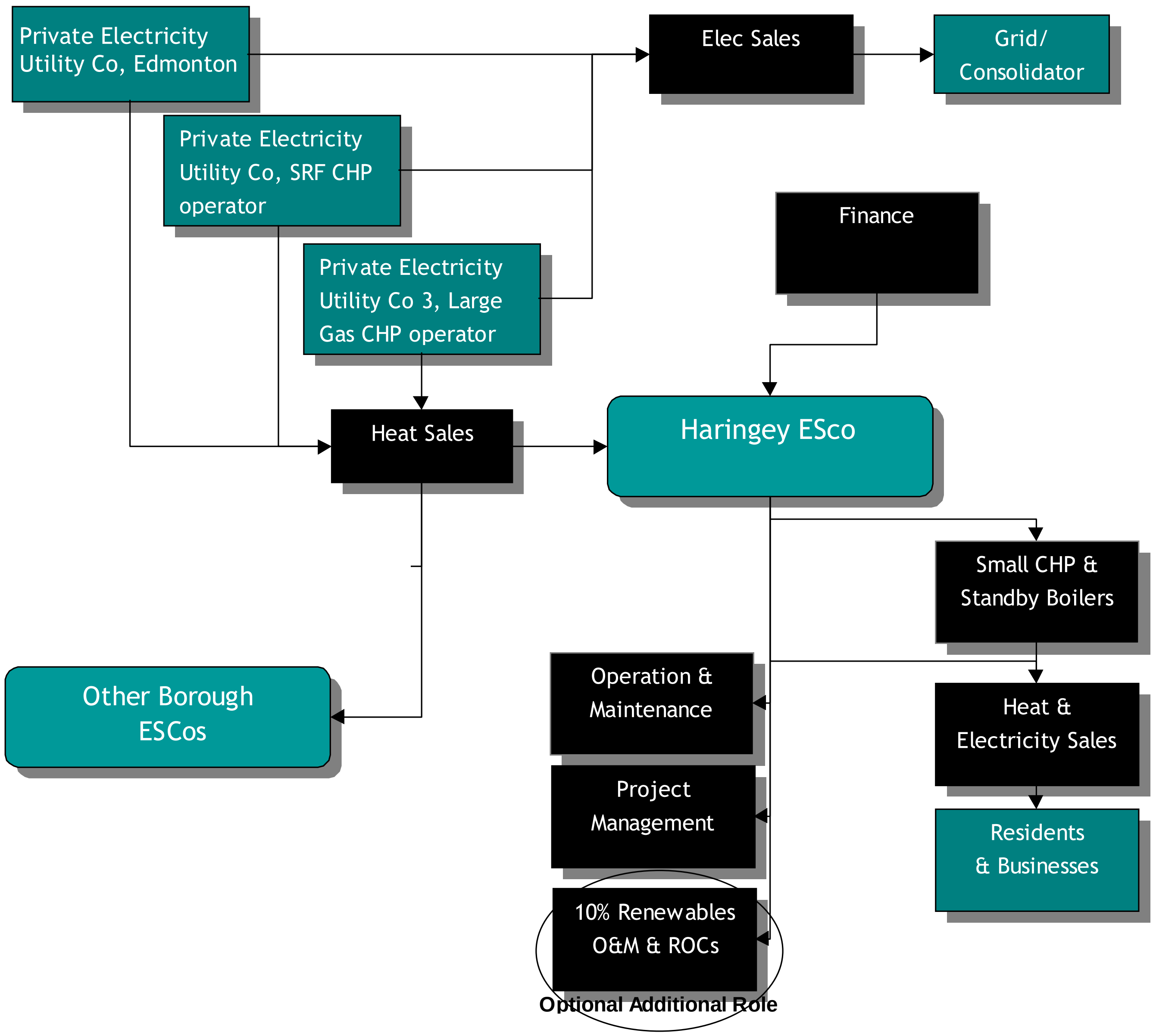


Figure 30: ESCo Roles

8.5 Possible ESCO Membership

If LBH chose to progress the option of a Haringey ESCo on the model of Aberdeen or Southampton Millbrook there are a range possible organisations that could form the board of the ESCo besides LBH itself.

8.5.1 Housing Associations

A number of Housing Associations are involved in the Barking Town Centre redevelopment. Housing Associations have in other areas been responsible for the management and operation of community heating. The chief executive of a local Housing Association would bring business administration expertise to the board of an ESCo as well as representing local interests.

8.5.2 Industry Champions

There are a number of individuals who may wish to become involved in the delivery of a CHP based ESCo. In Southampton, Michael King from the CHPA who has considerable expertise in this area is a director on their board.

8.5.3 Local strategic partners

Energy managers from local strategic partner organisations might wish to be involved. They could bring useful expertise and represent large potential customers, for example local hospitals.

8.5.4 Residents' Associations

A representative from local residents' association would enable residents to have a say in charging mechanisms and the provision of a critical service.

8.6 Conclusion

The development of a heat network served by combined heat and power will require a delivery organisation. It is recommended that LBH set up an Energy Services Company (ESCo) or contract with an existing ESCo to deliver the construction, operation and maintenance of the system, as well as retail the heat. The terms of reference for the ESCo could also include the delivery of energy efficiency initiatives to the existing building stock and responsibility for claiming ROCs for the renewable energy systems installed as part of the 10% requirement within Haringey. There are a number of successful models set out in this section that Haringey could draw on to develop an ESCo.

