MAYOR OF LONDON

Green light to clean power
The Mayor's Energy Strategy

February 2004

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contents

foreword

The way we use energy in London has huge implications for our environment, for economic regeneration and in terms of social equity. Of the six billion people living on this planet, the richest billion use 25 times more energy than the poorest two billion. As one of the world's wealthiest economies, London contributes to this inequity of energy use. We need to take a lead in being more responsible and thereby ensuring a sustainable future in London and beyond. That is why I decided to produce an Energy Strategy for London. It is central to my policies for sustainable development.

My vision for London as an exemplary city that is prosperous, accessible and green cannot be achieved without a clear set of policies for energy supply and use. This Strategy sets out a coherent energy policy for London for the next ten years and beyond. It aims to minimise negative impacts on health and on the local and global environment, while still meeting the essential energy needs of all those living and working in London. It will also make a major contribution to London's economic development through the expansion of new and developing clean technologies.

I am particularly keen for London to take a lead in the application of renewable energy technologies. Not only could these make a great contribution to reducing London's impact on the environment, but they could also create significant new business opportunities and employment. Success in this field will require a similar kind of revolution that once led to the rapid uptake of domestic central heating.

But this will not be easy. I have recently had first-hand experience of the difficulties faced by individual householders wishing to install a solar water heating system. This should be an easy thing to do, but the industry is far from being ready to deliver simple solutions for individual households. This has got to change quickly, and I hope my Energy Strategy will provide the impetus to get things moving.

One of the key aims of this Strategy is to help eradicate fuel poverty in London. To do this we need massive investment to improve energy efficiency in homes. London is not receiving its fair share of the funds available nationally to tackle this problem and I am determined that we find ways of harnessing these funds more effectively. I am already taking steps to work with the energy supply industry to develop joint projects that will make a real difference, especially in the most deprived areas of London.

The way we use energy has already proved to be a key element in other strategies that I have produced, particularly in relation to transport, air quality, municipal waste management and economic development. In all these areas we are seeking solutions that are less polluting and more

sustainable in the long-term. Some of the crucial policies in this Strategy are those relating to planning. These policies are also contained in my London Plan, which sets out the strategic planning framework for London. I am looking to developers to play their part to ensure that we capitalise on opportunities to incorporate renewable energy in future developments.

One of the greatest environmental challenges that we face today is global climate change. I am confident that my policies for energy use will help to reduce London's contribution to this problem. We must find alternatives to reduce our dependence on fossil fuels and I would like to see London leading in the application of new technologies such as hydrogen fuel cells. We now have a pilot scheme of three hydrogen-powered buses running in London. This is just a start. What we need next is a major expansion of innovative economic developments, utilising to the full the wide range of renewable and energy efficient technologies currently being developed. This is the future for London in the 21st century and I am confident that this Strategy will set us on the right course.

I would like to thank all those who have contributed to the development of the Strategy through the different stages of consultation. I am delighted that the proposals have been so widely acclaimed. It is clear that this Strategy has very substantial support from many sectors of society. I look forward to working with stakeholders to deliver the Energy Strategy, in particular through the London Energy Partnership.

I hope that everyone with an interest in securing London's future success will work together to ensure that London becomes the exemplary sustainable world city that I would like it to be.

Ken Livingstone
Mayor of London

preface The Mayor's Environmental Strategies

This Strategy is one of a series dealing with environmental issues in London. The Mayor is required to produce four environmental strategies addressing Air Quality, Ambient Noise, Biodiversity and Municipal Waste Management. He has also decided to produce an Energy Strategy for London. The main elements of each environmental strategy are reflected in the overall London Plan and, where appropriate, in the Transport and Economic Development Strategies. This series of strategic plans together provide the basis for improving London's environment. They also provide an integrated framework for sustainable development.

Whilst improvement of London's immediate environment, by reducing pollution and improving the quality of life for Londoners, is the main purpose of the environmental strategies, this is not the sole objective. The strategies also need to take account of London's wider impacts on the global environment and identify action to reduce damaging or unsustainable processes. To do this we need to understand the way that London functions in terms of its daily processes and be aware of its wider ecological footprint, recognising that this extends to virtually all parts of the globe.

A detailed analysis of London's ecological footprint, published in 2002, quantified the energy and materials used or wasted by current practices. This was summarised in the Mayor's *State of the Environment Report for London* published in May 2003. It demonstrates unsustainable levels of resource use resulting from a fundamental difference between the way a city works and the processes of the natural world. Whilst natural ecosystems have a series of inbuilt circular processes, preventing most wastage, the metabolism of a modern city is almost entirely a one-way process. This is particularly true of affluent cities in developed countries, where vast quantities of material are imported daily for human use and waste products are discharged as unwanted residues. London is no exception. Examining individual elements of London's functional metabolism, such as waste or energy will help to identify action we can take to improve our environmental performance and reduce damaging impacts elsewhere. This is crucial if we are to be successful in combating climate change and reducing London's global impacts on biodiversity and natural resources.

The Mayor's London Plan makes it clear that to become an exemplary, sustainable world city, London must use natural resources more efficiently, increase its reuse of resources and reduce levels of waste and environmental degradation. As London grows, these objectives will become ever more important. The shift towards a compact city, which is inherent in the London Plan, will contribute towards these objectives. It

will enable more efficient use of resources such as land and energy and will also enable the 'proximity principle' to be applied to promote greater self-sufficiency.

Implementing the Mayor's environmental policies will enable London to draw on the resources it needs to live, breathe and develop as a growing world city. It must aim to become a more sustainable and self-sufficient city, healthier to live in and more efficient in its use of resources. It should also be a better neighbour to its surrounding regions by consuming more of its own waste and producing less pollution.

How we use energy is fundamental to long-term sustainability. If London is to make a significant contribution to the reduction of greenhouse gas emissions we need to restrain our use of fossil fuels, encourage greater energy efficiency, and promote renewable energy. Implementation of the Mayor's Energy Strategy will help to mitigate climate change by reducing carbon dioxide emissions This Strategy has wide implications, promoting new kinds of fuel for transport and encouraging high performance buildings with less demand for energy. It promotes good practice in new developments and supports examples such as the Beddington Zero Energy Development. Although one of the principal objectives of the strategy is to reduce our dependence on fossil fuels, it also addresses the vital social issue of energy poverty.

Waste is another area where we need to significantly improve our efficiency. It is not simply a matter of improving levels of recycling, which is how the problem is often perceived. If London is to become sustainable, a more fundamental long-term change is required to establish a secondary materials economy. We need to develop a new business culture, where components of the waste stream are automatically considered as potential products for new industries. The policies contained in the Mayor's Waste Strategy set the framework for such a change. Substantial progress has already been made through the London Remade Programme, funded by the London Development Agency, and this approach is now being promoted as a component of economic development. The Mayor's Green Procurement Code is another key initiative which provides the necessary link between environmental improvement and business performance.

Air quality is one of London's most severe environmental problems and has direct consequences for human health. The main causes are emissions from road traffic in the form of nitrogen oxides and air-borne particles. London currently fails to meet EU and national targets for air quality because of the size of the conurbation and because of the density of road

traffic. The Mayor's Air Quality Strategy, published in 2002,makes proposals for meeting the legal targets, and for longer-term solutions to introduce cleaner vehicles.

Strategic policies to deal with noise have until recently been far less advanced than other areas of environmental concern. However, the requirement for the Mayor to produce the UK's first citywide strategy for tackling environmental noise has resulted in much progress over the past three years. His Noise Strategy sets out the main steps that need to be taken, including quieter road surfaces, smoother traffic flow, rail infrastructure improvements, aircraft noise measures, and improved design for new developments.

Conservation of biodiversity is addressed in detail in the Mayor's Biodiversity Strategy and in the London Plan. The sub-title of the strategy Connecting with London's Nature emphasises the social context, since one of the main objectives is to ensure the conservation of London's natural heritage for people to enjoy. The Mayor has adopted the well-established procedures for identification of important habitats in London as the basis for his Biodiversity Strategy, which was published in 2002. At present, London is the only part of Britain where there is a statutory requirement for a biodiversity strategy as part of regional planning and it may provide a useful model for other towns and cities in the UK. The strategy also has an international dimension by making proposals to clamp down on the illegal international trade in endangered species for which London's airports are one of the main points of entry to Europe

The overall effect of the Mayor's five environmental strategies over the next twenty years will be to make significant improvements in our own local environment as well as reducing London's wider global impacts. The strategies provide many of the essential ingredients to make London a truly sustainable world city.

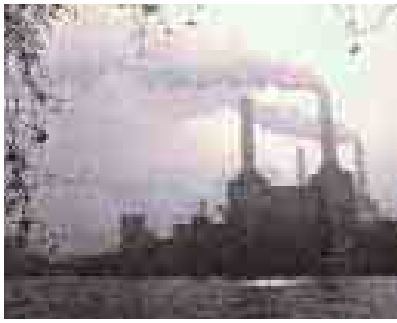
David Goode
Head of Environment


Lewisham

executive summary

We all take energy for granted - until the lights go out and the trains grind to a halt. Thankfully, these are rare occurrences. But they remind us just how fundamental energy is to our lives and the functioning of the capital.

To make London the city that it is - a hub of business, a focus for tourism and entertainment, a lively and dynamic place in which to live and work - requires a large amount of energy. London consumes more energy than Ireland and about the same as Greece or Portugal. We all rely on the power being there when we need it. We all also bear some responsibility for how energy is used. The decisions we make about how we travel, how we use heating and lighting in our homes and offices and where we purchase our energy all have an effect in a city of seven million people.



Energy use and supply in London

The way our energy is supplied is changing. Over the past few decades, and the last ten years in particular, there has been a move in the UK away from electricity generators that use solid fuels and oil. There has been a corresponding shift towards natural gas and an increase in the use of nuclear fuel.

This trend has led to a significant decrease in the carbon intensity (the average amount of carbon emitted when a unit of energy is consumed) of energy used in the UK.

Between 1965 and 1999, energy consumption in Greater London increased overall by around 16 per cent, despite a net fall in population of seven per cent. The per capita rate of energy consumption has risen significantly.

Moreover, London's population has been growing again since 1983 and it is now growing faster than in the UK as a whole. This is driving increases in energy consumption in domestic buildings, offices, and the transport system that outstrip the national rate of growth in energy demand. There is no sign of this growth slowing: projections in the London Plan indicate a net population increase of some 800,000 people - equivalent to a city bigger than Leeds - by 2016.

Without concerted action to reduce both the carbon intensity of energy and the amount of energy consumed, it is likely that carbon dioxide emissions from London will only continue to decline until 2005, and will then start rising again.

Climate change

One of the most important problems resulting from current energy supply and consumption patterns is climate change. There is international

consensus that human activity is altering the global climate through emissions of greenhouse gases, with potentially serious consequences for society worldwide.

Since 1992, international efforts have been made to secure agreements to stabilise and reduce greenhouse gas emissions. The Intergovernmental Panel on Climate Change has indicated that emission reductions far in excess of those agreed upon at Kyoto will be necessary during the 21st century. The Royal Commission on Environmental Pollution recommends a carbon dioxide emissions reduction target for the UK of 60 per cent, relative to 2000 levels, by 2050, and in the Energy White Paper of February 2003, the government accepts these findings.

Even with concerted efforts to meet these targets, some effects of climate change are inevitable. In October 2002, the London Climate Change Partnership published a report identifying a range of London-specific sensitivities to climate change. The partnership's analysis predicts much higher summer temperatures for London, increasing demand for electricity and water, a decrease in both the comfort and safety of buildings and the transport infrastructure; and a higher risk of flooding, along with an increase in the economic impact floods could have, due to the value of assets located in flood-prone areas.

The capital's economy might benefit in some respects, from the climate change. Warmer summers could lead to a growth in tourism and recreation, for example. However, with London's financial centre now embedded in a global system, even the geographically distant economic effects of climate change are increasingly likely to be felt in London.

Fuel poverty

Fuel poverty represents a critical social problem associated with energy use. A significant number of people in London and the UK have to spend a large part of their income on energy for their home. As a result, many are unable to maintain healthy indoor temperatures. Households in this situation are defined as 'fuel-poor', and in 1996, this applied to at least one in six of households in the capital.

Fuel poverty is caused by a combination of low income, poorly insulated and/or under-occupied housing, inefficient heating equipment, and energy pricing and payment structures that tend to penalise consumers who use less energy. Living with temperatures below the recommended minimum can damage people's health and even result in death. These risks are greater for people on lower incomes, children, older people, and people with disabilities. Of the 70,000 deaths that occur in London each year,

some 6,000 more occur during the winter than would otherwise be expected. Fuel poverty also affects the wider community, as it can increase health expenditure and damage local economies.

An Energy Strategy for London

Against this background, the Strategy sets out the Mayor's proposals for change in the way energy is supplied and used within London over the next ten years and beyond, against a long-term vision of a sustainable energy system in London by 2050. The Strategy aims to improve London's environment, reduce the capital's contribution to climate change, tackle fuel poverty and promote economic development.

The Strategy's specific objectives are:

- to reduce London's contribution to climate change by minimising emissions of carbon dioxide from all sectors (commercial, domestic, industrial and transport) through energy efficiency, combined heat and power, renewable energy and hydrogen
- to help to eradicate fuel poverty, by giving Londoners, particularly the most vulnerable groups, access to affordable warmth
- to contribute to London's economy by increasing job opportunities and innovation in delivering sustainable energy, and improving London's housing and other building stock.

Delivering the Energy Strategy - the Mayor's key policies

To deliver these objectives, the Mayor sets out a number of policies and proposals, which follow three principal approaches:- setting challenging yet achievable targets; using the Mayor's powers and the activities of the GLA group; and working in partnership to deliver change.

The Energy Hierarchy

The Mayor has defined an Energy hierarchy to help guide decisions about which energy measures are appropriate in particular circumstances. When each step of the Hierarchy is applied in turn to an activity, it will help ensure that London's energy needs are met in the most efficient way:

1. Use less energy *(Be Lean)*
2. Use renewable energy *(Be Green)*
3. Supply energy efficiently *(Be Clean)*

Using less energy, for example simply by switching off lights or insulating buildings, ensures that the demand for energy is minimised. Maximising the use of renewable energy conserves natural resources, and reduces the amount of carbon dioxide released when energy is used. Finally, by

supplying the remaining energy demand efficiently, for example from combined heat and power, the use of fossil fuels is minimised, further reducing overall carbon dioxide emissions.

The Energy Hierarchy can be used to guide the decisions of a range of stakeholders, from architects, planners and developers to individuals in the home.

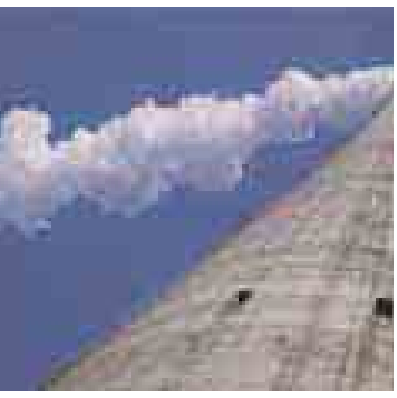
Working in partnership

Although the Mayor can deliver considerable change through his own activities, he will work in partnership to tackle issues he cannot adequately address alone. To achieve this, the Mayor will facilitate the establishment of a major new initiative - the London Energy Partnership.

The London Energy Partnership should adopt the Mayor's energy targets and develop aan action plan to help meet them. This could include major projects, securing funding for Londonwide projects and promoting best practice. Other partnerships - for example the Hydrogen Partnership - are also strongly supported by the Mayor. The Partnership is an independent body and will define its own work programme, taking into account the recommendations of the Mayor.

It is important that London as a whole adopts the Mayor's energy targets as a common framework for action. To help to achieve this, the Mayor will seek the commitment of the London boroughs and other key organisations by inviting them to sign a declaration of their support for and commitment to delivering the strategy's targets. The London Energy Partnership will also be invited to sign the declaration.

Addressing climate change



London should reduce its emissions of carbon dioxide by 20 per cent, relative to the 1990 level, by 2010, as the crucial first step on a long-term path to a 60 per cent reduction from the 2000 level by 2050. This will ensure that London plays its full part in meeting national targets for cutting carbon dioxide emissions.

Developments such as BedZED in Sutton show that it is possible to integrate energy-efficient design with renewable energy production, and deliver a zero-carbon building with an attractive living environment. The Mayor believes that there should be at least one zero-carbon development in every London borough by 2010. To achieve this, he expects each borough to identify at least one suitable site for such a development, use their powers as landowners or partners with others to bring about its development, and include the identified sites in their Development Plan Documents.

The Mayor requires planning applications referable to him to incorporate passive solar design, natural ventilation, borehole cooling and vegetation on, and adjacent to, buildings where feasible. Boroughs should expect the same. As a guiding principle for sustainable design, and to help reduce London's carbon dioxide emissions, the Mayor will, and boroughs should, request an assessment of the energy demand of proposed major developments. This should also demonstrate the steps taken to apply the Mayor's Energy Hierarchy.

The Mayor expects the London Development Agency to ensure that its regeneration work demonstrates high standards of sustainable design, by promoting and demonstrating best practice in sustainable energy.

The Mayor will ask the Metropolitan Police Authority, the London Fire and Emergency Planning Authority, the London Development Agency and Transport for London to report annually on the energy used in and carbon dioxide emissions resulting from their operations, what measures they have taken to minimise these, and the savings made.

Providing energy services

People do not need fuel and electricity for their own sake, but the services that these energy sources provide. Typically, these include a warm indoor environment in winter, sufficient lighting levels, and the services of electrical appliances such as washing machines, computers and televisions.

If energy markets can be focused on providing energy services rather than focusing on fuel and electricity supply, then these services could be delivered much more efficiently.

Energy services can be taken forward in a number of ways, and existing examples provide the models and lessons upon which to develop further schemes. The Mayor wants to see their further development in London.

Improving energy efficiency in housing and eradicating fuel poverty

Housing is responsible for 44 per cent of London's overall energy consumption and carbon dioxide emissions. The Mayor wants to see radical improvements in the energy efficiency of London's housing stock, with the domestic sector playing its full role in meeting London's carbon dioxide reduction targets.

A significant number of homes in London are very energy inefficient, as reflected in their low SAP (standard assessment procedure) ratings[1]. Sixteen per cent of London homes have a SAP rating of less than 30. This

situation must be improved. The Mayor wants there to be no occupied dwelling in London with a SAP rating of less than 30 by 2010, and less than 40 by 2016. He will seek to have these targets included in future revisions of London's Housing Strategy, and requests boroughs to do the same in their housing strategies.

Badly insulated homes and inefficient heating systems contribute to fuel poverty and increased carbon dioxide emissions. The Government defines a household as fuel poor if it needs to spend in excess of ten per cent of its total income on fuel in order to maintain a satisfactory heating regime. The Mayor believes that this definition artificially deflates the number of fuel poor households in the capital, because of the higher cost of housing here. In the strategy, the Mayor proposes a new definition for fuel poverty based on disposable income, to take account of the cost of housing in London being above the national average.

The Mayor's definition will capture all those in fuel poverty under the Government's definition, and more. Under the new definition, in 1996, 34 per cent of London's households were in fuel poverty, as opposed to 17 per cent under the Government definition[2]. We estimate that between 400,000 and 500,000 London households are in fuel poverty, under the Mayor's definition.

Fuel poverty needs to be addressed by a wide range of partners working together. The Mayor recommends that the London Energy Partnership consider initiating a Londonwide fuel poverty programme, building on existing networks to co-ordinate the range of relevant stakeholders and funding, and learning lessons from Newham Warm Zone.

Significant funding, from EU and Government programmes, and from UK energy supply companies, is available for energy efficiency projects in the UK. Currently, London is not receiving its fair share of these and the Mayor would like the Partnership to tackle this problem. The Mayor is already taking steps to work with the energy supply industry to develop joint projects to improve energy efficiency in London's homes.

Improving energy efficiency in commercial and public sector buildings

The commercial and public sectors account for approximately 30 per cent of London's energy consumption and carbon dioxide emissions. New offices and retail outlets tend to require more energy than older buildings, owing to higher levels of illumination and air conditioning. Growth in new office space in London remains prolific, so that the energy efficiency of new buildings affects London's overall office energy demand.

The Mayor wants this sector to play its full role in meeting London's carbon dioxide emissions targets and looks forward to London becoming a showcase for sustainable commercial and public sector buildings - through improved energy management in existing buildings and exemplary, energy efficient new buildings.

In general, cost-effective energy efficiency improvements of 15 to 20 per cent are available in existing buildings. New buildings can incorporate natural lighting and ventilation, and efficient supply technologies such as combined heat and power, to contribute to reducing energy demand further, cost-effectively.

There are many high-profile office buildings in London, which are landmarks, not only for Londoners but also for the rest of the UK and even the world. The more high-profile, good practice office buildings London can boast, the bigger its influence will be as a leading world-class sustainable city. City Hall and Portcullis House are good examples of such buildings.

The Mayor is expanding his Green Procurement Code to cover energy use and carbon dioxide emissions. The Code currently promotes the use of products made from recycled materials to commercial organisations, by offering a one-to-one brokerage of the service. Many organisations which have signed up to the Code have expressed interest in similar services for other environmentally sensitive commodities, including energy. The Mayor is working with the London Development Agency to take this idea forward, as part of its work to improve advice to business on their environmental performance.

Increasing renewable energy

A huge opportunity exists for London to obtain heat and power, by deploying urban renewables across the capital and purchasing green power generated outside the capital. The Mayor wants renewables to make a major contribution to London's future economy and energy supply mix.

London should aim to 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 meet this target, London should aim to 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. These capacities should then be at least tripled by 2020.

The Mayor will use his planning powers to help achieve these targets. He requires applications referable to him to incorporate renewable energy technologies and applications for major developments to generate a proportion of its energy needs from renewables on site where feasible. He will expect this proportion to be at least ten per cent. Boroughs should adopt the same policies; and the Mayor urges the Government to incorporate similar requirements in national planning policy.

The Mayor requests boroughs to set targets, consistent with London's targets, for the generation of renewable energy in their areas, to include them in their Development Plan Documents, and to use their planning powers, land and property control, and awareness-raising activities to meet them. The Mayor also requests each borough to seek to establish at least one well-founded 'showcase' renewable energy project in their area in order to raise the profile of renewable energy best practice and help to bring it to the mass market.

London can also increase the amount of renewable electricity imported from elsewhere in the UK. The Mayor will lead by example in purchasing renewable energy. The Underground system, for example, consumes more than three per cent of the electricity used in the capital. The Mayor wants a significant and growing proportion of power for the Underground to come from renewable sources during the next ten years and encourages London Underground to investigate the possibility of entering into long-term relationships with renewable electricity suppliers.

The Mayor expects the functional bodies of the GLA group to seek to power all their buildings from renewable electricity by the end of 2005. They should also investigate the feasibility of employing renewable energy technology on their buildings. The London Development Agency has a key role in assisting renewables in London as part of its work to promote the growth of a distinct environmental business sector.

Increasing combined heat and power

Combined heat and power (CHP), whereby heat and electricity are produced and utilised simultaneously, is almost twice as efficient as separate production. Increasing its use is an effective way of reducing 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.

In London, there is huge demand for heat and power, both of which could be met from CHP plants in conjunction with community heating systems. Achieving this would bring significant reductions in carbon dioxide emissions.

The heat generated from combined heat and power plants can be used in industrial processes, or for heating or cooling buildings via community heating networks. These can provide affordable warmth to large numbers of homes, helping to tackle fuel poverty.

To help to deliver significant increases in CHP capacity in London, the Mayor requires planning applications referable to him to include CHP and community heating where viable. Boroughs should expect the same. As a key player in urban regeneration, the Mayor expects the London Development Agency to promote combined heat and power and community heating in its work.

To identify the best ways of increasing community heating in London, the Mayor recently led a successful application to the Government's Community Energy Programme for a community heating development study. This will involve various stakeholders, including London boroughs, as project partners.

Establishing hydrogen and fuel cells

Hydrogen fuel is a common, commercially available industrial gas. When combined with oxygen in a fuel cell, electricity and heat are produced almost silently, and with no emissions at the point of use except water. When produced from renewable energy sources, energy from hydrogen is emission free across the entire fuel cycle. Fuel cells using hydrogen generated from renewable energy, therefore, represent the ultimate objective of clean fuel development.

The world's largest economies are taking hydrogen and fuel cell technology seriously. London must do likewise. The expansion of this industry has promising implications for the future of cities and their economies.

The Mayor has therefore led the formation of a London Hydrogen Partnership to help to deliver a hydrogen economy. However, it will take time to establish this. In the short to medium term, the Mayor sees a need for strong financial incentives for hydrogen and fuel cell applications.

The Mayor will use his powers and the activities of the GLA group to support and promote the development of London's hydrogen economy. He will encourage planning applications referable to him to make a contribution to the hydrogen economy where viable, for example, through the installation of a fuel cell combined heat and power unit.

Delivering cleaner transport

Transport is a major user of energy and emitter of carbon dioxide and other harmful pollutants in London. The sector uses more than 20 per cent of the energy consumed in the capital, and is responsible for about the same proportion of carbon dioxide emissions, 80 per cent of which come from road transport.

Through Transport for London, the Mayor is working to deliver an exemplary sustainable transport system for the capital that contributes to reductions in carbon dioxide emission, by encouraging people to switch from private vehicles to public transport, walking and cycling, and by encouraging use of vehicles that use low-carbon fuels. This work is led through the Mayor's Transport Strategy, London Plan and Air Quality Strategy.

The Mayor will request that Transport for London (TfL) lead in adopting new and fuel-efficient technology for use in London's public transport and TfL's own vehicles. This will include actively reviewing the opportunities for hydrogen and fuel cells.

Heathrow, London's largest airport, is a considerable energy consumer in terms of ground operations as well as flights. The Mayor strongly supports the Government in the condition it has set that a Heathrow runway should only go ahead if environmental limits can be met.

Aviation currently accounts for just over 3.5 per cent of total global carbon dioxide emissions. According to the Intergovernmental Panel on Climate Change scenarios however, by 2050 emissions from aircraft could contribute up to 15 per cent of global emissions. It appears unlikely that improvements in aviation technologies will prove able to deliver sufficient efficiency improvements. The Mayor considers that the Government should promote international action to manage aviation demand sustainably.

In either case, the Mayor considers that the aviation industry should pay for the external costs that it imposes on society, including those relating to climate change, and supports ending the exemption of aviation fuel from taxation.

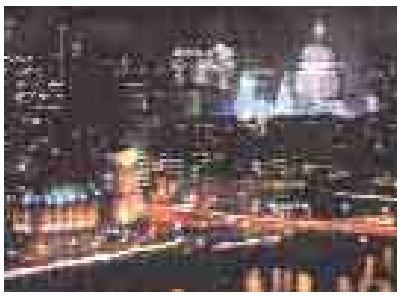
Opposing nuclear power

The Mayor believes that nuclear power is excessively expensive, presents significant health and environmental risks, and diverts resources and attention away from emerging technologies such as renewables. He is opposed to any new nuclear power capacity in the UK, and wishes to see energy efficiency and low carbon technologies replace nuclear capacity when Britain's remaining nuclear power stations are decommissioned from 2005 onwards.

Energy Action Areas

The Mayor wants to see this Energy Strategy and its targets implemented at the local level across London. He therefore wants to establish a small number of 'Energy Action Areas', which will be defined geographical areas that act as showcase low-carbon communities, demonstrate a range of sustainable energy technologies and techniques in different types of buildings, and provide a means of targeting resources. Concentrating activities in this way would add value and profile to projects, generate nodes of good practice, and provide a model for the rest of London and other urban areas to follow.

The Mayor will work with the boroughs, the London Development Agency and other relevant organisations in defining and establishing Energy Action Areas across London.



Providing information on energy in London

The GLA Act requires the Mayor to provide information on energy use and greenhouse gas emissions in Greater London. Along with this requirement, and as part of the strategy development process, we have built an accurate picture of current energy consumption patterns, and the direction of certain important trends. This is presented in the strategy as background. It also informs the State of the Environment Report, first published in May 2003, as required by the GLA Act. The Mayor has collated data on energy consumption and associated carbon dioxide emissions, and the fuel poverty situation in London and it is available for use.

References and notes

1 The SAP system rates the energy efficiency of domestic buildings and their heating systems from 0 (very inefficient) to 120 (very efficient).

2 Moore, R., Energy Efficiency and Fuel Poverty in London, An Analysis of the English House Condition Survey, a report for the Greater London Authority, November 2002. See www.london.gov.uk/.

1 introduction

Purpose of the Energy Strategy

1.1 The Energy Strategy sets out the Mayor's proposals for changes in the way that energy is supplied and used within London during the next ten years and beyond. The strategy aims to improve London's environment, reduce London's contribution to climate change, tackle fuel poverty, and promote economic development in the capital. This will be done by promoting energy efficiency and introducing new and renewable energy technologies across London.

1.2 The strategy provides a framework for the diverse and disparate work on energy taking place in London. The production, distribution and consumption of energy involve a complex configuration of infrastructure and activities that range from the local through to the global scale. The strategy is therefore high-level in its approach, aiming to lead change across London, wherever the Mayor's powers allow, in order to ensure that the Mayor's work adds value to existing activity.

1.3 Energy supply and use is the main cause of climate change, as well as the principal cause of poor local air quality. While critical to all of London's activities, it also contributes to poor health in the city, directly through local air pollution and indirectly through fuel poverty. Fundamental changes are needed to the ways in which energy is supplied and used in the capital during the coming decades. These are essential to improving London's environment and health, to ensuring London's contribution to the fulfilment of a range of national and international policies and targets and, in the longer term, to achieving sustainable development. There are several national policies and targets relevant to energy which the strategy aims to help deliver. These concern climate change, renewable energy and fuel poverty.

1.4 Energy efficiency and renewable energy offer considerable scope for enhancing the profitability of business and contributing to economic development on the local, national and international levels. Reducing the amount of energy wasted saves money. Certain applications of renewable energy are already cost-effective, while the introduction of the climate change levy, from which renewables are exempt, means that using renewably sourced electricity can also reduce costs. As the demand for renewables increases, potentially significant opportunities for business and employment will open. This positive message for London is central to the Energy Strategy.

The Mayor's powers and responsibilities

1.5 Under the Greater London Authority Act 1999[1], the Mayor has a statutory obligation to produce eight strategies: on Spatial Development, Transport,

Economic Development, Culture, Biodiversity, Ambient Noise, Municipal Waste Management and Air Quality. The Mayor has a duty to promote equalities and health across all his strategies, objectives and activities, and must have regard to the need for consistency between his statutory strategies, national policy, and international obligations and targets.

1.6 In addition, the Greater London Authority is required to take specific account of sustainable development, and must exercise its powers in ways that it considers best contribute to sustainable development in the UK. Energy is fundamental to sustainable development because its supply and use have major impacts on the local and global environments, on the quality of people's lives, and on economic activity.

1.7 Section 30(1) of the Act grants the GLA the power to do anything which it considers will further any one or more of its principal purposes. The Mayor considers an Energy Strategy to be essential to the delivery of one of the GLA's three principal purposes, namely promoting the improvement of the environment in Greater London, and implicit in the delivery of aspects of the GLA's two other principal purposes - promoting economic development and wealth creation, and promoting social development in Greater London. It is for these reasons, and the need to take account of sustainable development, that the Mayor has decided to produce an Energy Strategy alongside the other eight statutory strategies.

1.8 Energy is critical to the Mayor's policies on planning, transport and economic development. Consequently, the principal mechanisms for implementing the Energy Strategy by the GLA group include the London Plan, Transport for London and the London Development Agency.

Working in partnership

1.9 However, the GLA group cannot act alone in bringing about all the changes needed. Everyone who lives and works in London creates demand for energy and bears some responsibility for how it is used. Our personal decisions, about how we travel, how we use the heating and lighting systems in our offices and homes, and where we purchase our electricity from, all have an effect - and actions that may seem inconsequential if done by individuals will make a very significant difference if done by seven million Londoners.

1.10 This highlights the need for the involvement of key individuals, organisations and networks, as well as the largest energy users: the public sector, business, energy companies, energy agencies and special interest groups. The Mayor recognises that effective partnerships offer the best

way of enabling these groups to work together to tackle London's energy issues in a co-ordinated way.

1.11 In places, the strategy provides guidance to policy makers and those who implement policy. This is not intended to be prescriptive or imposed, but to provide standardised guidance for practitioners across London to consider alongside other relevant factors and issues.

Consultation

1.12 During the course of preparing this strategy, the Mayor has undertaken a thorough process of consultation to ensure that it represents a strategy that meets London's needs. This was important because local authorities and many other organisations have been working on energy issues for many years and the role of an Energy Strategy for London was not defined by legislation.

1.13 A consultation event was held at the beginning of the strategy development process in November 2000. More than 120 delegates attended from a wide range of stakeholder groups, including the energy industry, central and local government, businesses, trade organisations, London-focused organisations, special interest groups, housing associations and academia. The outcomes formed the basis for the draft Energy Strategy.

1.14 The first draft of the strategy was scrutinised by the London Assembly and a number of expert witnesses. The recommendations produced informed the draft Energy Strategy for public consultation. A three-month consultation period followed the launch of the draft strategy in January 2003, and involved a broad range of stakeholders as well as the general public. The feedback received from questionnaires, workshops, letters and written reports has informed this final strategy. A report summarising the consultation responses received is available on the GLA website - www.london.gov.uk.

1.15 As partnership working will be critical to its long term success, consultation will continue throughout the lifetime of the strategy; for example, through the London Energy Partnership. This will ensure that, as conditions within London and more widely evolve over time, the issues of highest priority are addressed.

Structure of the Energy Strategy

1.16 The Energy Strategy is structured around the mechanisms available to the Mayor to influence the supply and use of energy in London. Chapter 2 provides a background to the historical and current patterns of energy

supply and use in London, and discusses the key drivers of the strategy: climate change and fuel poverty. Chapter 3 presents the aims and objectives, and outlines a long-term vision for energy in London.

1.17 Chapter 4 deals with the strategic framework and sets out the Mayor's position on the key energy issues. Action on these issues is taken forward through policies and proposals in Chapters 5, 6 and 7. Chapter 5 presents policies that the Mayor will implement through his strategic responsibilities for planning in London. Chapter 6 includes those actions that the Mayor and the GLA group will deliver directly.

1.18 Chapter 7 presents policies and proposals for actions that the Mayor could deliver through working in partnership with others. The London Energy Partnership, which the Mayor will facilitate, will take much of this forward. This chapter also contains proposals relating to the London Hydrogen Partnership.

1.19 Chapter 8 outlines the implementation and monitoring of the Strategy.

References and notes

1 The Greater London Authority Act 1999, Her Majesty's Stationery Office 1999.

2 energy supply and use in London

Historical context and current patterns

2.1 Energy is an essential ingredient in the functioning of a modern city. It is fundamental to almost all urban activity, underpinning transport, domestic and office environments, industry, retail, construction; leisure activities, communication systems, and information technology.

2.2 It is perhaps because of this pervasiveness that energy is generally taken for granted and is not always recognised as a major issue in itself. However, its importance is highlighted in crisis moments when supply is compromised. There have been many of these, including the oil crises of the 1970s, the blackouts in California, the transport fuel protests in the UK and Europe, and most recently the electricity supply failure in August 2003 which affected hundreds of thousands of Londoners.

2.3 The way in which energy is supplied to consumers in the UK has changed in the last few decades. During the last ten years in particular, the fuels used, both by end users and by electricity generators, have shifted away from solid fuels and oil toward natural gas, and there has been an increase in the use of nuclear power.

2.4 Figure 1 is a simplified representation of the energy network currently serving domestic consumers in London. A comprehensive picture would include the commercial, industrial, transport and public sectors, along with the small amounts of solid fuel and paraffin still used in domestic heating. The diagram shows some of the pathways along which primary energy resources, for example natural gas, wind and uranium, are converted into electrical power and distributed to end users. Some fuels can be used at more than one point in the network. Natural gas is used to generate electricity in large-scale, centralised power stations, and in embedded electricity generation (for example, combined heat and power (CHP) plants). It is also used in its primary form as a heating fuel (requiring a separate distribution network), and may soon also be used for domestic self-generation of electricity and heat in micro-CHP units. The diagram also illustrates that what is actually required by end users is not fuels or energy in themselves, but energy services such as space heating, cooking and lighting, as well as the wide range of services provided by electrical appliances.

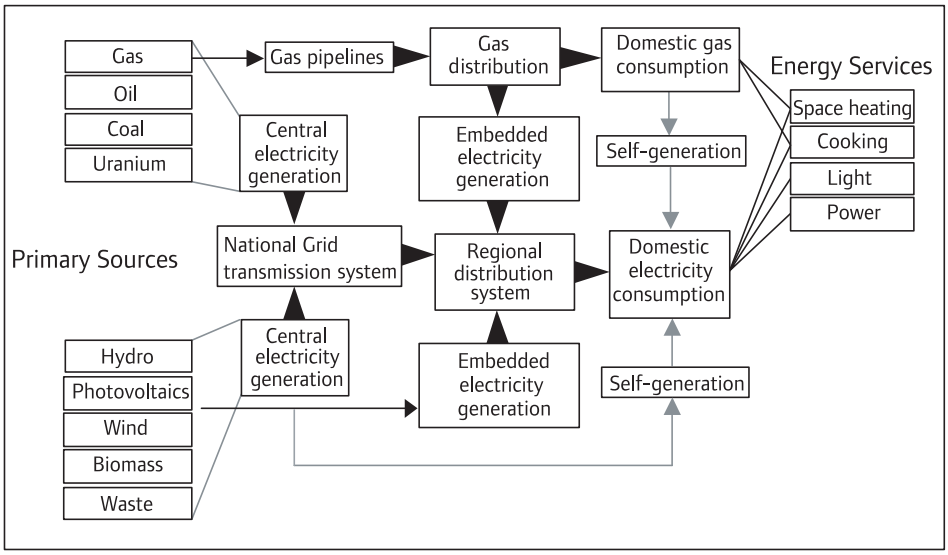
2.5 The combination of fuels and technologies, and the structure of the distribution networks, have changed continually over the years in response to changing demand patterns and technological development. Overall, energy consumption in Greater London increased by around 16 per cent between 1965 and 1999, from 132TWh (terawatt-hours) to 154TWh[1]. In the same period, there was a net fall in population of seven

per cent, indicating a significant increase in the per capita rate of energy consumption.

Energy consumption

2.6 The evolution of energy consumption by fuel type in London since 1965 is illustrated in Figure 2. These and all subsequent data refer to final energy consumption, as opposed to primary energy consumption. Final energy means the energy that reaches the end user, and excludes energy lost through conversion and distribution processes (such as electricity generation). The carbon dioxide (CO_2) emissions associated with these losses are nevertheless attributed to the end users.

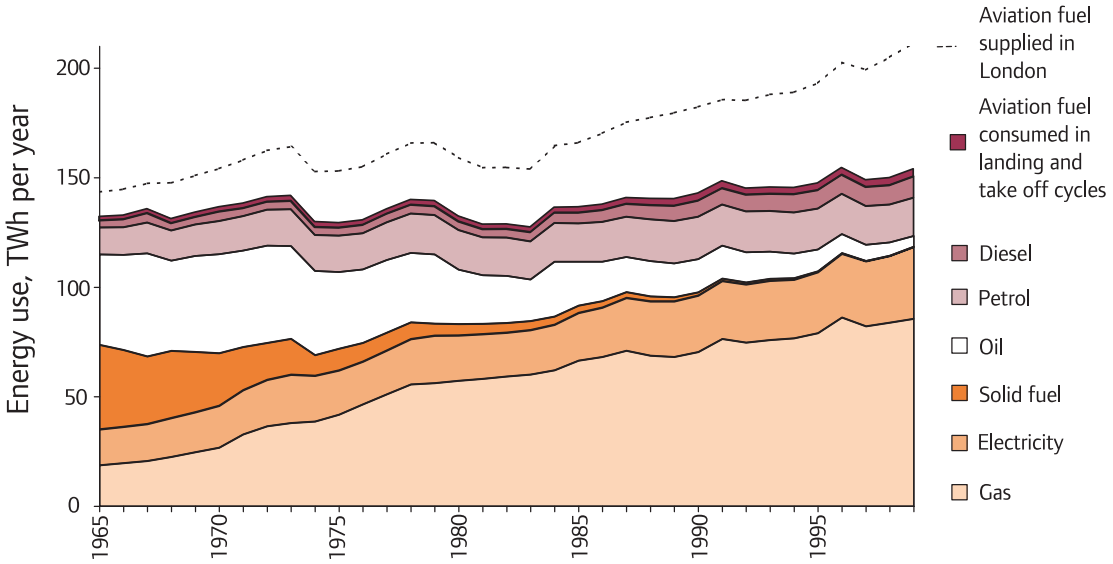
Figure 1 Simplified representation of the energy network serving London homes



source Adapted from TJ Foxon and MA Leach, The Reference Sustainability System - A Network Model for Material Flow Accounting. In Regional and National Material Flow Accounting: From Paradigm to Practice of Sustainability. (Wuppertal Institute), 1997, 77-81. (Proc. ConAccount Workshop, 1997)

2.7 The average rate of increase is equivalent to a growth rate of approximately one half per cent per year during the period from 1965 to 1999. The replacement of oil and solid fuels (coal and coke) with gas, and to a lesser extent electricity, is illustrated by Figure 2, as is the increase in the use of diesel for road transport.

Figure 2 Evolution of final energy consumption in London, 1965-1999



source Greater London Authority 2002
note Aviation fuel supply data from BAA except 1992-1999 extrapolated using national data

2.8 Gas consumption has the fastest long-term growth rate, followed by aviation, if all fuel supplied to outgoing flights is included (see dotted line in Figure 2). However, London's energy and CO_2 emissions inventory only includes aviation fuel consumed in landing and take-off cycles (up to 1,000 metres) at airports inside Greater London, as shown in the top solid area in Figure 2. This accords with international convention. Total flight energy consumption is excluded because assigning different components of this to points of departure, arrival, stopover, transfer etc, is a complex problem. For example, there is no obvious simple way to apportion the energy consumed by a passenger travelling from New York, who flies into Heathrow and takes a train to Bristol. It could be argued that all of the energy required should be attributed to New York and Bristol, and none to London.

2.9 The vast quantities of energy consumed internationally by flights to and from London do need to be taken into account in an analysis of London's sustainability. For example, in 1991, 3.5TWh of aviation fuel was consumed in landing and take-off cycles at London's airports. In the same year, more than ten times that amount (37TWh) was supplied to fuel outgoing flights. Meanwhile, all the CO_2 emissions associated with these flights contribute to the continuing increase in global CO_2 concentration (see Figure 9), and a proportion of this problem is certainly attributable to London.