9 Funding

9.1 Grant Funding

Community heating and CHP generally cost more to install, where an existing gas network is in place, than conventional individual boiler solutions, but when the operational costs and revenues are compared over the longer term (the life cycle cost) are often cheaper than the conventional alternatives. There are a range of possible funding sources for these options. A summary of these is set out in the table below.

Mechanism	Acronym	Summary	Value	Future variation	Total Value	Lifetime
Energy Efficiency Commitment	EEC	Subsidy to domestic energy saving & CHP	0.7-0.9p/kWh	Unknown beyond 2008	£396m for EEC2	EEC2 2005-8 EEC3 2008-11
Levy Exemption Certificates	LECs	CHP & renewable elec can claim	Up to 0.43p/kWh	Increase with RPI	Unlimited	
EU Emissions Trading Scheme	EU ETS	Cap & trade system on 20MWth plant	Current price £6/ tonne CO_2	Market instrument - value of carbon	Limited by govt caps	Phase II to 2012
Low Carbon Buildings Programme	LCBF	Capital support for building integrated renewables and CHP	Varies depending on technology	Unknown beyond 2009	£80m	2006-9
Renewable Obligation Certificates	ROCs	Awarded to renewable generators	4.5p/kWh	Market instrument	Limited by % obligation	2016
Utility Green Funds	-	Capital grants for community renewables	Approx 50% capital cost	Unknown	£2m/yr nationally	Unknown
EU Funding Concerto	Concerto	Capital support for building integrated renewables, CHP & Eco-building"	35% of capital cost	FP7 2007-2013 being agreed now	Around £3m per communit y	FP7 2007-2013 now being agreed
EU Intelligent Energy	Save Altener Steer	Support for sustainable energy initiatives	50% of programme cost	FP7 2007-2013 being agreed now	Approx £50k per project	FP7 2007-2013 now being agreed
Carbon Trust Schemes	-	Range of support programmes - free business audits	100% funding for business advice	Unknown	Unknown	Unknown
London Development Agency	LDA	Current business support programmes	100% funding for business advice	Unknown beyond 2009	Unknown	3 years
Renewable Transport Fuels Obligation	RTFO	Requires all transport fuel suppliers to sell a 2.5% of renewable fuels each year or buy certificates/pay buy out to the same value.	up to 15p/l (the set buy out price)	Will rise to 3.75% in 2009 and 5% in 2010	Unknown	To April 2011, may increase beyond then.

Table 34: Summary of support mechanisms

None of the above programmes are fixed and are subject to continual review. New schemes could radically alter the funding framework.

9.2 Other Mechanisms

The most obvious local options are to simply require developers to incorporate these technologies into developments or require developers to contribute to the cost through Section 106 Agreements. Where this is not possible the cost could be subsidised by accepting a lower value for the sale of LBH owned land.

Alternatively the cost of the installation of the network could be recouped by increasing heat charges. New homes will anyway have much reduced heating requirements compared to the homes they will replace. Some of this reduction in heating charge could be used to subsidise the development of the heat network. This strategy will of course not be available to the extension of the heat network to the non-regeneration areas where a reduction in heat charges will need to be offered to persuade consumers to connect.

10 Phasing

10.1 Heat and Power Maps

By using the LECI 2003 datasets, it was possible to map the use of gas and electricity densities within the borough, in 1km^2 grid cells, as shown in the following figures, where colours range from blue for the lowest values (less consumption) to red for the highest values (more consumption).