2.10 The data presented here refer to energy consumed inside London. This is not a 'footprint' study, although such an exercise - the City Limits project[2]

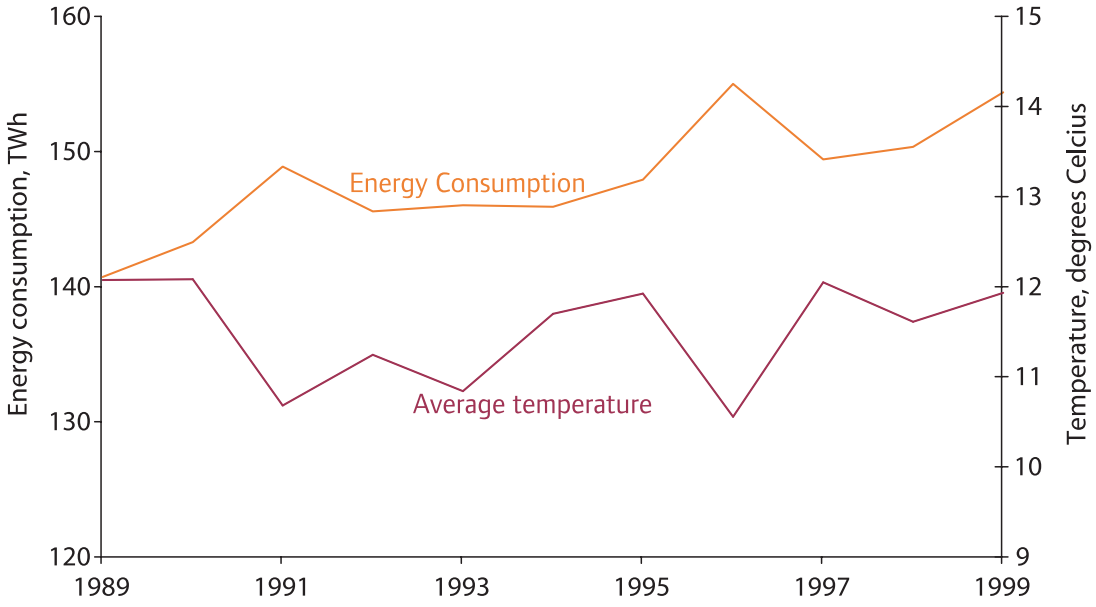
- has been completed separately from the Energy Strategy. For the purposes of the data presented in this Strategy, a line has been drawn at the Greater London boundary. This includes Heathrow and London City airports, but excludes Gatwick, Stansted and Luton airports, even though these also serve London. To take into account final energy use resulting from activities occurring beyond the Greater London boundary would involve complex apportionment affecting almost every aspect of energy use. There are well-established procedures for the preparation of atmospheric emissions inventories, which have been adopted here in the absence of similar rules for energy inventories.

2.11 Returning to Figure 2, there is a close relationship between energy consumption and economic activity. The recessions of the early 1980s and 1990s are seen as periods of temporary reduction in energy consumption. Equally pronounced is the impact of the first oil crisis in the early 1970s, when dramatic increases in the price of oil affected the economy. Weather conditions are another influential factor; energy consumption is higher in colder years, and this is highlighted in Figure 3.

2.12 Figure 4 compares energy consumption in London with the UK and a sample of other European nations. Internationally, London is a relatively large consumer of energy. In 1997, the city consumed more energy than Ireland, and about the same as the whole of Portugal or Greece.

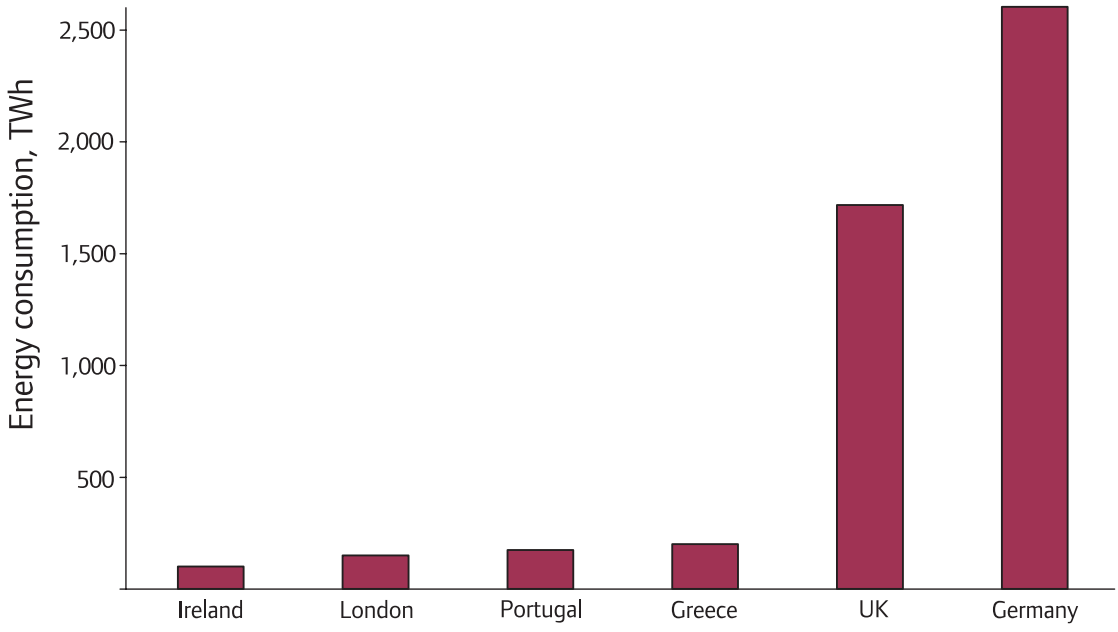
2.13 Figure 5 illustrates relative per capita energy consumption in European cities and countries. In per capita terms, London's 1997 energy demand was roughly 20 per cent below the EU average of 28MWh (megawatt-hours) per person. Per capita energy use in London is also lower than the UK national average, reflecting the lack of energy intensive industries, and economies of scale resulting from high population density and flatted housing. Average household energy consumption is higher in London, because of the region's above average affluence and smaller average household size. Despite this, at lower income levels there is little difference in income between London and other regions of the UK, while the costs of living are higher in London.

Figure 3 Mean annual temperature and energy consumption in London, 1989-1999



source Greater London Authority, 2002 and Met Office Monthly Weather Report

Figure 4 Final energy demand in London and selected European countries, 1997



source European Union Annual Energy Review, 1997 and Greater London Authority, 2001

Figure 5 Per capita final energy demand in London and Europe, 1985 and 1997

source European Union Annual Energy Review, 1997 and Greater London Authority, 2002

2.14 These figures refer only to energy consumed within London itself. This does not account for the vast quantities of energy and materials consumed internationally in activities that directly serve London. These have to be taken into account in an analysis of London's sustainability, as does the total amount of energy consumed in all forms of travel outside London but originating or terminating in London, including air travel.

2.15 In 1999, the London Underground accounted for around one per cent of London's total energy consumption, and three and a half per cent of electricity consumption[3]. These figures give an idea of the scale of a system that carries more passengers per day than the entire national rail network. Until recently, the system generated about 60 per cent of its needs from the 180MW (megawatts) Lots Road Power Station. The remaining 40 per cent was obtained via the National Grid, supplied by British Energy, which derives 75 per cent of its power from nuclear power stations, including Dungeness and Sizewell. Peak load on the Underground is estimated to be 200MW.

2.16 Lots Road Power Station was shut down in 2002 and British Energy meets the resulting demand via the National Grid. This means that almost 70 per cent of the Underground's electricity now comes from nuclear power. While replacing the Lots Road supply with modern fossil fuel sources

would secure significant emissions reductions, because of the inefficiency of the plant at Lots Road, using nuclear electricity results in almost zero emissions because nuclear generation is virtually CO_2 free. However, there is widespread public concern regarding the security and safety of nuclear installations, and the hazardous materials that result from their operation. This area of policy is discussed in more detail in Chapter 4.

2.17 Rapid increases in the use of electronic information and communication technologies have had a significant impact on electricity consumption growth. All computer equipment generates heat. In the context of offices in London, this has resulted in increased demand for cooling, typically met using conventional electrical air-conditioning systems, which are energy and carbon intense. Although most demand for cooling is in the commercial sector, the environmental problems resulting from the use of electrical air-conditioning systems could be exacerbated by a growth in demand for cooling in the domestic sector. However, there are alternative approaches to building temperature control that are more efficient, such as passive solar design, borehole cooling and absorption chillers. These are discussed in Chapter 5.

2.18 Although teleworking and video conferencing have long been said to offer opportunities to reduce travel, there is anecdotal evidence to suggest that, in some cases, additional trips are generated, and this is certainly true in the case of additional deliveries generated by e-commerce. Furthermore, the growth in the importance of the internet as a communication medium means that increasing numbers of internet servers are being sited in London. These are often housed in single-purpose buildings known as internet or data 'hotels'. These buildings consume a large amount of electricity to power the equipment, and for cooling. In 2000, the city's main electricity distribution company, EdF Energy, estimated that internet hotels would add 50GWh (gigawatt-hours) to total electricity consumption in 2001-2002, and a further 150GWh in 2002-2003. This is equivalent to a 0.6 per cent increase, and accounts for roughly 12 per cent of the expected growth for the period.

2.19 In 1999, electricity accounted for about a fifth of final energy consumption in London (see Figure 6). Gas was the most important fuel, accounting for more than half of final energy use. Most of the remaining 23 per cent was used in transport.

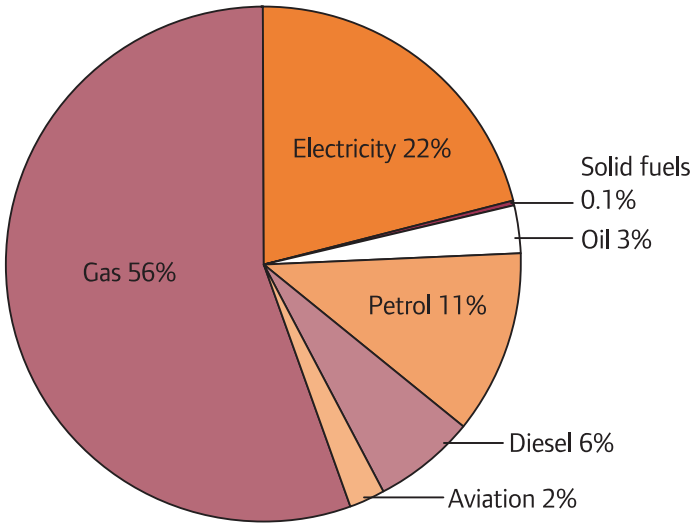
2.20 The structure of the electricity industry underwent radical change during the deregulation of the 1990s. This process continues, most recently with the introduction of the New Electricity Trading Arrangements (NETA), which came into force in 2001. Although NETA was designed to increase

the efficiency of the wholesale electricity market, new provisions, which impose penalties for intermittency of supply, disadvantage small and intermittent generators. As a result, some aspects of NETA are in conflict with efforts to increase the amount of electricity supplied from renewable energy sources in the UK. As these problems are resolved, the structure of the electricity supply industry will continue to evolve. This will lead to further changes in the fuel mix as smaller and more decentralised generation plants become more commonplace.

2.21 During the 1990s, there were changes in contributions to final energy consumption in London by different sectors. These included an increase in the proportions represented by vehicle, commercial and domestic energy consumption, and a decrease in industrial energy consumption. The changes (shown in Figure 7) reflect the growth of the commercial sector and the decline in manufacturing, which have been occurring in the UK economy as a whole since the 1960s, although these processes have tended to be more advanced in London and the South-East.

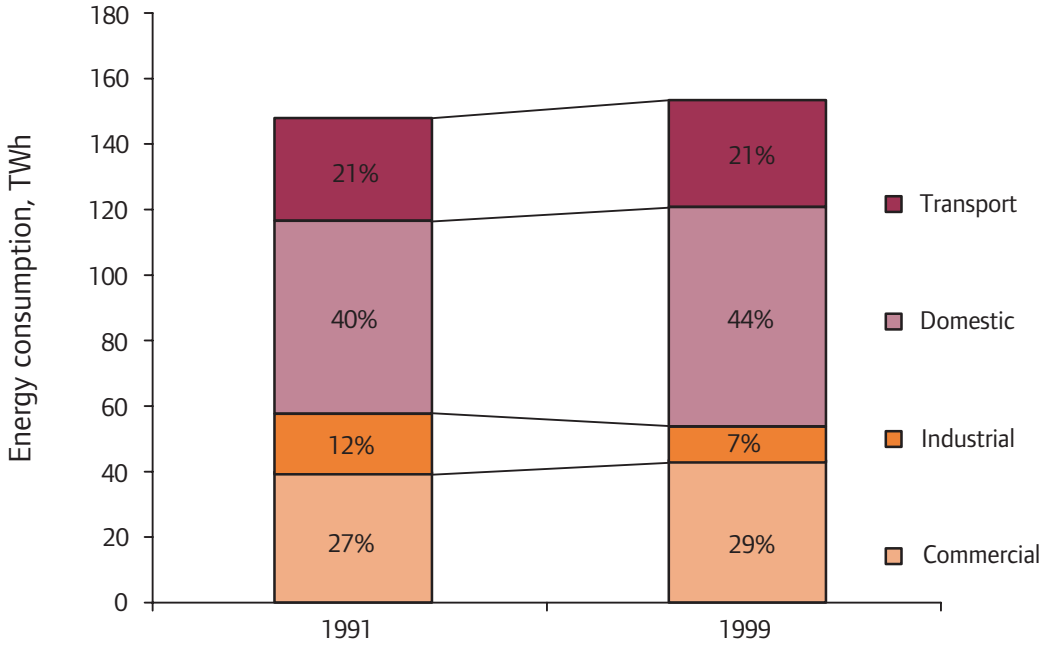
2.22 The last remaining coal and oil-fired power stations in inner London had been shut down by 1990. They have been replaced by new plants in outer London with higher efficiency and capacity. As a result, approximately 40 per cent of London's 1999 electricity consumption was generated at 17 locations within Greater London. These include 1GW at Barking and 350MW at Enfield, as well as the 180MW plant at Lots Road. The equivalent of about 60 per cent of London's electricity demand is met from power stations outside the capital.

Figure 6 Final energy consumption in London by fuel, 1999



source Greater London Authority, 2002

Figure 7 Sectoral final energy consumption, 1991 and 1999

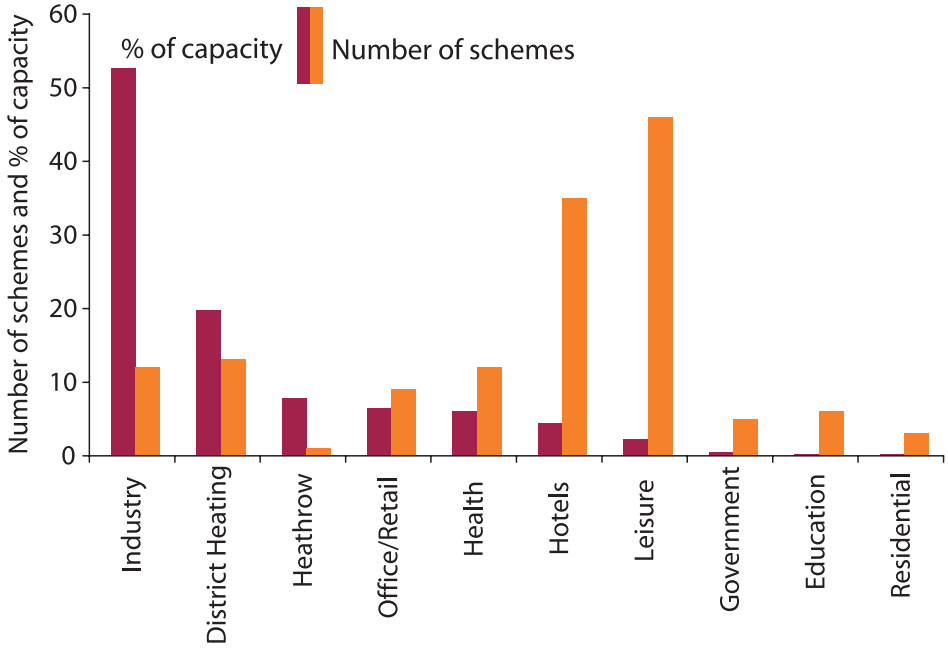


source Greater London Authority, 2002

2.23 In addition to these large-scale sites, there are approximately 140 CHP schemes operating in Greater London, with a combined primary energy consumption of about 7TWh from gas and gasoil. Total electrical output in 1999 was 2TWh, roughly equivalent to six per cent of overall electricity consumption. For the purposes of data analysis, this has been treated as gas rather than electricity consumption, and is excluded from the electricity total to avoid double counting.

2.24 London's electrical CHP capacity is about 175MW, which is four per cent of the UK total. This is disproportionately low because the majority of UK CHP capacity is on industrial sites, while London is no longer a major industrial centre. However, 27 per cent of the UK's non-industrial CHP plants are in London. The distribution of CHP schemes in London, in terms of the number of schemes per sector and the proportion of total capacity per sector, is shown in Figure 8.

Figure 8 Distribution of combined heat and power (CHP) capacity in London, 1999



source Greater London Authority, 2002 and Combined Heat and Power Association, 1999

2.25 Figure 8 shows that London's CHP capacity is concentrated in a small number of schemes, although there are also a large number of small schemes in operation in a range of sectors.

Energy consumption in commercial and public sector buildings

2.26 As is shown in Figure 7, the commercial sector accounts for approximately 30 per cent of London's energy consumption. During the last 25 years, there has been a rapid increase in these sectors' energy consumption in the UK, with the vast majority in commercial offices and retail outlets. UK commercial services' (offices and retail outlets) final energy consumption grew by 65 per cent from 1973 to 1996, and they now consume significantly more energy than the UK public sector[4]. This rapid growth in commercial sector energy consumption reflects expansion in floor space, as well as increased heating, lighting, information technology (IT) and air-conditioning loads in individual buildings. The last 30 years has seen rapid growth in commercial floor space across England and Wales. From 1970 to 1994, retail, office and warehouse floor space doubled.

2.27 Unlike other economic sectors, there has been no improvement in energy intensity in the UK commercial sector since the late 1980s, with energy consumption increasing just as rapidly as growth in economic output. Whereas newer homes, appliances and machinery tend to be more energy efficient than earlier versions, commercial buildings have gone against this trend. This is due to a growing demand for high levels of illumination in the retail sector, and the increased use of air-conditioning and IT equipment in offices.

2.28 Modern office designs often consume more energy per square metre than traditional buildings, primarily due to the rising use of air-conditioning. More and more new offices and retail outlets are built with air-conditioning and, considering that air-conditioned buildings consume so much more electricity, this is a significant concern for the growing energy use of offices and commercial buildings.

2.29 Offices and retail outlets are proportionally very high electricity users, which means that the conversion losses associated with centralised electricity generation have a greater effect on their overall CO_2 contribution than for other sectors. Although the energy consumption of the commercial sector has grown in the last ten years, its CO_2 emissions have not, largely because of the 'dash for gas' in electricity generation. The fuel mix of electricity generation has a large influence on CO_2 emissions from offices. This illustrates the benefits that energy efficiency in electricity use and building-integrated renewables can make in reducing the commercial and public sectors' contribution to climate change.

Potential cost savings from improving energy efficiency

2.30 The GLA recently commissioned Future Energy Solutions to model London's emissions of CO_2, and to investigate how these could be

reduced over time as part of the process of setting a target for the capital. This work is described in Chapter 4, and demonstrates that businesses could reduce their energy use by 20 per cent, solely by employing cost-effective measures. If implemented, these would save businesses significant amounts of money.

2.31 The Government's Energy Efficiency Best Practice Programme provides typical and good practice energy consumption benchmarks for four main types of office building: naturally ventilated cellular, naturally ventilated open-plan, standard air-conditioning, and prestige air-conditioning. This work shows that:

- a typical prestige office consumes 2.8 times more energy per unit of floor area than a typical naturally ventilated cellular building
- typical offices use 60 per cent to 90 per cent more energy than offices using good practice
- air-conditioned offices use substantially more energy than non air-conditioned offices to deliver the same energy services such as heating, lighting and ventilation
- a typical prestige air-conditioned office emits almost four times as much CO_2 per unit of floor area as a typical naturally ventilated cellular office.

Social and environmental effects of energy use

2.32 Two key social and environmental problems are associated with energy use. One concerns the pollution arising from energy production, distribution and consumption, and the effects on the local and global environments. The other is the question of access to sufficient high-quality energy resources in order to sustain an acceptable living standard.

2.33 Energy-related pollution is a broad issue. All non-renewable forms of energy, and some renewable forms, cause pollution problems. The effects of these vary in their extent over time and distance, and in the severity of the repercussions on human health and the environment. These problems are addressed in several of the Mayor's strategies, including Energy, Transport, Air Quality, Municipal Waste, Noise and Biodiversity.

2.34 The Energy Strategy focuses on one of the most important problems resulting from current energy production and consumption patterns, which is not substantially covered in the other strategies: climate change. The scientific and historical background to climate change is discussed below. This is followed by a description of London's CO_2 emissions. Problems with social access to energy services are dealt with later in this chapter in the section 'Energy efficiency and fuel poverty in London homes'.

Climate change

2.35 There is broad international consensus that the global climate is being affected by human-induced emissions of what are termed 'greenhouse gases', and that unless action is taken to reduce these emissions significantly, the effects of climate change on society worldwide could be extremely serious.

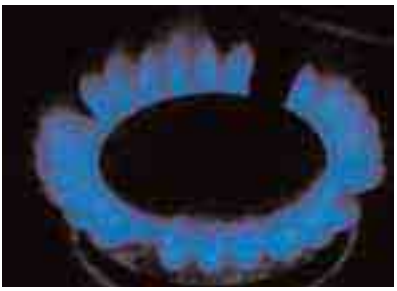
2.36 There are six principal greenhouse gases, emitted via a range of processes, some of them natural. These gases have different atmospheric lifetimes and affect the behaviour of the atmosphere at different rates. As a result, they have widely varying influences on climate. The Intergovernmental Panel on Climate Change (IPCC) has established a baseline for comparison called 'global warming potential'. In this scheme, CO_2 has a global warming potential of one, and the other gases are defined in relation to CO_2.

2.37 The process by which greenhouse gases affect the climate is as follows. Radiation from the sun passes through the Earth's atmosphere and reaches the surface, where it is absorbed and re-emitted at infrared wavelengths as heat. Naturally occurring greenhouse gases such as CO_2, water vapour and certain other gases in the atmosphere absorb this infrared radiation, reducing the amount of heat escaping back into space. This process, known as the 'greenhouse effect', is natural, and essential for maintaining temperatures suited to life on Earth.

2.38 The burning of fossil fuels in human activities such as industry and transport, and emissions from agriculture, has increased the volume of greenhouse gases entering the atmosphere. At the same time, processes such as deforestation have reduced the amount of CO_2 being taken out of the atmosphere by 'carbon sinks'. As a result, the atmospheric concentration of certain greenhouse gases has increased substantially, amplifying the greenhouse effect, and leading to increased global average temperatures as the extra stored energy warms the atmosphere.

2.39 Carbon dioxide, the most important of the greenhouse gases by virtue of the huge quantities emitted, is produced as a gas whenever carbon-based fuels are burned. Before the industrial revolution, wood was the most commonly used fuel. Carbon dioxide from wood did not become a global problem, in part because of the relatively low energy (and carbon) density of that fuel, and also because the quantities of fuel burned in the pre-industrial era were insufficient to cause a problem. The global atmospheric concentration of CO_2 began to rise significantly when people started burning coal at the start of the industrial revolution (see Figure 9). The continuing rise is now partly due to the rapid growth of the human population.

2.40 All fossil fuels (coal, oil and gas) are the concentrated remains of organic matter deposited over geological timescales. They are rich in carbon and have extremely high energy densities compared to living organic materials like wood; this is what makes them so useful as fuels. Once discovered, oil made possible the development of the internal combustion engine and of road transport as we know it today. Oil also replaced coal in other areas, such as for heating buildings and generating electricity.



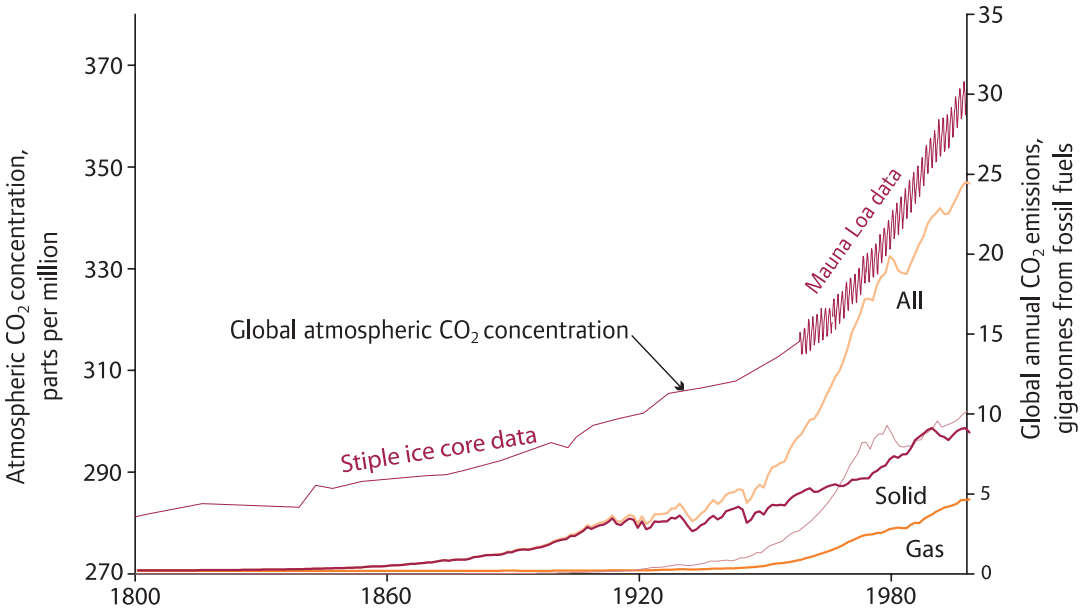
2.41 The most recent shift in this fuel history has been from oil to gas, which again decreased the amount of carbon per unit energy in fuel. This change has been restricted to heating and electricity generation because oil has a far higher volumetric energy density than gas, making it more economical to transport, and more suitable for transport applications.

2.42 Figure 9 shows global atmospheric CO_2 concentration from 1800 to 1998, in parts per million by volume (ppmv). Also plotted are CO_2 emissions from fossil fuel combustion (millions of tonnes per year) for the same period. The changes in fuel consumption patterns described above are reflected in the relative rates of emissions of CO_2.

2.43 Energy: The Changing Climate[5], a report published by the Royal Commission on Environmental Pollution in 2000, recommends a CO_2 emissions reduction target for the UK of 60 per cent, relative to 1990, by 2050. As the report explains, this is based on the UK contribution to an international target of stabilising global atmospheric CO_2 concentration at 550ppmv, following the contraction and convergence approach (see Chapter 4).

2.44 It is important to note that a CO_2 stabilisation concentration of 550ppmv is approximately double the concentration prior to industrialisation, and as the Royal Commission report states, '...on the basis of current scientific knowledge about human impact on climate, we support the proposal that an atmospheric concentration of 550 ppmv of CO_2 should be regarded as an upper limit that should not be exceeded'. It goes on to warn '...the choice of 550 ppmv as the upper limit will need to be kept under review'. The Mayor's position on this issue is presented in Chapter 4.

Figure 9 Atmospheric carbon dioxide concentration and fuel-based emissions, 1800-1998



source CO_2 emissions data: Marland et al, Global, Regional, and National CO_2 Emissions, 2001. CO_2 concentration data from ice cores (pre-1958): Neftel et al, Historical CO_2 record from the Siple Station ice core. University of Bern, Switzerland, 1994.

note Both of the above published in Trends: A Compendium of Data on Global Change. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, US Department of Energy. CO_2 concentration data from Mauna Loa (1958-1998): Keeling et al. Scripps Institution of Oceanography (SIO), University of California.

London's carbon dioxide emissions

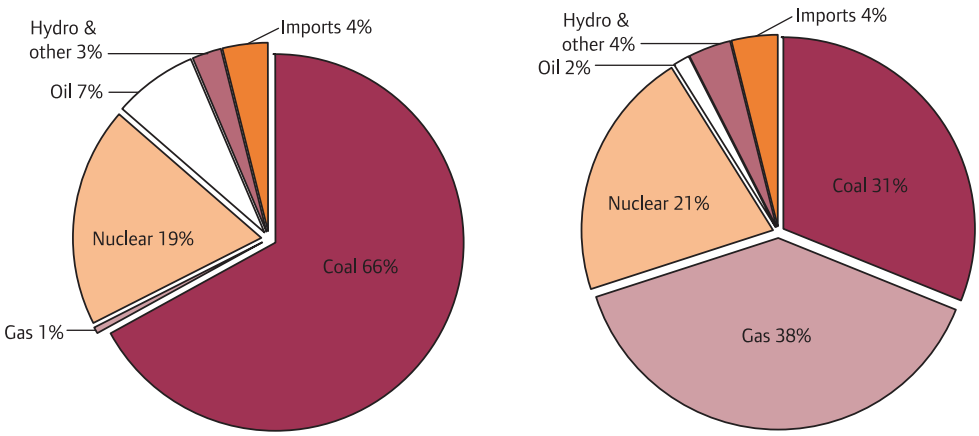
2.45 This section deals with emissions of CO_2 resulting from energy consumption within Greater London. Emissions data are presented in tonnes of CO_2.

2.46 Since 1990, the average carbon intensity of supplied energy in the UK has fallen because of the switch from coal to gas for electricity generation (see Figure 10). At the same time, energy consumption has been increasing throughout a long period of economic growth. In the UK generally, this has resulted in an overall growth in energy consumption of more than ten per cent during the period 1990-2000[6].

2.47 Figure 11 shows how sectoral contributions to London's overall CO_2 emissions changed between 1991 and 1999. Emissions from transport increased, while those from commerce and industry fell - dramatically in the case of industry, as a result of both decreased activity and the reduced carbon intensity of electricity. Domestic emissions increased,

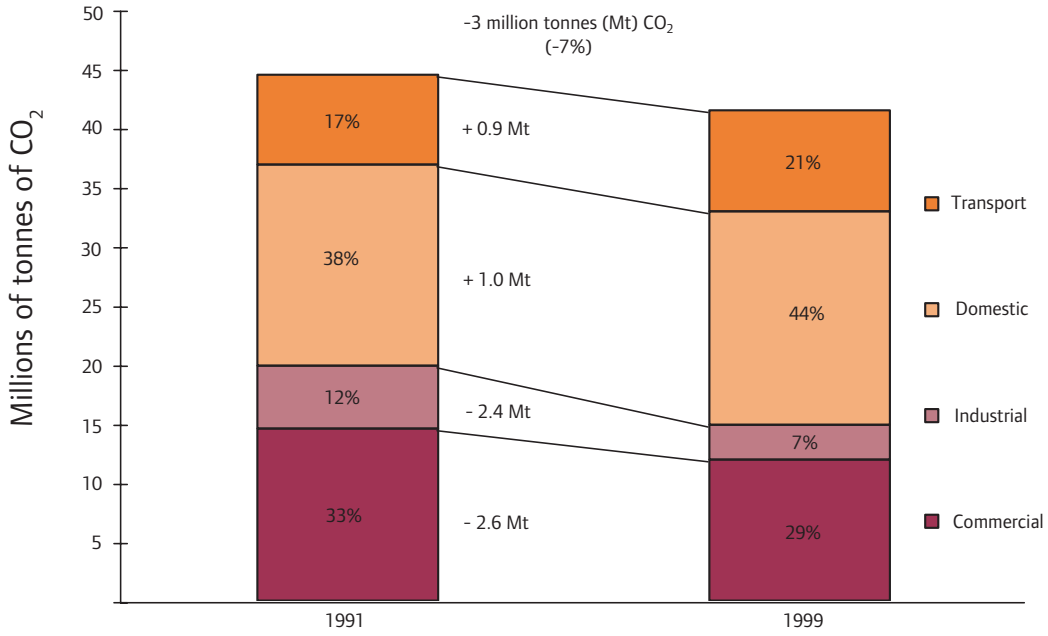
despite the changes to the fuel mix for electricity generation, because overall energy consumption in this sector increased significantly (see Figure 7).

Figure 10 UK electricity generation fuel mix, 1990 and 2000



source Department of Trade and Industry, Digest of UK Energy Statistics, The Stationary Office, 1999-2001

Figure 11 Sectoral Carbon dioxide (CO_2) emissions from London, 1991 and 1999



source Greater London Authority, 2002

2.48 London's population has been growing since 1983 and is now outstripping the national rate of population growth. Projections in the

London Plan indicate a population increase of approximately 800,000 people by 2016[7]. In the absence of concerted action to reduce the carbon intensity of energy services, population growth combined with probable future trends in the national energy supply industry mean that CO_2 emissions from London are likely to decline only until 2005, when they will stabilise, and could start rising again. Chapter 4 presents a summary of the results of a London CO_2 emissions modelling project, commissioned by the GLA.

The impacts of climate change

2.49 As greenhouse gas concentrations rise, the atmosphere and oceans warm, and weather patterns become less predictable. Globally, the average surface temperature has increased during the 20th century by about 0.6°C. The temperature in the lowest eight kilometres of the atmosphere has risen since the late 1950s (the period of adequate observations from weather balloons) at an average rate of 0.1°C per decade. Global average sea level rose between ten and 20cm during the 20th century. There is new and stronger evidence that most of the warming observed in the last 50 years is attributable to human activity and the increases in greenhouse gas concentrations.

2.50 According to the UK government, global temperatures are projected to rise by about 3°C during the 21st century. A report by the United Nations Intergovernmental Panel on Climate Change, published in February 2001[8], corroborates this view and estimates that global temperatures are likely to rise by 1.4-5.8°C during the same period.

2.51 Climate change is an important issue for London. The capital has a major role to play, both in terms of reducing the emissions of the gases that cause climate change and in managing the effects that climate change will create. Even with these efforts, some consequences of climate change are inevitable.

2.52 In October 2002, the London Climate Change Partnership published London's Warming: the impacts of climate change on London[9]. This study forms part of the UK Climate Impacts Programme and identifies a range of London-specific sensitivities to climate change, which will need to be addressed as part of a successful adaptation to the effects of climate change. These are summarised below.

2.53 Future temperature increases are likely to be exacerbated in London because of the urban heat island effect. Higher summer temperatures could lead to detrimental effects on air quality, summer electricity demand, and the comfort and safety of buildings and transport. By the

2080s, extreme summer temperatures in London could be comparable to those of present day New York.

2.54 London is already exposed to greater potential flood damage than any other urban area in the UK, because of the asset value in the capital, and because a large proportion of the city lies within the floodplain of the River Thames. The increased winter rainfall expected to result from climate change will mean that, in the longer term, flood protection, such as the Thames Barrier, and risk management will have to be improved significantly. If these issues are not successfully addressed, the effects on insurance costs, the property market and transport infrastructure are likely to be hugely damaging to London society and the economy.

2.55 In summer, the amount of water available per head of population in London is comparable to that of Israel. Climate change could both reduce the amount of water available during summer and increase demand, leading to acute water shortages.

2.56 Climate change could affect London's economy in a number of ways. These include effects of winter flood risk and summer drought, as well as the potential growth in tourism and recreation that might result from changes to London's summer weather. With London's financial centre now embedded in a global system, it is increasingly likely that geographically distant economic effects of climate change be felt in London. Distant effects could also be felt locally through increased pressure of migration from areas of the world adversely affected by climate change.

2.57 Nationally and in London, changes to biodiversity are likely to include species migration, local extinctions, and increased risk of pests and disease carriers, such as mosquitoes[10].

2.58 The Mayor's climate change policies for London are discussed in Chapter 4.

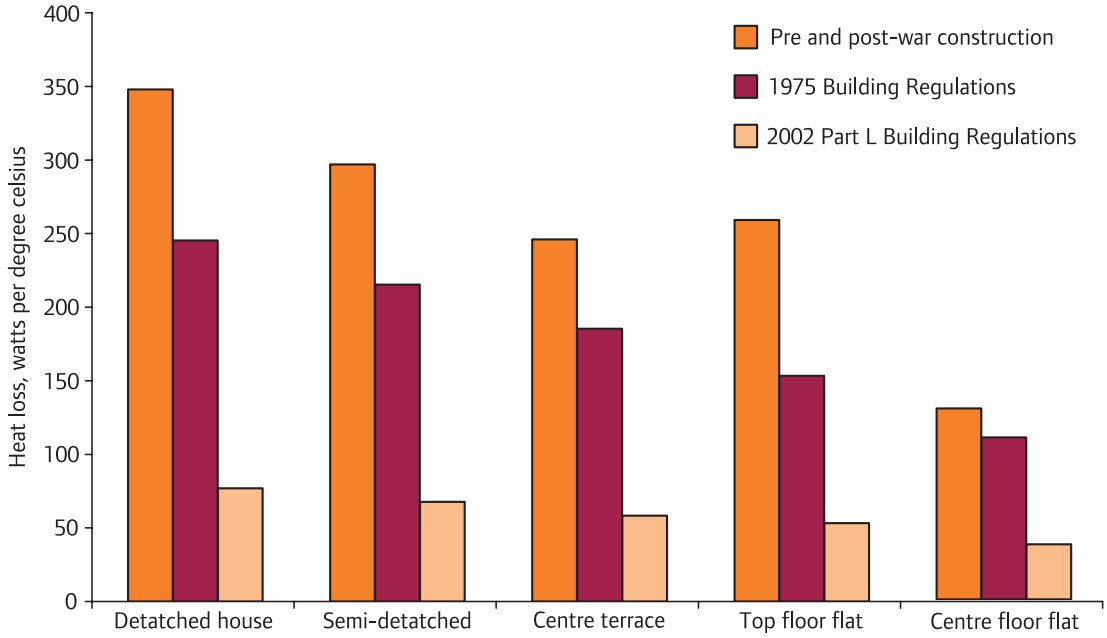
Energy efficiency and fuel poverty in London's homes

2.59 Domestic energy consumption accounts for around 45 per cent of London's energy consumption and CO_2 emissions, and is the fastest-growing energy sector. Along with the problems of environmental pollution and resource wastage common to all sectors, poor energy efficiency in homes is one of the primary causes of fuel poverty - a situation in which many people, both in London and across the UK, are unable to afford to heat their homes to a decent level.

2.60 Figure 12 illustrates the relative rates of heat loss from the main dwelling types present in London. The graph shows that the rate of heat loss is

worse in older buildings, as subsequent building regulations have specified progressively higher standards of insulation. Heat loss is also greater in detached houses, while centre floor flats tend to have the best thermal properties. These results are to be expected, given the physical environments around the different dwelling types shown. They are also consistent with the observation that fuel poverty is more likely in dwellings constructed before 1919[11], which represent about 30 per cent of London's housing stock.

Figure 12 Relative fabric heat loss from different dwelling types (all dwellings the same size - London average 72m^2).



source Greater London Authority, 2001

Measuring energy efficiency in homes

2.61 Building energy efficiency is influenced by many factors. To simplify the problem of representing it, a composite indicator was developed in 1993 by the Department of the Environment, Transport and the Regions (DETR), and the Building Research Establishment (BRE). This is known as the Standard Assessment Procedure (SAP) for the energy rating of dwellings. The SAP rating, which takes values from one (very inefficient) to 120 (highly efficient) is an index derived from the energy cost factor (ECF) of a dwelling[12]. In 2001, the system was updated to include a carbon index from zero to ten, where a higher number indicates better performance. The index is derived from the total annual carbon dioxide emissions per unit of floor area.

2.62 The energy cost factor represents the annual space and water heating cost per floor area required to maintain a satisfactory heating regime in a dwelling. It is calculated using the Building Research Establishment Domestic Energy Model, which takes into account a range of factors, including:

- thermal insulation of the building fabric
- efficiency and control of the space heating and hot water systems
- ventilation characteristics
- solar gain characteristics
- fuels used in the space heating and hot water systems.

2.63 Average SAP ratings for different housing tenures in London, set out in Table 1 below, reveal that the private rented sector in inner London is less energy efficient than other housing tenures, while the rented sector is worst in outer London.

Table 1 Average SAP ratings for social housing, owner-occupied and private rented homes in London

Region	Inner London				Outer London			
Tenure	**OO**	**PR**	**LA**	**RSL**	**OO**	**PR**	**LA**	**RSL**
% SAP <30	12.5	21.2	14.1	24.4	16.3	15.3	11.8	23.3
% SAP 30-60	65.9	57.8	54.9	49.2	71.1	60.1	65.3	55.2
% SAP >60	21.5	21	31	26.4	12.5	24.6	22.8	21.5
Mean SAP	47	45.1	48.5	45.5	44.6	47.3	48.4	40

source Energy Efficiency and Fuel Poverty in London. Report for the GLA. Richard Moore, 2002.
note OO: Owner Occupied; PR: Private Rented; LA: Local Authority; RSL: Registered Social Landlord

2.64 Table 3 shows that most homes in Greater London do not have adequate insulation and that this is particularly true of the private rented sector, which is also the hardest to reach in policy terms.

2.65 Despite a mild winter in 1991-1992, only 70 per cent of homes met the temperatures of the minimum heating regime set by the Government. When the outdoor temperature dropped below 4°C, the proportion of homes failing to meet the minimum regime rose to 50 per cent in owner-occupied dwellings, 62 per cent in council homes and 95 per cent in the private rented sector[13].

2.66 On average, households in London consume more energy than households in all but two other regions in England. This is despite London having smaller households, a higher proportion of people living in flats

and a milder climate than most other regions. Of London's households, 34 per cent are in the top fifth of households in England for total consumption per unit of floor. This probably reflects London's non-heating usage, which is in line with higher average incomes.

Table 2 Insulation standards in Greater London's homes

	Total households (%)	Owner-occupied (%)	Council rented (%)	Private rented (%)
Loft insulation (in 54% of households which have access to loft)				
With loft insulation	84	88	84	61
Without loft insulation	12	9	13	28
With adequate loft insulation	11	12	11	3
Tank insulation (in 73% of households which have a hot water tank)				
With tank insulation	94	97	92	88
With adequate insulation	61	64	58	45
Cavity wall insulation (in 46% of households which have cavity walls)				
With cavity wall insulation	10	12	12	4
With double glazing	46	58	37	25
With draught-proofing	24	20	37	18

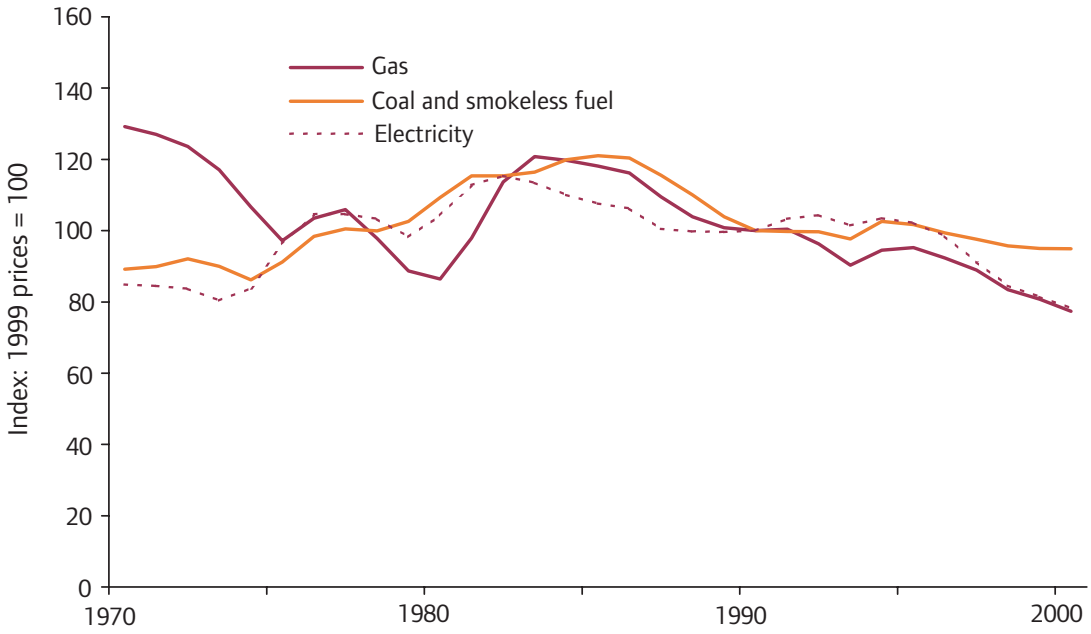
source GfK Marketing Services, 1997. Cited in: The London Assembly and Fuel Poverty. National Energy Action 2000

Fuel poverty

2.67 Although UK domestic energy prices have fallen steadily since the 1980s (see Figure 13), a significant number of people in the UK, including London, have to spend an unreasonable proportion of their income on domestic energy supplies.

2.68 According to the Government definition, a fuel poor household is one that needs to spend more than ten per cent of its income on energy in order to maintain a satisfactory heating regime. This includes all energy expenditure, not just that used for space heating. A satisfactory heating regime is defined as 21°C in the living room and 18°C in other occupied rooms[14]. There is some controversy about the definition of income; if it is taken to mean gross income, this reduces the number of households defined as fuel poor to about 4.3 million (on 1996 figures), whereas a definition based on disposable income includes some 5.3 million households nationally. In Chapter 4, the Mayor adopts a definition of fuel poverty based on disposable income, defined as net income, including housing benefits, minus housing costs.

Figure 13 Domestic fuel price index, 1970-2000



source Quarterly Energy Prices. Department of Trade and Industry, 2001. Online at http://www.dti.gov.uk/energy/energyprices/prices.htm

2.69 A combination of the size and energy efficiency of the building, the energy consuming equipment in use, the income of the occupants, and the price of the fuels in use determine the fuel poverty status of a household. Using SAP rating, income and fuel expenditure, it is possible to assess the severity of fuel poverty that a given household is likely to be experiencing.

2.70 The direct effects of fuel poverty are damage to the health of people living in cold homes, sometimes resulting in death, and the exacerbation of economic hardship. These risks are greater for people on lower incomes, children, older people and people with disabilities. Income is not uniformly distributed between ethnic groups, and fuel poverty is likely to be disproportionately prevalent in already disadvantaged groups. Language barriers may compound the problem, making it more difficult for people to take advantage of schemes that exist to help them, such as Warm Front grants.

2.71 Among the indirect effects of fuel poverty are the costs to the wider community of increased health expenditure, damage to local economies, and the increased energy consumption and CO_2 emissions which result from inefficient use of energy.

The extent of the fuel poverty problem

2.72 Fuel poverty affects different people to different degrees. Fuel poverty can be exacerbated when people conserve heating fuel to cover the cost of running electrical appliances. The data presented in this section are categorised by fuel poverty groupings, defined by ranges of percentage of household income spent on domestic fuel. The Mayor commissioned an analysis of the London portion of the 1996 English House Condition Survey, in order to develop a London-specific distribution of SAP ratings and fuel poverty. The data in Table 3 are from the report commissioned by the Mayor; the rest of the data in this section are from the original English House Condition Survey of 1996.

2.73 Table 3 compares the number of households in fuel poverty in 1996 in Greater London and in England, on both the disposable and the full income definitions. It can be seen immediately that the number of households in fuel poverty in London is significantly higher on the disposable income definition. It is also clear that the difference between the two definitions is more pronounced in Greater London than in England as a whole. Chapter 4 includes the Mayor's arguments for the use of the disposable income definition of fuel poverty.

Table 3 Numbers of households in fuel poverty in London and England

Region/basis			Mayor's preferred definition		Government's preferred definition	
	Fuel costs as % of disposable income				**Fuel costs as % of full income**	
	<5%	5-10%	all >10%	all >20%	all >10%	all >20%
1000s of households						
Greater London	1,050	805	961	357	475	54
England	6,525	6,144	6,974	2,255	4,274	640
% of households						
Greater London	37	29	34	13	17	2
England	33	31	36	11	22	3

source Energy Efficiency and Fuel Poverty in London. Report for the GLA. Richard Moore, 2002.

2.74 The following paragraphs are based on the full income definition of fuel poverty, and so should not be directly compared with the disposable income data in Table 3. National data have been used to show trends in fuel poverty, because the sample size of the London dataset was insufficient to examine certain relationships. Figure 14 shows the actual number of households suffering from fuel poverty in 1996[15], divided into three degrees of severity and grouped by English region. This shows that

in 1996 there were almost half a million households in London experiencing some degree of fuel poverty, just under a third of which spent more than 20 per cent of their income on fuel. In absolute numbers of households, London ranked fourth of nine English regions for extent of fuel poverty.

2.75 Along with income and fuel prices, the energy performance of housing stock is a key factor in determining the extent of fuel poverty. The below national average incidence of fuel poverty in London is due to several factors. These include above average household income, warmer than average ambient temperatures owing to London's latitude and the urban heat island effect, which can increase central urban temperatures significantly relative to surrounding areas[16], and a higher proportion of flats than the national average, which tend to have better energy efficiency than houses.

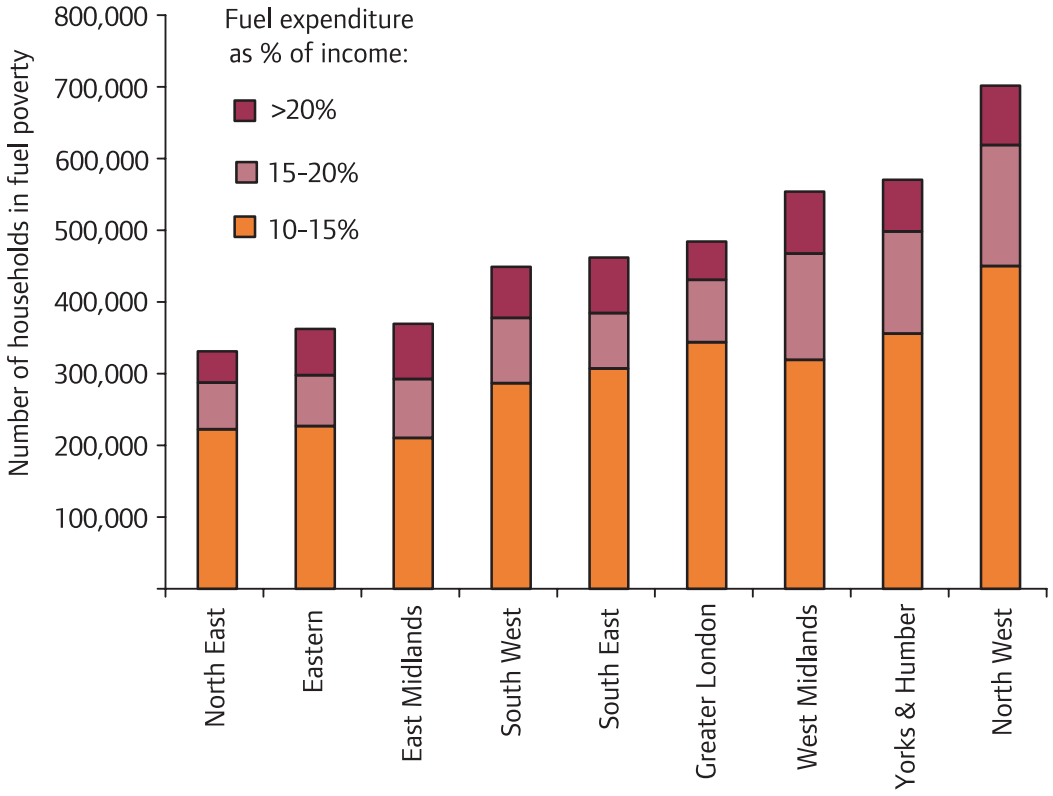
2.76 Despite London suffering proportionately less fuel poverty than most other regions of the country, it is still a significant problem for the capital. As shown in Figure 15, over 17 per cent of London's households - more than one in six - lived in fuel poverty in 1996. Nevertheless, only two of the nine regions in England have lower incidences: almost 11 per cent of England's fuel poor live in Greater London, while the region contains 14 per cent of the country's households[17].

2.77 Incidence of fuel poverty varies by location[18]. In isolated rural areas, 36 per cent of households experience some degree of fuel poverty; this type of location has by far the highest incidence proportionately speaking. There is much less variation in the other locations. In city centres the figure is 25 per cent, in both urban and village locations it is 23 per cent, and in rural residential and also suburban locations it is 21 per cent. In numerical terms, suburban locations have by far the largest number of fuel poor households (57 per cent of the English total), because such a large proportion of the population (60 per cent) live in the suburbs.

The fuel poverty trap

2.78 As with many issues of social deprivation, there is a catch-22, which tends to exacerbate fuel poverty and make it more difficult to escape from. This stems from the fact that fuel poverty selectively affects people on low incomes, and these are the very people who are most likely to be living in energy inefficient housing. Fuel costs are therefore higher for people who cannot afford to improve the energy efficiency of their homes. In addition to this, unit fuel costs are likely to be higher for people on low incomes, because of the prevalence of prepayment electricity and gas meters that attract higher tariffs.

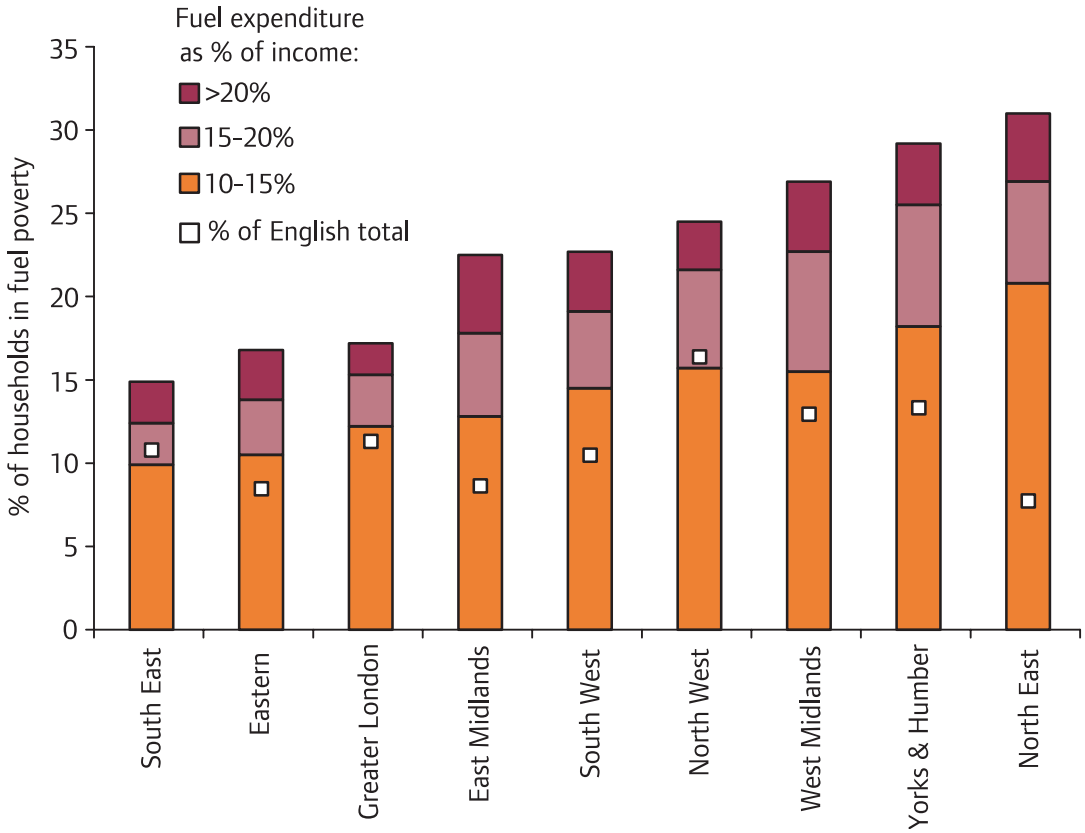
Figure 14 Number of households in fuel poverty by English region



source DETR, English Housing Condition Survey, Energy Report, 1996
note Full income definition of fuel poverty

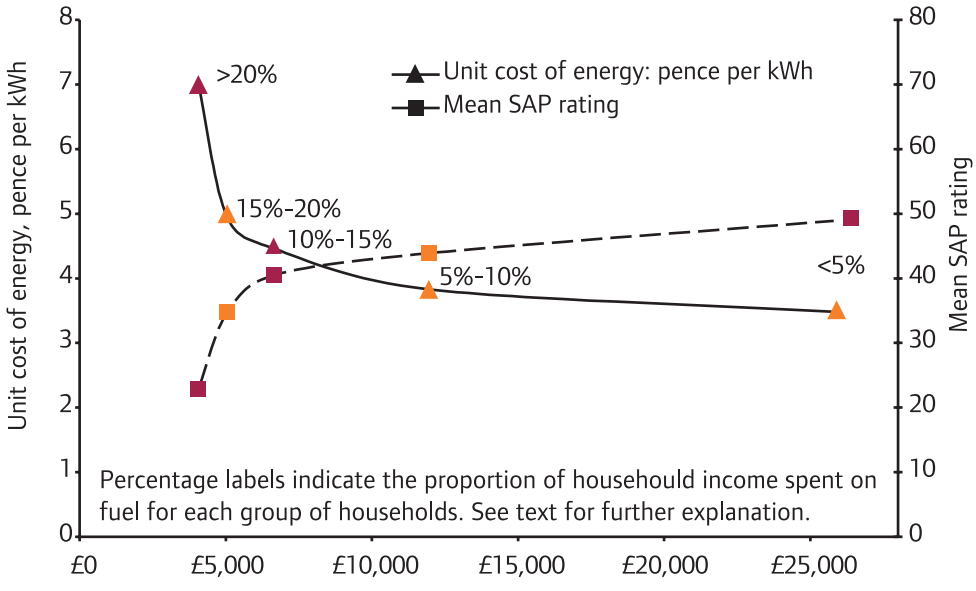
2.79 In Figure 16, households are divided into five groups, depending on the proportion of household income they spend on fuel. For each group, mean unit energy costs in pence per kWh [▲] and mean household SAP ratings [■] are plotted against mean household income. This gives the two different lines in Figure 16. The simple message conveyed by this graph is that households with the lowest incomes pay the most for their energy, and live in the most energy inefficient housing (having the lowest SAP rating).

Figure 15 Proportion of households in fuel poverty, by English region



source DETR, English Housing Condition Survey, Energy Report, 1996
note Full income definition of fuel poverty

Figure 16 Household mean income, unit energy cost, and SAP rating, by fuel poverty group



source Analysis by the Greater London Authority, 2002. DETR, Data from English Housing Condition Survey, Energy Report, 1996
note Full income definition of fuel poverty

2.80 In the most extreme cases of fuel poverty, where households are spending more than 20 per cent of their total income on fuel, a kWh of energy costs on average seven pence. In addition to this, the mean income for such households is just over £4,000, and the average SAP rating is about 23, which translates into an energy cost factor of about £8.50 per square metre per year if a satisfactory heating regime is to be maintained.

2.81 In the next group of households, spending 15-20 per cent of income on fuel, the average figures are 5p/kWh of energy, £5,000 annual income, and a SAP rating of 35, which roughly equates to energy costs of £6.50 per square metre per year. For households unaffected by fuel poverty (spending less than five per cent of income on fuel), the figures are very different. The average unit energy cost drops to 3.5 pence per kWh, while average household income is £25,000. Average SAP ratings are close to 50, translating into an energy cost of £4.60 per square metre per year.

2.82 Variation in unit energy costs between fuel poverty groups is largely related to reliance on electricity for space and water heating, instead of gas central heating. Figure 17 plots mean household unit energy cost (pence per kWh) against electricity use as a proportion of household fuel consumption, for each fuel poverty group labelled on the graph. The graph shows that electricity use as a proportion of household heating fuel, unit energy costs and proportion of income spent on fuel tend to rise together.

2.83 There are several reasons for this correlation. Poorer households are more likely to depend on electricity for heating, since the infrastructure is cheaper. Also, using electricity for heating is more expensive than gas, so the larger the electrical share of household energy use, the higher household unit energy costs become. Finally, low income households are more likely to be denied credit-based billing for fuel, and are then fitted with prepayment meters, which increase the cost of a unit of electricity.

2.84 For suppliers of electricity to the London area, the average annual cost difference (for identical consumers) between a direct debit and a prepayment meter in 2001 was 25 per cent for a typical low electricity consumption household bill[19].

2.85 It is a matter for concern that the use of prepaid electricity metering is on the increase. Table 4 shows the trend from 1993 to 1998, in the London Electricity area.

Table 4 Growth in use of electricity prepayment meters (London Electricity area) 1993-1998

Year	1993	1994	1995	1996	1997	1998
Customers using prepayment meters	255,826	294,518	349,299	374,693	388,905	390,019
% of total	15.1	17.3	20.3	21.5	22.2	22.1

source Office of Electricity Regulation. Cited in The London Assembly and Fuel Poverty, National Energy Action, 2000

The effects of fuel poverty

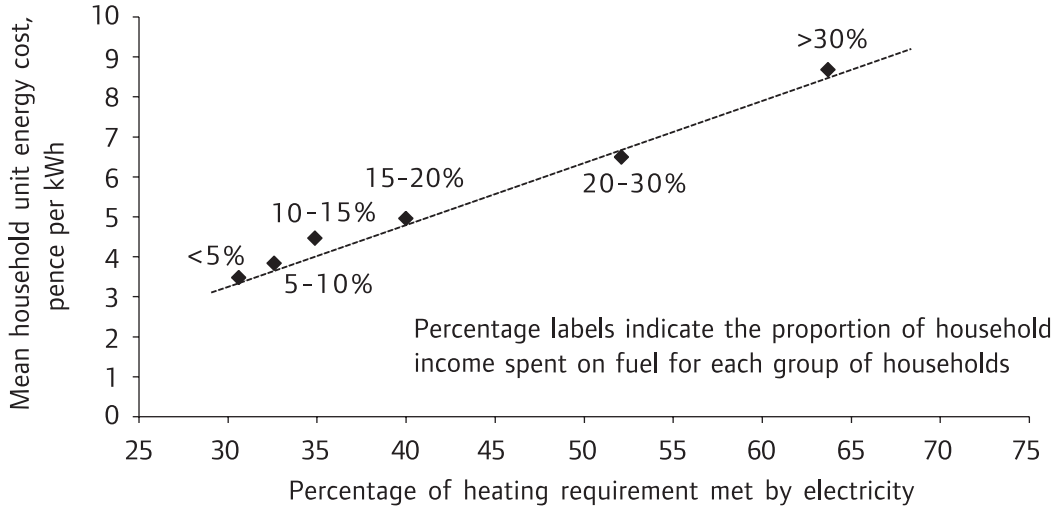
2.86 The principal effects of fuel poverty are increased economic hardship and low indoor temperatures, which present a significant potential health hazard. Below 18°C, some discomfort and risk of adverse effects occurs, including respiratory infections, bronchitis, heart attacks and strokes. Below 10°C, the risk of hypothermia is appreciable, especially for older people[20].

2.87 Clearly the health risks from low indoor temperatures are greatest during winter. Of the roughly 70,000 deaths in London every year, approximately 6,000 more occur during the winter than would be expected from the rate during the rest of year. There is some indication that this 'winter excess' may have increased during the 1990s[21].

2.88 Although little directly causal evidence exists to link housing with excess winter deaths, recent analyses of mortality in the South-East found the proportion of homes without central heating to be one of the strongest predictors of the winter excess, with age also strongly associated. After allowing for deprivation, the results suggest that around one per cent of all deaths in winter are attributable to lack of central heating, although factors such as age and influenza epidemics are as important. Figures 18 and 19 illustrate the relationship between excess winter deaths and lack of central heating.

2.89 It has been estimated that up to ten per cent of London winter excess deaths could be avoided through measures to reduce fuel poverty[22]. This could save up to 600 lives per year (more than the number killed on London's roads in 2000[23]), and secure improvements to health and quality of life for many more.

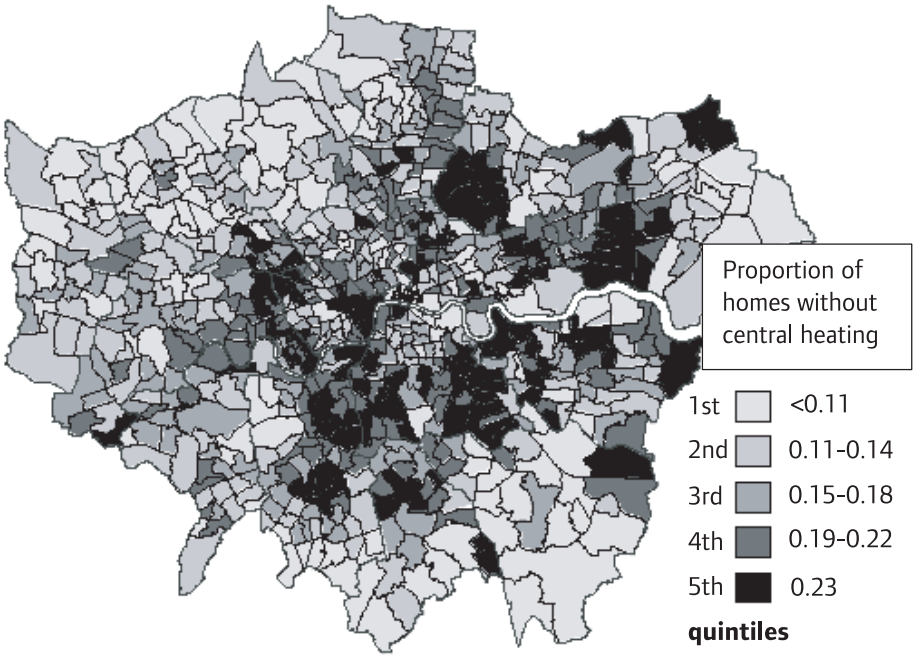
Figure 17 Unit energy costs against electricity usage, by fuel poverty grouping



source Analysis by the Greater London Authority, 2002. DETR, Data from English Housing Condition Survey, Energy Report 1996

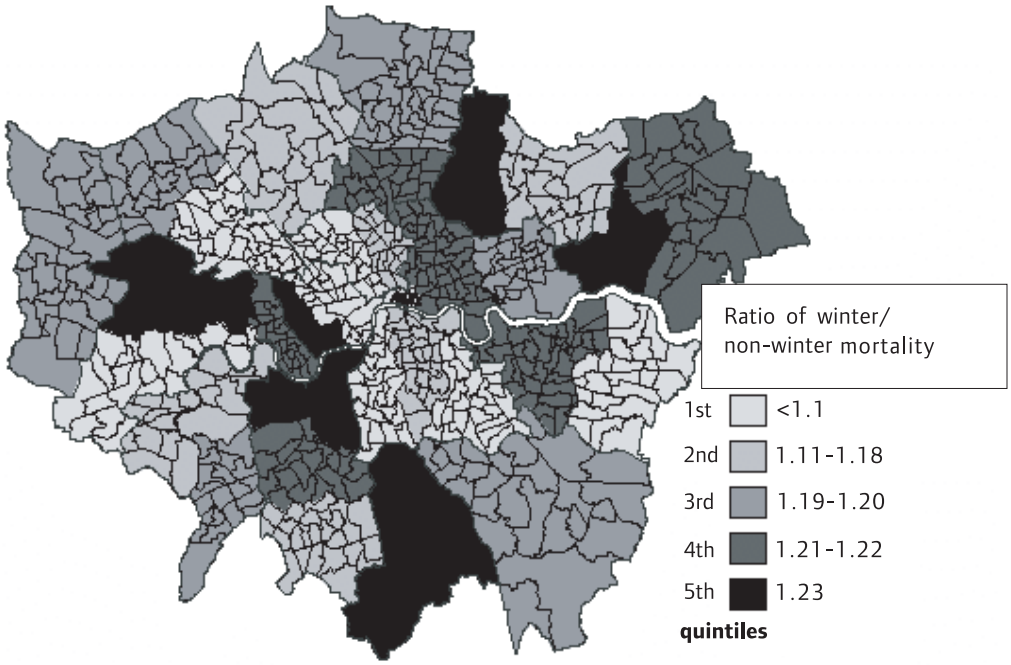
note Full income definition of fuel poverty

Figure 18 Proportion of homes without central heating



source Housing and the Built Environment, Rapid review of public health for London. Environmental Epidemiology Unit, London School of Hygiene and Tropical Medicine. November 1999

Figure 19 Ratio of Winter/Non-Winter Mortality in London, 1986-1996 by borough



source Housing and the Built Environment, Rapid review of public health for London. Environmental Epidemiology Unit, London School of Hygiene and Tropical Medicine. November 1999

2.90 Further studies of Britain's high rates of winter mortality reveal that the seasonal fluctuation is greatest for cardiovascular and respiratory mortality, and that it is larger in Britain than in many other countries of continental Europe and Scandinavia, which have harsher winters. Other influences may include seasonal increases in respiratory and other infections, and air pollution levels[24].

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LOOK RIGHT
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3 the vision and objectives for energy in London

An energy vision for London

3.1 The Mayor's vision is to develop London as an exemplary sustainable world city. To help move London towards this long-term goal, the Mayor has developed a more detailed energy vision.

3.2 The 2050 energy vision for London presented in the box below aims to illustrate how the current potential for technological, institutional, economic and social change could come together to create a sustainable energy system. It portrays a climate-friendly system, delivering the carbon dioxide (CO_2) reductions to stabilise global atmospheric CO_2 under the contraction and convergence approach (such as the 60 per cent reduction by 2050 which the Government has accepted). It provides quality energy services with significant economic and social benefits, in which fuel poverty has long since vanished. It acts as a long-term goal for the Mayor's Energy Strategy and helps to guide us towards a future of sustainable energy.

3.3 The majority of the technologies on which this vision is based are already available to the market place, or could be brought about through further development and investment in the coming decades. They also constitute the main solutions advocated by key energy reports such as the Royal Commission on Environmental Pollution's report, Energy - The Changing Climate[1], and the Performance and Innovation Unit's Energy Review[2]. See Box 1 for a summary of the Energy White Paper and Chapter 4 for an explanation of contraction and convergence as an international approach to addressing climate change. The EC High Level Group on Hydrogen's recently published vision[3] was also considered in producing the Mayor's vision.

3.4 Achieving sustainable energy means more than simply changing the energy sources of our energy system - it requires a total change in the way the overall system operates. In the long term we can change every aspect of our energy infrastructure, ranging from the structure of the electricity distribution system to the efficiency of electrical appliances. Through improving the delivery of our energy services, we can change the demands on our energy inputs.

Box 1: A 2050 Energy Vision for London

Overview

It is 2050 and London has a radically different energy system from the one that characterised the 20th century - it is a high performance system powered by renewable energy and a reduced fossil fuel input which has delivered carbon dioxide (CO_2) emission reductions of more than 60 per cent relative to those of 2000[4].

Organisations and residents have an understanding of environmental issues and the effects of their actions. They play a key role in increasing the sustainability of their city.

Sustainable energy use

Radical improvements in energy production have resulted in highly sophisticated use of energy in all applications across all sectors. This is characterised by:

- a high performance building stock (brought about by highly efficient new buildings and retrofitting of existing buildings)
- highly efficient electrical appliances
- widespread use of computer control systems to manage both energy demand and small- scale generation (in homes and business)
- a shift to walking, cycling, public transport and greater use of super-efficient, quiet, pollution-free, fuel cell vehicles
- companies which provide all energy services to domestic and commercial customers. They manage and control all electricity and heat production and procurement at the local (on-site) level. This focuses management attention on the performance of energy services so that efficiency is maximised and customers receive high-quality services at minimum cost
- widespread improvements in the performance and effectiveness of energy-using equipment. As a result, the quality, or quantity, of energy services has been improved while the quantity of fuel or electricity consumed has declined.

Sustainable energy provision

The development of decentralised electricity generation has delivered huge fuel productivity benefits by enabling the convergence of heat and power generation, as well as leading to massive growth in renewable energy production. This is characterised by:

- dynamic local electricity networks with large numbers of micro-generators
- combined heat and power operating at the domestic and community level, in business and industry
- extensive renewable energy generation in London and imported renewable energy
- fuel cells have become the dominant technology in transport, heat and power, increasing the efficiency of fossil fuel use owing to their high energy conversion efficiency, and complementing the production of renewable energy. This decentralised energy system constitutes the emergence of a full hydrogen-oriented economy.

Sustainable economy

The new economy focuses primarily on service provision rather than continuously increasing the production and supply of material goods. This has reduced waste, increased product lifespan and reduced the quantity of materials flowing through the London and UK economy - which in turn has reduced the amount of embodied energy that is consumed in the manufacture and transport of these materials and waste.

Policy context

The market place, and governance and institutional structures, of the 2050 energy system have changed and developed substantially since the 20th century. This has included:

- effective leadership and co-ordination of sustainable energy policy in London and the UK as a whole
- fiscal reform, which has shifted the balance of tax onto the use of non-renewable resources, including energy
- a whole raft of legislative measures prioritising energy productivity in buildings, electrical appliances, vehicles and industrial equipment
- As a result, the power of the market has been focused onto energy productivity and decentralised power, and
- effective partnership working between the many different elements and organisations comprising the London energy system.

The development of the green economy has created a competitive edge for London and the UK as a whole, which has contributed to the prosperity of the British economy.

Aims and objectives of the Energy Strategy

3.5 This strategy sets out how London can develop as an exemplary world-class city for sustainable energy, and begin to move towards the long-term vision presented here. It concentrates on the period up to 2010 and beyond. It has the following aim and objectives:

To minimise the effect of London's energy production and use on health, and the local and global environment, improve social equity, and economic performance. In particular:

- **to reduce London's contribution to climate change by minimising emissions of carbon dioxide from all sectors (commercial, domestic, industrial and transport) through energy efficiency, combined heat and power, renewable energy and hydrogen**
- **to help eradicate fuel poverty, by giving Londoners, particularly**

the most vulnerable groups, access to affordable warmth,

- **to contribute to London's economy by increasing job opportunities, by innovation in delivering sustainable energy and by improving London's housing and other building stock.**

The Mayor's Energy Hierarchy

3.6 Changes to the various components of the energy supply system will affect its overall social, environmental and economic performance. By making the most effective series of changes, we can ensure that we work to deliver optimal improvements, in terms of reduced CO_2 emissions, and increased energy and economic efficiency.

3.7 Energy is fundamental to urban activity and adequate provision is a priority. Increasing the efficiency of energy use is often the most cost-effective way to reduce CO_2 emissions, as it reduces the consumption of primary resources. It also reduces the dependence on imports and the associated risks, improving security of supply and the balance of trade. Energy efficiency at the household level lessens the likelihood of fuel poverty, makes homes more comfortable, and cuts heating costs. Renewable energy can contribute to meeting our remaining energy demand without causing CO_2 emissions.

3.8 The Mayor proposes to adopt the following Energy Hierarchy. This is a set of principles to guide decisions on energy, while optimising environmental and economic benefits. The three principles outlined below would ideally be applied in sequence, and be considered alongside other factors, such as economic and social costs and benefits, and potential future options.

Meet essential energy needs

1. Use less energy

'Be Lean'

eg

- Reduce consumption through behaviour change
- Improve insulation
- Incorporate passive heating and cooling
- Install energy efficient lighting and appliances

2. Use renewable energy

'Be Green'

eg

- On site: install renewable energy technologies, such as solar water heating, photovoltaics, biomass, wind turbines
- Off site: Import renewable energy generated elsewhere

3. Supply energy efficiently

'Be Clean'

eg

- Use combined heat and power, and community heating
- Cut transmission losses through local generation

3.9 A combination of using less energy and using more renewable energy supply is the only sustainable way to reduce our dependence on fossil fuels. They should therefore always be considered first.

3.10 Reducing energy demand keeps the size, cost and environmental impact of the whole energy system to a minimum. It then becomes possible to supply a greater proportion of the remaining demand from renewables, thereby minimising CO_2 emissions. In cases where the additional cost of renewable energy is prohibitive, it is essential to maximise the efficiency with which fossil fuels are used. This is the logic of the hierarchy, as it ensures that energy needs are met in the most efficient way.

3.11 The hierarchy is flexible, and can be adapted to many applications by a range of users. For example, it could support the work of architects, developers, clients of developers, boroughs in development control, and building and transport managers. It can also be applied to the behaviour of individuals, for example in the home.

3.12 Examples have been provided in terms of energy for buildings. However, the hierarchy could also be applied to transport. 'Lean' transport could include working from home, video conferencing, walking to the shops, and using local facilities. 'Green' transport could be cycling. 'Clean' transport would be the use of public transport and vehicles that are more fuel efficient. There are also air quality and congestion benefits to the options at the top of such a hierarchy.

3.13 The Hierarchy is intended to guide decisions in individual situations and should reduce the energy that would otherwise have been used in that situation. However, while Londonwide CO_2 emissions should fall, predicted population growth means that total energy use is still expected to increase.

3.14 The Mayor's proposals to support the Energy Hierarchy approach, and to help overcome barriers to it, are presented in later sections of this strategy.

Delivering the objectives

3.15 There are three principal approaches to implementing the Energy Strategy:

1. **The Mayor setting targets for London** (Chapter 4)
2. **The Mayor using his own powers** (Chapters 5 and 6)
3. **The Mayor and London working in partnership** (Chapter 7)

3.16 The Mayor will take a lead in setting targets for London, as part of a strategic framework for action for all who live and work in the capital.

Targets provide a clear and simple means of setting out the direction of change and need to be challenging, yet achievable. They can provide a benchmark for measuring performance and the extent to which the objectives of the strategy are being met.

3.17 The Mayor will use his own power to contribute to meeting the Londonwide targets in the following ways:

1. **The Mayor's planning powers.** The London Plan (the Spatial Development Strategy) sets the overall planning policies for London and influences the content of borough Unitary Development Plans. Furthermore, the Mayor makes decisions about specific strategic planning applications.
2. **The London Development Agency.** The London Development Agency (LDA), part of the GLA group, has the task of promoting a more balanced and sustainable economic structure for London. It has significant resources for taking effective action on the variety of issues that this overall task implies. One of these issues is energy, and in particular the need to promote the renewable energy and energy efficiency sectors of London's economy.
3. **Transport for London.** Transport for London (TfL), part of the GLA group, has wide-ranging responsibilities for the transport system. This is an important sector of London in terms of quantity of energy consumed. The Mayor intends to use his powers in relation to TfL to integrate the objectives of this Energy Strategy into TfL operations and policy.
4. **Leading by example.** The Mayor will apply and deliver the strategy's policies through his services and activities, and those of the GLA group (TfL, LDA, the Metropolitan Police Authority, and the London Fire and Emergency Planning Authority.
5. **Providing information on energy in London.** To make progress, it is critical to know how London uses and sources its energy. This is a fundamental part of this strategy. The Mayor will collect and analyse relevant data and disseminate it in a manner suited to the audience.
6. **Lobbying for change.** While the Mayor will do all he can to directly deliver the objectives of the strategy, widespread change lies in the hands of others. The Mayor will work to apply pressure to further the objectives of the Energy Strategy. This will include lobbying Government to reform national energy policy.

3.18 Although the Mayor can deliver considerable change through his own activities, he needs to work with relevant existing groups to tackle issues he cannot adequately address alone. The Mayor supports the development of partnerships that contribute to the implementation of his objectives, and will facilitate a London Energy Partnership involving all

relevant stakeholders in London. The partnership is discussed in detail in Chapter 7.

Scope of the Energy Strategy

3.19 This strategy provides a framework for leading change and working with others. While it spans the next ten years, this version reflects the priorities of the Mayor at this time, and is subject to further development over time.

3.20 The Energy Strategy aims to deal with all forms of energy - fossil fuels, renewable energy, hydrogen, electricity and heat - sourced outside London as well as locally. It focuses on more local, sustainable generation of London's power, increasing the proportion sourced from renewables. An integrated approach to heat management, particularly in buildings, is also promoted, for example, by increasing deployment of combined heat and power and community heating.

3.21 The strategy provides a framework for action, shaped by the Mayor's influence and the opportunity for improvement. Initiatives that the Mayor can directly affect, which also offer a large opportunity for improvement, are of highest priority.

3.22 Understanding how energy is used in London, and the resultant CO_2 emissions, reveals opportunities for improvement. In 1999-2000, energy used in buildings was responsible for the majority - about 80 per cent - of London's CO_2 emissions, compared to 20 per cent from transport. The three million households in the capital consume more than 50 per cent of the energy used by buildings. The remainder is consumed within the less than half a million commercial and industrial properties[5]. Although the domestic sector consumes slightly more than the commercial and public sectors, this share is distributed between almost six times as many properties. Therefore, while the scale of opportunity is perhaps greater in the domestic sector, it is likely to be more difficult to influence.

3.23 CO_2 is the only greenhouse gas discussed fully in the Energy Strategy. The GLA Act places an obligation on the Mayor to report on the emission of all greenhouse gases in London, and these have been covered in the Mayor's State of the Environment Report. Of the 'basket of six' greenhouse gases[6], only CO_2 and nitrous oxide (N_2O) are emitted during the combustion of fuel. However, emission of N_2O is not directly proportional to fuel use, but related more to the conditions under which it is burned.

3.24 The Energy Strategy takes account of a wide range of relevant national, European and international policy documents and programmes.

Box 2: The Energy White Paper

In the Energy White Paper of February 2003, the Government sets out its view of the key energy challenges facing the UK and its agenda for tackling them. The challenges are climate change, the decline of indigenous UK energy supplies, and the need to update the UK energy infrastructure. The Government's response is outlined by the four goals set out in the White Paper:

1. To put the UK on a path to achieving a 60 per cent reduction in CO_2 emissions relative to 2000, by 2050. The Government 'expects to aim for' CO_2 emissions equivalent to between 22 and 29 per cent below 2000 levels by 2020. The reductions are split between savings from energy efficiency (50%), renewable energy (20%), transport (15%) and carbon trading (15%).

These are to be achieved through a range of policies, including an aspiration to extend renewable electricity supply to 20 per cent by 2020; a possible extension of the Energy Efficiency Commitment from 2005 to 2008, with double the level of activity; market instruments including the existing UK Carbon Emissions Trading Scheme, with a Europe-wide scheme from 2005; an early revision to the building regulations, in 2005; a proposal for Ofgem to develop a framework of incentives for distribution network operators to develop distributed generation; no plans to develop new nuclear power stations.

2. To maintain the reliability of energy supplies. The Government identifies a number of risks to the security of energy supplies, ranging from lack of investment in local infrastructure to political disruption in energy exporting regions. The latter is expected to become more important as the UK becomes increasingly dependent on imported energy.

Maintaining security of supply is based on prioritising reliability within the regulatory environment; diversity of sources, fuels and trading routes; good relations with exporting countries; competition in energy markets in the UK and beyond; monitoring of energy supply and demand; and market responses to changes.

3. To promote competitive markets in the UK and beyond. This is identified as a specific goal in itself, as well as an important factor in maintaining security of supply. The Government emphasises the need for continued price competition in domestic energy markets, through mechanisms such as the New Electricity Trading Arrangements (NETA). A review of low carbon support bodies and programmes is proposed before

the end of 2004, and there are proposals to develop the skills base necessary to maintain a healthy UK energy sector.

4. To ensure that every home is adequately and affordably heated. The Government reaffirms its national fuel poverty strategy, adding a new target, of 'as far as reasonably practical nobody in Britain should be living in fuel poverty by 2016-2018'. It is claimed that as a result of falling energy prices, higher social security payments, national grant schemes and the Energy Efficiency Commitment, fuel poverty has fallen nationally from 5.5 million homes in 1996 to around 3 million today.

Delivery in partnership

It is the Government's view that partnership working will be critical to the delivery of its objectives on energy. It has proposed the establishment of a new Sustainable Energy Policy Network, which will include several Government departments, the devolved administrations in England, Wales, Scotland and Northern Ireland, Ofgem, and the Environment Agency.

The White Paper proposes that a strategic approach to energy policy be developed and implemented in each region. Specifically, that each regional strategy should set out a vision of its interaction with national energy policy, and specific local and regional concerns; include regional targets negotiated with national Government; set out an action plan showing how regional and local bodies will deliver the strategic objectives through their various functions; and contribute to the development of national policy.

The Mayor's view on the Energy White Paper is expressed in the lobbying section of Chapter 7.

References and notes

1 Royal Commission on Environmental Pollution, Energy - The Changing Climate, Twenty-second report, June 2000
2 Performance and Innovation Unit of the Cabinet Office, UK Energy Review, February 2002
3 European Commission Community Research, High Level Group for Hydrogen and Fuel Cells, Hydrogen and Fuel Cells - a vision of our future, 2003
4 The Royal Commission on Environmental Pollution recommended a 60 per cent reduction in carbon dioxide emissions by 2050 in its report, Energy - The Changing Climate.
5 3,061,000 households in 1998, 1,596,000 VAT registered enterprises in 1999. Source: London Research Centre, Focus On London 2000, 2000.

6 The Kyoto agreement refers to the basket of six greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydroflourocarbons (HFCs), perflourocarbons (PFCs), sulphurhexafluoride (SF6).

4 The strategic framework

4.1 This chapter sets out the Mayor's key strategic energy policies. In combination, they paint a picture of how the Mayor would like to see the supply and use of energy in London in ten years' time. This forms the Mayor's strategic framework for energy in London.

4.2 The Mayor cannot deliver the policies and targets set out in this framework alone. Subsequent chapters describe the actions which the Mayor, the GLA Group and other key stakeholders need to take to deliver the framework, following the discussions and consensus building undertaken during the process of developing this Strategy. To demonstrate commitment at the outset, the Mayor proposes that:

- the new London Energy Partnership should adopt the strategic framework and targets as soon as practicable
- the Mayor should issue a declaration of commitment to the Energy Strategy's policies and targets which all London Boroughs, the London Energy Partnership and other key organisations will be invited to sign

Translating national targets

4.3 Developing regional targets can help London to play its full role in meeting national targets, and set a marker for the level of progress that is required. The GLA Act requires that 'in setting targets, the Mayor shall seek to ensure that they are not less demanding than any related targets or objectives which are set nationally'.

4.4 This does not mean a straight application of a national target to London. Many factors determine how demanding a target is and these will often vary across the UK, depending on population density, activity by geographical area and mix of economic activity, for example. Such factors need to be considered in setting any target for London.

4.5 The Government has a number of targets and aspirations relating to energy, which this strategy considers. These are discussed later in this chapter, and are primarily:

- to reduce UK greenhouse gas emissions to 12.5 per cent below 1990 levels by 2008-2012, the legally binding obligation of the Kyoto Protocol
- to reduce UK carbon dioxide (CO_2) emissions to 20 per cent below 1990 levels by 2010
- an 'expectation to aim for' CO_2 emissions equivalent to 22-29 per cent below 2000 levels by 2020
- a goal of putting the UK on a path to achieving a 60 per cent reduction in CO_2 emissions, relative to 2000, by 2050
- to meet ten per cent of UK electricity demand from renewable energy

by 2010 through the Renewables Obligation
- an aspiration to extend renewable electricity supply to 20 per cent of electricity demand by 2020
- to have at least 10GW (gigawatts) of combined heat and power (CHP) capacity in the UK by 2010
- to 'seek an end to the blight of fuel poverty for vulnerable households in the UK by 2010'
- to ensure that 'as far as reasonably practical nobody in Britain should be living in fuel poverty by 2016-18'.

4.6 The Government is in the process of developing further targets, notably for aspects of the hydrogen economy. London should consider how it will address any new targets that are developed for this and other aspects of energy.

4.7 Targets need to be challenging, yet achievable. They should be set to a timeframe that is long enough to allow progress to be made and measured, but short enough to motivate action. Each target will relate to an established baseline against which progress can be properly measured.

policy 1 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.

4.8 The Mayor's direction for change is set out by issue, describing what the Mayor would like London to achieve over time. The issues are generally ordered to follow the Energy Hierarchy by starting with energy efficiency and ending with fossil fuels.

Climate change

4.9 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 (see Chapter 2). The Mayor acknowledges and welcomes the Government's acceptance of these recommendations in its Energy White Paper of February 2003.

4.10 The Mayor believes that short and medium-term CO_2 targets must be understood as part of a long-term global strategy to achieve climate stabilisation. Arguably the most widely supported, equitable, global approach to tackling climate change is contraction and convergence (see Box 3). It presents a progressive and potentially effective way forward for

international climate change policy. However, it does imply radical long-term reductions in emissions from developed countries, and has yet to be adopted internationally. The Mayor endorses contraction and convergence and supports the Kyoto Protocol as a necessary interim step.