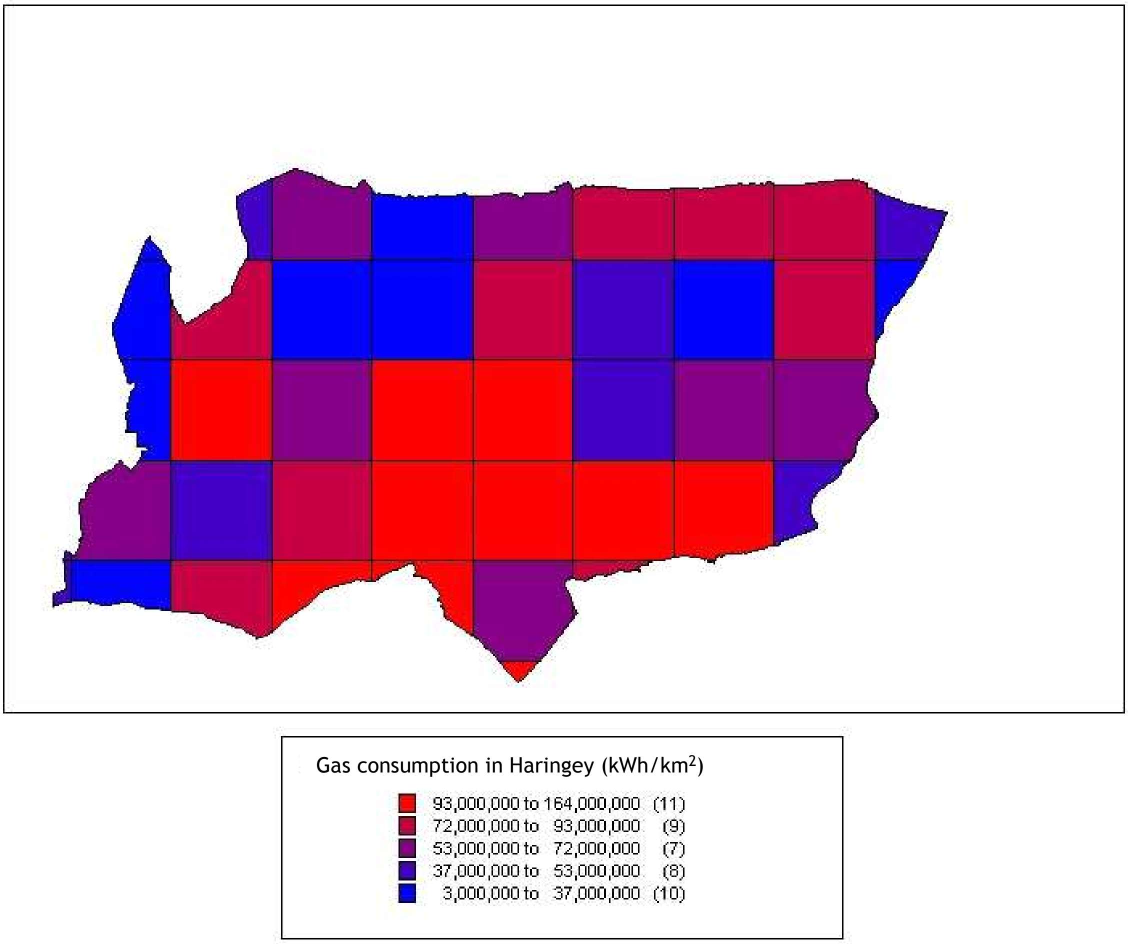


Figure 31: Gas consumption densities (LECI 2003)

Clearly the highest gas use densities occur to the south of the centre of the borough. The next two figures break this down further into gas consumption in the domestic and non-domestic sectors.

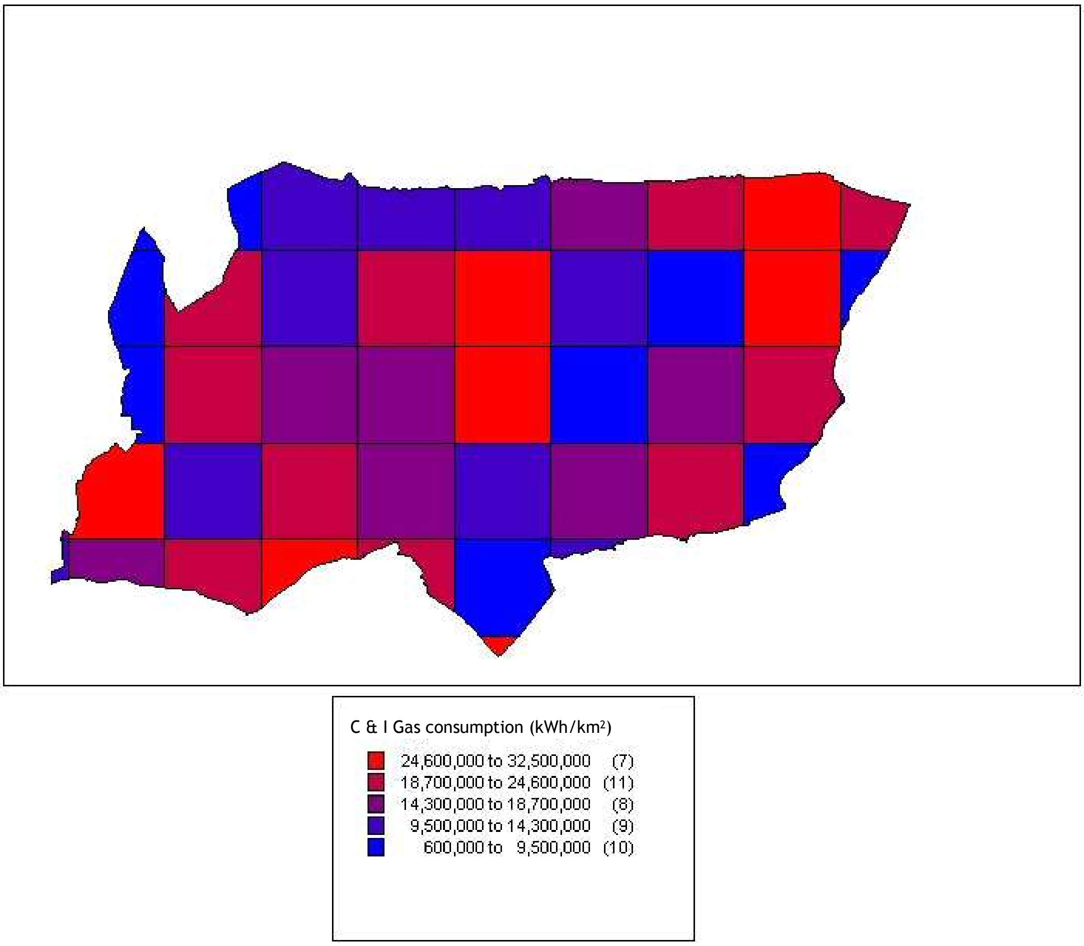


Figure 32: Non-domestic gas consumption densities (LECI 2003)

Figure 32 shows that non-domestic gas use occurs mainly along the eastern edge of the borough (the Lea valley), in the centre and in the south-west corner.

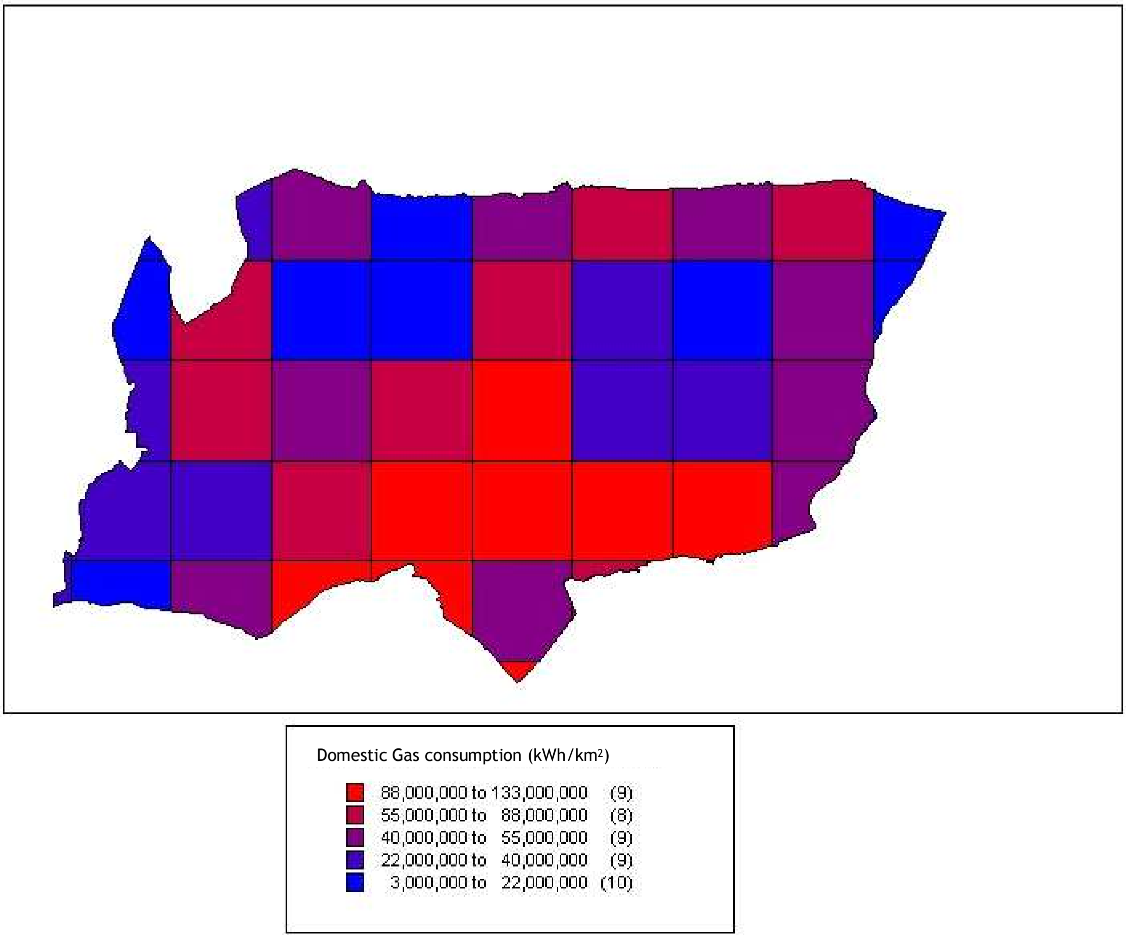
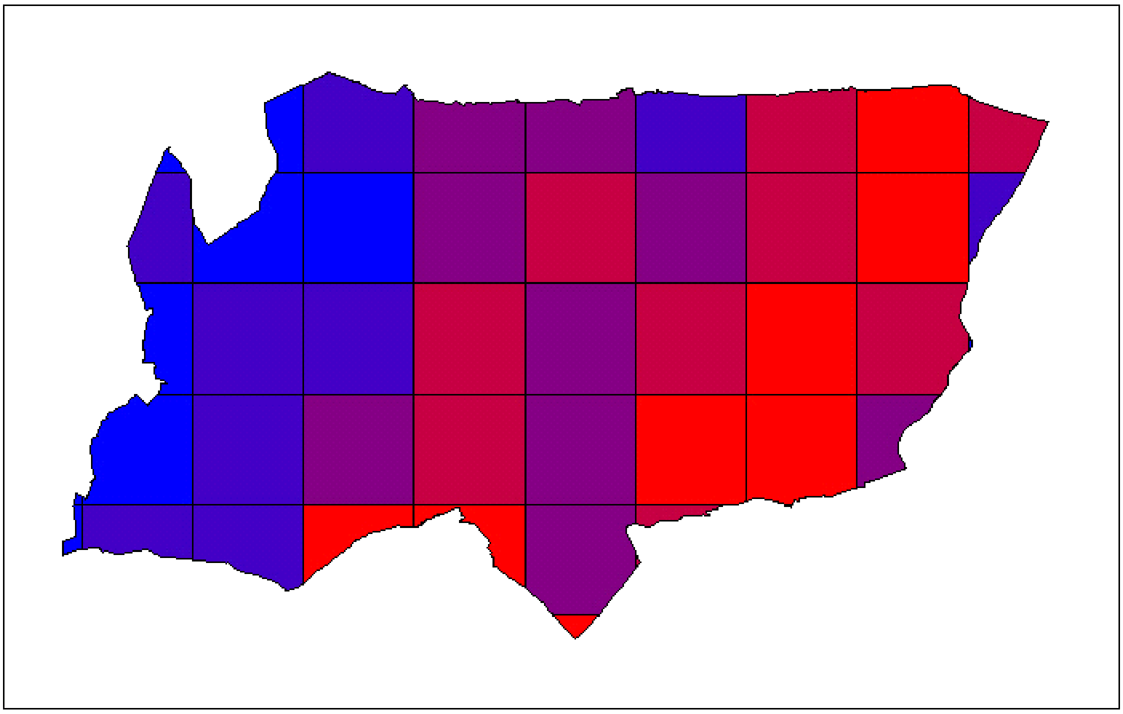