Box 3: Contraction and convergence†

Contraction and convergence is a simple approach to distributing the total greenhouse gas emission reductions required internationally, between various countries or groups of countries. The approach is based on two principles:

i) that there is an upper limit to acceptable global atmospheric greenhouse gas concentration, beyond which the damage from climate change would not be acceptable

ii) that the atmosphere is a global commons, so that as individuals we all have equal rights to emit greenhouse gases.

These principles are applied to the problem of distributing internationally the right to emit greenhouse gases, as follows. First, the target atmospheric concentration is agreed, and a date is set at which point the atmospheric concentration will be stabilised at the agreed level. From these factors, the global annually allowable greenhouse gas emissions can be calculated for each year of the stabilisation period. This will be a decreasing number over time, as global emissions contract to the sustainable level defined by the target concentration.

An individual person's emissions entitlement for a given year is the global allowance for that year divided by the global population. From this, national entitlements are calculated on the basis of national population. Therefore, a population cut-off point is required, after which additional population growth does not generate emission entitlements. To achieve these emission reductions via gradual transition, there would be a period during which emission entitlements for all nations converge to an equal per capita share globally. This period is independent from the stabilisation date for atmospheric greenhouse gas concentration: rates of both contraction and convergence would both be agreed through negotiation.

Emission entitlements created through contraction and convergence could be internationally tradable, so that the resulting system would be compatible with global carbon trading.

† *The contraction and convergence proposal was developed by the Global Commons Institute, London. Details of its origins, methodology, and support are available online at http://www.gci.org.uk.*

4.11 The recommendations of the Royal Commission on Environmental Pollution are based on a contraction and convergence scenario in which global emissions converge in 2050, and atmospheric CO_2 concentration is stabilised at 550ppm by 2100. The Mayor believes that all national and regional emissions reduction targets, including those proposed in this strategy, must be seen as part of this long-term process. The Government's support for the commission's recommendations for a 60 per cent reduction in emissions by 2050 implies an acceptance of the contraction and convergence scenario that produced the recommendation. The Mayor encourages the Government to acknowledge this.

policy 2 The Mayor supports the principle of contraction and convergence as a long-term international policy objective.

4.12 In the State of London Report 2000, the Mayor argued that we must make London a world leader in fighting dangerous climate change[1]. This action must take two forms. We need to minimise emissions of greenhouse gases to reduce London's contribution to climate change and, at the same time, London needs to adapt to cope with the expected effects of climate change.

4.13 The Mayor has completed a first audit of London's CO_2 emissions as required under the GLA Act. This data was included in the Mayor's State of the Environment Report 2003 and informs the policies proposed in the Mayor's Energy Strategy on mitigating these emissions.

4.14 The London Climate Change Partnership, of which the Mayor is a partner, published London's Warming - the impacts of climate change on London in October 2002. This report presents the likely impacts on London of a changing climate, and highlights the importance of integrating climate change considerations into all long-term decisions. The report will inform the work of all the partners of the London Climate Change Partnership. The Mayor and the GLA Group recognise the importance of integrating climate change considerations into their work, particularly for spatial and transport planning policy, to ensure that the necessary precautions are taken to minimise the impacts on London and Londoners.

policy 3 The Mayor is committed to making London a world leader in responding to the threat posed by global climate change. To achieve this, the Mayor supports mitigation by minimising greenhouse gas emissions, in conjunction with moves to understand and adapt to the inevitable impacts of climate change.

4.15 The London's Warming report predicted that climate change could have a number of serious impacts on London. These are discussed in Chapters 2 and 3. In terms of specific possible impacts on London's patterns of energy use,

climate change could lead to a switch in annual peak energy demand from winter to summer, and from gas to electricity, due to the increased demand for air-conditioning. Secondly, climate change is expected to reduce the problem of fuel poverty, due to the warmer year-round temperatures. An increased need for 'affordable cooling' is also likely, as a result of the warmer summers, exacerbated in London by the heat island effect.

4.16 The Mayor supports actual emissions reduction, rather than carbon sequestration, as the most effective way to reduce the concentration of CO_2 in the atmosphere. Although permitted under the Kyoto Protocol, the long-term stability of carbon capture, and storage mechanisms and techniques, such as injecting CO_2 into depleted gas and oil wells, is not yet understood. While such techniques may incorporate established technologies, as a whole the approach remains unproven. Avoiding real emissions reduction by relying on these techniques could therefore be counter-productive.

4.17 The Mayor is supportive of tree planting and woodland management programmes for many reasons. These are explained in the Biodiversity Strategy and developed in the London Biodiversity Partnership's Woodland Habitat Action Plan. However, the Mayor believes that planting trees specifically to absorb CO_2 is no substitute for cutting fossil fuel emissions. Even if such approaches were shown to be effective and reliable, there is not the scope locally or nationally for planting sufficient trees to have a significant influence on CO_2 concentration. The planting of trees for carbon sequestration in developing countries raises further uncertainties about long-term management, political and ethical issues regarding international development, and effects on biodiversity.

policy 4 The Mayor supports actual emissions reduction as the most effective way to reduce the concentration of carbon dioxide in the atmosphere. He opposes offsetting emissions through carbon sequestration activities, such as afforestation and carbon capture and storage, until their security and potential significance are proven.

A carbon dioxide target for London

4.18 The Mayor believes that setting a CO_2 emissions target for London is the best way to ensure that the capital plays its full part in meeting the national target. Action to reduce CO_2 emissions is required at all levels, and a target will serve to unify efforts, helping individuals and organisations to appreciate the level of action that is needed.

4.19 Engaging stakeholders in developing and agreeing targets for London is of critical importance. To this end, the Mayor requested the London

Sustainable Development Commission to initiate a process of consultation and then building a consensus. The objective was to recommend a CO_2 emissions reduction target for London, which is no less demanding than the national target.

4.20 To inform the London Sustainable Development Commission's work, the GLA commissioned Future Energy Solutions to model emissions of CO_2 in London. The model looked at how emissions from London might evolve during the period to 2010, and the relative costs of measures available to reduce them. The commission considered this when making its recommendation to the Mayor on what a CO_2 target for London should be, as set out in Box 4 below.

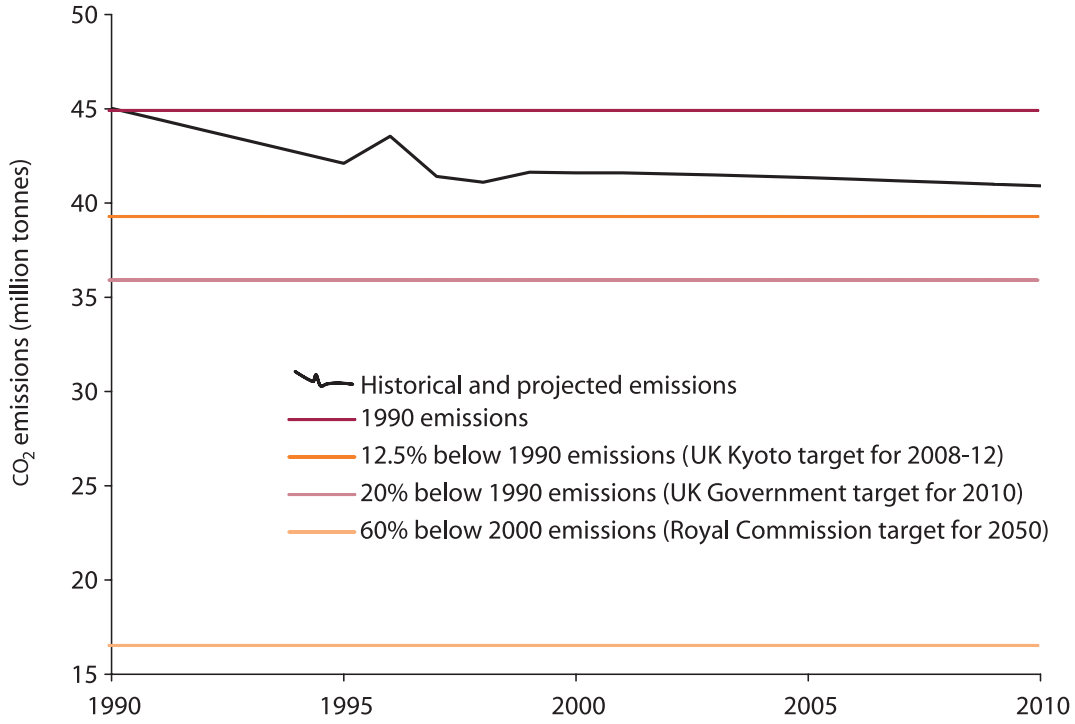
Box 4: The London Sustainable Development Commission's recommendation to the Mayor on a carbon dioxide target for London, 2002

The London Sustainable Development Commission recommends the adoption of a target for the reduction of carbon dioxide emissions in London of 20 per cent from 1990 levels by 2010. This target should be seen as the first stage in a process that would lead to a minimum target of a 60 per cent reduction in carbon dioxide emissions, relative to 2000, by 2050.

4.21 The figure below shows historic and projected CO_2 emissions from energy consumption in London, from 1990 to 2010. The projection is that developed by Future Energy Solutions for their model. Also plotted are reference lines indicating 1990 emissions, reductions of 12.5 and 20 per cent below 1990 emissions, and 60 per cent below 2000 emissions.

4.22 The table below presents a sectoral breakdown of the Future Energy Solutions model scenario, which informed the work of the London Sustainable Development Commission. This scenario assumes a 70 per cent uptake of cost-effective emissions reductions measures, and a ten per cent uptake of non-cost-effective measures, up to 2010. The first two columns show the contribution that each sector makes to the 20 per cent reduction on 1990 emissions identified in the scenario, as a percentage and in tonnes of CO_2. The third column shows the percentage reduction on 2000 emissions that these savings would represent, for each sector. The scenario indicates the need for approximately a ten per cent reduction on 2000 emissions by 2010, in conjunction with increases in renewables and combined heat and power. It should be noted that, in this scenario, renewable energy sources are grouped under the heading 'heat and electricity'. For more specific information on how different sectors are expected to contribute to increasing the use of renewables in London, see Chapter 5.

Figure 20 Carbon dioxide emissions from London, 1990 projected to 2010 with reduction target reference lines



source Emissions from 1990 to 2000 from work by GLA Environment Group, 2002. Emissions projection work from modelling by Future Energy Solutions, 2002, commissioned by the GLA

note This graph represents the base-case emissions scenario used in the modelling. This presents projected CO_2 emissions from London in the absence of London-specific CO_2 reduction policies

4.23 During the public consultation process on the draft Energy Strategy, a number of responses were received in relation to the commission's recommendation for a 20 per cent target. The overall message from across the range of formal stakeholder responses was that, although such a target would be difficult to meet, London, as both the capital of the UK and a world city, must show leadership in reducing CO_2 emissions. The majority view of consultation respondents was in favour of the Mayor adopting a 20 per cent target.

4.24 There was strong support for this from the public, with 96 per cent of questionnaire respondents supporting the Mayor in setting a challenging target to reduce London's CO_2 emissions. This was also seen by Londoners who formally responded to the consultation as the most important key aim of the strategy, with 35 per cent rating reduction of CO_2 emissions as the top priority.

Table 5 Meeting a 20% target - sectoral contributions by type

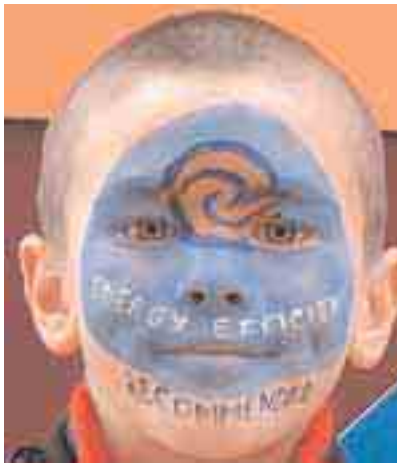
	Contribution to a 20% reduction relative to 1990 emissions		Equivalent sectoral % reduction relative to 2000 emissions
Sector	**as %**	**as tonnes of CO_2 (x 1,000)**	**as %**
Domestic	**22**	**1,986**	**11**
Building fabric	7	681	4
Efficient technology	14	1,301	7
Low carbon energy	0	4	0
Public, commercial and industrial	**12**	**1,105**	**8**
Behavioural	4	369	3
Building fabric	0	17	0
Efficient technology	8	719	5
Transport	**9**	**817**	**10**
Behavioural	2	140	2
Efficient technology	1	48	1
Low carbon energy	7	629	7
Heat and electricity	**9**	**787**	**does not apply**
Renewables	3	249	does not apply
CHP	6	539	does not apply
Baseline reductions	**49**	**4,538**	**does not apply**
Total	**100**	**9,233**	**does not apply**

source GLA 2003 (based on Future Energy Solutions 2002) .This table is derived from the FES 20% reduction scenario developed for the London Sustainable Development Commission

note Reductions have been grouped into four types: Behavioural (changes in behaviour, such as switching lights off in empty rooms), Buildings (building fabric improvements), Efficient technology (improvements to the efficiency of appliances, including domestic boilers, lighting systems, etc), and Renewables and CHP.
* Not applicable - this column shows the percentage CO_2 reduction for each sector, relative to that sector's emissions in 2000. Renewables, CHP and baseline reductions cannot be treated in this way

4.25 Greater London is a unique region in many ways, and this needs to be acknowledged in the development of an appropriate CO_2 target. For example, the rate of population growth in the capital is far higher than that of the UK, and is the main reason why it is more difficult for London to reduce its emissions by 20 per cent. Furthermore, industrial activity - which is where a sizeable proportion of the UK's CO_2 savings are expected by 2010 - is small in London compared to the rest of the country. Meeting such a target will therefore require serious commitment from business, the public sector, government, financiers and housing providers, as well as Londoners in general. However, the Mayor believes that it is

crucial that London contributes to reducing national CO_2 emissions during the 21st century.



proposal 1 London should reduce its emissions of carbon dioxide by 20 per cent, relative to the 1990 level, by 2010, as the crucial first step on a long-term path to a 60 per cent reduction from the 2000 level by 2050.

4.26 In January 2003, the London Assembly Environment Committee commissioned additional work from Future Energy Solutions. The emissions model was extended to look forward to 2020, with a view to understanding the potential for CO_2 emissions reductions to 2016 - the timescale for the London Plan. It showed that baseline emissions were likely to rise marginally between 2010 and 2020, meaning that further emissions reductions would be needed to maintain a 20 per cent target. The study indicated that emissions could be reduced to 23 per cent below 1990 levels by 2016.

Zero-carbon developments for London

4.27 Zero-carbon developments are highly energy-efficient developments, powered and heated by renewables with zero net carbon emissions. Zero-carbon developments represent an almost complete solution to many of the issues that this Energy Strategy is seeking to address. They are typically mixed use, including housing, office and retail, which contributes to more sustainable living patterns as well as helping to balance heat and electricity loads. Zero-carbon developments also aim to reduce the need for private car use through transport plans, and focusing on good pedestrian and cycling facilities as well as good links to public transport.

4.28 The BedZED development in Sutton, south-west London is currently the only example of this type of development in Greater London (see Case Study 1). The construction of further such developments across London would increase the pace with which both the planning system and the construction industry embrace sustainability as a fundamental design criterion. Multiple zero-carbon developments would accelerate innovation, creating shared knowledge on how to design the kind of zero-carbon buildings that will be essential to the long-term challenge of fighting climate change in urban areas. Every borough should play a role in this growing area.

proposal 2 There should be at least one zero-carbon development in every borough in London by 2010.

Case Study 1: BedZED - Beddington Zero Energy Development

BedZED is an environmentally friendly, energy-efficient mix of affordable and desirable housing and workspace on a former sewage works in Sutton, south-west London that was completed early in 2002. It is called a 'zero energy development' because it is highly energy efficient and only uses energy from renewable sources generated on site - it is therefore the first, large-scale, zero net carbon emission community in the UK.

Everything about the scheme, from the layout and the building materials, to the heating supply, has been designed to cut energy consumption. The energy-efficient design features include south-facing houses to make the most of the heat from the sun, excellent insulation, triple-glazed windows and stonecrop-covered green roofs. The thick walls of the buildings prevent overheating in summer and store warmth in the winter, to be released slowly during cooler periods such as at night and on overcast days. Well-sealed windows and doors, and the concrete construction, stop the heat leaking out. A heat exchanger in the wind-driven ventilation system recovers between 50 per cent and 70 per cent of the warmth from the outgoing stale air.

A combined heat and power (CHP) unit provides all the development's heat and electricity from timber produced from arboricultural and woodland waste in Croydon. The CHP unit will generate electricity and distribute hot water around the site via insulated pipes. These deliver heat to domestic hot water cylinders positioned centrally in every home and office so that they can double up as heat emitters in cold spells. BedZED has a green transport plan which aims to reduce reliance on the car by cutting the need for travel (eg through internet shopping links and on-site facilities) and through providing a car pool. All the homes are also fitted with photovoltaic panels, which provide power for the electric pool cars.

4.29 The Mayor's proposals for delivering this target are set out in the following chapters.

Energy services

4.30 People do not need fuel and electricity for their own sake, but the services that these energy sources provide. Typically, these include a warm indoor environment in winter, sufficient lighting levels and the services of electrical appliances such as washing machines, computers and televisions.

4.31 If the market can be focused onto providing energy services rather than fuel and electricity supply, then these services could be delivered much more efficiently. A more services-oriented economy is a key component of a sustainable economy, where industry and commerce focus on providing

the services that society requires, rather than solely on the production of goods and a high material throughput. These ideas, which underpin the concept of a sustainable economy, will also be progressed through the London Development Agency's green economy work.

4.32 The Energy Saving Trust is committed to the energy services concept and ran a grants programme between 1997 and 2001 that funded numerous projects. Although grants are no longer available, the trust runs an Energy Services Office that provides expert advice and support materials for local authorities, housing associations, community groups and energy supply companies that are interested in developing energy services packages.

4.33 Suppliers are encouraged to develop energy services packages through their Energy Efficiency Commitment obligations - they are eligible for 50 per cent extra energy savings for any efficiency measures that are delivered as part of an energy services package.

4.34 Energy services can be taken forward in a number of ways and the schemes that have been funded by the Energy Saving Trust can provide the models and lessons upon which to develop further schemes. The different approaches to energy services are described in Chapters 5, 6 and 7, in which the Mayor encourages supply companies and the London Energy Partnership to investigate options for their further development in London.

policy 5 The Mayor supports the development of energy services as an effective approach to improving energy efficiency and energy management, and to delivering social and environmental benefits.

4.35 Most - 87 per cent - of the Londoners who responded to the questionnaire in the highlights document of the draft Energy Strategy expressed interest in signing up to an Energy Services Company. Chapter 7 proposes some partnership projects on energy services.

Energy efficiency in homes and fuel poverty

4.36 As is illustrated in Chapter 2, the domestic sector is responsible for 44 per cent of London's overall energy consumption. The majority of this energy is used to provide heating and hot water, with lighting and electrical appliances consuming the rest.

4.37 There are two main ways of addressing domestic energy consumption. The first is improving the energy performance of housing fabric and the second is improving the energy efficiency of lighting and electric appliances to address electricity demand. Although there is a large

amount of electric heating in London, further demand will be reduced by improving energy performance and heating technologies.

4.38 As heating requirements constitute the main energy demand in the domestic sector, measures to improve the energy efficiency of housing and domestic heating systems will have a significant impact on reducing fuel demand and CO_2 emissions. These measures will also have a great influence on reducing fuel poverty, which is associated with poor quality housing in London.

4.39 The contribution of the Home Energy Conservation Act (HECA), which looks for a 30 per cent improvement in domestic energy efficiency by 2010, is valuable and is discussed below. However, HECA only covers existing housing, whereas new housing developments and the effect of efficiency improvements in household electrical appliances are also important in delivering CO_2 cuts from the domestic sector.

policy 6 The Mayor looks forward to a radical improvement in the energy efficiency of London's housing stock and considers that the domestic sector should play its full role in meeting London's carbon dioxide reduction targets.

4.40 Table 6 gives an indication of the domestic energy efficiency contribution to London's 2010 CO_2 target. This represents the majority of expected domestic CO_2 savings up to 2010. The Sustainable Energy Bill, which at the time of writing had completed its third reading in the House of Commons, could help to deliver these reductions.

Improving the energy efficiency of new housing

4.41 The energy performance of London's housing can be improved in two main ways; increasing the energy efficiency standards of new housing and upgrading existing housing.

4.42 Part L of the building regulations (which covers the Conservation of Fuel and Power) was upgraded in April 2002, and the standards required will deliver new dwellings that are 25 per cent more efficient on average than homes built under the previous standards. Nevertheless, these new standards are still well below the established standards in Scandinavia and Germany. However, the building regulations are undergoing continual improvement and it is likely that revised standards will be in place from 2005.

4.43 Voluntary standards are also available for far higher levels of energy efficiency, such as the Building Research Establishment's Ecohomes and

the Energy Efficiency Best Practice Programme zero heating standards[2]. The Ecohomes standard awards points for 10-30 per cent improvement in the thermal performance of the building envelope, compared to building regulation requirements.

4.44 The GLA forecasts that the number of households in London will grow by more than 300,000 in the next 15 years. This represents an excellent opportunity to develop sustainable and energy-efficient homes in London, and to begin a long-term programme of improvement that can ultimately lead to London housing stock that achieves the high-energy performance outlined in the Energy Vision in Chapter 3. Houses built now will be part of the building stock in 2050 and the energy efficiency of these buildings will affect our ability to meet future long-term targets. The BedZED scheme in Sutton (Case Study 1) is an example of the extremely high standards that can be achieved.

4.45 Social housing providers (local authorities and housing associations) have a lot of influence on the nature of future housing in London, and will be key contributors to improving the energy efficiency of London housing. Increasing the number of exemplary new housing schemes in the capital will be an important element of this. Local authorities and housing associations can directly choose more sustainable buildings in their refurbishments and new developments.

4.46 Chapter 5 outlines the Mayor's intentions to use his planning powers to stimulate improved energy performance of developments in London.

Improving the performance of existing housing

4.47 Although there is a large building programme in London, much of this is to accommodate London's growing population, and the actual replacement rate of housing is fairly slow. Therefore, for the short and medium term, and to a significant degree even the long term, improvements in overall energy performance will rely on investment in existing housing.

4.48 Currently, due to the way that HECA is written, improvement of energy efficiency in the housing stock focuses on improvements to average performance. This does not guarantee that the worst stock is improved. HECA gives the boroughs - London's Energy Conservation Authorities - a duty to report on delivery of a 30 per cent improvement in housing energy efficiency by 2010, relative to a 1995 baseline. Improvement from year to year is measured on an average energy efficiency performance for housing in each area. Hence, increases in energy efficiency may not be

derived from improvements in the most inefficient stock. The Mayor believes that there is a social imperative to tackle the very worst housing.

4.49 Chapter 2 explains that a significant number of homes in London have a very poor SAP (standard assessment procedure) rating. Based on 1996 data, the average SAP rating of London's homes is 45. Thirty per cent of London households (more than 800,000) have a SAP rating of less than 40, 16 per cent (more than 400,000) have a SAP less than 30, and nine per cent (more than 220,000) are extremely energy inefficient with a SAP rating below 20.

4.50 Almost a third of London's housing is very energy inefficient, with a SAP rating of less than 40. The Mayor would like improvements to the least energy efficient housing to be prioritised.

proposal 3 There should be no occupied dwelling in London with a SAP rating less than 30 by 2010, and less than 40 by 2016. The Mayor will seek to have these targets included in future revisions of London's Housing Strategy and requests boroughs to do the same in their housing strategies.

4.51 As this proposal infers, a SAP rating of 30 is not a satisfactory minimum[3]. The Mayor is keen that initial efforts are concentrated on the very worst housing. However, when a dwelling is being upgraded, the maximum feasible improvement should be sought, and it is likely that this will far exceed SAP 40. Energy efficiency standards are likely to become tougher in the long term.

4.52 At present the Government's Decent Homes Standard[4] does not set a minimum SAP rating for thermal comfort. This was because consensus could not be reached on what SAP rating is considered to be 'decent'. The Government definition of a 'decent home' is unlikely to change before 2010, as it is the basis of a 2010 target. However, the expectation the public has of a 'decent home' will change over time, as standards improve. Therefore, the Mayor encourages those tackling housing which is failing the Decent Homes Standard to use the standard as a call to fit the most efficient heating systems and insulation, rather than as a maximum level to be achieved. More detail on efficient heating systems is provided in Chapter 5.

4.53 In some boroughs, more than 50 per cent of private sector homes have a SAP rating of less than 30[5]. The private sector holds the most properties in the worst condition. Particularly challenging are private sector dwellings with solid walls, buildings in conservation areas and the most energy-inefficient tower blocks. These will need a pragmatic approach that

considers all options. The cost of improvement is likely to fall on the Government, energy suppliers, housing providers and occupiers.

4.54 Based on the latest HECA reporting round, the average UK improvement halfway through the HECA period (1996-2010) is up to eight per cent. Even considering the variations in monitoring techniques used to measure improvement, this reported improvement illustrates that the UK is currently not on target to achieve a 30 per cent improvement by 2010. The London boroughs have developed HECA strategies for improving housing energy efficiency in their areas, and these provide an underlying framework for developing a high-profile energy efficiency strategy for housing across London.

4.55 Many measures for improving the energy efficiency in London's homes will also help to tackle fuel poverty by reducing energy bills.

Tackling fuel poverty

4.56 As discussed in Chapter 2, a household is considered by the Government to be in fuel poverty if it needs to spend in excess of ten per cent of income on all household fuel use[6] in order to maintain a satisfactory heating regime. The way in which income is defined will clearly have an effect on the number and composition of households being defined as fuel poor. The debate about income definition centres on the question of whether income should be calculated before or after benefit payments are taken into account, and whether rent or mortgage payments should be subtracted from the total.

4.57 This question is of particular importance in London because of the higher housing costs in the capital relative to the rest of the UK. Households in receipt of housing benefit or mortgage support in the capital have artificially inflated incomes, relative to those in other regions. This reduces the number of households defined as fuel poor, potentially discriminating against people receiving these benefits and resulting in the denial of support to those in need.

4.58 Some experts in the field have therefore argued for a definition of fuel poverty based on disposable income, defined as net income including housing benefits minus housing costs. This approach leads to a larger number of households being defined as fuel poor than in other definitions[7]. The Mayor received support for adopting this definition during public consultation.

proposal 4 To take account of London's high housing costs, the Mayor defines fuel poverty as the need to spend more than ten per cent of household disposable income (which includes benefits minus housing costs) on all domestic fuel use in order to maintain a satisfactory heating regime.

4.59 The Mayor's definition will capture all those in fuel poverty under the Government's definition. Under this definition, in 1996, 34 per cent of London's households were in fuel poverty, as opposed to 17 per cent under the Government definition[8]. More detail is available in Chapter 2. The number of people in fuel poverty has reduced significantly since 1996, largely as a result of lower energy prices and increased incomes. In London, it is estimated that between 400,000 and 500,000 households are now in fuel poverty, under the Mayor's definition[9].

4.60 The Mayor's definition reflects the real extent of fuel poverty in London. He will use it in his reporting of fuel poverty and encourages the boroughs to do the same. However, the Mayor accepts that, for the sake of consistency, national targets and monitoring will continue to be based on the Government's definition.

4.61 Chapter 2 outlines the impacts of fuel poverty. The Energy White Paper states that the Government has set a target of eradicating fuel poverty by 2016-2018. The Mayor is pleased that London is contributing to the Government meeting its target. He recognises that it will be more challenging to eliminate fuel poverty in London based on this new definition, but that it is essential if fuel poverty is to be genuinely eradicated in the capital.

proposal 5 London should work to eradicate fuel poverty in London, based on disposable income, which should at least match progress nationally.

4.62 Promoting affordable warmth supports many strategic policy objectives, including social inclusion, health, economic development, regeneration, environmental improvement and affordable, high-quality housing. Successful affordable warmth strategies will actively contribute to all these areas.

4.63 There are a number of key issues and challenges involved in addressing fuel poverty in London that need to be systematically approached and managed so as to meet the targets outlined above. These issues include:

- the provision of information and advice on energy efficiency, heating controls and fuel poverty
- promoting and co-ordinating energy efficiency grants

- accessing the fuel poor through the development of effective partnerships and referral networks
- lack of take-up of energy efficiency grants, including 100 per cent grants available under Warm Front
- ineligibility for grants (a proportion of these would be eligible if they were claiming benefits to which they are entitled)
- access to grants for a key section of fuel-poor households
- lack of a good understanding of the fuel poverty baseline (needed in order to develop a good affordable warmth strategy)
- London's old solid-walled housing stock is difficult to target with insulation measures and so is losing out on EU grants
- installation costs are higher in London
- skills shortages for the installation of heating and insulation measures.

4.64 In the Mayor's Economic Development Strategy, the LDA described the benefits that providing insulation services could have in offering job opportunities in highly skilled, semi-skilled and unskilled work. There are particular opportunities here for intermediate labour markets. This is taken forward in Chapter 6, where many of the Mayor's policies and proposals relating to other areas of sustainable energy, such as energy efficiency, CHP, community heating and renewable energy, will also help to contribute to tackling fuel poverty.

4.65 There are already a large number of sectors and organisations working to tackle fuel poverty in London, and there are many successful initiatives that can be built on and replicated. The Mayor will work with others, for example through the London Energy Partnership, to help address fuel poverty in the most effective way across London.

Electrical appliances

4.66 Improving the energy efficiency of electrical appliances used in London's homes is largely a separate issue from the current efforts to improve domestic energy efficiency. The majority of this work has been carried out at European and national level. However, Energy Efficiency Advice Centres and energy supply companies have distributed many thousands of compact fluorescent light bulbs, and the Energy Efficiency Commitment schemes have distributed energy-efficient refrigerators. Improving the energy efficiency of domestic appliances requires the co-operation of product manufacturers and retailers.

4.67 The Government's Market Transformation Programme[10] aims to stimulate efficiency improvements in electrical appliances. Consumers can look out for the European Commission 'Energy Label' when purchasing new fridges, freezers, washing machines, tumble dryers, dishwashers, lamps,

electric ovens and air-conditioners. The Energy Saving Trust's 'Energy Efficiency Recommended' initiative complements the Energy Label by listing energy-efficient appliances, including fridges and boilers, on the Energy Saving Trust website.

policy 7 The Mayor supports the promotion of energy-efficient electrical appliances - including Government efforts to encourage manufacturers to develop more efficient products and retailers to promote energy-efficient products to consumers - and strongly encourages the use of efficient electrical appliances in London's households and offices.

4.68 The Mayor's proposals for working towards this objective are set out in Chapters 5, 6 and 7.

Energy efficiency in commercial and public sector buildings

4.69 As illustrated in Chapter 2, commercial and public sector buildings are responsible for 30 per cent of London's CO_2 emissions, which is more than from transport. They consume huge quantities of fuel and electricity. Measures to improve significantly the energy performance of London's offices will be central to the delivery of a more sustainable London. As prestige offices dominate the central London cityscape, this also provides an opportunity for London to develop showpiece sustainability developments. The efforts of the business sector are critical if London is to reduce its contribution to climate change.

policy 8 The Mayor looks forward to London becoming a showcase for sustainable commercial and public sector buildings - through improved energy management in existing buildings and exemplary, energy-efficient new buildings - and considers that this sector should play its full role in meeting London's carbon dioxide emissions targets.

4.70 The UK and London are addressing the challenge of reducing CO_2 emissions. Table 6 gives an indication of the energy efficiency contribution from the public and commercial sectors to achieving London's 2010 CO_2 target. This represents the majority of expected public and commercial CO_2 savings up to 2010.

4.71 As with housing, the overall energy performance of commercial and public sector buildings can be improved through increasing the standard of new buildings and raising the performance of existing buildings. Public sector action in this area must show Best Value.

Improving the performance of new commercial and public sector buildings

4.72 The growth in new office space in London is still prolific, and therefore energy-efficient new buildings can have a substantial effect on London's overall office energy consumption. Unfortunately, the vast majority of office buildings being built in London today are simply not achieving the energy efficiency standards that are possible and necessary for sustainable development. London's offices are also highly visible - not just to Londoners, but also to the rest of the UK and even the world - and the more high-profile, good practice London can boast, the bigger its influence as a leading world-class sustainable city. The new City Hall and Portcullis House are good examples of high-profile, energy-efficient buildings.

4.73 Chapter 2 outlines the typical energy consumption of the four main office-building types. This illustrates that a typical prestige air-conditioned office consumes three times more energy and emits four times as much CO_2 as a typical naturally ventilated cellular office. There exists a vast potential for improvement.

4.74 Chapter 5 considers a range of planning measures for encouraging more efficient new buildings that are powered and heated by renewables. Changes to the building regulations and recommended changes to national planning guidance are also discussed in Chapter 5. It is likely that the requirements of the European Directive on the Energy Performance of Buildings, described below, will be incorporated into the building regulations.

Box 5: European Directive on the Energy Performance of Buildings

The European Directive on the Energy Performance of Buildings (2002/91/EC) must be brought into force by member states by January 2006. The directive's objective is to 'promote the improvement of the energy performance of buildings within the European Community, taking into account outdoor climatic and local conditions, as well as indoor climate requirements and cost-effectiveness'. Each member state will achieve this through five main actions:

1. Creating a methodology to calculate the energy performance of buildings. This will encompass aspects of building design, construction and services. It will allow building designers and managers to meet energy reduction standards in a flexible and cost-effective way, incorporating simple energy indicators.

2. Applying minimum energy performance requirements, as measured by the methodology, to all new residential and tertiary (generally public and commercial) buildings, and to major refurbishments with floor areas greater than 1,000m^2.

3. Introducing an energy performance certificate for buildings that are constructed, rented or sold. Valid for a maximum of ten years, the certificate should include legal standards and benchmarks, and be accompanied by recommendations for cost-effective energy performance improvements. The certificate should be displayed prominently in public buildings, or other buildings serving large numbers of the public, where there is a floor area greater than 1,000m^2.

4. Regular inspection of boilers and air-conditioning systems above specified sizes.

5. Considering the technical, environmental and economic feasibility of alternative systems, and taking these into account before construction starts, for new buildings with a floor area greater than 1000m^2. Such alternatives include decentralised energy supply systems based on renewable energy, CHP, community heating or cooling if available, and heat pumps under certain conditions.

4.75 The Mayor welcomes the introduction of such a certification scheme. It should allow the cost of providing adequate heating and lighting to different buildings to be compared. The Mayor's Energy Strategy introduces a number of the above steps, in some cases going beyond them.

Improving the performance of existing commercial and public sector buildings

4.76 Chapter 2 explains that 15-20 per cent of total emissions from non-domestic buildings can be alleviated through cost-effective and readily available measures and techniques. There is almost always huge scope for all types of business and public sector organisations to save energy. Energy is unnecessarily wasted in a range of applications: lighting, space heating (through inefficient boilers and inefficient building fabric), water heating, air-conditioning, electrical appliances and inefficient vehicles. Reducing losses can often be a quick, easy and cheap process. In some cases, savings can be much higher than 20 per cent. For example, through undertaking energy efficiency measures, Harrods reduced its energy bill by 40 per cent[11].

4.77 Improving the environmental performance of business can reduce costs and increase profitability, as well as help to reduce negative effects on the environment. In addition, an environmentally responsible public image can be good for business. There is increasing pressure and expectation from the public, shareholders, clients and customers to improve environmental and ethical performance. This is reflected in the many businesses adopting

climate change policies, such as banks, supermarkets, pharmaceutical, power, oil and telecommunication companies.

4.78 Nonetheless, there are a number of challenges that are affecting the uptake of energy efficiency measures in the commercial and public sectors. As in the domestic sector, the main issue is the lack of awareness about, or interest in, energy consumption and energy efficiency within businesses and public sector organisations. Most business leaders are also domestic customers and competition between the electricity and gas suppliers to offer customers lower prices does nothing to promote energy efficiency in the workplace.

4.79 The quality of the office environment also has a significant effect on staff productivity, health and comfort. Research has demonstrated that buildings which have natural lighting and ventilation provide a more pleasant working environment, with corresponding health and productivity benefits. This provides another good reason for addressing the energy efficiency of offices.

4.80 Chapters 5, 6 and 7 look at these issues in more detail, and outline steps for addressing them and improving the energy efficiency of commercial and public sector buildings.

Renewable energy

4.81 The Government continues to develop policies and allocate funds to stimulate renewable energy. London needs to do its utmost to contribute to national policy objectives and targets. As a predominantly urban area, with a densely packed population, London faces a significant challenge in increasing the generation of renewable energy. Nevertheless, London also has a great opportunity to take forward urban renewable energy and to lead the way in the UK in demonstrating how urban areas can generate an increasing proportion of their own electricity.

4.82 A huge opportunity exists for London to source energy from renewables, through deployment of urban renewables within London and by purchasing green power which is generated outside the capital. The Mayor wants to see renewables make a major contribution to London's future economy and energy supply mix.

4.83 Londoners who responded to the consultation on the draft Energy Strategy saw renewable energy as a vital issue for London. Almost three out of four of those responding to the leaflet questionnaire favoured greatly increasing the amount of London's energy which is generated from renewable resources, second only to reducing CO_2 emissions.

policy 9 The Mayor considers that London should seek to maximise its own generation of renewable energy through developing urban renewables, and use its considerable purchasing power to support renewable energy across the rest of the UK.

4.84 There are many renewable energy technologies that are well suited to urban environments and could be deployed in London. Urban renewables are most likely to be small and medium scale, as opposed to the growing size of rural or marine-based renewable energy technologies. The following technologies and uses are considered particularly appropriate for London's buildings: passive solar design, passive ventilation, borehole cooling, solar water heating, photovoltaics (PVs), biomass-fuelled CHP, biomass boilers, heat pumps, and possibly building-mounted wind turbines. Using the renewable energy in the building where it is generated also improves the economics of a scheme. Some locations in London may be suitable to host much larger installations, such as large wind turbines or PV arrays on noise barriers along roads.

Green electricity tariffs

4.85 The Mayor would like as much of London's energy as possible to come from renewables. This includes power imported over the grid as well as generated within the London area. Green tariffs or green electricity - where electricity is sourced from renewables - are available for commercial and domestic customers from most energy supply companies.

4.86 As green tariffs are exempt from the Climate Change Levy, they may be cheaper, in which case there is a financial advantage to switching to green power. However, in cases where they are more expensive, the customer needs to consider what they are paying extra for.

4.87 On the one hand, paying a small extra amount for green electricity could be one way of making energy supply companies recognise the demand for renewables. It could also contribute towards the cost of installation of new renewable energy capacity, and could help energy companies to meet their Renewables Obligation.

4.88 On the other hand, it could be seen as paying for something that the energy companies are obliged to do anyway. It could also result in further financial gains to energy companies, because they will be 'fined' for not meeting their obligation and the money collected from the fines will be awarded to those that do. So, paying extra for a green tariff that contributes to the Obligation could lead to up to three financial gains for the energy supply company.

4.89 The question is whether energy companies, as part of their green tariff, source renewable energy on top of their legal requirement. Ofgem recommends that green tariffs be additional to the energy supplied under the Obligation. However, this is currently unregulated. So in most cases, energy supply companies are claiming Renewables Obligation Certificates for energy sold under green tariffs.

4.90 Similar problems arise with green funds, where the customer pays a premium towards the future installation of renewable energy schemes. Again, Ofgem recommends that these be additional to the Renewables Obligation but, as these are unregulated, there is no guarantee that this will be the case.

4.91 There are therefore advantages and disadvantages to purchasing green tariffs and funds. It is preferable to buy green tariffs that fund renewable energy additional to that required under the Renewables Obligation. This will result in renewable energy capacity that would not otherwise have been installed. Customers are encouraged to ask their energy supply company if the green tariff or fund results in any additional capacity.

4.92 Furthermore, green tariffs present an inconsistency with carbon accounting between the organisational, regional and UK levels. The Government's data on the carbon content of the average grid mix is used to calculate CO_2 emissions resulting from use of electricity. This is taken as the CO_2 emitted from electricity generation divided by the total amount of electricity delivered to end-users. However, this means that an organisation that has purchased a green tariff should not, in theory, be able to declare that its electricity is truly carbon free - as the renewables capacity allocated to it has already been accounted for in the average grid mix. This is also true at the regional level. It is not possible for a region to include imports or grid-connected generation of green electricity in calculating its CO_2 emissions. To do so would lead to a situation in which the sum of regional emissions would not equal the national total.

4.93 There may be an opportunity to eliminate this inconsistency in implementing the European Electricity Liberalisation Directive. DTI is due to issue a consultation in autumn 2003. The directive includes a clause on electricity disclosure requiring energy suppliers to be explicit about the generation mix sold to customers.

Renewables and hydrogen

4.94 The Mayor's aims for working towards a hydrogen economy are discussed later in this chapter. While hydrogen fuel cells offer the potential for clean power, zero-emission hydrogen production requires zero-emission

technologies such as solar, wind power or biomass. Therefore the true potential of hydrogen is only likely to be realised on a large scale if the development of a hydrogen supply infrastructure is coupled with massive investment in renewable energy. Intermittent renewables can benefit from the storage properties of hydrogen. The Mayor will work through the London Hydrogen Partnership to establish projects using the establishment of hydrogen and fuel cell technology to boost the renewable energy sector.

policy 10 The Mayor encourages the mutually supportive link between the use of renewable energy technologies and hydrogen as a fuel in London, as part of a move to establish widespread use of low and zero-emission sources of heat and power.

Renewable energy targets for London

4.95 A target for generating renewable energy in London would provide a clear goal to help engage and focus the attention of the many stakeholders needed to deliver any such target. This is why the Mayor has sought Londonwide ownership of renewable energy targets, through public consultation, and through the work of the London Renewables Group (see Chapter 7).

4.96 To inform the delivery of the national target for renewable energy, the Government requested each region to set its own target based on an assessment of the area's potential to generate renewable energy. London, although recognised by the Government as a special case, agreed to take part[12], and ETSU (now Future Energy Solutions) was commissioned to assess the potential for renewables in London. The Government Office for London (GOL), the GLA and the Association of London Government (ALG) jointly published ETSU's study in December 2001 as a basis for further consultation[13].

4.97 London faces unique challenges and limitations in generating a high proportion of its energy use from renewables, particularly in the short term. First, London has a highly concentrated energy demand, which means that it needs to install significantly more renewable energy capacity in a much smaller area to meet the same target as an equivalent area elsewhere in the UK. Second, London's dense urban environment limits the types of technologies that are suitable. For example, large wind turbines are one of the most economic renewable energy technologies, with a relatively high output. However, due to London's lack of suitable open spaces and relatively low wind speeds, they are not so applicable here. Urban and building-based renewables, such as solar water heating and PVs, and smaller-scale, or urban, wind turbines offer the biggest opportunities for London, but are currently

more expensive. However, their costs are projected to come down during the next 20 years, which will allow London to generate significantly more renewables in the longer term. Action now to employ these technologies will pave the way for greater employment in the future.

4.98 Since the publication of ETSU's work, which suggested a challenging yet achievable target for the generation of renewables in London, there has been a great deal of discussion about the target London should adopt. This includes debate and comments received during the Assembly's scrutiny and public consultation on the draft Energy Strategy, and the London Renewables' consultation in July 2003. All this feedback has informed the final target.

4.99 In the draft Energy Strategy, the Mayor consulted on a combined target for the use and supply of renewable energy in London. This was that 'London should aim to supply at least 14 per cent of its electricity from renewable energy (ten per cent through the Renewables Obligation, the rest from green tariffs and generation within the Greater London area) by 2010'. Analysis of consultation responses and further research revealed that this is a confusing target. The reasons for this were outlined in the section above on green electricity tariffs, combined with the fact that generation in London will often contribute to the Renewables Obligation.

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.