Figure 33: Domestic gas consumption densities (LECI 2003)

Figure 33 shows that residential gas use is concentrated in the centre and to the south of the centre of the borough. It is domestic gas consumption that dominates the overall picture shown in Figure 31.



Electricity consumption in Haringey (kWh/km^2)

36,600,000 to 72,900,000	(8)
31,500,000 to 36,600,000	(10)
24,700,000 to 31,500,000	(9)
18,800,000 to 24,700,000	(9)
14,200,000 to 18,800,000	(9)

Figure 34: Electricity consumption densities (LECI 2003)

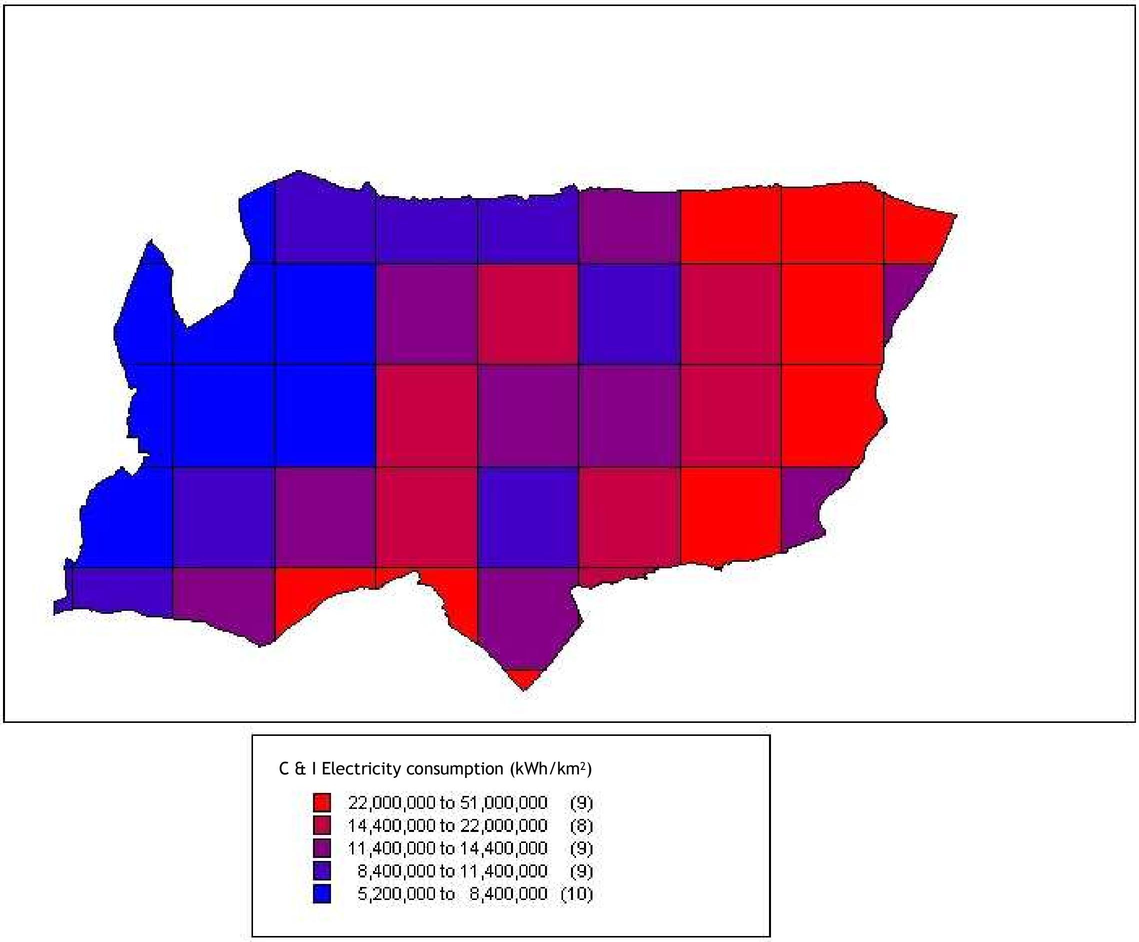


Figure 35: Non-domestic electricity consumption densities (LECI 2003)

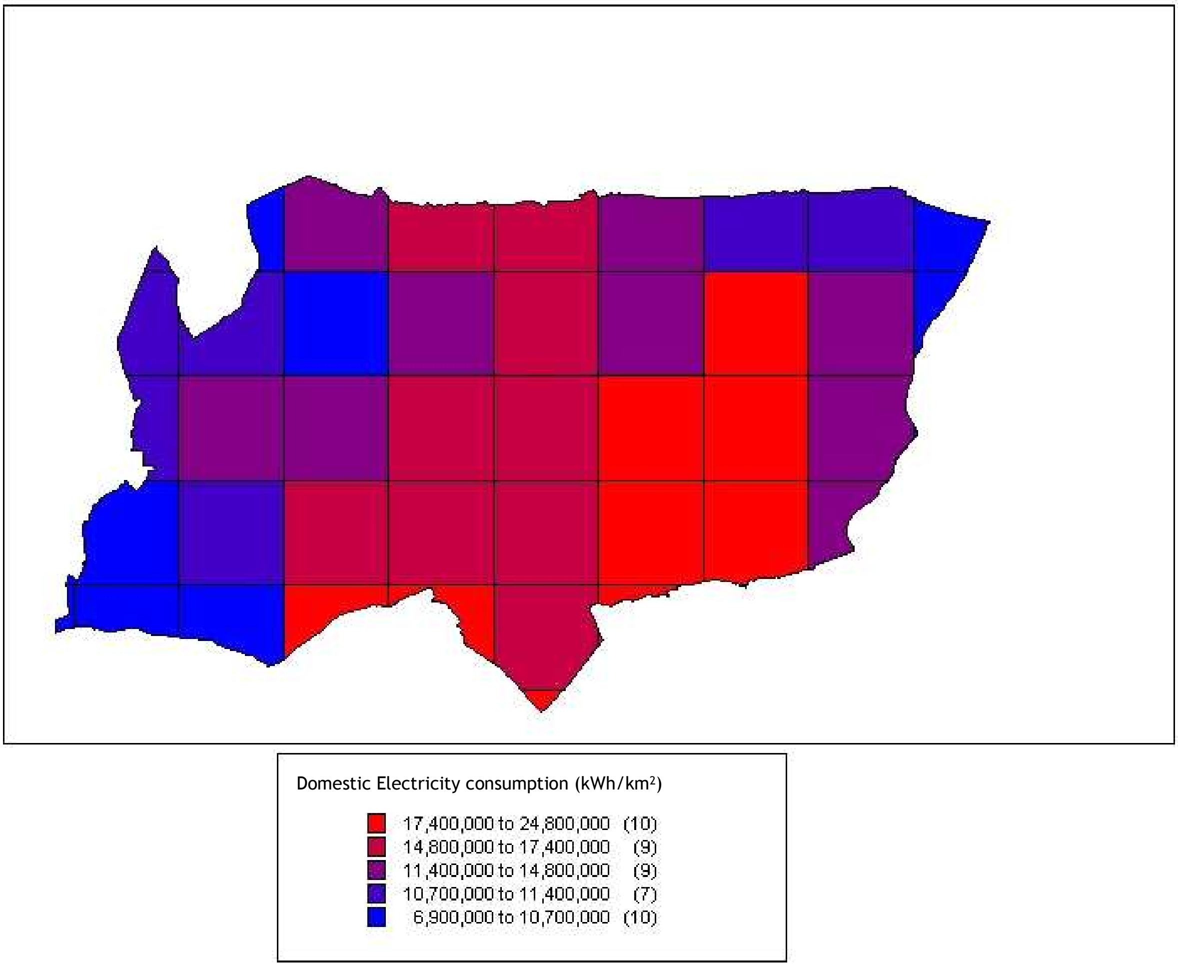


Figure 36: Domestic electricity consumption densities (LECI 2003)

Figure 34 to Figure 36 show that non-domestic electricity consumption is concentrated in the north-east corner of the borough, while domestic electricity consumption is greatest in the centre and east to centre of the borough.