4.100 The target for total renewable electricity capacity equates to at least five per cent of the electricity generated within Greater London in 2000 and at least two per cent of London's electricity consumption in 2000.

4.101 To meet the total renewable energy target, more than the technologies included above will be needed, such as standalone photovoltaics, eg on

road barriers, as well as biomass and anaerobic digestion-fuelled combined heat and power.

4.102 The Mayor has introduced a 2020 target for renewable energy technologies to ensure that London continues to work to the same timescale as the Government in this area. The Energy White Paper - issued when the Mayor's draft Energy Strategy was out for public consultation - included an aspiration to double renewables share of electricity from the 2010 target by 2020. The Mayor believes that London could triple the above 2010 technology targets by 2020 considering the short time left to meet the 2010 target and the lead time needed to set in motion the mechanisms to deliver the targets.

4.103 The Mayor will use his powers - particularly those in planning - to help meet these targets. The London boroughs, through their planning and service delivery remits, the construction industry and its clients, and housing providers will all have an important role to play if the targets are to be achieved.

4.104 To give an idea of the scale of this target, around 250 strategic planning applications are referred to the Mayor each year. More than half of these are for commercial developments. This means, for example, that around one in four commercial applications to the Mayor will need to incorporate photovoltaics if the target is to be met through new strategic developments alone. The Mayor's detailed planning policies in this area are set out in Chapter 5.

4.105 The ability to contribute to the targets will vary by borough according to, for example, its size, resources, and the rate and nature of new developments. But, to help understand the scale of action required at the local level, an average borough would need to install more than 200 (or 450kWp) domestic photovoltaics, eight (or 360kWp) commercial photovoltaic applications and 760 solar water heating applications by 2010. Assuming there are very few existing schemes in most boroughs, this represents a yearly installation rate of more than 28 (or 64kWp) domestic photovoltaics, one (or 51kWp) commercial photovoltaic application and 108 solar water heating schemes.

4.106 With the current level of Government support for renewable energy, the slow progress to date and the short period of time available, these are challenging targets for London. However, the Mayor believes they are achievable, taking account of the proposals in this strategy; the commitment demonstrated by stakeholders during consultation; and the

huge opportunity that new developments offer for the more economic installation of renewables.

4.107 In February 2002, the Department of Trade and Industry and the Department for Transport, Local Government and the Regions combined the regional renewable energy assessments to see how they met the national target[14]. This work revealed that the national ten per cent target is more or less reached under the high targets proposed in the regional assessments, but not under the low targets. So, even with London's apparently small contribution, the UK can still meet its target.

4.108 The study also showed that the most of the ten per cent target is expected to be reached through rural-based renewables, such as large-scale wind and landfill gas, with only 1.3-3 per cent coming from those technologies suited to London and an urban environment (such as biomass, anaerobic digestion, PVs and energy from biodegradable waste). While suitable to London, biomass still presents a greater opportunity for rural areas. This places London's potential in context and demonstrates that, in working towards realising the target, London will be making a major contribution to the development of smaller-scale urban renewables in the UK.

4.109 London and the UK should always be looking abroad for lessons to learn about energy. A few countries, such as Germany and Japan, have high targets for solar roofs and have each installed a significant capacity to date. While the Mayor will seek to work with and learn from leading cities, it is important to consider the political context in which achievements are possible. With governmental support comparable to other leading countries, London and the UK could reach much higher targets.

4.110 Action is required at all levels to deploy successfully renewable energy on the scale proposed. This Strategy focuses on using the Mayor's powers and working with the intermediary sectors and organisations that seek to influence a larger number of organisations and individuals. Important stakeholders include the construction industry and its clients, the energy companies, boroughs, the Government, and the large numbers of residential, public and commercial energy users. Widespread awareness and commitment are needed before extensive installation of renewable energy can occur across the capital. This is perhaps one of the greatest challenges. Schemes such as Solar for London are already working to raise awareness among the public.

Box 6: Solar for London[15]

Solar for London is a five-year programme, managed by Sustainable Energy Action, aimed at promoting awareness of solar water heating and increasing the number of installations in London. It is a collaboration between Sustainable Energy Action, Energy Saving Trust, 25 London boroughs and London Electricity, and provides a one-stop service for Londoners wanting a solar water heating system professionally installed in their home.

The programme installs solar water heating systems for a discounted price and with quality assurance. Before discounts are applied, it will cost around £2,100 to install a system in a 1-2 bedroom house and around £2,400 for a 3-4 bedroom house.

Solar for London has five-year targets, which would deliver more than 6,000 solar water heating installations by 2008.

The programme has been initiated through the Energy Saving Trust's Innovative Carbon Reduction Pilot Scheme.

4.111 Further guidance is given in Chapters 5 and 6, on how the Mayor aims to contribute to meeting the renewable energy targets through his planning powers, economic development work with the LDA, strategic transport action through Transport for London, and through demonstrating best practice across the GLA group. Chapter 7 sets out the Mayor's ideas for how London stakeholders can work in partnership to ensure that renewable energy targets are met.

Combined heat and power

4.112 When fuel is burned to generate electricity alone, even the most efficient plants convert less than half the chemical energy in the fuel into electricity. In a combined heat and power plant, the heat in the cooling water and flue gas is recovered and used, so the overall efficiency of the process is greatly improved. CHP typically uses 40 per cent less primary energy, compared with separate production of heat and electricity in power stations and heat-only boilers. To put it another way, CHP is almost twice as efficient.

4.113 Public consultation responses indicated that there is some concern that siting CHP systems in residential areas could have a detrimental effect on local air quality. However, providing that the plants are designed and operated to meet Environment Agency guidance, this is not the case, and indeed, the opposite may be true.

4.114 Even if the heat provided to the local community from the CHP plant displaces an equivalent output from a number of individual boilers, local air pollutant emissions will rise. This is because electricity, which had been generated at remote power stations, is now being produced locally along with heat. The increased efficiency of CHP means that less overall emissions now result, but there will still be a net increase in local emissions, since the amount of fuel being used locally increases. According to the Building Research Establishment[16], assuming a 2:1 production ratio of heat to power, switching to CHP reduces total fuel consumption for heat and power by around 40 per cent, while increasing local fuel consumption by the same proportion. Switching to heat-only boilers for community heating would not increase local fuel consumption and emissions, but neither would it reduce overall fuel consumption and emissions.

4.115 However, we are describing a scenario in which a large number of small boilers are being replaced with a single large plant. This is likely to result in more efficient fuel use, since a central plant is more likely to be properly maintained and operated. More significantly, individual boilers emit pollutants at or near ground level, while Environment Agency[17] guidance requires CHP plants to be fitted with a stack of sufficient height to eliminate significant local air quality impacts. This means that local air quality is likely to be improved by switching heat production from individual boilers to a community CHP plant.

4.116 Under the Government's Climate Change Programme, CHP will provide the largest single contribution to the UK's CO_2 emissions reduction targets. The technology contributes at least £500 million of economic benefits in the UK each year, and has created significant numbers of new jobs in the manufacturing and service sectors[18].

4.117 Heat from CHP schemes can be used in industrial processes, and for providing heating or cooling to buildings or communities. Community energy can contribute to CO_2 emission reductions, urban regeneration and, through providing low-cost heat, to tackling fuel poverty.

4.118 The Government has a target to double UK CHP capacity (based on 2000 levels) to at least 10GW (gigawatts) by 2010. The Government consulted on the UK Combined Heat and Power Strategy during the summer of 2002. It is important that London contributes as much as it can to the current and any future targets, as CHP is well suited to the capital and offers a range of benefits.

4.119 London is well placed to benefit from an expansion in the use of CHP, thanks to its high, constant and local demand for heating/cooling

throughout the year. A constant heat load optimises the efficiency of CHP systems. This can be achieved by supplying a mixture of building types: for example, from the domestic, public and private sectors, which have complementary heat demands. In addition, by virtue of a high heat demand density, London is suited to the development of community heating/cooling networks in its central and inner areas, and in major town centres. These could provide stable heat load for CHP plants.

proposal 7 London should maximise its contribution to meeting the national target for combined heat and power by at least doubling its 2000 combined heat and power capacity by 2010.

4.120 The financial performance of CHP is affected by the relationship between gas and electricity prices, and by the availability of local heat demand. With electricity historically cheap, and gas relatively expensive, the margin for a CHP operator is reduced. However, this can be compensated through the lower discount rates made possible by public investment. The challenge is to develop the supply and demand sides of the community energy market at complementary rates.

4.121 Nevertheless, many opportunities for such schemes have already been exploited, with London making a sizeable contribution to national CHP capacity. More opportunities undoubtedly exist, and London should continue to help meet the UK target for CHP.

4.122 Overall in London, 175MWe (megawatts electricity) are generated from around 140 CHP plants, equivalent to four per cent of the UK's CHP capacity. This total contribution appears relatively low because 93 per cent of UK CHP is in the industrial sector and London generally lacks industry, with only two per cent of national industrial CHP. However, London holds almost a third of the UK's non-industrial CHP, which is a considerable contribution to the UK's total capacity. In addition to this, London's community heating schemes, representing over 60 per cent of the UK total, serve more than 97,000 dwellings[19].

Table 6 Examples of how combined heat and power capacity in London could be increased in different sectors

Sector	Current capacity (MWe)	Potential increase	Capacity in 2010 (MWe)
Residential	35	x4	140
Education	0. 4	x2	0. 75
Health	10	x2	21
Government estate	0. 8	x2	1. 7
Hotels	7. 5	x2	15
Leisure	4	None	4
Office	6	x3	18
Retail	5	x2	10
Industrial	55	x1. 5	81
Sewage	37	None	37
Airport	14	x1. 5	21
Total	**175**	**x2**	**350**

source Greater London Authority, 2002

4.123 If London were to double its CHP capacity by 2010 in line with the national target, an extra 175MW would need to be installed during the next six years. Table 6 shows an example of a combination of sectoral increases that would meet London's target. This list is not intended as a target per se, but as an indication of the kinds of increases that could be expected in various sectors.

4.124 The economic, social and environmental benefits of CHP need to be better communicated to developers, building managers, businesses and public bodies in London. The numerous Government measures supporting CHP also need to be marketed better. These include the Climate Change Levy exemption, enhanced capital allowances, VAT reduction for domestic CHP, the energy efficiency commitment, the Community Energy programme, and the professional advice and information provided through Action Energy.

Decentralised electricity generation and the distribution network

4.125 As outlined in the Energy Hierarchy in Chapter 3, there are three ways to reduce CO_2 emissions from building energy use. The first is to use energy more efficiently, and the second and third are zero- and low-carbon energy supply, from renewables and CHP respectively.

4.126 The UK electricity network was developed as a centralised system of large, electricity-only generating plants feeding into a national transmission system. This, in turn, feeds the local distribution networks that deliver

electricity to end-users. However, CHP requires distribution networks for both heat and electricity. In the case of electricity these already exist, but it is more difficult to distribute heat - national distribution is not feasible, and there are currently only isolated and relatively very small local distribution networks in the UK. As a result, the maximum size of a CHP plant is generally limited by the amount of heat that can be distributed in the locality of the plant. In practice, this size restriction means CHP plants are most often connected to the local rather than national electricity network. This is known as embedded or distributed electricity generation - and it also applies to much renewable electricity generation, the exception being large wind farms and their equivalents.

4.127 The accommodation of an increasing proportion of embedded electricity generation within local distribution networks is known as 'decentralised energy', and is vital to the development of renewable energy and CHP in London and across the UK. Decentralisation has benefits beyond facilitating the use of zero and low-carbon energy supply. The Government's Energy White Paper highlighted the importance of embedded generation in contributing to the security of supply of the UK energy system, and this is equally true for the security of electricity supply within London. Embedded generation also avoids the significant financial costs and energy losses associated with the long-distance national transmission system.

4.128 To achieve the decentralisation required for the development of CHP and renewables, significant changes will need to be made to the functioning of local distribution networks. The current passive networks were designed to move electricity in one direction, from national transmission network supply points to individual users. A more active system is now needed, which is capable of dynamically balancing large numbers of small and intermittent generators with consumers within the local distribution area. Failure to develop the local electricity distribution networks in this way would significantly constrain the development of decentralised low-carbon generation, reducing the likelihood of meeting local and national targets for CHP, renewables and CO_2 emission reductions.

4.129 However, the current regulatory and commercial framework of the electricity industry both reflects and reinforces the centralised system. The barriers to decentralisation include large connection and use-of-system charges, penalties for intermittent generation, and the physical configuration of the local distribution networks, which, as discussed, does not easily allow for two-way distribution of electricity.

4.130 In its Energy White Paper of 2003, the Government recognised the importance of removing the barriers to decentralised generation. The White Paper commits Ofgem to developing a new framework of incentives for distribution network operators to connect and utilise embedded generation. This is to be published by the end of 2003, and implemented in April 2005.

policy 11 The Mayor supports the growth of decentralised electricity generation as a core component of sustainable energy supply, and recognises the importance of developing the electricity distribution network so that it can accommodate and facilitate increased decentralised generation.

4.131 Chapters 5, 6 and 7 outline proposals for taking forward these electricity network issues.

Community heating

4.132 The majority of energy consumed in buildings in London is used for heating, provided by on-site use of gas or electricity. This means that most heating in London is produced by a large number of small boilers or electrical heating systems. Overall, this is an inefficient way of heating a city. An effective alternative is to use larger, more efficient heat sources, such as CHP plants. These supply groups of buildings through heat distribution networks known as district or community heating systems.

4.133 Community heating is not a new concept in London. A substantial number of heat-only schemes were built here during the 1960s and 1970s. At that time, community heating was preferred on the grounds of lower running costs, maintenance problems associated with some other forms of heating, and the problems of condensation and mould which had resulted from intermittent use of warm air heating systems. However, some older schemes were poorly designed or maintained, and as a result people became disenchanted with community heating. For this reason, a number of schemes were taken out of use during the 1980s and early 1990s. Nevertheless, community heating serves around 100,000 homes in London today. London's existing community heating schemes must be maintained if the potential benefits of CHP are to be realised.

4.134 The late 1990s saw changes in attitudes to community heating in the UK. One particular problem with the older schemes was heat metering, but accurate electronic heat meters are now available. A good example of modern community heating is the Barkantine project in Tower Hamlets, which provides heating and hot water to Seven Mills School, 540 local homes and the Tiller Leisure Centre. This is a joint venture between the London Borough of Tower Hamlets and the London Power

Company, a subsidiary of EDF Energy. Electricity is sold through the local distribution network.

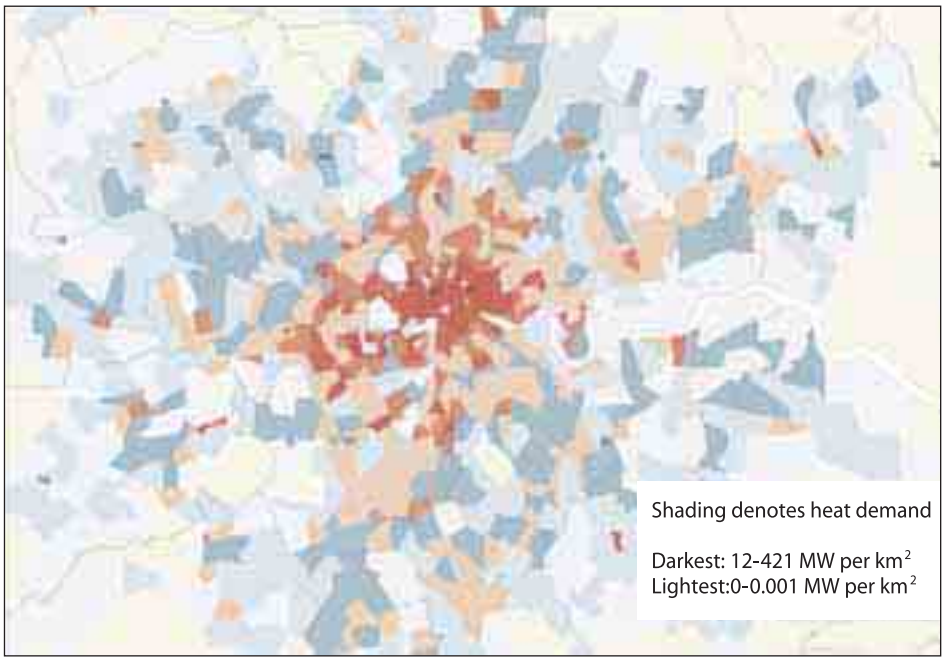
4.135 Community heating schemes are not confined to serving domestic buildings. One of the largest community heating systems in London is the Government's Whitehall system. Established in 1955, it extends from Admiralty Arch to Great George Street and from Northumberland Avenue to St James's Park, serving a total of 26 buildings with a peak heat load of 35MW. In the City of London, the Citigen CHP scheme generates electricity for, and provides both heating and cooling to, the Barbican Centre, the Guildhall, the Museum of London and adjacent buildings.

4.136 As mentioned in Chapter 2, the demand in London for energy for cooling - mainly for offices - is growing, due to the increased use of electric air-conditioning systems. Electric air-conditioning is a very carbon intensive technology. A more efficient alternative is to use heat for cooling by means of absorption chillers. This also provides a demand for heat during the summer, thereby increasing the economic viability of CHP. Other sustainable ways of cooling buildings, such as passive design, are discussed in Chapter 5.

4.137 The expansion of heat distribution networks will be critical to the success of CHP in London, which in turn will have a huge influence on London's ability to achieve its CO_2 emissions reduction targets. Two of the most important factors determining the economic viability of heat distribution are the spatial density of heat demand and the heat load diversity. A mixture of different kinds of users requiring heat at different times of the day and year allows a constant overall heat output from the generating plant, maximising fuel efficiency and income from both heat and electricity sales. It is widely agreed that London is well placed on both these counts.

4.138 Through the Building Research Establishment's Energy Conservation Support Unit, DEFRA commissioned work to develop a heat demand density map of the country to postcode level. This identifies the greatest opportunity nationally for community heating as being in central London, and suggests that 27 per cent of the national potential for new community heating is in London as a whole. A heat density map of London produced from this project is illustrated below. The report reveals that London has by far the biggest potential for CHP and community heating in the UK.

Figure 21 Composite heat density map of London



source Building Research Establishment, 2002

policy 12 The Mayor supports the expansion of community heating in London as a means of reducing carbon dioxide emissions and helping to deliver affordable warmth.

4.139 There are a number of issues facing the expansion of community heating in London that need to be addressed. These include:

- lack of awareness among consumers. Businesses and communities tend not to be familiar with CHP or community heating, and are not aware of its environmental, economic and social benefits,
- capital cost and long payback. The high capital cost of community heating is a key problem, although there are significant cost savings as compared to other heating options over the whole life of the investment,
- shortage of technical skills,
- piecemeal developments do not have the sufficient holistic planning required for community heating,
- perceived risk of adopting new technologies,
- negative perception of community heating based on experience of older systems,
- the current market and regulatory framework of the electricity industry is not conducive to the development of CHP,
- new community heating schemes generally require new heat supply plant (eg CHP or boilers), because of a lack of access to existing surplus heat sources. This can increase the cost of schemes.

4.140 Community heating and CHP are complementary technologies. Within an area, the presence of CHP with spare heat capacity makes new community heating more viable. Conversely, existing community heating infrastructure can make new CHP more viable. The development of longer-distance interconnections between heat supply and demand could enhance the prospects for both CHP and community heating schemes, potentially across London. It could also allow the considerable amount of heat currently being dumped in London to be put to use.

4.141 The Mayor considers that community heating in conjunction with CHP has the potential to make a decisive contribution to reducing London's CO_2 emissions, while helping to tackle fuel poverty and stimulate London's economy. The Mayor is committed to supporting efforts to bring about a significant increase in the use of these technologies in the capital.

4.142 Chapters 5, 6 and 7 outline specific measures for taking forward CHP and community heating in London.

Micro-combined heat and power

4.143 Micro-CHP for individual households is a promising emerging technology. At the end of 2001, the Government announced a pilot study of micro-CHP units in 6,000 homes as a component of its Fuel Poverty Strategy. It was claimed that such units could replace a fifth of the UK's domestic central heating boilers and cut UK CO_2 emissions by five per cent[20]. DEFRA also suggests that within 20, or 30 years, there could be up to ten million micro-CHP installations in the UK, generating 10-20GW of electrical power overall.

4.144 Micro-CHP is located within the home and uses natural gas as a fuel to produce heat and power simultaneously. The technology offers significant opportunities for the development of energy supply businesses, and could save users significant amounts of money while providing environmental benefits. The Combined Heat and Power Association believes that it could cut domestic energy bills by up to £200 a year. The Energy Saving Trust suggests that, for an individual home, after cavity wall insulation, micro-CHP could become one of the best ways of saving energy.

4.145 Micro-CHP units are now commercially available and could achieve significant levels of market penetration within five years. Energy service companies which would own the units and charge the users for the heat and electricity supplied could install units. Fuel cell micro-CHP units are currently being tested in Germany and other countries, and are expected to be commercially available before 2005.

4.146 Although micro-CHP could eventually play a significant role in reducing domestic CO_2 emissions in the UK, it is unlikely to match the energy and carbon efficiency of community-scale CHP. Community systems are inherently more efficient, both because of their size and because they have access to far greater heat load diversity. For these reasons, micro-CHP is likely to be the best option in situations where community heating is not viable, for example, in areas of low heat demand density. Conversely, large-scale uptake of micro-CHP in areas of high heat load density could damage the prospects for community CHP. This situation should be avoided, as it would result in a lost opportunity to reduce emissions, along with community benefits. There is also the problem of increased emissions of local air pollutants, as discussed earlier, but without the mitigating effect of tall stacks.

4.147 As a new technology and consumer product, micro-CHP faces market-entry problems and it is currently substantially more expensive than conventional gas boilers. Chapters 5, 6 and 7 outline measures aimed at contributing to the market penetration of micro-CHP.

policy 13 The Mayor supports micro-combined heat and power for homes in London. In deciding where to locate the technology, he urges that account is taken of the possible negative effects on local air quality and the viability of community combined heat and power, particularly in areas of high heat demand density.

Hydrogen and fuel cells

4.148 The Mayor strongly supports the development of zero-emission technologies, as the reduction of harmful emissions and the growth of green industry are two of his key policy objectives. London faces severe challenges in meeting the health-based national air quality objectives. Failing to meet these challenges could affect economic and social opportunities, particularly as health and quality of life become increasingly important factors in location decisions.

4.149 Hydrogen is a fuel and a common industrial gas that is already commercially available. It is stored in safe systems and is no more hazardous than petrol, natural gas or liquid petroleum gas (LPG). When combined with oxygen in a fuel cell, electricity and heat are produced almost silently, with no emissions at the point of use except water. When produced from renewables, such as wind, biomass or solar PV, energy from hydrogen is completely emission-free. Fuel cells using hydrogen generated from renewable energy therefore represent the ultimate objective of green fuel development.

4.150 It is important that London plays its full role in working towards a hydrogen economy - a national energy infrastructure based on hydrogen from carbon-neutral, primary energy sources. The UK is currently lagging behind in working towards a hydrogen economy. Germany, Japan, Canada and the United States are taking hydrogen and fuel cell technology very seriously and investing in it for zero-emission vehicles and buildings. Furthermore, all major car manufacturers have a fuel cell development programme. The expansion of this industry has promising implications for the future of cities and their economies, from which the Mayor wants London to benefit.

4.151 There are a number of established organisations and research activities in the UK, with a number of new entrepreneurial companies and potential suppliers to the industry. The Department of Trade and Industry now recognises that there is an opportunity to establish the UK's international profile as a leader in the fuel cell industry of the future.

policy 14 The Mayor strongly supports the development of hydrogen and fuel cell technologies in London as a means of providing low and zero-emission energy.

4.152 There was strong support for developing hydrogen and fuel cells from 86 per cent of the Londoners who responded to the consultation questionnaires on the draft strategy.

4.153 It will take time to establish a hydrogen economy. The introduction of major new fuels and technologies is rare, and requires major changes to policy, legislation, infrastructure and so on. Interim technologies will therefore be valuable in contributing to the establishment of a supply infrastructure and building public acceptance. These include the use of hydrogen in internal combustion engines, currently piloted by BMW, and the use of natural gas or methanol in certain types of stationary and portable fuel cells. Hybrid electric vehicles provide a key stepping stone to fuel cell transport, as the electric traction and control systems are common to both[21]. A recent report commissioned by Government promotes an incremental path to full hydrogen fuel cell passenger cars, with increasing hybridisation and CO_2 savings expected at each step[22]. It is also considered important to maximise the carbon benefits of renewables by offsetting fossil fuel power generation in the national grid, rather than the mass production of transport hydrogen from renewables, until such time as there is an over-capacity of renewables in the UK[23].

4.154 The Mayor considers that such a position should not be adopted as a 'do nothing' stance. Investment in renewable hydrogen capacity - including

biomass and waste as sources - should begin now, hand in hand with 'stepping stone' hydrogen sources such as natural gas. In the short to medium term, the Mayor sees a need for early incentives for hydrogen and fuel cell applications. He will work with the LDA and London Hydrogen Partnership to support the development of renewable hydrogen fuel cell projects as demonstrations or sustainable, decentralised energy solutions. As outlined below and in Chapter 6, he will also promote, where appropriate, the rapid uptake of fuel cells in fleet vehicles, such as buses and taxis.

4.155 In summary, the Mayor supports the development of available technologies such as hybrid electric vehicles and hydrogen internal combustion engines as part of the pathway to the widespread establishment of hydrogen fuel cell power in the longer term.

Box 7: Hydrogen and fuel cells - an introduction

Fuel cells are an energy conversion device invented in London in 1839 by William Grove. They generate electricity at high efficiencies and are analogous to batteries charged with a constant supply of reactant. Some can run directly on a range of hydrogen-rich fuels, including methanol and natural gas, though a fuel processor may be used to generate the hydrogen from other fuels such as gasoline. However, the basic principle of combining hydrogen with oxygen to produce electricity, heat and pure water is common to all. The hydrogen fuel cell, operating on hydrogen produced from renewable sources, can deliver heat and power wherever it is needed with zero CO_2 emissions. Hydrogen fuel cells produce no pollutants at the point of use.

It is unlikely that these technologies will become sufficiently widespread to contribute to reductions in the short term. In the longer term however, as the technology becomes established through interim fuel sources and as renewable capacity increases, an emerging hydrogen economy could result in significant emission reductions.

All major car manufacturers have a fuel cell development programme, with Toyota and Honda having launched the first hydrogen fuel cell cars in limited numbers in 2003.

The UK is lagging behind the rest of the world in investment in the technology and support for industry. Recently, however, British activity has stepped up a gear with the Fuel Cells UK initiative, and there are a number of local initiatives in place. More on current activities can be found in Chapter 7.

Safety

4.156 Hydrogen gas is a common industrial gas that is colourless and odourless. Some 35 million tonnes are produced globally every year, about one per cent of the amount of oil produced globally in 2001. Consequently, extensive safety protocols already exist and work is also under way to produce internationally standardised handling procedures for everyday situations[24]. For example, the US National Fire Protection Association has safety standards for users of both liquid and gaseous hydrogen[25].

4.157 As a fuel, hydrogen gas is energy dense. This means that, as with many commonly used fuels, such as petrol and natural gas, there is a danger to health and property in the event of uncontrolled combustion or explosion. All fuels require the application of fuel-specific safety controls, and hydrogen is no exception. But there is no evidence to suggest that hydrogen is more dangerous than conventional fuels in general, and some evidence that it is safer, for example in a vehicle fire[26 27]. The main difference between hydrogen gas and petrol is in its behaviour when released to the air. Hydrogen gas disperses rapidly and fires burn out quickly, dissipating heat only very locally.

4.158 The Mayor recognises that education and awareness campaigns will be essential to build acceptance of new technology, and overcome public misconceptions about hydrogen.

London's role in developing a hydrogen future

4.159 In the past, the UK has lost opportunities to lead in a number of clean technology industries-for example, wind turbines and PVs-to countries such as Denmark, Germany, Japan and the United States. In an effort to make sure that fuel cells and hydrogen do not become another lost opportunity, a pro-active approach is being taken in London to support the hydrogen and fuel cell industries. In January 2001, the Mayor and the Chief Executive of the London Development Agency called for London to lead the fuel cell industry[28].

4.160 The Greater London area's extensive public transport system, the level of mayoral control of public transport, and its high number of taxis and small delivery vans, offers a massive opportunity for developing the use of hydrogen. There is a large potential market for hydrogen and hydrogen fuel cells, and high potential for the development of refuelling infrastructure that could fan out to the rest of the country.

4.161 Facilitating fuel cells in London could have the effect of stimulating other clean technologies in the capital. Hydrogen can be produced from renewable energy, either by using renewably generated electricity to split

water to produce hydrogen, or by collecting the hydrogen-rich methane gas produced during the decomposition of waste, such as digestion of sewage and other degradable waste, landfill sites and gasification of waste. Generating hydrogen through either of these approaches would help to boost and support London's renewable energy generation, and the energy storage benefits of hydrogen complement intermittent renewables, such as wind and solar PV (see earlier policy). These links are being explored in the UK's first fuel cell training course at the College of North West London (see Case Study 2).

Case Study 2: Hydrogen Fuel Cell Training at the College of North West London

Close collaboration for nearly four years between the College of North West London and Eneco Ltd has resulted in a facility for practical and theoretical training in the area of hydrogen fuel cells. A 400W educational unit coupled to an interactive virtual learning package will enable students to learn operating principles, commissioning procedures, maintenance and installation requirements, as well as related health and safety issues, all in a hands on educational environment. The equipment is sited in an area that shows the cells' ability to power static plant, such as refrigeration/air-conditioning equipment. The college also has a working electric vehicle that was used as an early hydrogen zero-emission prototype by the City of Westminster. The course offers a complete package for those interested in theory, installation, maintenance or application to other technologies.

The college will be offering short programmes of stand-alone hydrogen fuel cell dedicated training, as well as including it within existing curricula such as BTEC National and Higher National Certificate and Diploma. Similar programmes dealing with solar energy are also available. Links between the two energy generating sources are already recognised, giving the college the ability to develop learning programmes that meet industry needs as technology advances.

4.162 Hydrogen fuel cells can help in delivering many of the Mayor's policy objectives and can greatly benefit the city. The Mayor is working with the hydrogen and fuel cell industry and others through the London Hydrogen Partnership. The partnership is developing a London Hydrogen Action Plan, containing objectives and targets as a tool for delivering the hydrogen economy[29]. Chapter 7 describes the work of the partnership.

Transport

4.163 Transport in London is a major user of energy and emitter of CO_2. The sector accounts for just over 20 per cent of total final energy consumed in

London and about the same proportion of CO_2 emissions. Road traffic is responsible for most of this, at around 80 per cent, and it is also the major source of those pollutants which contribute to poor air quality. Although the London Underground system is efficient in terms of emissions per passenger kilometre, it consumes more than three per cent of the electricity used in the capital.

4.164 If London is to take seriously the above objectives to reduce its contribution to climate change, action in the transport sector is required. A whole package of measures will be imperative to delivering this, including increasing walking and cycling, reducing unnecessary use of private cars and increasing use of public transport, and minimising the emissions from journeys taken by vehicles.

policy 15 The Mayor considers that London should work to achieve an exemplary sustainable transport system for the capital that contributes to mitigating climate change through maximising the transfer from use of private vehicles to public transport, walking and cycling, and encouraging greater use of vehicles using low-carbon fuels.

4.165 The Mayor's Transport and Air Quality strategies lead on the Mayor's policies to develop sustainable transport for London. Chapter 6 contains detailed policies on how the Mayor intends to work towards sustainable transport through the strategic work of TfL and through best practice projects. The Mayor is particularly keen to encourage visible sustainable transport projects at the major tourist hubs, such as London's airports and international railway stations. The Energy Strategy leads on promoting the Mayor's policies on hydrogen as the ultimate clean fuel for vehicles, as well as other energy applications.

Nuclear power

4.166 Nuclear power currently contributes about 26 per cent of the UK's electricity supply. This contribution is due to decline from around 2005 onwards, as the older stations begin to close. In the Government's climate change programme, it is estimated that 'two-thirds of existing nuclear capacity could close by around 2012'. It also says 'there are currently no proposals for new nuclear power stations in the UK, largely due to the inability of nuclear energy to compete on cost grounds with other types of generation'. Furthermore, 'issues related to waste disposal and public acceptability would also need to be resolved before industry put forward any proposals for approval'.

4.167 In the past 50 years, subsidies for nuclear power have been enormous - about 100 times the amount the UK has spent on developing renewable

energy. In the late 1980s, after the privatisation of the electricity industry, the Government introduced the Non-Fossil Fuel Obligation (NFFO), mainly to support nuclear power. The nuclear industry received £8 billion of NFFO funds, whereas less than ten per cent (£750 million) was invested in renewable energy. Massive further subsidies will be required to deal with the backlog of nuclear waste and the decommissioning of existing power stations.

4.168 The Government's Energy White Paper delays the decision on the UK's future nuclear policy, keeping 'the nuclear option' open. The paper recognises the problems with the economics, public acceptability and 'waste legacy' of nuclear power and that 'it is right to concentrate efforts on energy efficiency and renewables[30] '.

4.169 The Mayor opposes the development of new nuclear capacity in the UK because nuclear power is excessively expensive, provokes health and environmental concerns, and diverts resources and attention away from emerging clean energy technologies, such as renewables. The Mayor strongly urges the Government to support the development of energy efficiency, renewable energy and CHP, before considering new nuclear capacity when the UK's remaining nuclear power stations start to close in 2005. The benefits of renewables and low-carbon technologies are discussed elsewhere in this strategy.

policy 16 The Mayor opposes the development of any new nuclear power capacity in the UK, and wishes to see energy efficiency, renewable energy, combined heat and power, and other low-carbon energy technologies replace nuclear capacity when nuclear power stations are decommissioned from 2005 onwards. To reflect this, nuclear power is placed at the bottom of the Mayor's Energy Hierarchy.

Adopting the strategic framework for London

4.170 It is important that London as a whole adopts the strategic framework set out in this chapter, including the proposed targets. In Chapter 7, the Mayor proposes that the London Energy Partnership adopt the framework.

4.171 The Mayor will also seek commitment from the London boroughs and other key organisations to the strategic framework. He will do this by inviting all boroughs to sign a declaration of their support for and commitment to delivering the strategy's targets. The London Energy Partnership and key organisations will also be invited to sign the declaration. Chapter 8 gives more detail on how the Mayor will seek borough commitment to implementing the strategy.

proposal 8 The Mayor will issue a declaration demonstrating commitment to helping to deliver the Energy Strategy's targets, which the London Energy Partnership, all London boroughs and other key organisations will be invited to sign.

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5 Delivery through strategic planning

5.1 The previous chapter set out the Mayor's strategic framework for action on energy. The following chapters contain detailed policies and proposals on how the Mayor aims to lead in delivering this framework. These are arranged under the principal mechanisms for implementation set out in Chapter 3, to reflect a focus on how the proposals will be delivered. The text under the mechanisms is then laid out by issue, in the order set out in Chapter 4.

5.2 This chapter includes policies and proposals on how the Mayor will deliver his energy objectives through his strategic planning work. In Chapter 6, the Mayor proposes actions for the functional bodies and Chapter 7 includes the Mayor's proposals on how others can work in partnership with him.

5.3 The Mayor has responsibility for strategic planning in the capital, implemented through:

- the London Plan (Spatial Development Strategy, also referred to as the SDS)
- his role in decisions on major planning applications
- representing the interests of London in relation to other planning matters.

5.4 One of the biggest opportunities that the Mayor has for delivering his statutory obligation to promote sustainable development, and his vision to develop London as an exemplary sustainable world city, is to shape the nature of future development through the planning process.

The Mayor's London Plan

5.5 The Mayor's London Plan sets out an integrated social, economic and environmental framework for the future development of London. The requirement for the drawing up of a Spatial Development Strategy (SDS) is included in the GLA Act. Section 334 states that the SDS must include statements dealing with the general spatial development aspects of strategies, the Mayor's other policies and proposals, whether or not the strategy, policy or proposal relates to the development or use of land. Energy supply and consumption are major influences on, and are themselves influenced by, population density, the location of new buildings and other features of spatial development. Energy is therefore a consideration for the London Plan.

5.6 Government Office for London circulars and the GLA Act together guide the content of the London Plan. However, Planning Policy Guidance 11 (PPG 11) on Regional Planning[1] represents further government views on

which planning policies constitute best practice at the regional level, and includes guidance on energy-related issues. Although PPG 11 excludes London, much of its guidance on energy is relevant to London. For this reason, and to demonstrate best practice, the Mayor has chosen to comply with it.

5.7 The London Plan operates at three different levels. Some of its policies are general, but relevant throughout London. Some content is concerned with the geography of development of London, including the influence of transport infrastructure and economic development funding. It also includes guidance to the boroughs on the policies in their Unitary Development Plans (UDPs), which are required by the GLA Act to be 'in general conformity with' the London Plan. The Mayor intends to use the powers provided by the London Plan at each of these three levels to influence the more sustainable use and provision of energy in London.

Planning applications referred to the Mayor

5.8 The Mayor has the right to be consulted by London planning authorities and intervene in planning applications of strategic significance. He can use this power to help implement all his policies, not just those in the London Plan.

5.9 The kinds of application referred to the Mayor are specified in the Town and Country Planning (Mayor of London) Order 2000, and include most of the big, strategically significant proposals, as well as small schemes that have significant implications for London as a whole. For example, he will be consulted on housing schemes of more than 500 units; large developments, measured by site area, floor space or height; major transport schemes; certain proposals that depart from the planning authority's UDP; and sites safeguarded by the Secretary of State, for example specified Thames-side wharves.

National planning policy context on energy

5.10 There has been international interest in the relationship between energy and urban planning, but less so in the UK. One reason for this is that energy supply planning in the UK was the responsibility of the large nationalised industries, rather than local government. In Scandinavia, on the other hand, local authorities were in many cases the suppliers of gas, electricity and community heating.

5.11 More recently, increasing onus is being placed on regional and local planning authorities to plan for more sustainable energy. In PPG 11, the Government expects 'two main energy dimensions to RPG: reducing

demand for energy and facilitating the provision of renewable energy'[2]. The Mayor takes both of these forward in the London Plan.

5.12 PPG 11 goes on to recognise the important link between patterns of development and energy demand. It states that 'an energy efficient pattern of development and energy efficient buildings will form an essential part of the UK's response to international climate change agreements and to sustainable development strategies'. As such, 'RPG should promote energy efficiency both in the pattern of development proposed in the Spatial Development Strategy and in the more general advice it may set out for the preparation of development plans. The spatial strategy can assist in the promotion of energy efficiency through encouraging a more efficient use of land and locating major new development in a way which reduces the need to travel, and by facilitating access within and to existing major urban areas by a wide range of modes'.

5.13 Most planning decisions are driven by local considerations, with few requiring account to be taken of national or global consequences. Energy efficiency and renewable energy are both largely motivated by global consequences - climate change and resource depletion - but are implemented locally. It is difficult for the local community to weigh the global benefits fairly against any immediate local disbenefits, such as visual impact, as required by PPG 22 on Renewable Energy. This is why it is critical that regional and borough level planning policies ensure that the non-local and long-term benefits of energy efficiency and renewable energy are given due weight, and the local contribution to reducing CO_2 is recognised. Nevertheless, there are also many local economic, social and environmental benefits arising from the development of energy efficiency and renewable energy, and these also need to be better represented in planning and local decision-making.

5.14 The Government's recent Energy White Paper indicates that the Government 'will be examining how to bring consideration of the use of renewables and energy efficiency in developments more within the planning scope of the planning systems, in the context of the review of PPG 22 and the Government's wider planning reforms, and in a way that does not impose undue burdens on developers'[3]. The Mayor will take the outcome of this work into account.

The Mayor's planning policies on energy

5.15 The London Plan sets out the Mayor's planning policies relating to energy efficiency and renewable energy. Borough UDPs must be in general conformity with these policies. The Energy Strategy provides technical

background and detail to the Mayor's energy-related policies in the London Plan and gives guidance on how they may be adopted and implemented. The energy-related policies in the London Plan are set out in boxes below. Additional policies and text are given in support of those in the plan. The Energy Strategy also provides a means for supporting the London Plan in further developing the Mayor's energy policies that have spatial development implications.

policy 17 Through the London Plan, statutory consultations and planning referrals, the Mayor will work to ensure that, as far as possible, development is exemplary and demonstrates the highest standards of sustainability to deliver the objectives of the Energy Strategy. Boroughs should do the same.

5.16 The Mayor recognises that additional resources could be required to implement this objective and the more specific proposals that follow. Many elements may not incur any extra cost, such as passive solar design, and there are grants and subsidies available for others, such as photovoltaics and solar water heating.

5.17 Energy efficiency measures and renewable energy are at their most economic when installed in new developments, rather than retrofitted. It is important that this opportunity is exploited to ensure that London meets its targets in the most economic way. In comparison to the total development cost, any extra cost of meeting the following proposals will tend to be small. There are further opportunities with Private Finance Initiatives and public private partnerships, as additional costs can be spread over a longer period and the longer-term savings can be taken into account.

5.18 Many of the planning policies that are in the London Plan and the following sections are unprecedented in the UK and introduce a new approach to planning for a more sustainable future. Consultation revealed that they have a great deal of support.

5.19 Application of the planning system constantly evolves as concerns around the built environment change. For example, it is now successfully used to promote affordable housing - not previously considered a planning issue. The Mayor and boroughs are able to pursue objectives through the planning process, where this supports strategic objectives. With increasing national, regional and local objectives on sustainable development and the London Plan's policies on energy (see Box 8), boroughs are expected to adopt pro-active energy planning policies.

5.20 It is important to promote developments that demonstrate sustainable energy. Awareness within the community of higher standards and their

benefits will provide evidence of what is feasible, and could help to raise expectations of minimum acceptable standards.

Energy-related policies in the London Plan

Box 8: London Plan energy policy

London Plan Policy 4A.7 Energy efficiency and renewable energy

The Mayor will and boroughs should support the Energy Strategy and its objectives of reducing carbon dioxide emissions, improving energy efficiency and increasing the proportion of energy used that is generated from renewable sources by:

- improving the integration of land use and transport policy and reducing the need to travel by car (see Chapter 3, Part C)
- requiring the inclusion of energy efficient and renewable energy technology and design, including passive solar design, natural ventilation, borehole cooling, combined heat and power, community heating, photovoltaics, solar water heating, wind, fuel cells, biomass-fuelled electricity and heat-generating plant in new developments wherever feasible
- facilitating and encouraging the use of all forms of renewable energy where appropriate, including giving consideration to the effect of new development on existing renewable energy schemes
- minimising light lost to the sky, particularly from street lights.

The Mayor will work with strategic partners to ensure that the spatial, transport and design policies of the London Plan support the Mayor's Energy Strategy and contribute towards achieving CO_2 and renewable energy targets.

London Plan Policy 4A.8 Energy assessment

The Mayor will and boroughs should request an assessment of the energy demand of proposed major developments, which should also demonstrate the steps taken to apply the Mayor's Energy Hierarchy (see below).

The Mayor will expect all strategic referrals of commercial and residential schemes to 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.

Boroughs should apply the same criteria to major developments.

London Plan Policy 4A.9 Providing for renewable energy

The Mayor will and boroughs should require major developments to show how the development would generate a proportion of the site's electricity or heat needs from renewables, wherever feasible.

London Plan Policy 4A.10 Supporting the provision of renewable energy

The Mayor will support and encourage the development of at least one large wind power scheme in London together with building mounted schemes, where these do not adversely affect the character and amenity of the area. UDP policies should identify suitable sites for wind turbines and other renewable energy provision, such as non-building integrated solar technologies along transport routes, reflecting the broad criteria to be developed by the Mayor in partnership with the Environment Agency and boroughs.