10.2 Phasing of Schemes

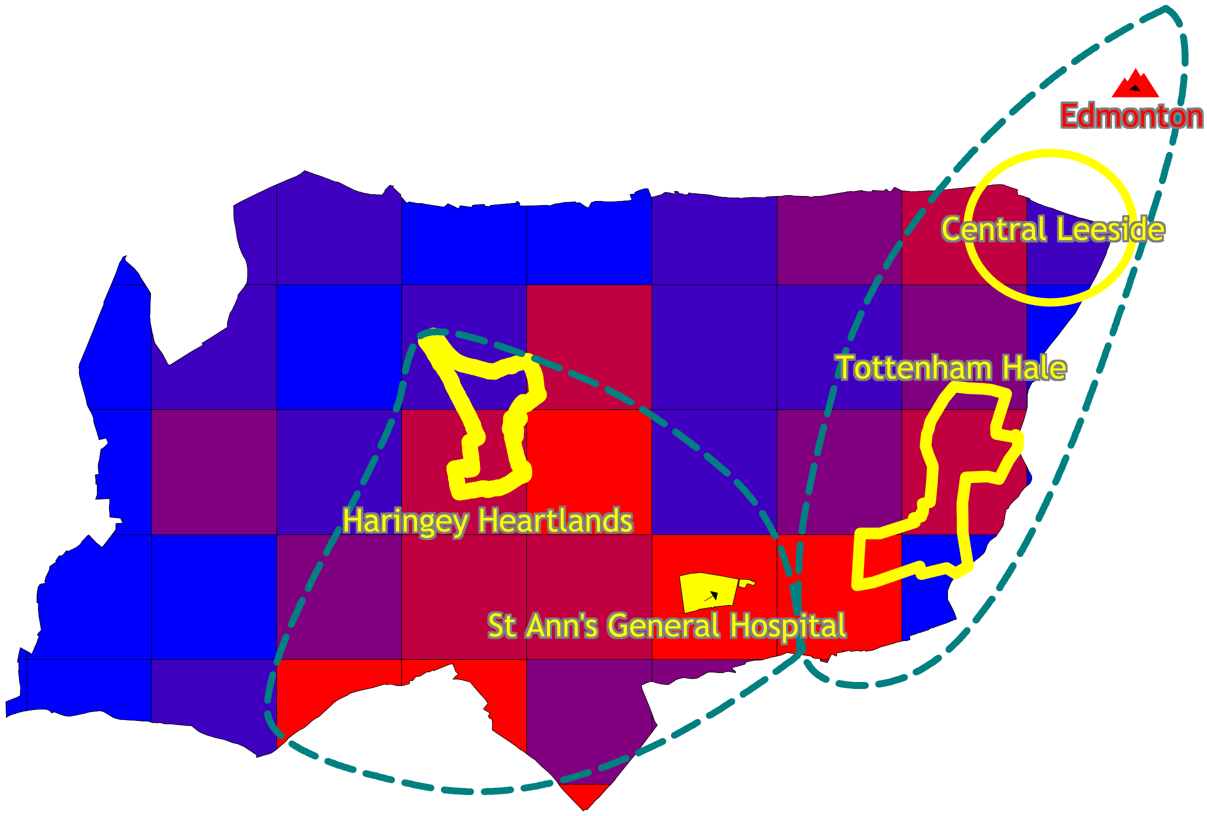


Figure 37: Phasing of a heat network

As there is just one estate in Haringey with community heating (Broadwater Farm, with around 1000 dwellings), the borough is effectively a blank canvas in terms of a heat network. Based on an initial analysis of gas use densities and land use, this section outlines where a heat network should be targeted.

Figure 37 shows the key features that will determine the phasing of a heat network. The colouring of the grid is the same as for Figure 31 and shows gas consumption densities. It makes sense to build heat networks where there is a greater demand for heat as more customers can be reached with less pipe work, which makes the scheme more cost effective.

The location of the incinerator at Edmonton is shown, to the north-east of the borough. A connection to this source of heat is proposed.

There are two major regeneration areas in Haringey, Tottenham Hale and Haringey Heartlands, as shown above. Clearly if a heat network is to be developed, any new developments must be built with community heating in place. In the North East of the borough, closest to Edmonton, is the Central Leeside area. This is a collective name for various strategic employment sites around the area indicated on the map and covers parts of Haringey and Enfield boroughs. There is potential to link up to demand for industrial process heat and commercial heating load in this area and this might be a good starting point for a heat network given its proximity to the existing power station at Edmonton.

Finally, the main hospital in the borough, St Ann's, is shown. Hospitals represent large and continuous heat loads well suited to community heating.

10.3 Developing a heat network

10.3.1 Connecting to Edmonton

A central part of the heat network in the scenario presented in this report is the connection to an existing power station at Edmonton. If Edmonton were able to export heat, thereby becoming a CHP plant, the additional income from ROCs would be substantial. SEA/RENUE proposes that an Edmonton heat connection is established as soon as possible to take advantage of this legislation, which is not guaranteed beyond 2016.

Figure 32 shows that in the north-east corner of the borough close to Edmonton there is a significant concentration of non-domestic gas consumption. It is proposed that the industry located here should be connected to Edmonton initially. A heat network can then be developed, progressing along the Lea Valley to the east of the borough and connecting to the Tottenham Hale regeneration area.

The current incinerator at Edmonton is expected to be replaced in 2015. It is essential that a heat network is developing by this time to ensure that the new plant is optimised for CHP.

10.3.2 Regeneration schemes

Community heating should be implemented across the two regeneration areas of Haringey Heartlands and Tottenham Hale. These could initially be served by local small scale plant.

A heat network can then branch out from Haringey Heartlands to the south, to serve the higher density residential areas and St Ann's Hospital.

A network beginning in the Tottenham Hale regeneration area can eventually connect to the heat network developing from the north based around the connection to Edmonton, and to the heat network spreading out from the centre of the borough and Haringey Heartlands.

Once these connections are made, a significant proportion of the boroughs thermal demand will be met by community heating networks. Expansion further out to the north and to the west will then be possible.

10.3.3 Further development of the heat network

The proposed scenario envisages that well over half of the total thermal demand for Haringey will be met through CHP. This heat will be delivered through a community heating network.

As the network develops, it is anticipated that it will become increasingly attractive for private householders and businesses to connect to it. This can be further encouraged by competitive pricing of heat and power sales and by the use of planning requirements and other incentives.