London Plan paragraph 4.21 Renewable energy

Where land is needed for the provision of renewable energy technologies, such as anaerobic digesters and biomass plants, as part of appropriate developments, boroughs should encourage this provision through their inclusion in development briefs and area development frameworks. The Mayor, in partnership with the boroughs and the Environment Agency will produce broad guidelines to define locations where renewable energy schemes would be appropriate and set criteria for the assessment of such schemes. The Mayor will encourage use of renewable technologies. These include photovoltaics and solar water heating, which should be incorporated wherever site conditions make them feasible. Developments not initially incorporating photovoltaics should be of a suitable design and orientation to incorporate them later. The first review of this plan will consider the issues around the proportion of renewable energy that a site will be expected to generate.

5.21 The Mayor's Supplementary Planning Guidance on Sustainable Design and Construction will give further indication on how his sustainability policies will be implemented through the various stages of the planning process, and particularly through development control.

5.22 In cases where building designers do not already have access to specialist energy advice, the Mayor suggests the use of Design Advice to help design more sustainable buildings[4]. Design Advice offers professional, independent and objective advice as part of the Government's Action Energy programme. Clients are offered a one-day general consultancy on a building project, paid for by a cash-back programme. The recommendations also cover the potential commercial benefits.

Additional guidance on the London Plan's energy policies

Planning to tackle climate change

5.23 The significant quantity of new housing and commercial floor space that is expected in London will clearly place additional pressure on London's energy consumption and CO_2 emissions. However, at the same time, it represents an opportunity to improve the performance of London's building stock. New stock is, in general, far more energy efficient than existing stock, and can be made more so by, for example, incorporating renewable energy into its design.

5.24 The high density of London's population, buildings and accessible public transport systems places the capital in the position of being able to support growth in a more sustainable way. The opportunities presented by efficient infrastructure need to be fully exploited during the further development of the capital, without compromising the economy. The London Plan will work towards achieving this.

5.25 A significant amount of new development is needed in London to accommodate the expected population growth of approximately 800,000 by 2016. This equates to 336,000 more households over the next 15 years. In addition a further 11,200 new homes a year are needed to meet London's existing housing needs. To meet this growth the Mayor is looking to increase London's housing output to 30,000 homes a year. This will require building new housing at higher densities in areas with good public transport accessibility, and will also require bringing approximately 25,000 vacant properties back into use[5].

5.26 In addition to new housing, there is expected to be a large increase in office floor space to account for a growing workforce in London. By 2016, this is expected to result in an additional 8.1 million square metres, catering for approximately 460,000 new jobs[6].

5.27 A proportion of all new developments will be referred to the Mayor for consideration, presenting an opportunity for him to influence best practice and sustainable development. Those developments that are not referred to the Mayor will require approval at the borough level, and the Mayor encourages best practice here too.

5.28 The building regulations and a range of national PPGs set the context for making development more sustainable. Only the building regulations are statutory. While PPGs do include guidance on energy efficiency and renewables, this needs to be reflected in local planning policies to have effect. Up to now, this has rarely happened fully, as was demonstrated by ETSU's assessment[7].

5.29 The building regulations ensure that all new buildings achieve set standards of energy efficiency. The Mayor will lobby the Government to raise standards over time. He will focus on London-specific opportunities to demonstrate exemplary practice, and the application of renewable energy not currently required by the building regulations.

5.30 The Mayor proposes to publish Supplementary Planning Guidance (SPG) on Sustainable Design and Construction. This SPG will provide detailed strategic guidance for more sustainable future development across the whole of London, and for sustainable energy in new buildings. The Mayor will expect all applications referable to him to comply with it.

5.31 The BedZED scheme in south-west London (see Case Study 1 in Chapter 4) is an example of how to undertake a sustainable energy, zero-carbon development, which is also a desirable living and working space. Zero-carbon developments such as this satisfy many different environmental and social objectives, and will be a key component in achieving substantial CO_2 emission reductions in the longer term.

5.32 Planning has a key role in implementing the target in Chapter 4 for at least one zero-carbon development in every borough by 2010.

proposal 9 To achieve at least one zero-carbon development in every borough in London by 2010, the Mayor expects each borough to identify at least one suitable site for such development, use their powers as landowners or partners with others to bring about its development, and include the site(s) identified in the next Unitary Development Plan.

5.33 Boroughs can require a zero-carbon development in the development brief for an area of their own land. Following Sutton's example in enabling BedZED, it is possible to release the land at a lower cost, under best value, in order to offset additional costs for such a development. The Mayor urges the boroughs to identify sites that they can release at lower cost for zero-carbon developments.

5.34 Boroughs, and the GLA as the strategic planning authority, may need to consider the value of a zero-carbon development relative to other planning policies. For example, to help absorb any extra cost of such a development, certain compromises may be sought, such as height or density of the development. While all applications should be considered on a case-by-case basis, the Mayor will look favourably upon zero-carbon developments - and looks to boroughs to do the same - which, for the lifetime of this Strategy, will be exceptions in each borough.

Support for such exceptional applications will play an important role in bringing down their costs.

Planning for energy efficiency in new buildings

5.35 In order to be able to appreciate the most effective ways for new developments to save energy and optimise the use of renewable energy, an understanding of expected energy demand is needed. This is particularly important for large commercial and domestic developments, as the scale of opportunity for sustainable energy measures is greater and needs to be more carefully considered.

5.36 In the London Plan, the Mayor states that he will request those applications referable to him to include an assessment of the energy for electricity, heating and cooling requirements of the proposed development. The Mayor requests that applications also demonstrate the steps taken to apply the Energy Hierarchy to ensure that the energy demand of the development will be met in the most efficient way, with the minimisation of overall emissions of CO_2. The boroughs should apply the same criteria to major developments.

5.37 Developers are encouraged to use BREEAM (Building Research Establishment Environmental Assessment Method) and submit the results with the planning application. BREEAM considers all sustainability aspects of a building, not just energy. Nevertheless, like any tool, it does have some limitations.

5.38 Proposers of large developments requiring high power loads should liaise with the appropriate power distribution network operator. This should be done before submitting the planning application, to allow time for the network operator to consider plans for any increase needed in the supply network capacity.

5.39 As outlined in Chapter 4, energy efficiency simply has not featured as a key concern in the design of office buildings, for either the architect or the owner. The environmental services of buildings have tended to be an afterthought, so that air-conditioning needs to be fitted to overcome the effects of inappropriate building design.

5.40 As air-conditioning has such a large and negative effect on the energy consumption of a building, it is vitally important that all new offices incorporate natural ventilation as far as is possible. It is imperative that all new commercial developments utilise passive solar design, natural ventilation, CHP and heat pumps if London is to move towards sustainable energy use in this sector (see Case Study 4 below on City

Hall). Vegetation on walls, roofs, and adjacent to buildings can also assist in cooling buildings in summer and insulating them in winter. Methods to avoid air-conditioning are discussed in later sections on planning for passive design, natural bore cooling, CHP and heat pumps.

5.41 The building regulations ensure that new homes achieve a minimum level of energy efficiency and should be affordable to heat. Housing that is not affordable to heat tends to be in existing stock and not subject to the planning process. Chapter 7 sets out the Mayor's proposals for how London should work in partnership to tackle the existing stock.

5.42 This said, even more still could be done to ensure that heating and cooling systems in new homes are more efficient and provide affordable warmth, particularly for those on low incomes. The Mayor has set a target for 50 per cent of all new housing in London to be affordable, including 35 per cent for social renting and 15 per cent for intermediate housing for people on moderate incomes.

Box 9: London Plan Policy 3A.6 Definition of affordable housing

UDP policies should define affordable housing as 'housing designed to meet the needs of households whose incomes are not sufficient to allow them to access decent and appropriate housing in their borough'.

Affordable housing comprises social housing, intermediate housing and in some cases, low-cost market housing.

UDP policies should ensure that new affordable housing provision seeks to meet the full spectrum of housing need.

5.43 In accordance with the above definition of affordable housing, 'affordable heating' is inherent in housing that is 'designed to meet the needs of households whose incomes are not sufficient to allow them to access decent and appropriate housing'. Even in new buildings which comply with the building regulations and the levels of energy efficiency that these require, the source of heating and its costs can vary. The Mayor requests that boroughs include affordable heating in their interpretation of 'decent and appropriate housing', which can be achieved by following the Mayor's heating/cooling ranking (see the London Plan policy 4A.8 in Box 8).

5.44 The Mayor advocates applying the following heating/cooling ranking method to all new developments - and particularly affordable housing - before the time of planning application. Considering this ranking alongside other factors, for example, technical and financial, factors will help to ensure that the most efficient, affordable heating and cooling system is provided.

5.45 All too often, heating and cooling systems are considered at a late stage in the design process of a new development. To arrive at an optimal heat delivery system, an integrated approach to heat management should be promoted as central to the design of all new developments. It is particularly important to identify opportunities for CHP and community heating early on in the design process, as the associated infrastructure demands are considerable.

5.46 All too often, electric heating is installed in new buildings as the cheapest option. These systems are generally inefficient in the overall use of energy, expensive, and environmentally damaging in terms of CO_2 emissions. While there are safety issues with gas supply to tall buildings, there are preferable alternatives to electric heating. These include community heating, described in more detail later in the chapter.

5.47 It is important to consider energy use implications of other aspects of development, not just buildings. This includes lighting around the development.

proposal 10 Wherever lighting is proposed in developments referable to the Mayor, this should be energy efficient, minimising light lost to sky. Boroughs should expect the same.

Planning for energy efficiency and solar energy in conservation areas

5.48 The buildings within nationally and locally designated heritage areas constitute a sizeable proportion of London's building stock, and have an important role to play in achieving urban sustainability. Visual impact is very important, but so is ensuring active and viable usage of heritage sites, in many cases as homes.

5.49 Planning policy relating to conservation areas sometimes acts as a barrier to energy efficiency in London's housing. These energy efficiency measures could otherwise have a positive effect on the quality of life of occupants, contributing to affordable warmth, reducing noise pollution, and maintaining the integrity of the building fabric, for example by preventing damp.

5.50 In conservation areas - and, for example, 80 per cent of housing in Westminster is in a conservation area - planning permission is often refused for double-glazing and gas boilers where the plume emits onto the street side of the building, on the grounds of visual impact. This can lead to electric heating being installed in poorly insulated properties.

5.51 For similar reasons, solar energy systems are sometimes not allowed on the roofs of housing in conservation areas. Solar energy technology is permitted, provided it does not alter the shape of the dwelling. In conservation areas, the Mayor recommends consent to be given where possible.

5.52 PPG 15 (para 4.19) says that planning decisions in conservation areas have to give a high priority to the objective of preserving or enhancing the character or appearance of the area. The Government says that while this may reduce the scope for the installation of renewable energy technology, it does not preclude renewables and it should not reduce the scope for energy-efficient measures, apart from external insulation.

5.53 Single dwellings receive wide permitted development rights, even in conservation areas, and some measures (for example, secondary glazing) may not even comprise development. However, Article 4 directions allow boroughs to require planning permission for some measures that are classed as permitted development[8]. This means that energy efficiency measures and renewable energy technologies that could be installed without the need for permission are being stopped, on a basis that is currently inconsistent between boroughs.

5.54 While energy efficiency and renewable energy retrofit projects are not normally a concern for planning, for the above reasons, they can be in areas of conservation. It is important that planners work with the heritage sector to overcome tensions between improving the energy performance of existing high-profile and inefficient sites and conserving their character and profile.

5.55 While the current planning policy should not lead to this problem, when applied at the local level, there is an apparent conflict between visual impact and ensuring active and viable usage of heritage sites. This has some bearing on the long-term success of conservation-led regeneration initiatives, and is an important issue for urban renaissance and urban regeneration in heritage areas.

5.56 Boroughs currently do not have consistent policies on energy efficiency and solar energy technology in conservation areas. Some boroughs will not allow these technologies anywhere on housing in a conservation area, others will allow them, but only on façades that do not face onto a public highway.

5.57 The Mayor expects planning authorities to weigh properly the wider social, environmental and economic benefits that energy efficiency and renewable energy may offer against any local visual impact that may occur.

proposal 11 The Mayor urges English Heritage and the boroughs as planning authorities to look actively for ways to reconcile the need for energy efficiency and renewable energy with conserving character. To inform negotiations on individual schemes, boroughs should promote and share experience and expertise on the successful incorporation of energy efficiency and renewable energy in areas of heritage.

Planning for renewable energy

5.58 Chapter 4 proposed renewable energy targets for London. Here, the Mayor sets out how he will work towards meeting these targets, using his planning powers.

5.59 In response to a parliamentary question in March 2000, Nick Raynsford, then Planning Minister, stated 'a positive, strategic approach to planning for renewable energy is essential to help to deliver the Government's targets and goals for renewable energy and climate change, which are central to achieving sustainable development, while continuing to protect the environment"[9]. PPG 11 states more specifically, that 'RPG should assist in the delivery of these [renewable energy] targets by defining broad locations for renewable energy development and setting criteria to help local planning authorities select suitable sites in their plans'.

5.60 Regional Planning Guidance for the South-East, RPG 9, published in 2000, advises that 'using their development control and building regulation processes, local authorities should seek to influence the design of new development to incorporate the use of renewable energy heating or power systems'. PPG 12 states that 'in UDPs, authorities should include their detailed policies for developing renewable energy sources and should identify broad locations, or specific sites, suitable for the various types of renewable energy installations.... Authorities will need to consider both the immediate impact of renewable energy projects on the local environment and their wider contribution to reducing emissions of greenhouse gases'[10].

policy 18 Through the London Plan, planning referrals, and consulting on borough UDPs, the Mayor will encourage and facilitate an accelerated rate of deploying renewable energy to meet London's targets.

5.61 As part of ETSU's assessment of the potential for renewable energy in London, the planning policies of all 33 boroughs were reviewed[11]. The aim of this exercise was to provide an understanding of the nature and extent of existing planning policies on renewable energy. For consistency, the renewable energy content of the UDPs was appraised against a series of policy quality indicators. A full analysis is provided in the ETSU report,

but in summary: the renewable energy content of 43 per cent of UDPs was found to be 'satisfactory'; no plans were considered 'excellent'; 24 per cent were rated as 'good'; the remaining one-third of plans were rated as 'poor'. There is clearly considerable scope for improvement in this area on which the Mayor aims to lead through the London Plan.

5.62 While the Mayor will work to influence those planning applications referable to him, many new developments are only referable to the local authorities. As planning authorities, owners of sizeable building stock and also as awareness raisers, London's boroughs are key to delivering renewable energy targets for London. For this reason, the Mayor requests the boroughs to set renewable energy targets for their areas, to include these in their UDPs, and to implement them using their planning and development control powers.

proposal 12 The Mayor requests boroughs to set targets, consistent with London's targets, for the generation of renewable energy in their areas, to include them in their Unitary Development Plans, and to use their planning powers, land and property control, and awareness-raising activities to meet them.

5.63 The Mayor considers that borough-level renewable energy targets should take into account the number and type of planning applications that the borough receives per year, as well as the renewable energy resources available. This approach would be consistent with one of the key means of implementing the target - through planning decisions - and would reflect the different capacity that each borough has for installing renewables. The London Renewables Group proposes to provide support to the boroughs and develop guidance on setting local renewables targets. This will be done in consultation with the boroughs.

5.64 Many design features and technologies which could contribute to sustainability are not incorporated as standard into buildings, as there is insufficient incentive to do so. Energy costs are often insignificant compared to other costs to business, and particularly to other developmental costs. This is especially true in London where the cost of land is very high. However, this does mean that the additional costs associated with sustainability features, such as incorporating renewable energy plant, can more easily be absorbed. This is particularly so at the development stage, as it would represent a small fraction of total costs. The economics could be made more favourable with longer term management deals, such as private finance initiatives (PFIs), where the investor can appreciate the economic benefits of extra initial costs over a longer period. In any case, new developments offer a huge opportunity

for London's buildings to become more energy efficient and generators of renewable energy.

proposal 13 To contribute to meeting London's targets for the generation of renewable energy, the Mayor will expect applications referable to him to generate at least ten per cent of the site's energy needs (power and heat) from renewable energy on the site where feasible. Boroughs should develop appropriate planning policies to reflect this strategic policy.

5.65 The above proposal supports London Plan Policy 4A.9 and, along with proposals that follow, seeks for each site developed to exploit its full potential for generating renewable energy.

5.66 Developers will be required to demonstrate that they have investigated the feasibility of the range of technologies and measures to meet the target. The Mayor will expect funding and partnerships to be sought in order to assist economic feasibility of a scheme. The import of renewable energy from green tariffs will not count towards the target.

5.67 While the proposal primarily concerns renewable energy, it does encourage higher standards of energy efficiency. The most economic way of meeting the target will be first to reduce the energy demand using cheaper energy efficiency measures. A relatively smaller amount of renewables generation is then needed. Indeed, achieving the ten per cent target may only be feasible with high standards of energy efficiency.

5.68 A number of boroughs have already included similar policies in their UDPs. Furthermore, the UK Business Council for Sustainable Energy has argued to the Government that 'guidance for the development of housing and other buildings should require that, wherever possible, new developments include some form of sustainable energy generation within their design.' The Town and Country Planning Association is also actively supporting the positive planning for urban renewables agenda.

5.69 Many potential renewable energy generation schemes experience resistance through the planning process. Proposers can greatly improve the chances of gaining planning permission through involving those who would be affected by the scheme. This process of consultation is particularly important for highly visible schemes, such as wind turbines. The wind turbine in Swaffham, Norfolk is an example of a project whose success was undoubtedly achieved because of good consultation with the local community.

5.70 Public opposition often results from a lack of awareness of the scheme and the effect it could have on them and their community, as well as a general sense of having no control over the developments that occur near them. Effective consultation can help the community to recognise the benefits that a scheme could bring, and remove the perception that the project is being imposed on them. This could be true, for example, if the community were to benefit from the direct sale of affordable embedded electricity generated by the proposed scheme. If the community feels that it is part of the decision-making process and is able to influence the details of the scheme, then it is more likely to offer its backing, rather than reacting against it later on in the process.

proposal 14 The Mayor expects those presenting planning applications for renewable energy schemes referable to him to conduct best practice in public consultation where relevant, particularly in the case of highly visible schemes, such as wind turbines.

Planning for passive solar design

5.71 Passive solar design involves taking full advantage of the way the local environment - energy from the sun and local air movement - interacts with a building to minimise the amount of energy that the building needs to 'buy in'.

5.72 Given the level of development in London, there is significant potential for the use of passive solar design. It has wide benefits and applicability to London, and consequently, the Mayor strongly supports it. Passive solar design is a proven and economic 'best-buy' option for significantly reducing building energy requirements and CO_2 emissions.

5.73 When people experience passive solar design, they generally react positively. People who live and work in such buildings nearly always like them, and these buildings can offer more comfortable and healthier conditions. As passive solar design can avoid the need for electrically-driven air-conditioning systems, any health concerns regarding the quality of air from such systems can also be avoided. It can also reduce noise, particularly in commercial buildings, by avoiding the need for fans or other mechanical systems. If London is to meet the challenging 2050 CO_2 emissions reduction target, it is critical that homes are designed to avoid the need for electric air-conditioning, particularly as ambient temperatures are expected to rise over time.

5.74 Passive solar design should also incorporate vegetation on building surfaces, as well as adjacent landscaping where possible. Vegetation on walls, for example, can assist in cooling buildings in the summer and

insulating them in winter[12]. In summer, shading reduces solar gain on a building's façade, and additional cooling is provided by evaporation and transpiration. In winter, evergreen species reduce convectional heat loss, though energy savings are more pronounced on less well-insulated buildings[13]. Similar energy benefits can be realised by green roofs, which, along with green walls, offer benefits for biodiversity, sustainable urban drainage, aesthetic appearance and noise[14]. These benefits are apparent at the new Creekside Education Trust building in south-east London (see case study below).

Case Study 3: Creekside Education Trust building, Deptford

Set alongside Deptford Creek in south-east London, the building utilises the principles of passive solar design and other features of sustainable design and construction. The architects, Alexander-Sedgley, incorporated high and low-level windows for natural ventilation, south-facing roof lights to passively heat the entrance and exhibition space, natural fibre wall insulation and underfloor heating provided by a CHP generator. The entire roof is covered in recycled aggregate/soil mix to encourage the natural colonisation of plants, and the whole scheme is a showcase for wasteland biodiversity conservation. Rainwater is collected and used for flushing the toilets.

5.75 Most passive solar designs present no special visual or other planning problems. However, planners do need to recognise that achieving reductions in CO_2 emissions may require placing and aligning buildings in particular ways. While passive design in buildings may *affect* its appearance, it does not *determine* it. There are as many 'looks' for a passive solar building as there are for any other type of building, from London's City Hall (See case study 4 below) to Portcullis House in Westminster.

5.76 The importance of considering energy issues early on in the design process was emphasised earlier. This is particularly true for passive solar design, in which orientation and internal design both greatly influence the opportunities.

Case Study 4: London's City Hall

The building's orientation and form have been designed to save energy. Its shape is derived from a geometrically modified sphere, a form that contains the greatest volume with the least surface area. The glazed façade of the Assembly Chamber faces north to minimise the amount of direct sunlight falling on it and so minimise solar gain. The building leans back towards the south, where the floor plates step outwards to provide natural shading for the offices beneath.

The building has a highly integrated system of environmental controls to minimise its energy use. Opening vents positioned below the windows can naturally ventilate the perimeter office spaces. The building's cooling system utilises cold groundwater, pumped up via boreholes from the water table and passed through chilled beams in the ceilings; this avoids the need for noisy and unsightly chillers on the roof. Analysis indicates that, as a result of the combination of these energy-saving devices, the annual energy consumption for the building's mechanical systems will be approximately a quarter of that of a typical high-specification air-conditioned office building.

proposal 15 The Mayor requires planning applications referable to him to incorporate passive solar design, natural ventilation, borehole cooling and vegetation on buildings where feasible. Boroughs should expect the same.

proposal 16 The Mayor expects consideration to be given to the effects of proposed new developments on existing renewable energy schemes, for example by overshadowing, and reasonable steps to be taken to minimise any such negative impact.

Planning for heat pumps

5.77 Heat pumps represent a highly efficient way of generating heat from electricity as they deliver two to four times more heat energy than they consume in electrical energy. A heat pump uses the same technology as a refrigerator and essentially operates as a fridge in reverse - it works by extracting available heat from the outside air, ground or water and transferring, or 'pumping', it inside the building. Heat pumps can also operate in reverse and work to cool buildings by extracting heat from the inside and pumping it outside.

5.78 Although a heat pump takes energy from the surrounding environment and can therefore be described as utilising renewable energy, it requires an energy input in order to function. If this electricity comes from a renewable energy source, then the heat generated by the heat pump becomes 100 per cent renewable - and in this context it provides a way of

not only converting renewably generated electricity into heat, but also of increasing the amount of renewable energy that is captured.

5.79 In the short and medium term, the majority of heat pumps will be powered with electricity from the national grid, which is predominantly fossil fuel in origin. However, even when using national grid electricity, ground-sourced heat pumps represent a lower carbon heating source than conventional heating systems, and have far lower CO_2 emissions than conventional electric heating. For example, compared with a gas condensing boiler, heat pump systems result in around lower CO_2 emissions[15]. When compared with a new oil-fired boiler system or an all-electric system, CO_2 emissions are cut by more than 40 per cent and nearly 60 per cent respectively[16].

5.80 The UK domestic heat pump market is currently very small, with approximately 3,000 systems being installed during the entire course of the 1990s. Nevertheless, heat pump systems in houses are not overly expensive and are comparable with the cost of installing a conventional gas heating system. They also tend to have a long life and low maintenance costs. The industry is fairly well developed on the Continent and in the USA, and heat pumps are a proven and reliable technology. Depending on the size of the system that is installed, heat pumps can sometimes require backup space and water heating capacity at the coldest times of the year.

5.81 Although it is clear that heat pumps could have a role in reducing London emissions, it is not so clear where and when heat pumps should be deployed in homes across London. In what circumstances are heat pumps more appropriate than CHP or gas condensing boilers? Heat pump systems could play a useful role as a replacement for standard electric heating, where they can deliver up to 60 per cent in CO_2 savings, or as energy-efficient heating for apartment blocks where gas central heating is less favoured for safety reasons. They could also be used to achieve a zero-carbon heating system when used in conjunction with green power. The Mayor will observe the future uptake of heat pumps and consider the most appropriate conditions in which they should be promoted.

Planning for solar power and solar water heating

5.82 Solar energy represents one of the biggest opportunities for London, mainly because it can be integrated within, or mounted onto, one of London's most abundant resources - its buildings. Whereas in many applications, such as new build, solar energy can be economical, in many retrofit situations it can still be expensive. Costs are predicted to continue to come down over time, in which case solar energy should make a more

substantial contribution in the future. Nevertheless, installations that are put in today will play an important part in helping to bring down costs and establishing the industry.

5.83 Once installed, solar water heating and photovoltaics provide cost-free, emission-free, noise-free energy and take up little, if any, extra space. The technologies are well-proven, with high costs - more so for photovoltaics (PVs) - being the only current real barrier to its wider use. However, with increasing production, costs will continue to fall. The Mayor will strongly promote and facilitate the deployment of solar energy. The objective of this strategy is to provide a suitable positive policy context to aid this process.

5.84 As part of a renewable energy target for London, the Mayor proposes specific targets for PVs and solar water heating systems. Proposers of new buildings should recognise that they have a contribution to make towards meeting these targets.

5.85 New buildings have a design life beyond 25-30 years. Buildings need to be designed to anticipate and accommodate the potential deployment of solar energy technology during their lifetime, as it becomes cheaper. Where solar energy technology is not integrated into new developments for economic reasons, buildings should be designed to accommodate it at a later stage incorporation, through suitable orientation wherever possible.

5.86 PVs come in thin panels or tiles mounted on a wall or roof. In commercial buildings, the panels can act as cladding, replacing similar-looking materials, such as smoked glass or marble. In prestige commercial and residential developments, the extra costs of PVs can be more easily absorbed into the total cost of development. Considerable savings can be made when PVs are building-integrated, eliminating the cost of conventional cladding and special support structures. In such cases, the solar power is effectively supplied to the building free or at a low cost. These favourable opportunities for employing PVs should not be missed.

5.87 PVs are already the cheapest means of supplying electricity to a range of small-scale applications that are not connected to the grid. This is often true for applications such as bus shelters and stops, parking ticket meters, road signs, telephone boxes and closed-circuit cameras, where the nearest grid connection point is some distance away and often very expensive to connect to. As other applications, such as street lights, become more efficient, combined with the falling costs of PVs, off-grid niche opportunities will become more abundant. Avoiding connection to the grid also avoids the need to dig up the roads, reducing congestion,

disruption and costs to the public, business and the local environment. Battery back-up ensures that the power supply is reliable and available at night. Examples of such applications exist in the capital, such as PV-powered street lights in Wood Green, parking ticket machines in Ealing, railway points in Waterloo station, and Trinity House's buoys and markers in the Thames.

5.88 Planning applications referred to the Mayor will be required to have investigated the feasibility of using PVs to power appropriate applications.

proposal 17 The Mayor requires all planning applications referable to him to incorporate solar water heating and photovoltaics, where feasible. Developments not initially incorporating solar technologies should, where practicable, be of suitable design to support them later. Applications considering prestige cladding should incorporate photovoltaics where feasible. Applications including new street appliances (eg bus shelters, bus stops, parking ticket machines and road signs) should incorporate off-grid solar power where feasible. Boroughs should apply the same policies.

Planning for wind power

5.89 The London Plan includes a policy to support and encourage the development of wind turbines of all scales in London (see Box 8). Boroughs are also advised in the London Plan, while reviewing UDPs, to identify suitable sites for wind turbines of all scales where they will encourage such schemes. There is potential for wind power in London, both to contribute to the grid and to provide additional power to individual buildings. There is scope for single, large-scale commercial wind turbines, or groups of such turbines, where suitable open space is available and wind speeds are high enough to generate electricity cost-effectively.

5.90 The advantages of wind power for London include: the potentially considerable provision of decentralised, cost-effective, carbon-free electricity; the contribution to local, national and international targets for renewable energy; the reduction of London's ecological footprint; and the awareness-raising potential of high-profile schemes. In the longer term, embedded renewables such as wind power will be needed to complement the development of a hydrogen infrastructure in London.

5.91 The Mayor believes that wind turbines have a positive contribution to make to London's energy system, providing that careful attention is paid to the choice of technology and location for these installations. Applications for wind turbines are likely to require Environmental Impact Assessments in accordance with the relevant regulations[17].

5.92 Renewable energy plant within and outside London should minimise its negative effect on local environments and communities. To ensure the success of wind power in London, consideration must be given to the potential negative effects of wind turbines. Large wind farms in particular should be sited carefully to avoid conflict with local heritage and biodiversity[18]. The key sensitivities are visual amenity, noise, biodiversity and public safety, all of which are influenced by the number, type and precise location of the turbines.

5.93 Visual impact is a subjective issue, and although many people view wind turbines positively and are happy living alongside them, others may object to the visual intrusion. One aspect of this is the flicker effect that can occur when turbine blades reflect sunlight. This can have implications for road safety but, for example, can be avoided through careful site design. On the other hand, it should be noted that wind turbines could also add amenity value, for example through the inclusion of public viewing facilities from the top of the turbine towers.

5.94 Wind turbines, particularly in large coastal and offshore wind farms, have been shown to affect local biodiversity. Breeding, wintering and migrating birds have been particularly affected by some schemes. However, it is widely agreed that negative effects on birds can be avoided if turbines are placed at a suitable distance away from sensitive sites[19]. In London, this applies particularly to Sites of Importance for Nature Conservation, including the Thames. The Mayor's Biodiversity Strategy makes it clear that these sites should be protected from harm. This said, the sensitive management of land shared with turbines could provide opportunities for the conservation and enhancement of biodiversity and other open space users, for example on brownfield land in the Thames Gateway.

5.95 Large turbines require a separation distance from dwellings, airports and other development, not just from a height perspective, but also for the radio waves that they reflect. Government guidance exists on these issues and should be followed during the early stages in the development of any wind turbine scheme. Airports and National Air Traffic Control Services must be consulted on proposals for wind turbines that lie within 30 kilometres of them.

5.96 The noise generated by wind turbines also needs to be considered. However, during the last ten years, technological developments have successively reduced both the mechanical and the aerodynamic noise that results from their operation. Considerable data exists on the performance of horizontal axis turbines, and there are guidelines for the separation of

large wind turbines from residential spaces, which should be considered for London[20].

5.97 Providing that these sensitivities are taken into account, the Mayor encourages the development of wind power schemes at a range of scales in London, including large turbines, medium-sized turbines and smaller building-mounted installations. Potentially suitable sites include industrial areas and particularly riverside locations in industrial or commercial use, where wind speeds are likely to be at their highest. Wind turbines may also be compatible with low-density leisure areas, particularly if viewing platforms are integrated into the turbines to add amenity.

5.98 In Chapter 4, the Mayor proposed a target for at least six turbines of 1.5MW (megawatts) in different suitable industrial or riverside sites, and suggests that this target could reasonably be higher. Six turbines could generate up to 20GWh (gigawatt-hours) per year - enough to power 6,000 homes. If located in areas of high wind speeds, for example in the Thames Gateway, even more energy could be generated.

5.99 The Mayor also proposes in Chapter 4 that up to 500 small-scale grid-connected systems are deployed across London, which could give a resource of up to 1MW by 2010. Small wind turbines are suited to the more densely developed parts of the urban environment and can range in size from a few watts to 20kW (kilowatts), although an average capacity of 2kW is assumed. Domestic-sized, grid-connected wind turbines of up to 2kW demand less space and infrastructure than larger turbines. They can be accommodated in school grounds or in a large garden. One wind turbine manufacturer has designed a 2.5kW turbine with low noise emissions specifically for urban areas, with the potential for integration into buildings, ie mounted on a flat roof. Innovative building design integrating wind turbine technology is also encouraged. The potential for building-integrated turbines is still unknown, but in time could contribute sizeable amounts of local emission-free energy.

5.100 The smallest turbines are generally used for off-grid applications, charging a battery that then feeds power to the application, for example. One possible application in London could be powering new street lights, perhaps in combination with PV panels. Street lights are available which have been specifically designed for this, although the urban settings can lead to overshadowing of both solar panels and wind turbines. Most of these systems are small - a few hundred watts or less - so while there is a potential for hundreds of them to be installed, they will only make a small contribution in terms of installed power. The resource is estimated to be between 5kW and 500kW.

5.101 Although turbines supplying power to dwellings are eligible for reduced VAT (five per cent), capital costs are relatively high. Consequently, they are unlikely to be cost-effective in the short term, particularly considering the relatively low wind speeds in many residential parts of London.

5.102 Sixty large-scale wind turbines are currently proposed on two offshore sites beyond the Thames Estuary - 30 on Kentish Flats, located off Whitstable/Herne Bay, and 30 on Gunfleet Sands, off Clacton-on-Sea. In both cases, the nearest turbine to shore is likely to be located at least seven kilometres away. Although these sites are outside the Greater London boundary, it will be an important demonstration close to the capital. They will also offer opportunities for London to purchase more of its electricity from wind power.

Planning for power from biomass and biodegradable wastes

5.103 London produces about 17 million tonnes of waste every year. Of this, 4.4 million tonnes is collected by local authorities from households, as well as some commercial and industrial sources, and is classified as 'municipal waste'. The vast majority of municipal waste (73 per cent) is disposed of to landfill, with 85 per cent of this going to sites outside Greater London. A further 19 per cent of municipal waste is currently incinerated at the two waste incineration plants within London (at Edmonton and at SELCHP in Lewisham), where electricity is generated.

5.104 In September 2003, the Mayor launched his Municipal Waste Strategy[21], through which he will implement his policies on the recovery of energy from waste. Section 4E of the Municipal Waste Strategy describes these policies, which are listed in the box below. A background explanation follows, with more details being in the strategy.

Box 10: The Mayor's policies and proposals on energy recovery from waste, taken from the Mayor's Municipal Waste Strategy.

Policy 17: Where waste cannot be reused, recycled or composted, value should be recovered in the form of materials and energy. In the case of energy, this should be done using a process that is eligible for Renewables Obligation Certificates, maximises the efficiency by using both the heat and the electric power, and minimises emissions of pollutants to all media.

Policy 18: The Mayor will support proposals for the treatment of residual waste through new and emerging advanced conversion technologies for waste or new waste treatment methods.

Proposal 29: The Mayor will support proposals for and work with key stakeholders to introduce new and emerging advanced conversion technologies for waste (for example, anaerobic digestion, gasification or pyrolysis) which satisfy the requirements of the Renewables Obligation Order 2002, supplying electric power and wherever possible also heat, and minimise the quantity of hazardous solid residues.

Proposal 30: The Mayor will support proposals for and work with key stakeholders to introduce new waste treatment methods such as Mechanical Biological Treatment and the production of biofuels to be used in London.

Proposal 31: The Mayor will encourage the development of anaerobic digestion plants, which treat segregated biodegradable waste and produce a digestate suitable for agricultural and horticultural use.

Proposal 32: The Mayor will support the use of waste wood as a fuel, or for producing fuel. This will contribute to meeting the requirement of the Landfill Directive to reduce biodegradable waste to landfill and will also help London contribute its share to meeting the national renewable energy targets.

Proposal 34: The Mayor will work with LondonWaste Ltd and SELCHP, the waste authorities and local industry to explore the opportunities to develop heat distribution networks to supply heat from the existing incineration plants to housing, commercial and public buildings in the vicinity.

Proposal 36: Having regard to existing incineration capacity in London, and with a view to encouraging an increase in waste reduction, reuse, recycling and composting and the development of new and emerging advanced conversion technologies for waste and new waste treatment methods such as Mechanical Biological Treatment, the Mayor will support

and encourage these waste management methods in preference to any increase in conventional incineration capacity. Each case, however, will be treated on its individual merits, having regard to the Best Practicable Environmental Option and whether it meets the requirements of the Renewables Obligation Order 2002. The aim is that existing incinerator capacity will over the lifetime of the plan, become orientated towards non-recyclable residual waste.

5.105 A significant proportion of the waste stream is organic, ie it originates from plant and animal matter. Where electricity is generated from biomass, it may count towards meeting the national renewable energy target and be eligible for the Renewables Obligation Order 2002. Energy may be recovered through some processes, such as anaerobic digestion and pyrolysis, in the form of gas. This gas may then be used directly as a fuel, for electricity generation, as a chemical feedstock, or to produce hydrogen as a fuel. Such processes can offer advantages of long-term flexibility.

5.106 The Mayor's Municipal Waste Strategy states that once all the waste that can be reused, recycled or composted has been removed from the waste stream, value should be recovered from the remainder in the form of other materials and energy[22]. In the case of energy, this should be done using a process that is both eligible for the Obligation, maximises the efficiency through use of CHP and minimises emissions of pollutants to air, land and water. Combustion processes not eligible for the Obligation should not be used to recover energy from waste. The Mayor will work with key stakeholders to encourage the development of new and emerging advanced conversion technologies in London which meet these objectives.

5.107 Under the Obligation, the Government has brought together a group of new and emerging technologies under the term of 'advanced conversion technologies'. The definition specifically includes anaerobic digestion, pyrolysis and gasification. The Government views this approach as consistent with its support for waste reduction, recycling and reuse while supporting the development of more efficient and environmentally benign energy conversion from biomass. These new technologies are largely compatible with pre-separation of recyclable material from the waste stream and are well suited for community-sized developments.

Anaerobic digestion

5.108 One technology that can successfully treat the organic fraction of wastes is anaerobic digestion. This has been used for centuries to manage wastes and generate energy. It is widely used in Asian villages, where the climate is suitable for low-technology designs, to produce biogas that is then used for heating and cooking. More recently, it has been developed into

an industrial process for large-scale waste treatment and energy recovery, although with the exception of sewage sludge treatment, most of the examples are outside the UK.

5.109 Anaerobic digestion is the bacterial fermentation of organic material in the absence of oxygen. This produces biogas, which is typically 65 per cent methane, 35 per cent carbon dioxide. This biogas can be burned directly in modified gas boilers or internal combustion engines. Between 40 and 60 per cent of the organic matter present in the waste is converted to biogas. The remainder consists of an odour-free residue, which has an appearance similar to peat and a commercial value as a soil improver or growing medium.

Box 11: Anaerobic digestion in London

Anaerobic digestion has been used in London for many years for the treatment of sewage sludge prior to the dumping of the residue at sea. When sea disposal was discontinued in 1998, the two east London anaerobic digestion plants were no longer needed and have remained idle since. However, part of the plant could be converted for the digestion of biodegradable waste at a lower cost than the construction of new facilities. The main sites are at Beckton in the London Borough of Newham and Crossness in the London Borough of Bexley. Each of these sites could process some 220,000 tonnes per annum of biodegradable waste. In addition, there is potentially spare capacity at Mogden (London Borough of Hounslow), which continues the digestion process and recycles the product to agriculture. Mogden could potentially process 90,000 tonnes per annum. Beddington (London Borough of Sutton) is also a site with strong potential for anaerobic digestion, provided that additional digestion capacity was constructed. All the sites except Mogden have land available to accommodate new equipment for the separation of the biodegradable material from other waste. The total potential for digestion at London sewage works is in excess of 600,000 tonnes per annum.

5.110 Biogas produced from anaerobic digestion needs some treatment to remove hydrogen sulphide and reduce the moisture content before it can be burned in boilers or engines. Where it is used to generate electricity, it can be eligible to earn Renewables Obligation Certificates. A longer-term option for London could be to convert the gas to hydrogen for use in fuel-cell vehicles. The conversion of biogas to hydrogen for use in a fuel cell has been successfully demonstrated, for example at the Hokubu Sludge Treatment Centre in Yokohama[23]. In this case, the fuel cell produces electricity for use in the treatment works, but the gas treatment

system could produce hydrogen for fuel cell-powered refuse collection vehicles, buses or taxis.

5.111 In addition to the larger-scale anaerobic digestion facilities that might be developed through the adaptation of former sewage treatment plant, there is scope for the development of smaller-scale community-based schemes. The biogas produced could be used in small CHP plants with the electricity and heat supplied to surrounding buildings. ETSU estimated in its report entitled *Development of a Renewable Energy Assessment and Targets for London* that the anaerobic digestion of municipal waste could provide 1.6MW of electrical generation capacity by 2010.

Gasification and pyrolysis

5.112 Thermally treating waste can unlock its energy value, either directly as heat or by producing solid, liquid and gaseous fuels, which can be used in other processes. Waste's volume and weight is reduced in the process and its hazardous properties, if present, can be reduced. Advanced thermal treatment processes include gasification and pyrolysis.

5.113 Pyrolysis is the thermal degradation of waste, without an oxidising agent (eg air or oxygen), into gaseous, liquid and solid products which can then be used as a fuel. Usually operating in temperatures between 400°C and 800°C, it results in a solid 'char', comprising carbon and other carbon-based organic compounds, and gas, which can be used as a fuel. Pyrolysis has been under development for many years with pilots operating since the 1970s. There are now commercial-scale plants in full operation, eg RWE Umwelt's Contherm pyrolysis plant adjacent to the coal-fired power station at Hamm-Uentrop[24].

5.114 Gasification is similar to pyrolysis, except that the feedstock is converted into a gas by partial oxidation at temperatures in the range 800°C to 1,600°C, depending upon the oxidising medium, which is usually air. If normal municipal solid waste is used as the feedstock, the gas produced is a mainly a mixture of carbon monoxide, carbon dioxide, hydrogen, methane, water and nitrogen, with a calorific value of about 10MJ/Nm3. If oxygen-enriched oxidation conditions are used, the calorific value can be as high as 15MJ/Nm^3. (Natural gas has a calorific value of about 39MJ/Nm3).

5.115 Small-scale waste-to-energy gasifiers are available that use a range of feedstock, including wood, poultry litter and sewage sludge. The fuel gas produced is used to power gas engines that drive electric generators or pumps. A recent example is BedZED in Sutton, which uses locally sourced woodchips in a CHP plant.

5.116 Gasification is not a new process, having been used in the past historically to gasify coal in order to produce 'town gas'. The use of gasification for waste has received increasing attention during the last quarter-century, but it is only recently that full-scale commercial plants have come into operation. A 225,000 tonnes per annum plant, using a combination of pyrolysis and gasification known as Thermoselect-HTR, began operation in Karlsruhe, Germany in 1999. These plants demonstrate a large-scale treatment of waste in direct competition with incineration. A second plant is in operation at Chiba, Japan, and two plants use a similar process, known as R21 (Recycling in the Twenty-First Century). One plant in Chikugo handles 82,000 tonnes per annum, the other in Toyohashi 164,000 tonnes. Several more plants are under construction in Japan.

5.117 The air pollutant emissions from modern gasification and pyrolysis plants can be less than ten per cent of those permitted under the EU Incineration of Waste Directive, and modern pyrolysis and gasification plants minimise the quantity of hazardous solid waste that requires landfilling. The problem with conventional incineration plants is that pollutants, such as heavy metals, are removed from the flue gasses and then require disposal as hazardous solid waste. A small amount of dioxins can also be produced in the flue gas stream, though this is also largely removed via the flue gas treatment and then has to be disposed of as part of the hazardous solid waste.

Biofuels

5.118 Biofuels are currently made from food crops. The Government states in the recent Energy White Paper that 'we are also interested in supporting the development of bioethanol and biodiesel production from biomass such as farm wastes, forestry residues, coppice crops and possibly also domestic waste. These can potentially deliver bigger carbon savings and wider environmental, farming and rural employment benefits'. The EU has put forward an objective to substitute 20 per cent of traditional fuels alternatives for the road transport sector by the year 2020, which has lead to a draft directive on the promotion of biofuels[25]. The Government announced in 2002 that it proposes to introduce the same 20 pence per litre incentive for bioethanol, subject to EU agreement. This can also be used in blends for existing cars, and potentially as an 85 per cent pure biofuel in adapted cars[26]. Currently, the most commercially viable production of bioethanol is from waste, due to the avoided costs of landfill and landfill tax. The Mayor's Municipal Waste Strategy discusses biofuels in more detail.

5.119 The production of bioethanol could be a useful partner technology to anaerobic digestion. Anaerobic digestion is not well suited to processing

woody wastes, whereas ethanol production converts cellulose and starch to glucose, which is then fermented and distilled to produce the ethanol. The process can handle waste such as wood with lead paint, boron-based fire retardants or fungicides because heavy metals are settled out.

5.120 While the production of bioethanol from crops is not currently commercially viable, its production from waste could be viable when the avoided costs of landfill and landfill tax are taken into account.

Wood wastes as fuel

5.121 London has many trees. Around five per cent of London is woodland[27] and there are many trees in streets, gardens and parks. A study of the potential for supplying biomass fuel from arboricultural operations in London, produced for the London Tree Officers Association by Econergy, estimated that 106,000 tonnes per annum of wood for fuel could be recovered. At present, much of this goes to landfill (for example the London Borough of Tower Hamlets reports that 6,000 tonnes of timber waste is transported via the River Lea to landfill sites) and is classified as household, municipal or commercial waste, depending on how it enters the waste stream.

5.122 Around 11 per cent of civic amenity waste is wood and sawn timber, some of which could be used as fuel. Clean wood, for example wood from gardens, can be collected separately at civic amenity sites and be used in the same sort of schemes as the wood from arboricultural operations. The removal of these wood wastes from the waste stream would make a significant contribution to meeting the requirements of the landfill directive to reduce the volume of biodegradable waste. However, wood contaminated with paint, preservatives and adhesives cannot be mixed with this 'clean' wood, as contaminated wood can only be burned in boilers and stoves that have been approved under the clean air legislation for this purpose.

5.123 Wood-fuelled plant may vary in scale from small boilers in individual buildings to large-scale power plants. In London, the sources of wood fuel are dispersed and plants are therefore likely to be on the smaller scale. London is subject to smoke control orders that limit people to using authorised fuels - electricity, gas and solid smokeless fuel. While wood is not an authorised fuel, as burning it will inevitably produce smoke, there are closed wood-burning stoves that have been 'exempted' from the controls, as they are capable of burning wood without producing smoke.

5.124 Proponents of energy crops argue that fast-growing plants such as willow, and grasses such as elephant grass, can be grown in London to provide

solid fuel for CHP or liquid fuel for transportation. Several biocrop electricity generation plants already exist in the UK[28]. Potential new schemes in London should aim to enhance local farmland biodiversity, as encouraged by the Mayor's Biodiversity Strategy.

5.125 ETSU estimated in its report *Development of a Renewable Energy Assessment and Targets for London* that the quantity of potential clean wood fuel that could be recovered from civic amenity sites is ten per cent of the quantity of waste passing through the civic amenity site system. This gives about 50,000 tonnes per year of suitable material across London. ETSU estimated actual and prospective biomass arising from forestry and energy crop (short rotation coppice) sources in and around the Greater London area. The results are given in the table below.

Table 7 Wood arising from forestry operations in and around London

Source	Location	Existing wood (tonnes per annum)	Coppice (tonnes per annum)
Forestry operations and prospective short rotation coppice	Within London	2,195	120
	Within 40 km of the perimeter of London	63,441 (which could generate up to 12. 7 MWe)	174,900 (which could generate up to 35 MWe)

source Development of a Renewable Energy Assessment and Targets for London, GOL, GLA, ALG, December 2001

5.126 Various projects are under way in London to find new uses for 'waste' timber and brash arising from the management of local woodlands and street trees. They include charcoal production, chipping and the setting up of 'timber stations' to collect wood for transfer to large wood-burning plants outside London. In London, the BedZED development at Beddington, Sutton uses locally sourced woodchips in a CHP plant.

Existing incineration

5.127 In 2001 - 2002, London incinerated 19 per cent of its municipal waste in two plants that generate electricity. Although the capacity of the plants is 950,000 tonnes per annum, equal to 21 per cent of London's municipal waste in 2001 - 2002, both plants take in commercial waste and other municipal waste from outside London.

5.128 Conventional incineration plants are relatively inefficient in generating power. However, if heat is supplied to community heating schemes or

industry, the overall efficiency is greatly improved. The SELCHP plant was conceived as a CHP plant that would supply heat to the many existing community heating schemes nearby. However, the plant was constructed without the heat supply network. Although the Edmonton plant was planned as an electricity generating plant, the potential for heat supply has been investigated on a number of occasions. The Mayor believes in the benefits of community heating and CHP and supports the development of heat supply networks.

5.129 London's waste incineration plants are now required to operate to far stricter standards than those that were in place when the Edmonton plant first began operation in 1971, due to progressively more stringent regulations controlling their operation and emission levels. In 2000, the EU adopted a new directive on the incineration of waste, which sets significantly lower emission limits to be met for new plants by the end of 2002 and for existing plants by the end of 2005. SELCHP and LondonWaste Ltd are making the results of air pollution monitoring available on the internet. Despite significant reductions in emissions from waste incinerators, there is continuing public concern about the emissions of heavy metals and persistent organic pollutants, such as dioxins. The Environment Agency is evaluating techniques for the continuous monitoring of dioxin emissions. The Mayor will keep this work and other developments in emissions control, monitoring and health consequences under review and, where appropriate, press the organisations responsible to adopt new techniques. Londoners need to be reassured that sufficient measures are being taken to protect their health.

5.130 Incineration reduces the volume of waste by about 90 per cent and its weight by 65-70 per cent. Most of the residue is in the form of bottom ash, the remainder consisting of air pollution control filter residues (fly ash). Air pollution control systems minimise the release of fine particles, heavy metals such as mercury and cadmium, as well as organic compounds such as dioxins. Recently there have been developments in the reuse of bottom ash as a building material, reducing demand on virgin materials, and further reducing the amount of waste going to landfill. The Municipal Waste Strategy contains more details on this issue of bottom and fly ash.

New incineration capacity

5.131 Combustion of unsorted waste comes at the bottom of the hierarchy of waste recovery methods. The construction of new conventional incineration plant would not contribute to achieving either the national recycling objectives nor national renewable energy targets and it would presuppose a failure to achieve recycling targets at the local level. To

argue in favour of further conventional incineration of unsorted waste at this stage is, by implication, to expect the worst possible outcome from the uncertainties about the growth in waste, no improvements in recycling, and a failure to develop new technologies.

Landfill gas

5.132 As well as being the least sustainable waste disposal option available, landfilling biodegradable waste is also a major source of methane. Methane is a major greenhouse gas, more than 20 times more potent than CO_2. The gas which is produced in landfill sites (40-60 per cent methane) when organic materials in waste decompose, can be collected and used as a fuel for producing heat, generating electricity or both. Around eight per cent of London's renewable energy currently comes from landfill gas and the Mayor believes that waste disposal authorities should encourage the use of landfill gas as a renewable energy source. However, as progressively more biodegradable waste is diverted from landfill in accordance with the targets set by the landfill directive, the future capacity of this renewable energy source is set to diminish.

5.133 More than 40 landfill sites in London are currently accepting waste, or have only stopped receiving it in the past few years, and any contract that includes the landfilling of municipal waste should involve the production of energy. Since November 2003, Thames Water has been generating a further 5MW at its Beddington landfill site in Sutton. The electricity generated is used to power equipment on site. The remainder is exported to the national grid.

Planning for hydro and tidal power

5.134 Small-scale hydropower - where the power of water flowing through turbines is used to generate electricity - can typically be situated on rivers or be included within reservoir dams. A number of small-scale hydro schemes have been investigated and developed in London. St Joseph's RC School in Wandsworth receives power from a micro-hydro scheme on the nearby River Wandle. The London Borough of Brent commissioned a feasibility study into a hydro scheme in the Welsh Harp reservoir in 1997, but did not have adequate funds to take it forward. ETSU, in its report *Development of a Renewable Energy Assessment and Targets for London*, considered the urban and relatively flat terrain of London to have little potential for significant energy generation from hydropower. However, it does propose that a nominal number (zero to three) of small schemes might emerge within London during the period to 2010.

5.135 Running through the centre of London, the Thames experiences a sizeable tidal range. This raises the question of whether tidal power would

be appropriate, especially considering the size of the flood barrier already in place at Woolwich Reach. Tidal power was historically significant in London. For example, Three Mills on the River Lea in Bow, east London, built in 1776, is the largest tidal mill still standing in Britain. However, London's mean tidal range is unlikely to be high enough for it to be considered seriously as a location for energy-generating tidal barrage technology, even beyond 2010. Furthermore, vessels navigate in and out of the Thames every day, and these would have to pass freely through any barrage.

5.136 There are also major environmental concerns associated with the use of barrages. Typically they result in the loss of inter-tidal habitats, present an increase in flood risk, cause upstream siltation and require a high level of inspection and maintenance. For these reasons, it is unlikely that any barrage-based schemes will prove to be acceptable or viable. However, the upgrading or replacing of existing flood defences could be used as an opportunity to look more closely at the prospects for barrage-based energy production and consider these alongside environmental concerns.

5.137 Tidal stream is a relatively new energy technology, which relies on a different approach to tidal barrages. Tidal barrage schemes use the rise and fall of tides to store water behind a barrage, which is used to produce electricity as it flows back to the sea. On the other hand, tidal stream technology extracts energy from the flow of the currents produced from the rise and fall of the tides. These currents usually have a low velocity, but this depends on the local topography. The best sites have narrow straits with strong currents, making the Thames unlikely to be a suitable site. The technology is still to be proven through demonstration, especially in respect of likely costs. Nevertheless, it is important that the technology's progress is monitored, and considered for London in the future.

Planning for combined heat and power and community heating

5.138 The London Plan includes a policy stating that the Mayor requires planning applications referable to him to include CHP and community heating wherever feasible, and that boroughs should expect the same.

5.139 The Mayor is clear about the benefits of CHP; these are set out in Chapter 4, alongside the current and future opportunities for CHP in London. This section states how the Mayor will work to increase London's use of CHP and community heating, for heating and cooling, through the planning process.

5.140 Government guidance on the role for regions in planning for CHP is given in PPG 11: 'RPG should also encourage development plans and other

regional partners in their investment programmes to promote more local energy-efficient developments through such measures as CHP and community heating schemes. These need to be considered at the earliest stage of development because of the infrastructure required. CHP, along with a community heating scheme, can offer optimum energy efficiency and contribute towards urban regeneration and a sustainable environment. CHP/community heating schemes are particularly relevant to assisting an urban renaissance, since they work most efficiently when they are supplying a mix of nearby residential and commercial buildings. This is particularly so in high-density city areas, because of the diverse heating and electricity requirements throughout the day.'

5.141 CHP and/or community heating may be appropriate for large-scale development of housing, industrial and commercial premises in London. As discussed in Chapter 3, the Directive on the Energy Performance of Buildings requires that, by 2005, new buildings exceeding 1,000m^2 consider the feasibility of alternative systems, including CHP and community heating and cooling. This must be taken into account before construction starts.

5.142 There are significant opportunities for converting the many older community heating schemes in London to CHP, as well as developing new CHP/community heating schemes. Chapter 7 outlines the Mayor's proposal for a project to identify promising potential community heating schemes, interconnections between existing schemes, and the use of currently wasted heat sources. This work will also involve recommending the best ways to instigate such developments, while maintaining a strategic overview of heat supply and demand across London.

5.143 Planning applications for CHP schemes will be expected to seek approval of the 'good- quality CHP' index from HM Customs and Excise. This will make the power produced exempt from the climate change levy, as well as optimising the efficiency of energy supply. Proposals for those schemes not considered 'good-quality CHP' will be expected to demonstrate clearly how and where the heat will be used. The Mayor expects boroughs to attach appropriate conditions to planning permission for all CHP plant to ensure that the plant is not switched on until the heat load is connected.

proposal 18 The Mayor requires planning applications referable to him to include combined heat and power and community heating where feasible. Applications for electricity generating plant referable to the Mayor should use the heat, where feasible, even if that means distributing it to other buildings nearby. Boroughs should expect the same.

5.144 The benefits of community heating, with and without CHP, are explained in Chapter 4. It was also noted that a number of community heating schemes installed in the 1960s and 1970s have been decommissioned. New development in London needs to move towards re-establishing and developing communal heating systems.

5.145 Properties with six floors or more often have electric heating, which is generally inefficient in terms of overall use of energy, expensive and environmentally damaging. Therefore, in these instances, community heating should be the preferred option, and should always be investigated. Community heating can supply heat to homes and businesses in tall buildings, and this is commonly done in mainland Europe. In London, the Citigen scheme serves 20-storey, commercial office buildings in the City. The Barkantine CHP scheme in Tower Hamlets also provides heat to high-rise dwellings. Many other good examples exist throughout Europe, especially in Scandinavia.

5.146 The Mayor's proposal earlier in this chapter to use a heating/cooling ranking method aims to ensure that CHP and community heating are considered at the earliest possible stage and installed where feasible.

5.147 London's two large-scale solid waste incinerators - Edmonton and SELCHP - only generate electricity and have never operated as CHPs, although SELCHP was designed to. The heat produced during generation of the power is currently discharged to the atmosphere and wasted, but it could be used to heat around 15,000 local homes and schools.

5.148 The plant operators have had little incentive to recover heat from these plants. CHP operation slightly reduces electricity output and since electricity has a higher market value than heat, it has been more economic for SELCHP and Edmonton to produce electricity alone. By the same token, only 14 per cent of energy from waste incineration capacity nationally contracted under the last round of the Non-Fossil Fuel Obligation operates as CHP. The operators of SELCHP are investigating the opportunities for recovering the heat, and the London Borough of Lewisham is investigating the feasibility of providing it to a proposed new Convoys Wharf development. The Mayor strongly supports work in this area.

proposal 19 The Mayor will work with LondonWaste Ltd, SELCHP, the waste authorities, boroughs and local industry to explore the opportunities to develop heat distribution networks which will supply heat from the existing incineration plants to domestic, commercial and public buildings in the vicinity.

5.149 There is also potential for Barkantine to provide energy to more buildings in its vicinity. The London Borough of Tower Hamlets is currently working with Barkantine's operators to extend the scheme to private developments on the Isle of Dogs. One extension is to the fire station in nearby Bying Street. However, it is developers that decide on the type of heating system employed on a site. Their general lack of understanding of community heating presents a barrier to its employment. Planning authorities should be proactive about encouraging community heating extensions where they are possible.

Planning for a hydrogen infrastructure

5.150 Fuel cells for CHP are becoming more widely available worldwide and fuel cell back-up power systems are now commercially available. Large CHP installations generally use high temperature fuel cells, which do not necessarily require a pure hydrogen feed, but can be fed with natural gas or some other hydrogen-rich gas. Direct use of natural gas by these applications results in some local emissions of oxides of nitrogen (NO_X), though these are typically less than ten per cent of the NO_X emissions from similar electric or gas-powered systems[29].

5.151 The advantages of gas-fed installations like these are that they can operate without a national hydrogen infrastructure and may be coupled to the production of hydrogen for use in vehicles. Hydrogen fuel cell vehicles are described in the Air Quality Strategy Section 4B on cleaner road vehicles. Conversely, using hydrogen produced from sustainable sources (for example, the electrolysis of water using renewable electricity) is a means for achieving zero emissions across the board.

5.152 The following are examples of good practice fuel cell CHPs:

- Woking Leisure Centre uses a fuel cell combined with a conventional CHP system and photovoltaics to heat and power the swimming pool complex. Woking Borough Council reduced emissions of NO_X by 63 percent between 1990-1991 and 2000-2001, along with achieving energy savings of more than 40 per cent[30] (see case study in Chapter 7).
- Energie Baden Wuerttemberg AG, a German utilities group, is installing fuel cell CHP units in 55 houses in Mingolsheim, Germany.

5.153 The Mayor encourages the use of appropriate fuel cells to power buildings in London and is looking at the possibility of installing a fuel cell CHP at City Hall. Leading by example in this way is a key method by which the Mayor can facilitate change. This is proposed and explained in more detail later in this chapter.

5.154 Other measures that can be undertaken by developers in support of a hydrogen economy include the use of hydrogen storage to complement on-site electricity generation from intermittent renewables (see proposal in Chapter 4 in support of hydrogen and renewables compatibility), small-scale cogeneration from the gasification of waste, using fuel cells instead of combustion engines, with less noise and emissions. Further opportunities will arise in the next few years as more commercial products become available.

proposal 20 The Mayor will encourage applications referable to him to make a contribution to the hydrogen economy where viable; for example, through the installation of a fuel cell unit on site.

5.155 To help raise awareness and knowledge in this area, the Mayor will work with the London Development Agency (LDA), Association of London Government, boroughs and the London Hydrogen Partnership to raise awareness of fuel cell and hydrogen issues with borough planners and other officers.

5.156 Fuel cell CHP units for homes and offices may use hydrogen produced locally by the reformation of natural gas. Such reformers could be installed in a variety of situations and it is possible that they could also provide hydrogen for transport applications. Molten carbonate fuel cells have the potential to produce hydrogen as an output from the gas source, in addition to electricity and heat. There are therefore likely to be synergies in the future between fuel cell CHP and hydrogen production for vehicles.

5.157 A hydrogen infrastructure is likely to contain these discrete local production units, as well as local hydrogen from renewable schemes. It is widely agreed that the development of depot-based fleets fuelled with hydrogen has considerable advantages, not only for the technology and public acceptance, but also for the establishment of the foundations for a wider supply infrastructure. Enhanced capital allowances and grants are available to enable fleet owners to offset any higher initial costs, and the Mayor will work with the London Hydrogen Partnership on these important issues (see Chapter 7). In particular, the Mayor will remain closely involved with the Imperial College study on the requirements of a London hydrogen infrastructure, expected to end in 2004, and will consider its recommendations.

5.158 Many new alternative refuelling sites will require planning permission, or alteration of present planning permission, especially natural gas and hydrogen sites. The Mayor expects London boroughs to look favourably

upon the provision of infrastructure for refuelling alternatively-fuelled vehicles, where this is under their influence. In particular:

- incorporating measures into local development plans that promote the provision of the alternative fuelling infrastructure - adapting existing refuelling stations or depots may be most appropriate - and seeking to retain, where practicable, filling stations with the potential for its provision
- making full use of the planning system, including Section 106 agreements, in seeking to expand the alternative refuelling infrastructure. Where there are new developments, particularly large or distribution-based developments, the Mayor would encourage London boroughs to seek the provision of such infrastructure.

5.159 The Mayor has set policies in the London Plan to encourage the expansion of an alternative refuelling infrastructure in London, including hydrogen. The functional bodies also have a role to play in the development of the hydrogen economy, particularly Transport for London and LDA. More detail on these two organisations is provided below.

Planning for a cleaner transport infrastructure

5.160 Many studies have shown that the way that cities are laid out can greatly influence the way that the transport infrastructure is used, and consequently how much energy is consumed. For example, in the early 1980s, Dale Keyes (1982) studied car fuel consumption in a sample of American standard metropolitan statistical areas.[31] He took into account the total population of the urbanised region, population density, population clustering, proportion of population living at high densities, location of employment, as well as certain transport and economic factors. Keyes concluded that between 40 per cent and 50 per cent of the variation in per capita car fuel use could be explained by differences in urban form.

5.161 Governmental acknowledgement of the relationship between urban form and transport energy use came with the publication of PPG 12 on Development Plans and Regional Planning Guidance[32]. This states that one way in which development plan policies can encourage greater efficiency in the use of energy is through the location of new development. The idea was developed further in PPG 13 on Transport[33]. The Government's overall approach is now set out in *A Better Quality of Life: A Strategy for Sustainable Development for the UK*[34].

5.162 People want easy access to facilities, family and friends, rather than travel for its own sake. Most travel is undertaken for a purpose, such as to work,

to shops, to schools, to leisure facilities, or to visit friends and family. In choosing where to live, people take into account both the time and cost involved in travel, as well as the quality of home they can afford. With the high and rising house prices in London, people tend to travel further between work and home.

5.163 To use energy efficiently in London, planning policies should aim to give people access to facilities with both the minimum of travel and the maximum proportion of travel provided by energy-efficient modes of transport. These policies will also help in benefiting those who have difficulty getting around, such as parents and carers with young children, and disabled people. The London Plan requires that, generally, high trip-generating development should be located with both high levels of public transport accessibility and capacity. The plan also requires provision to be made for cyclists, such as parking and high-quality cycle routes, along with provision for pedestrians, such as directly accessible pedestrian routes from new developments to public transport nodes and key facilities.

5.164 The London Plan and the Transport Strategy both include policies to achieve the energy- efficient urban forms and transport systems that are described above. Major, high trip-generating development will be located where existing or planned new public transport services will be able to serve the development. This will present opportunities to reduce the need to travel by car, thereby reducing growth in traffic and related energy use and emissions.

Planning for cleaner vehicles

5.165 To enable cleaner vehicles to operate, the refuelling infrastructure needs to be adequate. Further infrastructure is needed for hydrogen, Liquid Petroleum Gas (LPG), and compressed natural gas (CNG). Without this, there exists a significant barrier to their take-up, and an issue for those whose work entails a significant amount of driving in central London, for example taxi drivers. To address this problem, the Mayor is working with the Energy Saving Trust to identify areas where refuelling sites could be provided.

5.166 Planning permission is only required for new petrol stations that represent a change of land use. However, the Mayor will, through the London Plan, support the increased provision of cleaner transport fuels, particularly the refuelling infrastructure (see London Plan Policy 4A.6). Hydrogen refuelling points may require additional space if hydrogen is produced on site and this need should be considered.

5.167 The Clean Fuel Working Group, chaired by the Association of London Government, is looking at the incentives and barriers to developing an alternative refuelling infrastructure, especially electric vehicle recharging.

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6 Delivery through the GLA group's activities

6.1 This chapter includes policies and proposals on how the Mayor will deliver his energy objectives through the strategic work and activities of the GLA group, including economic development and transport. It includes actions for the functional bodies. Chapter 7 includes the Mayor's proposals on how others can work in partnership with the Mayor.

policy 19 The Mayor will work to deliver the objectives of the Energy Strategy, through the strategic work of the Greater London Authority and the functional bodies, for economic development, transport, fire and emergency planning, and the police, and by leading by example.

The London Development Agency delivering the Strategy

6.2 Working with the London Development Agency (LDA) offers significant scope for making London's development, regeneration and businesses considerably more sustainable. The LDA has identified the environment sector as a priority, with particular focus on energy and waste. The GLA is working with the LDA to ensure that the latter's work on economic development contributes to delivering the objectives of this strategy.

6.3 Through the Economic Development Strategy, the LDA has developed a Charter for London as a framework for LDA programmes. It comprises four guiding principles: 1) economic growth, 2) knowledge and learning, 3) diversity, inclusion and renewal, and 4) sustainable development, with a commitment to 'ensuring that London's growth respects the need for social progress, environmental protection and conservation of scarce resources'. Specific objectives include 'ensuring that growth promoted in London is sustainable' and 'developing an environmental business sector and promoting green business practices'.

6.4 The LDA recently commissioned consultants to conduct a study on the sustainable energy sector in London. This investigated the opportunities for the sector's growth within the London economy and to develop an understanding of the prospective support mechanisms and LDA's role in pursuing these[1].

6.5 The study found that the sustainable energy market in London could be worth around £3.35 billion by 2010 and employ between 5,000 and 7,500 people. The sustainable energy market across the whole of the UK could be worth approximately £36 billion by 2010. Given the size of the market in London, the study reveals that 'there is enormous potential to deliver significant economic development outcomes.' The report makes recommendations to the LDA on how it could help to deliver these outcomes, both directly through its own property development and indirectly through partnerships.

6.6 There are three principal mechanisms for the LDA to achieve its objectives:

- through the LDA's funding and influence of regeneration projects, which are often large scale, and demonstrating exemplary schemes
- through the LDA's promotion of and support for industry, which can help promote the sustainable energy sector and increase associated employment in London
- through the LDA's work with businesses, which can promote sustainable practices, in many cases making business more competitive.

policy 20 The Mayor will work with the London Development Agency to ensure that the objectives of the Energy Strategy are promoted through its work with industry, business, regeneration, development and labour markets.

6.7 The following policies and proposals build on those set out in the Economic Development Strategy. They combine to establish how the Mayor aims to work with the LDA to ensure that its work contributes to the strategic framework set out in Chapter 4. Proposals are ordered by issue, to reflect the action being taken by the LDA to directly deliver the strategic framework.

Working with the LDA to tackle climate change

6.8 The LDA has a statutory requirement to contribute towards sustainable development. One way of achieving this is to expect all ventures to meet high standards of sustainable design. It should also request and promote the development of exemplary sustainable buildings under programmes administered by them.

6.9 London has a well-established regeneration policy and programme, which is described in the Mayor's Economic Development Strategy. That strategy sets out the LDA's approach to working with the range of economic development and regeneration organisations in London. This approach ensures that the range of funding - from the 'Single Pot' to European Structural Funds and Neighbourhood Renewal - works together to achieve regeneration in London.

policy 21 The Mayor will work with the London Development Agency to ensure that its regeneration work demonstrates high standards of sustainable design, by promoting and demonstrating best practice in sustainable energy.

6.10 The Mayor's Supplementary Planning Guidance (SPG) on sustainable design and construction will guide standards for developments administered through the LDA.

6.11 Funding for activity directly supported by the LDA comes from the Government, and is linked to a series of centrally determined programmes including, land and property, and the Single Regeneration Budget. Many current programmes still have several years to run.

6.12 Since April 2002, the introduction of the 'Single Pot' funding regime enables the LDA to be more proactive in setting the agenda for London's future economic development. As inherited funding commitments decrease, more funding will be channelled to meet strategic objectives for London, as identified in the Economic Development Strategy.

6.13 The Mayor requests the LDA to monitor and report on how its work has contributed specifically to sustainable development in London, and in particular to the Energy Strategy objectives for minimising CO_2 emissions and increasing use of renewable energy.

proposal 21 As part of its work to improve the environment, the Mayor requests the London Development Agency to monitor and report annually on how it has sought to reduce carbon dioxide emissions and use renewable energy through its regeneration work.

6.14 As part of its monitoring and evaluation framework, the LDA is developing a set of sustainability indicators, based on its Sustainability Checklist. These indicators will be used to capture over time the contribution of all LDA projects to sustainable development, including promotion of energy efficiency and the use of renewables.

6.15 The LDA is working with partners to establish a Private Investment Commission; this will identify ways that will enable the public sector to bring in private funding to achieve regional objectives. The Mayor would like the commission to consider the theme of 'Investment in Sustainable Design and Construction' as part of this work. This could examine the barriers to and opportunities for increasing the take-up of sustainable design in new development, and the implementation of the SPG on sustainable design and construction.

proposal 22 The Mayor requests the London Development Agency to ensure that its Private Investment Commission examines the delivery of sustainable design and construction, in order to identify the barriers to and opportunities for increasing investment in sustainable design, and identify to high-profile exemplary projects.

Working with the LDA to deliver energy services

6.16 Chapter 4 introduced the energy services approach as an effective means of delivering energy efficiency and energy management, and also of addressing fuel poverty. The LDA can play a role in supporting and facilitating the development of Energy Service Companies (ESCos) as a means of developing the green economy in London. The energy services approach has struggled to develop in the current energy market, which focuses on the supply and consumption of electricity and gas. The LDA could work to stimulate and encourage the energy efficiency and management market place and provide support for ESCos.

policy 22 The Mayor expects the London Development Agency to support the development of Energy Service Companies for servicing domestic, commercial and public sector markets.

6.17 Chapter 7 outlines the four main models for energy services and provides case studies of each type. The fourth energy services model includes energy generation (normally CHP combined with energy efficiency/management) and provides an excellent model for regeneration and meeting a range of social, economic and environmental objectives. The LDA should consider its potential role in facilitating a more holistic approach to energy services delivery and management within developments. They should aim to involve energy management and energy services experts, and the network operators, at a very early stage to assess how new developments can plan for a sustainable energy system, including self-generation and energy efficient design. This could be taken forward within an Energy Action Area.

6.18 The Tower Hamlets' Barkantine CHP project is delivered by the Barkantine Power Company and provides energy efficiency measures and management alongside the CHP system . When promoting CHP in developments, the LDA should also consider whether there is scope for adding value and developing CHP energy services. The wider benefits of CHP energy services schemes are outlined in Chapter 7 and these complement the wider objectives of the LDA.

6.19 Thameswey Energy Company operates as a complete ESCo which aims to deliver sustainable energy in Woking (see case study in Chapter 7). Thameswey runs its own private wire network and a heat network, and demonstrates that the establishment of a self-generating ESCo providing local heat and power can provide an excellent approach for taking forward sustainable energy.

proposal 23 The Mayor encourages the London Development Agency to work with the London Energy Partnership in its consideration and promotion of energy services schemes, based on the Barkantine combined heat and power and Thameswey Energy Services scheme models, and to help in resolving the business issues associated with schemes of this type.

Working with the LDA to deliver energy efficiency in homes and tackle fuel poverty

6.20 In Chapter 4, the Mayor proposes that London should work to eradicate fuel poverty and in Chapter 7 recommends that the London Energy Partnership initiates a Londonwide programme to co-ordinate action to tackle fuel poverty in the capital. The Mayor proposes that the LDA plays a key role in the development of this programme and its delivery, building on and complementing the work of others in this area. This should be conducted in close consultation with the London Energy Partnership and the boroughs.

6.21 There is a national skills shortage for installing energy efficiency measures - heating systems and insulation - and the situation in London is particularly acute. It is estimated that the national shortage of gas heating engineers is more than 5,000. It is not uncommon for waiting times for Warm Front installations in London to be more than a year.

6.22 This skills shortage is a barrier to addressing fuel poverty and energy efficiency improvements in general, and addressing the issue also constitutes an employment opportunity for London. The LDA could examine in detail the potential training and employment opportunities in the energy efficiency sector as a whole, including through the Intermediate Labour Market Model - providing jobs in areas of high unemployment which also suffer high rates of fuel poverty - and job transition, addressing the issue of long-term unemployment and exclusion from the labour market. The skills base, which is discussed later in this chapter in relation to renewables, could also play a key role.

6.23 The Government recognises this problem and is attempting to address it in a number of ways:

- Proposed creation of an Energy Utility Sector Skills Council
- The Department of Work & Pensions' Ambition Energy programme is a three-year, £22 million programme aimed at getting 4,500 unemployed and disadvantaged people into good jobs in the gas and engineering construction sectors; just under half will be central heating installers

- The Learning and Skills Council has backed a programme for gas training and qualifications to be awarded at many more further education colleges and training centres
- DEFRA, Eaga and the Employment Service developed a programme to train central heating installers to deliver the Warm Front programme, producing 400 qualified installers.

6.24 Energy companies are also working to tackle the problem. Centrica has announced plans to train 5,000 new gas engineers up to 2007 to work on the home servicing and installation side of the business. Transco has developed a programme of retraining skilled staff made redundant from other industries, and has trained 300 new gas installers so far.

6.25 A successful programme to eradicate fuel poverty would secure significant reductions in health costs associated with cold-related illnesses. There are also benefits to the local economy, resulting from employment opportunities associated with energy efficiency improvements in homes and businesses. These include the manufacture, installation and maintenance of domestic energy hardware, such as solar water heating, PVs, district heating, CHP and micro-CHP, as well as more established technologies, such as cavity wall insulation and double glazing.

proposal 24 The Mayor will work with the London Development Agency to address the skills shortage for installing insulation and heating measures in homes. This will include the London Development Agency investigating the potential for development of a suitable new skills base for those energy efficiency measures identified as having potential, for example, through intermediate labour markets and accredited training schemes.

Working with the LDA to deliver energy efficiency in commercial and public sector buildings

6.26 There are direct economic benefits associated with improvements to London's energy systems. In 1999, London spent an estimated £5.14 billion on energy[2]. A one per cent improvement in energy efficiency, leading to a corresponding reduction in energy use, would release £51 million per annum for alternative investment. Companies improving their energy efficiency or switching to green energy supply will also save money by reducing or avoiding costs under the Climate Change Levy.

6.27 The Mayor aims to assist the implementation of energy efficiency policy at both the macro and micro level by supporting the application of strategic (national) energy efficiency initiatives in London and the provision of advice to individual businesses. The Mayor therefore recommends that the LDA works with the Carbon Trust to take forward

the trust's programmes in London and stimulate the development of the low-carbon economy in London. The Carbon Trust aims to stimulate business energy efficiency and low-carbon technologies. As well as running the Action Energy programme, it also operates the Low Carbon Innovation Programme, which seeks to accelerate the development of new and emerging low-carbon technologies.

The LDA and new developments

6.28 The LDA will raise awareness and increase pressure on private sector developers and public sector clients to raise standards of sustainable design through design specifications for new buildings. This will be supported by the GLA's SPG on Sustainable Design and Construction.

6.29 Initial focus could be placed on community buildings. In these, energy running costs form a higher share of outgoings, and sustainable design could reduce long-term running costs considerably. In addition, landlord-tenant problems are less likely to occur.

6.30 The LDA should seek to achieve an 'excellent', or at least a 'very good' BREEAM rating on all building developments in which it is involved. Through developing its capacity, understanding and experience of exemplary sustainable practice, including the process, cost implications and savings, the LDA can encourage sustainable design in developments in London.

6.31 The Mayor will work with the LDA to realise the sustainable energy, biodiversity, quality of life and local climatic benefits of living features, such as green roofs and vegetated walls, in building design. The standard set in this by developments such as BedZED and the Laban Dance Centre, as well as in Switzerland and Germany, should be matched elsewhere in London.

proposal 25 The Mayor expects the London Development Agency to investigate the potential for an exemplary development as part of its regeneration programme.

The LDA and existing buildings

6.32 As outlined in Chapter 4, although there are numerous Government initiatives promoting and facilitating energy efficiency improvements in existing commercial and public sector buildings, take-up is fairly low. The profile of energy efficiency and its benefits needs to be increased substantially in order to boost energy efficiency and management in offices.

6.33 The different sub-sectors within commercial and public sector organisations require different approaches. The commercial sector can be

divided into two main organisation types, corporate (large) businesses, and small and medium-sized enterprises (SMEs). The methods of approaching these two business types are very different, as are the issues they each face. The environmental agenda tends to have more significance for large businesses as they are well-known brands and have to consider corporate reputation, which has an influence on share value. They tend to have larger premises, and a building manager who can focus on energy consumption issues. Furthermore, large businesses are more likely to be able to pay for energy advice and to fund investments. Business organisations and networks, such as London First, can be drivers for change in companies of all sizes.

6.34 Central London is home to many large corporations based in high-profile buildings. As an important first step towards radically improving the efficiency of London's offices, the Corporation of London could act first and set the standard for the degree of improvement and standard that is achievable. Indeed, the City of London could act as an Energy Action Area in seeking to demonstrate best practice in energy efficiency and renewable energy use, or even consider establishing an integrated local sustainable energy system as outlined in the Energy Services section above.

6.35 The current provision of environmental advice to business in London is variable. In some areas, a comprehensive network exists, whilst in others very little advice is available. There is also no common standard of advice, which means there is variation in the type and quality of advice and support provided.

6.36 The organisations that are currently working to provide environmental business advice include Business Link and Groundwork. The Energy Saving Trust is also funding staff within Energy Efficiency Advice Centres (EEACs) to provide specific energy advice to SMEs, and there are currently two London EEACs - north and south-west London - providing this support.

6.37 The Mayor and the LDA are working in collaboration with London First and London Business Link and intend to further develop their links with business. The LDA is currently leading a working group on the provision of environmental advice to businesses in London and how this may be better co-ordinated, better targeted and improved. This study also aims to develop common standards for advice provision and provide suggestions for:

- facilitating a comprehensive network of environmental business advice across London which helps to translate Government policy and legislation into practical actions for SMEs
- encouraging and facilitating change in SMEs through awareness raising, support, mentoring and dissemination of good practice
- encouraging new environmental businesses and assisting them with business planning and networking.

6.38 To deliver this more effectively will require training of relevant staff, clients and designers. A central referral or brokerage system could help with this, along with providing case studies and promoting the good practice called for in the proposals. This should support the step change in thinking that is required to deliver more sustainable buildings.

6.39 The London Sustainable Development Commission carried out a consultation exercise to assess stakeholder interest in expanding the Mayor's Green Procurement Code to include CO_2 emissions. The code currently promotes the use of products made from recycled materials to commercial organisations, by offering a one-to-one brokerage service. By making it as easy as possible to find recycled alternatives, the code has led to an increase in the number of organisations using recycled products. Many organisations which have signed up to the code have expressed interest in similar services based on other environmental issues.

6.40 The consultation showed support from a wide range of organisations for a Londonwide carbon emissions reduction target, which they could support through a pledge and brokerage system. As with the existing Mayor's Green Procurement Code, this could have different steps of commitment to bring on board as many organisations as possible. The LDA could play a key part in expanding the Mayor's Green Procurement Code to include energy as part of its work to improve the environmental performance of business.

proposal 26 The Mayor challenges London's major corporations to deliver high levels of energy efficiency and management that set an example to the rest of London's businesses. He expects the London Development Agency to work with key business organisations, including London First, to support this challenge, for example, through the expansion of the Mayor's Green Procurement Code to cover energy and carbon savings.

proposal 27 The Mayor will work with the London Development Agency to encourage small and medium-sized enterprises, and the public sector to enhance their energy performance, and to this end supports the agency's work to improve the provision of environmental advice to businesses in London.

Working with the LDA to deliver sustainable energy

Supporting the growth of the renewable energy industry

6.41 The Mayor is committed to increasing the number of jobs in London in the green economy, and recognises the potential for expanding the sustainable energy sector. In the State of London Report, the Mayor declared that London is very well placed to attract inward investment in the sustainable technologies of tomorrow, including greater use and production of renewable energy technologies.

6.42 At the regional level, there is an opportunity for London to nurture home-grown energy service and technology companies, as well as encouraging existing organisations to relocate to the capital. It is possible to envisage an upward spiral, whereby the presence of local manufacturers accelerates the growth of local markets for green technology. This could have significant economic, social and environmental benefits, and could be facilitated by the development of a national sustainable energy economy.

6.43 The LDA should support renewables for new local business and employment opportunities. These range from highly skilled research and development jobs, to skilled and semi-skilled installation jobs. In addition to being a growth sector, environmental industries also have the potential to address problems of social exclusion, and focus on priority regeneration locations.

policy 23 As part of the London Development Agency's work to promote the growth of a distinct environmental business sector, the Mayor requests strong support for the sustainable energy industry, and particularly renewable energy technologies, where opportunities can be identified.

6.44 The LDA is establishing a number of business-led advisory 'sector commissions'. These will draw on the expertise of key partners in business and education, focusing initially on manufacturing and creative industries. The commissions will advise on how to enhance the competitiveness of London industries, by exploring relations between other sectors, identifying opportunities for links between sectors that exploit new growth potential, and developing sector strategies.

6.45 The LDA's study on the scope for the sustainable energy sector outlines the opportunities to support the growth of the renewable energy industry in London. This will then feed into work with the business community to overcome the barriers, attracting appropriate inward investment to the capital in the process.

6.46 There is massive scope for employing photovoltaics (PV) in London, and there could also be potential for developing the technology here. Any potential for manufacturing PV in London is likely to involve the assembly of PV components into a product that is ready to use, for example as a building material. Local manufacture of such an end product will enable PV to be more easily and cheaply available. An important objective would be to develop a product that would have significant UK demand, as well as considerable export potential.

6.47 The lack of a secure demand is a major barrier to production in the UK. This strategy aims to provide a supportive framework to increasing the use of PV in London. However, supply-side issues need to be tackled at the same time as working to increase demand, firstly to be able to meet an increase in demand, and secondly to facilitate an increase in demand through bringing down production costs.

6.48 Earlier, the strategy referred to the Mayor's support for a number of appropriately placed, large-scale wind turbines in London. The LDA could have a role to play in this as a major landholder, particularly in the Thames Gateway, where wind speeds are among the highest in London. The Mayor requests the LDA to initiate investigations for such schemes on its land. Wind turbines could supply sustainable power to local developments, and offer a high-profile demonstration of the technology in an urban environment.

6.49 Perhaps the biggest contribution that the LDA could make to support the renewable energy industry is the development of a suitable skills base for those technologies identified as having potential in London. This is particularly relevant for solar energy technology, where an increase of deployment above the current low level of take-up will probably create noticeable skills shortages. Furthermore, appropriate and available skills are a big magnet to industry. This could include accreditation training for PV and solar water heating installers and engineers. The Mayor will work with the LDA to investigate opportunities for this.

6.50 In the Energy White Paper, the Government highlights the need to address skills shortages and proposes the development of the Energy Utility Sector Skills Council as a new means of addressing the problem. The Mayor and the LDA will need to work in consultation with the Government in this area to ensure complementary action.

6.51 As part of this work, the niche opportunities for London to support growth in manufacturing, skills and employment, particularly for the renewable energy industry, will be explored. It may also be appropriate to

consider how to transfer skills from existing energy (or non-energy) industries, which may not form part of the vision for the future, to the new and growing industries.

proposal 28 The Mayor will work with the London Development Agency to investigate the barriers and opportunities for supporting and accelerating the growth of the sustainable energy sector as part of its green business strategy. This work will include addressing the skills shortage for installing renewable energy technology.

6.52 In order for industry to gain the security it needs to make the necessary long-term investments, the LDA may need to commit to policies spanning more than ten years. The London Sustainable Development Commission recommends addressing this in a number of ways. One could be to focus policy on transforming the market to create sustainable demand for new technologies, rather than propping them up with funding. The LDA could also consider how it could work with financial institutions to establish security of investment. These measures could be taken forward with the London Energy Partnership. Energy Action Areas could act as a test-base for these ideas.

6.53 It is important that the LDA co-ordinates its work in this area with surrounding development agencies, such as South East England Development Agency. A balance is needed between regions in creating local jobs to ensure that approaches are complementary approaches and that there is no competition between neighbouring labour forces.

6.54 The LDA should strongly promote the integration of renewable energy technology into developments, particularly high-profile ones. The LDA should fund them where appropriate. Financial support is needed to increase the take-up of urban renewables, eliminate the barriers to their deployment, and accelerate their uptake.

Working with the LDA to deliver combined heat and power and community heating

6.55 As already noted, a large amount of CHP and community heating is already in operation across London, but there is huge scope for new schemes, and for expanding and linking existing schemes. There are many regeneration programmes across London. These represent a substantial opportunity for developing new CHP and community heating schemes, and for delivering low-carbon energy services in line with the objectives in this strategy. This work could be taken forward in line with the Energy Action Areas that the Mayor aims to initiate across London.

6.56 The Mayor requests the LDA to encourage incorporation of community heating where it can in developments, preferably with CHP, for example through the community renewal programme. This heat can be used for providing cheap heating for homes, thus helping to tackle fuel poverty, and for heating and cooling offices. When regenerating a site with an established CHP or community heating scheme, or close to such a scheme, the scope for upgrading, expansion and linkages should be investigated and promoted. This would reinforce London's embedded generation network and reduce loads on the electricity distribution networks. The LDA should work with the Government's Community Energy programme in promoting the opportunities presented by community heating and using the expertise and funding that is available to assist community heating projects.

6.57 In order to assist in overcoming the barriers to the installation of CHP, the LDA could provide guidance on the costs of installing community heating and the approaches available for financing large CHP schemes. As already noted in relation to other technologies, the skilled labour necessary for the development and maintenance of community heating schemes is lacking in London. The LDA could play a key role in developing the construction and maintenance skills needed for CHP and community heating systems through supporting training programmes.