11 Conclusions & Recommendations

11.1 Baseline emissions

This strategy has identified the baseline CO_2 emissions for the London Borough of Haringey as 968 ktpa. Of these 49% are from dwellings, 33% from non-domestic buildings and 18% from transport.

Growth in the borough is expected to increase these emissions by 68 ktpa for dwellings, 36 ktpa for non-domestic buildings and 91 ktpa for transport if allowed to grow unconstrained.

Haringey has adopted a target to reduce CO_2 emissions by 60%, a reduction of 776 ktpa when the expected growth is accounted for.

11.2 Carbon scenarios

SEA/RENUE have developed a model to analyse various combinations of several technologies that could supply energy, reduce demand or reduce transport emissions. The proposed scenario is subject to various constraints.

The model suggests a scenario that can meet the target, and can be financially viable. This in turn suggests a vision of how the borough might meet its energy and transport needs between now and 2050.

The scenario also includes the interim years 2010, 2016 and 2030. This gives an indication of how the energy and transport mix might develop over time.

		Total capacity installed by			
Technology	**Units**	**2010**	**2016**	**2030**	**2050**
Renewable CHP	MWe	0.0	0.0	5.0	5.0
Gas CHP - Large	MWe	0.0	0.0	80.0	141.0
Gas CHP - building	MWe	12.0	30.0	8.0	0.0
Heat from power station	MWth	0.0	5.0	20.0	25.0
PV - Domestic	Dwellings	200	2,000	10,000	33,000
PV- Large	MWe	0.5	3.0	4.0	150.0
Wind - large	MWe	6.0	8.0	8.0	10.0
Wind - small	Dwellings	50	150	500	5,000
Solar thermal	Dwellings	100	200	1,000	5,000
Biomass boilers large	MWth	1.0	2.0	0.0	0.0
Biomass boilers small	Dwellings	200	300	100	0
GSHP	Dwellings	50	100	50	0
Micro-CHP stirling	Dwellings	1,000	2,000	3,000	0
Micro-CHP fuel cell	Dwellings	0	50	3,000	0
Cavity wall ins	Dwellings	5,000	15,000	20,000	36,000
Loft insulation	Dwellings	5,000	10,000	15,000	25,000
Double glazing	Dwellings	2,000	5,000	15,000	30,000

		Total capacity installed by			
Technology	**Units**	**2010**	**2016**	**2030**	**2050**
Solid wall insulation	Dwellings	20	200	2,000	5,000
Energy Efficient Lighting	000's m2	50.0	300.0	800.0	1,500.0
Double Glazing - Commercial	000's m2	1.0	2.0	5.0	20.0
Street Lighting - Efficient Lamps	Lamps	5,000	10,000	14,000	14,000
Reduce car passenger-km	million pass-km	12	20	40	130
Reduce road freight tonne-km	million t-km	3	7	18	35
Reduce CO_2 emissions of fleet - cars	gCO_2/pass-km	5	15	30	60
Reduce CO_2 emissions of fleet - freight	gCO_2/t-km	2	4	10	30
Reduce CO_2 emissions of fleet - buses	gCO_2/pass-km	2	4	10	20
Reduce CO_2 emissions of fleet - trains	gCO_2/pass-km	1	2	5	9
Modal shift, cars to public transport	million pass-km	15	30	90	200
Modal shift, freight road to rail	million t-km	3	6	15	25

Table 35: Carbon scenario in 2050

11.3 The Vision

This strategy envisages a fundamental shift in the way energy is supplied in the borough. By 2050, much of Haringey will be served by a community heating network distributing hot water to buildings. This will be supplied by CHP power stations using gas, biomass and wastes as fuels.

The CHP and heat network will supply a majority of the heat demand for the borough and meet 60% of the carbon reduction target. It will also supply electricity to the borough and to the national grid.

This CHP will be complemented by a range of efficiency measures to reduce demand in both the domestic and non-domestic sectors. In addition, there will be several renewable energy installations in the borough, principally wind and solar PV supplying renewable electricity.

In the transport sector, private car use will have reduced by around a quarter as people switch to public transport and walking and cycling. Road freight will also be reduced by efficient logistics and a switch to rail. A combination of efficiency improvements and alternative fuels will have reduced the emissions per kilometre travelled for all modes of transport.

11.4 Implementation

Action must start now to implement the recommendations of this strategy. Haringey will have to begin by leading by example and reducing its own corporate emissions. It will need to work with a wide range of partners to help reduce emissions further. It will have to use its influence and set a policy framework to ensure that the right choices are made early on.

A range of policy measures are recommended in this strategy document and in the companion document *Haringey Climate Change Action Plan*.

In the short term, policies can be implemented to shape the longer term developments in transport and energy. Energy efficiency measures must continue to be installed throughout the existing building stock. The borough will also need to provide some renewable energy, probably wind turbines, to meet short term targets.

The regeneration areas of Haringey Heartlands and Tottenham Hale are also key. Large redevelopment projects such as these can be used as a template for the whole borough.

This report also outlines the start of developing the bigger infrastructure projects that will be needed by 2050, particularly the heat network. Decisions made now will have an impact on energy use in the borough in 2050, and it is important to set the right policies now. This means formulating a detailed plan and setting up an ESco to deliver the infrastructure.

The local authority is uniquely positioned to see the long term view and guide the borough towards its vision for 2050.