6.58 As micro-CHP is a new technology, the central heating industry will not be familiar with it and training will be required in order to facilitate its take-up. The LDA should work with manufacturers, retailers and installers to increase familiarity and provide training for installation and maintenance, as a component of the trial of the technology.

proposal 29 The Mayor expects the London Development Agency to promote combined heat and power and community heating in its regeneration programmes, in line with the Mayor's Energy Hierarchy. The agency should also explore the opportunities for supporting a programme to develop the skills capacity to enable the increased construction and maintenance of community heating schemes in London.

Working with the LDA to provide adequate energy infrastructure

6.59 A key challenge facing the growth of London and its economy is an adequate energy infrastructure to allow this growth to happen. For example, growth in the Thames Gateway will place huge pressure on the current infrastructure, requiring investment to power 140,000 new homes. This presents a unique opportunity to invest in a modern infrastructure based on sustainable energy systems, such as renewable energy and CHP.

6.60 As part of its role in supporting the growth of London, it is critical that the LDA works to ensure that an adequate energy supply infrastructure is provided. This should support and promote sustainable energy systems as part of the LDA's commitments to sustainable development.

Working with the LDA to deliver hydrogen and clean transport

6.61 Businesses are the engines of economic growth in London, enabling improvements in Londoners' standard of living. However, economic growth can also create environmental costs. The challenge for business is to innovate and create products and services that allow London's economy, society and environment to improve and develop together. Sustainable development is a spur to innovation and an increasingly important factor in business competitiveness. Nowhere is this more relevant than in the clean energy technology sector.

6.62 London's academic expertise in hydrogen and fuel cells is already well established. It is likely that the establishment of centres of expertise for training and teaching in all aspects of the hydrogen economy would contribute significantly to London's green economy, as skills shortage is a key supply side constraint on growth.

6.63 The LDA is working with others to promote opportunities for the attraction, development and growth of environmental industries. These could include producing and fitting retrofit technologies, converting vehicles to gas power, developing the emerging technology of fuel cells, energy efficiency measures and renewable energy technologies. The LDA can support the growth of the fuel cell industry, specifically through its technical knowledge of current capacity and commercial viability, work on enabling manufacturing and skills clusters, and work on a London skills action plan.

policy 24 The Mayor will work with the London Development Agency to support the development of hydrogen, fuel cells and associated technologies in London, through its role in the London Hydrogen Partnership.

6.64 In Chapter 4, the Mayor proposed to initiate a partnership to facilitate the use of hydrogen as a clean fuel in London. The Mayor will invite the LDA to play a central role in developing and delivering a successful hydrogen action plan for the capital. The LDA can help to support the growth of the industry, raise awareness among business and promote high-profile projects in the field.

proposal 30 The Mayor will work with the London Development Agency, through the London Hydrogen Partnership, to build the contribution of hydrogen, fuel cell and related industries to the development of London's green economy.

6.65 Encouraging alternative fuels for vehicles will also generate jobs in the green economy. This work includes converting vehicles to gas power and supporting the emerging energy-generation and conversion technologies, such as fuel cells. Some of these are already available within London, and others are looking to move into London, as it is an important market.

Transport for London delivering the Strategy

6.66 The Mayor has more direct influence over transport than other significant energy-using sectors. It is therefore an area in which the Mayor can lead by example. The Mayor's Transport and Air Quality strategies aim to cut congestion, encourage the use and further development of more sustainable forms of transport, and clean up the vehicles that are in use. Many of these measures also contribute to improving energy efficiency and reducing noise.

policy 25 Through Transport for London and the London Plan, the Mayor will work to implement transport measures that reduce emissions of carbon dioxide by enabling and encouraging more sustainable patterns of travel, including a shift towards public transport, walking and cycling, as well as the use of cleaner fuels and vehicle technologies.

6.67 The Energy Strategy builds on policies set out in the Transport and Air Quality strategies. Measures proposed in these strategies which will have an energy benefit include:

- facilitating a major improvement in public transport capacity, and encouraging a shift from car travel towards public transport, walking and cycling
- encouraging business to reduce the energy consumption and emissions from their transport activities
- encouraging and promoting the benefits of more efficient technologies and fuels, and zero-emission technologies for transport.
- ensuring that Transport for London and other GLA group fleets set a good example and develop plans for reducing energy use and emissions from the taxi fleet (currently regulated by TfL), and the private hire vehicle fleet (to be regulated by TfL)
- developing and implementing traffic management measures that reduce energy use and emissions, as well as encouraging safe, economical and considerate driving

- central London congestion charging, which will reduce traffic volumes and encourage the use of public transport on journeys in and through central London
- examining methods of reducing energy use and pollution by traffic, including a joint feasibility study with the London boroughs, central Government, the Association of London Government and others to consider a low emission zone in London.

6.68 Much of the Transport Strategy relates to action by boroughs and local businesses, which are responsible for providing transport services and infrastructure. Enormous scope exists for individuals and organisations to contribute towards making travel in London less environmentally damaging, for example, by reducing the number of trips made in the private car. Private car use has significant social and economic overheads, such as traffic congestion, which must be minimised. The message is 'use public transport, walk and cycle, and use your car sensibly'.

Road traffic

6.69 Road traffic is responsible for 80 per cent of transport energy use, and emissions of CO_2. It is also the major source of those pollutants that contribute to poor air quality[3]. Different modes of transport make different contributions to London's emissions of CO_2, so it is important to know how the choice of mode for a journey affects the associated energy consumption and emissions. The table below demonstrates that road traffic is not only the major source of pollution overall, but is also worst for air pollution and climate change per unit distance.

Table 8 Comparison of environmental burdens (per tonne/km) of freight transported

Environmental burden	Road	Rail*	Inland shipping
Air pollution (g NOx and hydrocarbons)	0. 84	0. 35	0. 47
Climate change (g of CO_2 equivalent)	59. 0	28. 0	22. 0

note: * Diesel/electric (average)
source: Bureau Voorlichting Binnenvaart (BVB), Promotion Council for Inland Shipping, 1999. Web Site, www.inlandshipping.com/en/pub/4motor.html

6.70 There are two main ways to reduce emissions from road transport: limiting the growth in traffic (tackled primarily through the Mayor's Transport Strategy and London Plan) and reducing the emissions of individual vehicles (on which the Air Quality Strategy concentrates).

6.71 The Mayor's Air Quality Strategy emphasises reducing emissions from road transport because this is the major source of pollution and because this is where immediate results are most achievable. It sets out a package of measures to stimulate the faster adoption of cleaner vehicle technology and fuels. Specific policies include:

- promoting best practice through vehicle fleets owned or regulated by the GLA group
- raising awareness of the benefits of cleaner vehicle technology
- promoting grants available through the Energy Saving Trust
- promoting retrofit technology to clean up existing road vehicles
- promoting the adoption of cleaner fuels.

6.72 For more background information, and associated policies and proposals, see Chapters 4 and 5 of the Mayor's Air Quality Strategy.

Reducing the fuel consumed by road vehicles

6.73 Saving fuel used by vehicles will benefit individual vehicle and fleet owners alike. Savings are made easily and quickly through a range of simple methods.

6.74 There is a strong business case for companies to improve their fleet's fuel efficiency. Firstly, from April 2002, the company car tax regime was reformed to reward drivers of cleaner, more fuel-efficient company cars, and the tax is now linked to the car's CO_2 emissions. The level of road tax, called vehicle excise duty, is also linked to the vehicle's CO_2 emissions for all cars registered after March 2001. Secondly, better fuel management can have many commercial benefits, on top of saving costs and reducing emissions of CO_2. For example, driver training can significantly reduce road accidents and reduce maintenance costs. Reducing business travel can save time, money and stress.

6.75 Fuel costs form an important part of the total costs involved in running a vehicle fleet. Historically, fuel costs have increased faster than most other elements of the fleet budget. However, despite being the most easily controlled of variable costs, they are often disregarded by fleet operators. When a car or van is fully costed[4], fuel costs represent about 25 per cent of the total costs. Even where the organisation pays only for the fuel needed for business use, it accounts for up to 17 per cent of total costs[5].

Box 12: Government support schemes for improving fuel efficiency

The Government's Transport Energy programme, managed by the Energy Saving Trust, provides guidance to help vehicle operators to cut costs and CO_2 emissions by improving fuel efficiency[6]. Guidance is also provided on benchmarking for self-assessment, setting targets and drawing up outline fuel improvement plans.

The Government-backed award scheme, Motorvate, is designed to help company car fleet operators cut their fuel costs and help the environment. Motorvate sets simple, realistic targets for improving fuel efficiency and reducing fleet mileage to enhance economic and environmental performance. The core target is a reduction of 12 per cent in the fleet's CO_2 emissions over a three-year period, three per cent of which must be achieved through reduced business mileage. A typical 200-strong car fleet could save around £34,000 per year by meeting the scheme's targets. For further information, see the Motorvate website: www.greenerfleet.org.uk.

Fuel efficiency in Transport for London's fleet

6.76 While the Mayor and functional bodies have already done much to reduce the fuel use and emissions from their fleets, the scope for further reducing fuel used by these sizeable Londonwide fleets is potentially even larger. The Mayor expects TfL to fully exploit this opportunity to save fuel through fuel management programmes, following advice from the Energy Efficiency Best Practice Programme and Motorvate, and strongly urges the Metropolitan Police Authority and London Fire and Emergency Planning Authority to do the same.

6.77 London's buses are operated under contract to TfL, which also operates its own fleet of vehicles for particular departments. TfL also regulates taxis, private hire vehicles and tourist coaches. It can seek to reduce fuel used by the fleets under its influence in a number of ways. Tenders will place a requirement on contractors to state their policy on fuel efficiency and good vehicle maintenance, where this is practical and legally acceptable. Targets for vehicle fuel efficiency will be set for the functional bodies, together with assessment criteria for the purchase and lease of vehicles, and relevant proposals are set out in the section 'leading by example'. Proposals relating to the management of strategic fleets (buses, taxis, coaches, freight etc) are set out below.

6.78 London Underground Ltd Distribution Services Team, which is part of the infrastructure company JNP (Jubilee Northern Piccadilly), manages the support fleet on behalf of TfL, London Underground, London Bus

Services Ltd and British Transport Police. These vehicles are regularly serviced and maintained, and there is a fuel management system in place, providing fuel utilisation data that could be used for target setting. There are more than 330 vehicles in total, about 200 of which are standard petrol and 130 are standard diesel vehicles. Most vehicles within the fleet, both diesel and petrol, are relatively high mileage and cover up to 22,000 miles per year.

6.79 The TfL part of this vehicle fleet comprises 181 vehicles, made up of 116 diesel and 65 petrol vehicles, including three motorcycles and one electric vehicle. TfL currently operates a fleet of 31 vehicles to support the work of the Traffic Technology Services Division, which is responsible for traffic signals and other automated transport infrastructure. As the vehicles become due for replacement, alternatively powered vehicles will be sought to replace them. Trials of alternatively powered vehicles are continuing, to ensure that new technology meets performance requirements.

6.80 TfL has been part of the Th!nk@boutLondon project. Since September 2001, a Ford Th!nk electric car has been successfully tested on the internal courier service which collects and delivers post three times a day to five buildings in the London SW1 area. During the first 12 months of the project, the vehicle covered 4,500 miles, saving approximately 720 litres of petrol. However, although this saving brings local air quality benefits, it offers no reduction in CO_2 emissions, once the remote electricity generation used for recharging the vehicle is taken into account. The exception to this is where electric cars are directly recharged from renewable electricity sources; this is currently rare.

Alternative fuels for road vehicles

6.81 Distribution Services in TfL has signed up to the London First Clean Air Charter and has objectives to demonstrate improvements each year as part of this commitment. It is are also working towards ISO 14001 accreditation to operate under an approved Environmental Management System, and it has carried out trials on a range of alternatively fuelled vehicles and fuel additives. These will continue.

6.82 The majority of the Mayor's work with TfL in adopting new and fuel-efficient technology for vehicles is delivered through his Air Quality Strategy. Natural gas has been tested by TfL, but is not currently economic in London as a result of fuel duty and higher capital costs, the relative impact of the fuel duty rebate, and the significant progress being made in improving the environmental performance of diesel engines.

6.83 Further work in this area includes the London Buses trial of three zero-emission buses operating on hydrogen fuel cells - an exciting and highly promising project for London. The fuel cell bus is effectively an electric vehicle that uses fuel cells to generate its own electricity from hydrogen on board. On the London buses, hydrogen is stored in large tanks located in the roof of the vehicle. The trials will be reviewed and more fuel cell buses considered.

6.84 As an added incentive, the Mayor has decided that a 100 per cent discount from congestion charging will apply to all electrically propelled and alternatively-fuelled vehicles, including vehicles powered by automotive gas and fuel cells, provided that they meet specified emissions standards.

policy 26 The Mayor requires Transport for London to lead in adopting new and fuel-efficient technology for use in London's public transport.

proposal 31 In leading the adoption of new and fuel-efficient technology for vehicles, the Mayor expects Transport for London to review actively opportunities for the beneficial use of alternative fuels and technologies, such as hydrogen and fuel cells.

London Buses

6.85 Buses are an essential part of London's public transport system, and have made substantial progress in recent years in developing the use of cleaner and more efficient engines. Although buses are more fuel efficient per passenger kilometre than other modes of road transport, the large numbers of people using buses mean that they still use a considerable amount of fuel. Also, new buses tend to be heavier and contain more electrical equipment, both of which increase fuel consumption.

6.86 TfL is already undertaking extensive work on increasing efficiency and reducing emissions from the 6,400 buses in the London bus network fleet. By 2005, the entire fleet will be Euro II standard plus particulate trap, or better. This will be achieved, in part, by large-scale fleet replacement, accelerating the introduction of new 'low floor' buses.

6.87 Driver training is important for customer safety and satisfaction, as well as in terms of pollution and fuel cost savings. London Buses has introduced a BTEC driver training qualification which all new bus drivers must take, and which it intends to extend to all existing drivers over the medium term. TfL will work with bus companies to encourage smoother driving, primarily for passenger comfort but to also reduce fuel costs and reduce emissions.

Coaches and tourist buses

6.88 Coaches provide efficient and effective transport for both commuters and long-distance travellers, which the Mayor's Transport Strategy encourages as part of an integrated transport system. Coaches are also widely used by tourists visiting London. Coaches and buses are similar in terms of passenger capacity, as well as fuel use and emission characteristics, and benefit from similar efficiency measures.

6.89 Local bus services that are not part of the London bus network, such as sightseeing tours, commuter services and other limited stop routes, are required to operate in London under a London Service Permit (LSP). These vehicles are not part of TfL's London bus network and must be covered by an LSP if they have one or more stopping places in London. TfL grants LSPs under Section 185 of the GLA Act. In deciding whether or not to grant a LSP, consideration is given to criteria included in the Mayor's Guidance Document[7]. These criteria include the need for services to comply with measures that seek to promote improvement of the environment. All vehicles are expected to comply with statutory requirements regarding exhaust emissions, which will lead to progressive reduction in emissions from new vehicles. In addition, TfL wishes to see reductions in exhaust emissions from vehicles already in operation, particularly in central London.

6.90 Between 200 and 300 vehicles fall under a LSP, and a significant proportion of these operate in central London. TfL expects all services to develop a strategy designed to reduce emissions during the lifetime of the permit. Wherever possible, TfL will make such a strategy a condition of granting the LSP. Such strategies could include improvements to vehicles and use of alternative fuels, as well as training drivers in techniques that reduce emissions.

6.91 The London Coach Forum provides a proactive, co-ordinated and planned approach to dealing with all the issues regarding coach travel. This includes working together to identify how negative environmental effects of coach travel, including effects of energy use, on air quality and noise can be reduced. The forum was originally established by the Greater London Council, and was administered by Westminster City Council from 1986 until 2002, when TfL assumed responsibility.

6.92 The round-London sightseeing tour buses can incur high mileage travelling in central London and often use relatively old, inefficient vehicles. To reduce emissions from these vehicles, TfL will work with the operators and relevant boroughs.

6.93 Through the Air Quality Strategy, the Mayor will look to work with the London Tourist Board to promote the use of cleaner, more efficient coaches in London. The Mayor will also work with the board to raise awareness of the need for coaches and round-London sightseeing buses not to be left with the engine idling for long periods of time - this is particularly relevant while drivers are waiting for passengers to return to the coach. Reducing this idling will also reduce costs, noise and air pollution. Boroughs should use their powers to enforce this.

Taxis and private hire vehicles

6.94 In June 2002, there were approximately 20,160 taxis in London, operating around 85 million trips a year, predominantly in central London and around Heathrow. It is also estimated that there are at least 40,000 private hire vehicles (minicabs) operating predominantly outside central London, and carrying an estimated 70 million trips a year.

6.95 The operating life of a taxi can often be as long as 15 years, but as of June 2001, only 50 were more than 15 years old (or less than 0.3 per cent of the taxi fleet). At June 2002, 53 licensed taxis had been converted to LPG (comprising less than 0.3 per cent of the fleet) but with more planned.

6.96 Taxis account for 14 per cent of road vehicle kilometres travelled in central London and two per cent in Greater London. Given the amount of time spent on the road, it is particularly important to the health of taxi drivers that the emissions produced from their vehicles are as low as possible. The Public Carriage Office, now part of TfL, regulates taxis in London and was given additional powers to regulate the minicab trade from early 2001.

6.97 Reducing taxi 'empty mileage' - the number of kilometres driven with no passengers - can also reduce fuel use and exhaust emissions. TfL will work with the taxi trade to increase the number and improve the quality of taxi ranks where taxis can ply for trade. This will reduce the amount of empty mileage.

6.98 Through the Air Quality Strategy, the Mayor will work with TfL to encourage taxi manufacturers, leasing companies and owner drivers to provide and operate vehicles in London that are as fuel-efficient and create emissions that are as low as practicable. The Mayor will make information available to assist taxi owners in conforming to the set standards and obtaining grants to offset the costs of conversion or retrofitting vehicles.

Freight

6.99 Road freight and servicing (heavy goods vehicles (HGVs) and medium and light goods vehicles) account for approximately 14 per cent of all vehicle kilometres travelled on London's major roads, including motorways. Reducing the distance travelled by heavy goods vehicles or improving the efficiency of delivery and service vehicles in London could therefore have a significant effect on reducing energy use, CO_2 emissions and air pollution, while clearly producing cost savings. Section 4K of the Mayor's Transport Strategy sets out how he aims to support the shift of freight onto more sustainable forms of transport - for example, from road to rail and river when possible. The Mayor's Air Quality Strategy sets out how he proposes to clean up the vehicles that transport freight, as well as outlining mechanisms to reduce unnecessary journeys by these vehicles. See these strategies for more information.

6.100 TfL has set up the London Sustainable Distribution Partnership (LSDP), whereby organisations concerned with freight can work together to address issues. These include the LDA, business, local authorities, environmental interest groups, and freight organisations. The aim is to ensure that distribution, freight and servicing are carried out in the most appropriate way. Although freight generally has fewer alternative options than other trips, increasing the efficiency of vehicle use can produce cost savings. The industry has improved the efficiency of vehicle use during the last ten years. For example, between 1990 and 2000, the proportion of all goods vehicles over 3.5 tonnes running empty fell from 29.8 per cent to 26.9 per cent[8]. Pilot schemes in London have suggested further ways in which deliveries could be rationalised so that less travel time occurs without payload, thereby improving efficiency, and reducing the costs incurred and the distances travelled.

6.101 The issues around distribution must also be looked at on the sub-regional and local levels. The Mayor's Transport Strategy mentions that freight quality partnerships have been effective outside London, but so far few have taken root in London. Local freight quality partnerships involve dialogue between local authorities, the business community, residents, environmental groups and industry. In London, they could produce local solutions to local needs within the wider context of the Mayor's strategies and the framework of proposals identified by the LSDP.

6.102 Traffic congestion makes freight vehicles less efficient, preventing vehicles from being driven smoothly and increasing the time engines are idling. Cutting congestion will thus help to reduce fuel use and emissions from freight vehicles as well as enabling freight operators to estimate journey times more accurately. Reduced congestion in London will also have the

effect of improving the reliability of trips, thus reducing the number of vehicles required for delivery rounds and so further reducing congestion. Combined redistribution depots may help to facilitate this. These will also be investigated through the LSDP.

6.103 Each year, the average light goods vehicle in the UK travels 130,000km (80,000 miles) and uses diesel costing £20,000 (1998 figures). Most fleets that embark on fuel management programmes show savings of at least five per cent, meaning an average saving of £1,000 per vehicle per year. If the price of fuel continues to rise faster than general inflation, the value of fuel savings will increase further. The impact of making a five per cent saving in costs is usually magnified in its effect on profit. For example, if total costs are £500,000, fuel costs (at 30 per cent) are £150,000, and current profit (at five per cent) is £25,000. This means that a five per cent saving in fuel costs (of £7,500) will increase profit by 30 per cent to £32,000[9].

Shipping and rail

6.104 Shipping and rail have a lower environmental burden per tonne per kilometre than road traffic (see Table 1, above), and should be encouraged as sustainable modes of transport. Water and rail transport are both potentially more fuel-efficient than road transport, and can carry larger loads with the same engine power, although with local accessibility constraints and speed restraints for water.

6.105 The Port of London is the UK's biggest seaport, handling 52.4 million tonnes of cargo per year. Although serving London, much of the port is physically located outside the Greater London boundary. The Thames provides sustainable freight access into the heart of the capital, though only a small proportion of the total is transported in this way.

6.106 The Government's ten-year plan for transport[10], published in 2000, reported a 22 per cent growth in rail freight nationally during the past three years, and looked forward to an 80 per cent increase over the next ten years. The Strategic Rail Authority has forecast that 16-17 per cent of this increase could be in London, with the majority of this being non-bulk items transferred from other modes. The Hatfield accident and its aftermath have affected confidence in rail freight. The period immediately afterwards saw a seven per cent reduction in the amount of freight carried compared to the corresponding period of the previous year. Rail freight operations are expected to recover from this, helped by the Rail Regulator's recent near halving of track access charges for freight. However, the Strategic Rail Authority's Freight Strategy[11] recognises that

achieving the ten-year plan's targets will be harder than was the case when the plan was published.

6.107 The Mayor's strategies support the transfer of freight from road to rail where it is practicable, in keeping with the other policy objectives, including minimising negative effects on the environment in the vicinity of track and depot/handling facilities. However, even with greatly increased use of other modes, the vast majority of goods transport in London will continue to be road-based.

6.108 Increasing the amount of cargo transported by non-road-based transport, such as water and rail, is essential and is supported by safeguarding facilities such as designated wharves and railheads. Currently, 54 wharves in the Port of London lie within the Greater London Authority's boundaries, of which 39 are operational.

6.109 The Government introduced a system of safeguarding wharves in 1997. This provided a procedure to ensure that facilities required for water freight use cannot easily be lost to other forms of development. This power has now been transferred to the Mayor. Currently, 30 upstream wharves are protected. A review of proposals for safeguarding additional downstream wharves and existing safeguarded sites is being undertaken and is expected to be completed in 2004.

6.110 Air freight accounts for a small proportion of freight movement, but is significant due to the energy intensity of Heathrow and the road vehicle trips it generates. Heathrow Airport handled 55 per cent of UK air cargo in 2000.

Waste vehicles

6.111 There are a large number of vehicles operated by waste authorities, or by contractors on their behalf, for the collection and transport of waste. They are generally heavy vehicles, working under 'stop start' operation and using considerable amounts of fuel. Many authorities are already working through their own vehicle fleets and their tendering system to ensure that these vehicles are as clean and efficient as possible.

6.112 The Mayor's Municipal Waste Management Strategy contains a proposal that 'the Mayor will seek to ensure that all waste authorities encourage fuel management programmes, and that when waste contracts are reviewed, emissions criteria are specified for the vehicles used. Emissions criteria should comply with the currently applicable Euro standard, or the previous Euro standard with suitable after-treatment as a minimum, ie Euro II with Reduced Pollution Certificate until 2005. Waste authorities

should consider all vehicle options, including those which can achieve more stringent emissions standards for air quality, and which may also bring other benefits to the environment, such as reduced noise or carbon dioxide emissions.' The Mayor acknowledges that some authorities have already taken this step. There is also scope to move to clean alternative fuels for waste vehicles, eventually using hydrogen fuel produced from the gasification, pyrolysis or anaerobic digestion of waste.

Traffic management

6.113 Responsibility for the roads in London is split between three organisations:

- Transport for London has direct responsibility for the Greater London Authority road network, as described in the Greater London Authority Act 1999, now called the Transport for London Road Network (TLRN). It comprises 550km of London's Red Routes. While the TLRN constitutes less than five per cent of the total road network within Greater London, it carries more than a quarter of London's vehicular traffic
- The London boroughs are responsible for the majority (13,000km) of public roads and streets within Greater London and therefore have a major role to play in managing London's streets. About 1,200km of borough streets are classified as 'principal roads' and designated as 'A roads'. These carry a further 30 per cent or so of London's vehicular traffic, and much of London's high-volume bus and pedestrian movements. They are frequently the locations where the competing demands of distribution, access and amenity are at their most acute
- The Highways Agency, reporting to the Secretary of State for Transport, is responsible for the motorways (M1, M4, M11 and M25) and an access road to Heathrow Airport within Greater London.

6.114 The Mayor's Transport and Air Quality strategies include the Mayor's policies and proposals on how TfL and the boroughs will manage road space and reduce traffic levels in central London, and traffic growth elsewhere. The Mayor's Air Quality Strategy also sets out the Mayor's investigation, together with other stakeholders, into the feasibility of a Low Emission Zone (see section 4C). It also encourages the implementation of other Clear and Home Zones by the boroughs. The main aim of these is to improve local air quality, but they should also reduce fuel used by vehicles, as drivers are encouraged to use other forms of transport. See the Mayor's Transport and Air Quality strategies for more information.

TfL delivering hydrogen and fuel cells

6.115 TfL is supportive of the use of fuel cell technology in principle, and acknowledges its potential to power buses, taxis, river services and the organisation's buildings in the future.

6.116 Hydrogen fuel cells are likely to be adopted first in buses, which are able to carry large fuel tanks and refuel at their own depots. Indeed, the first hydrogen fuel cell (HFC) buses have completed trials in Canada, Germany, the USA and elsewhere. During 2004, TfL will be taking part in the trial of three fuel cell buses as part of a two-year international trial. TfL is working in partnership with EvoBus UK (the manufacturer), EST, BP (who are developing the infrastructure to provide the hydrogen fuel) and FirstGroup plc (who will operate the HFC buses in London). The London HFC Bus Project, part of the EU-funded Clean Urban Transport for Europe (CUTE) project, is in line with proposals made by the Mayor in his Transport Strategy. The buses will operate alongside conventional buses on a standard route into central London.

6.117 The entire CUTE project - at €18.5 million over five years - is the largest individual grant application ever financed by the EU's Directorate General for Transport and Energy. Apart from London, cities hosting trials of the new HFC buses are Amsterdam, Barcelona, Hamburg, Luxembourg, Madrid, Porto, Stockholm and Stuttgart. Reykjavik and Perth (Australia) are also receiving buses under the EU-funded ECTOS project.

6.118 If the outcome of the London Hydrogen Fuel Cell Bus Project is favourable, the Mayor will work with TfL to introduce fuel cell buses into the London fleet.

proposal 32 The Mayor will work with BP, Transport for London and others in the London Hydrogen Fuel Cell Bus Project and London Hydrogen Partnership to ensure the useful life of the CUTE hydrogen filling station beyond the end of the bus trials.

6.119 Initial demand for fuel cell vehicles is likely to come from depot-based operations. The Government has set a target that by 2012, 600 new buses a year should be low carbon, defined as 30 per cent below current average carbon emissions. By using hydrogen from renewable sources, 100 per cent carbon reductions would be possible. The priority in the short term is on improving the standard of diesel engines in taxis. However, it is expected that taxis and light delivery van fleets will follow buses in the conversion to fuel cells, and will be a stepping stone from large depot-based vehicles to the commercialisation of fuel cell cars. Imperial College has found support for the concept of hydrogen fuel cell

cabs among London's taxi drivers. The Mayor will be involved in work to develop fuel cell taxis for London[12].

proposal 33 If fuel cell taxis are shown to be commercially feasible and acceptable to the public and taxi drivers, the Mayor will work with Transport for London to encourage their take-up in the London fleet and develop a supply infrastructure.

The London Underground

6.120 The London Underground system consumes more three per cent of all electricity used in the capital, and is responsible for 1.5 per cent of the city's overall CO_2 emissions[13]. Nevertheless, the Underground system is a relatively efficient mover of people, in energy and CO_2 terms, when compared with aviation or road transport. London Underground Ltd (LUL) already closely monitors energy expenditure throughout the Underground system, including at tube stations and various points along each of the lines, and is expanding these monitoring systems. It also operates energy efficiency schemes, with incentives to encourage employees, for example at each tube station, to adopt best practice, saving energy and money. The Mayor welcomes these initiatives, and will work to increase energy efficiency on the Underground.

6.121 Energy is supplied to the Underground system in a variety of ways. It has a dedicated electricity distribution network providing power to the tracks, as well as some stations and office buildings. This distribution network receives electricity from six 'bulk supply points', with emergency back-up and load management from a dedicated power station in Greenwich. The bulk supply points are spread across the network, and connect the Underground to the regional electricity distribution network, run by London Power Networks. The larger of the two power stations owned by LUL, at Lots Road, was decommissioned in late 2002.

6.122 In addition, many of the sites owned by LUL are supplied directly from the regional electricity distribution network. Of these, about 480 have a demand of less than 100kW, while around 32 have a demand greater than 100kW. LUL currently purchases 150GWh of renewable electricity, representing 100 per cent of its non-traction electricity requirements.

6.123 This situation is mirrored in the way that electricity supply contracts are structured. There is an annual contract for the bulk supply points. This recently reached about 1TWh (terawatt hour) per year, 90 per cent of overall electricity consumption, when Lots Road Power Station was decommissioned. This contract is currently held by British Energy, which supplies ten per cent of it from renewables. The remaining 90 per cent

comes from its normal portfolio, 75 per cent of which is nuclear. LUL has recently become part of TfL and is taking over energy procurement for the whole organisation. LUL is currently reviewing its energy procurement policy and the Mayor looks forward to a positive approach to renewables emerging from this process.

6.124 As part of the GLA group, policies and proposals in this strategy relating to the GLA group apply to the London Underground system and associated activities.

6.125 There are opportunities to increase the proportion of renewable electricity consumed by the Underground system. The Mayor's approach to reducing the environmental impact of the Underground system will be through increasing the use of renewable electricity and improving building energy efficiency and management, as well as changing train driver behaviour.

6.126 It is important to note that plans to upgrade lines generally involve the replacement of old rolling stock. New trains tend to have higher power requirements (due to high-performance acceleration and braking to reduce run times, provision of audio and visual customer information, in-car CCTV, emergency talk alarms, etc). However, new rolling stock also offers opportunities for more efficient power use (for example regenerative braking, where braking energy is converted back into electricity for use by accelerating trains elsewhere) and Automatic Train Operation, which eliminates operator variability. Station improvements can also increase power requirements (for example provision of help points, CCTV, new lifts for step-free accessibility etc), although these can be kept in check through efficiency and management improvements in heating and lighting systems. Hence, new and additional trains, increased passenger numbers, and general upgrades to the Underground system will lead to increased power requirements. Improved energy management in buildings, and the use of energy-efficient technologies should counter these, wherever possible.

policy 27 The Mayor will work with the relevant organisations to minimise the contributions of the London Underground system to London's greenhouse gas emissions.

6.127 LUL is developing an energy policy for the Underground system and the Mayor will seek to work with it to reduce CO_2 emissions from all of the system's energy consuming activities. In developing this policy, the Mayor will work with LUL to make use of its status as a very large and stable purchaser of energy to ensure value for money, and to support the development of the renewables sector in the UK. This will include

investigating the scope for entering into a long-term relationship with renewable energy supplier(s). Ideally, some of the renewable energy plant supplying the Underground will be located in London, contributing to the capital's renewable energy target.

proposal 34 The Mayor will work with relevant organisations towards meeting a significant and growing proportion of power for the Underground from renewable sources during the next ten years. To achieve this, the Mayor encourages London Underground Ltd to investigate the possibility of entering into a long-term relationship with one or more renewable electricity suppliers.

Air traffic

6.128 London is a world city and an international gateway to the UK and Europe. Better access and continuing improvements to the international services that the capital provides are essential if London is to retain and enhance its world city status. These improvements must, however, be implemented in ways that minimise negative environmental effects, including reducing pollution emissions from aircraft and airport-related traffic.

6.129 The passenger turnover of airports in the London area has grown significantly in the last decade. In 2000, published data from Heathrow, Gatwick, Stansted, Luton and London City airports showed a combined total of 116 million passengers per annum (of a UK total of 180 million). Eighty per cent were international passengers. Heathrow dominates, with a total of 64 million passengers per annum, but all the airports in the London area have an important role as components of an overall system. The five airports handled 80 per cent of UK air freight[14]. Heathrow is the largest air freight facility in the UK, handling 55 per cent of all UK air cargo in 2000, mostly in the holds of passenger aircraft.

6.130 The number of passengers using London's airports is expected to grow significantly. With Heathrow Terminal 5 having been approved, extrapolation of recent increases in demand indicates that passenger numbers at Heathrow could grow from 64 million to 90 million per year by 2016. Air travel forecasts suggest that potential passenger demand across the five London airports could rise to around 200 million by 2015, and 300 million by 2030, compared to 116 million in 2000. Demand for air freight is also forecast to grow substantially. The Mayor accepts that the London area needs significant additional capacity for air travel, to support its world city role.

6.131 The White Paper, published in December 2003, supports making best use of existing runways, and the building of two new runways in the South

East in the period to 2030: a second runway at Stansted around 2011/12, with strict controls for noise and minimising the loss of heritage and countryside, and an additional runway at Heathrow provided strict environmental limits can be met, in the 2015-2020 period. The Mayor strongly supports the government in the condition it has set that a Heathrow runway should only go ahead if environmental limits can be met. He also considers that investment in public transport improvements is essential both around the airports and for their links and connecting stations within London, to cater for the surface transport needs of additional air travellers.

6.132 Heathrow, London's largest airport, is a considerable energy consumer, even when flight energy consumption is not taken into account. Real improvements to the energy systems at Heathrow, and on a smaller scale at London City, would improve London's overall environmental performance significantly. The same applies to Gatwick, Stansted and Luton airports, although these are outside Greater London and therefore not technically within the remit of this strategy.

6.133 According to the Intergovernmental Panel on Climate Change's Special Report on Aviation and the Global Atmosphere, aviation currently accounts for just over 3.5 per cent of total emissions today. According to the highest scenario in the IPCC report, however, by 2050, emissions from aircraft could contribute up to 15 per cent to the overall global warming produced by human activity[15].

6.134 The European Union's Communication on Air Transport and the Environment noted that,'the air transport industry is growing faster than we are currently producing and introducing technological and operational advances which reduce the environmental impact at source. The overall environmental impact is bound to increase since the rate of growth and the rate of environmental improvement appear to grow in important fields, such as emissions of greenhouse gases. The trend is unsustainable and must be reversed because of its impact on climate and the quality of life of European citizens'[16].

6.135 Subsonic aircraft being produced today are about 70 per cent more fuel efficient per passenger kilometre than 40 years ago. The majority of this gain has been achieved through engine improvements, and the remainder from airframe design improvements. A further 20 per cent improvement in fuel efficiency is projected by 2015 and a 40-50 per cent improvement by 2050, relative to aircraft produced today. There are also technical developments under way which are aimed at getting better fuel efficiency from existing aircraft or engine designs.

6.136 Although improvements are likely to continue to be made in the future, the rate of increase of air travel means that improvements are on too small a scale and at too slow a pace to avoid a steep growth in CO_2 emissions. Increasing the overall number of aircraft using Heathrow will increase emissions of CO_2[17]. To keep the rate of carbon emissions stable, every development, such as new runway capacity, would need to be accompanied by a matching improvement in energy efficiency and a reduction in the environmental impact of aviation more generally. The Mayor will work with industry towards this goal.

6.137 Aviation policy is under the control of the Secretary of State for Transport. While the Mayor has no jurisdiction over aircraft movements at Heathrow, he will work to exert influence in this area.

6.138 The Mayor can make representations to the Secretary of State concerning taxation and other measures. The tax exemption on aviation fuel is an anomaly, reducing the costs of air travel relative to other fuel-taxed forms of transport. Removing exemption from such a tax would help to ensure that the polluter pays the environmental costs and would give an incentive for further improvements in fuel efficiency, including technological advances. The Mayor will continue to urge the Secretary of State to do everything practicable to reduce fuel use and emissions from aviation, for example through international agreements, national regulations and economic instruments.

6.139 Through his statutory strategies, the Mayor intends to take action to minimise the environmental effects of any developments that do take place at London's airports. The Mayor's Transport and Air Quality strategies set out specific policies on how London's airports, and particularly Heathrow, can be made more sustainable.

policy 28 The Mayor will keep potential changes in the spatial distribution of London-related runway capacity and airport facilities under review, and will seek the fullest possible scrutiny of environmental effects, including those relating to energy use, as part of the consideration of implications for London. He supports the government in its commitment that an additional runway at Heathrow should only go ahead if it can be shown that its environmental effects are acceptable. The Mayor also considers that improved surface transport provision for additional air passengers is essential, in particular to minimise adverse environmental impacts.

policy 29 If aviation technologies prove unable to deliver sufficient improvements in energy and other environmental performance to match Londoners' legitimate expectations and the needs of sustainable development, the

Mayor considers that the Government should promote international action to manage aviation demand sustainably.

policy 30 The Mayor supports the view that the aviation industry should pay for the external costs that it imposes upon society, including those relating to climate change. The Mayor therefore supports ending the exemption of aviation fuel from taxation.

Surface access to Heathrow Airport

6.140 In 1999, approximately 42 million passengers arrived by road and rail, of which only 35 per cent used public transport. In the same year, approximately 75 per cent of employee trips (12 million) were made by car or taxi. This is not sustainable and major new public transport links are essential. The Mayor's Transport Strategy sets out how the Mayor plans to improve public transport links to London's airports, particularly Heathrow.

6.141 There are many initiatives currently being implemented to increase the proportion of both passenger and staff trips by public transport. The Mayor supports the position taken in the Government's 1998 Integrated Transport White Paper that airport operators should take the lead in implementing initiatives to improve the quality of public transport used by passengers and staff. It states that the aviation industry should help to pay for improvements to 'surface access' and that the contribution should reflect the extent to which the industry benefits from the improvements. Some transport proposals may require substantial financing. The Government expects the aviation industry to assist with funding public transport improvements or measures to mitigate the effects of road traffic to and from the airport, both directly and through (surcharge) levies on car parking charges.

6.142 The Mayor supports the development of a sustainable and balanced London area airport system. London's international transport links for passengers and freight need to be improved and expanded, subject to environmental capacity, and there should be efficient and sustainable public transport access to airports and international rail termini.

6.143 Improvements can occur through partnerships between BAA/Heathrow, the Mayor, TfL, local authorities and others. These are being actively pursued through the Mayor's Air Quality Strategy. At Heathrow, BAA and others are already undertaking the measures summarised below. The Mayor supports these measures to reduce fuel use and emissions, and encourages others to build upon them.

- Through facilitation by the Mayor, BAA plc and other operators are

talking to the Energy Saving Trust regarding funding to increase work on cleaning vehicles at Heathrow
- Improved fleet servicing - reducing fuel consumption by almost 30 per cent since 1996
- Encouraging staff to use public transport instead of making private car trips
- A Greener Driving leaflet, giving practical tips to encourage better practice
- alternatively fuelled company car fleet - LPG vehicles are available and measures are being developed to encourage choice of vehicles
- undertaking a study into aircraft holding and taxiing times to establish emissions improvements
- Reducing the use of ground power units and auxiliary power units.
- Using natural gas in most boiler houses
- Measures to achieve the BAA/Heathrow target of 40 per cent of all passengers travelling to Heathrow by public transport by 2007
- First Beeline - introduction of full conversion to CNG or LNG of all bus/coach vehicles operating on the 74/75/76 route.

The GLA group leading by example

The GLA group tackling climate change

6.144 The Greater London Authority and functional bodies must do all they can to improve the sustainability of London. This applies equally to in-house activities and public service provision. The Mayor has developed an Environmental Policy Statement for the core GLA and the functional bodies are encouraged to do the same.

6.145 This strategy sets out the Mayor's approach to improving the sustainability of energy supply and use in London. It should inform decisions on energy supply and use, across the GLA group.

6.146 To ensure that the functional bodies are working to achieve each year improvements in the way they use energy and the emissions they are responsible for, the Mayor requires them to monitor and report on an annual basis. The reports will detail their energy use and the emissions of CO_2 resulting from their operations, the measures they have taken to minimise these, and the savings made. The Mayor recognises that the functional bodies are a diverse group of organisations. In some cases, this reporting is already under way, and in others preparations are advanced.

6.147 The Mayor is aware that TfL, in particular, was formed recently, and may need additional time in which to collate the various data required. To work towards the requirement set out in the following proposal, TfL should report on the size, length and monetary value of all energy contracts

relating to its activities, including those carried out by contractors on its behalf. For all functional bodies, it is essential to report both the generating source of electricity, and its status with regard to the Renewables Obligation. This information can be obtained from the electricity supply companies.

proposal 35 The Mayor requests Transport for London to report on its operational structure, including all direct and contracted activities, buildings, and vehicles (including in-house and contracted fleets) by the end of 2004.

proposal 36 The Mayor requests the functional bodies to monitor and report annually on the energy used and carbon dioxide emissions from their operations, including those carried out on their behalf by contractors, and detail the measures taken to minimise these, and the savings made.

Energy efficiency in GLA group buildings

6.148 The GLA moved into City Hall near Tower Bridge in the summer of 2002. This new building has been designed to minimise its effect on the environment, using 25 per cent less energy than the equivalent volume rectangular building (see Case Study 3). It incorporates other technologies to minimise environmental effect.

6.149 Energy-related objectives of the Environment Policy Statement include:

- to contribute to the national target, the GLA will aim to reduce its levels of CO_2 emissions
- to establish a GLA target on reducing GLA energy use
- to buy all electricity from renewable sources
- to buy and use products and equipment that are energy efficient
- to promote energy efficiency through best practice, for example by giving practical advice to managers and staff
- to introduce new, more energy-efficient techniques and technologies without sacrificing productivity or comfort
- to measure and report on how much energy the GLA group's buildings and fleets consume and the equivalent greenhouse gas emissions.

6.150 The Mayor aims to deliver his environmental policy objectives through a number of mechanisms, including the procurement of goods and services. The Mayor is committed to best value and achieving value for money, while taking account of:

- whole life costs, quality and other benefits, and not just the initial price
- ensuring that GLA suppliers' actions are consistent with this statement, by conducting at least one pilot project or environmental audit each

year covering a part of the GLA
- using the European Commission's energy-labelling scheme, buying the most energy-efficient products where they give lifetime value for money.

6.151 The GLA is currently undertaking a BREEAM assessment of the operation of City Hall. It is also intending to seek energy accreditation under the Energy Institute's scheme in the next few years, once it has established a comprehensive set of baseline data.

proposal 37 The Mayor expects Transport for London and the London Development Agency to follow his lead and adopt environmental policies, which include demonstrating best practice and adopting an energy management programme.

6.152 The Government's Action Energy programme offers a wide range of excellent guidance on applying energy efficiency in different buildings, including how to establish energy management programmes. Guidance is free and available on the internet[18]. The functional bodies are all encouraged to refer to this accessible information to help them deliver the Mayor's policies.

The GLA group using renewable energy

6.153 The Government has produced guidelines on buying renewable energy to power its estate. Although directed at Government departments, it contains general advice that is applicable to all organisations that purchase their electricity by contract. This is available on the Government's sustainable development website[19].

6.154 There are a variety of contract models via which organisations can purchase renewable electricity. These include green tariffs, green funds and long-term agreements with a generator constructing plant on- or off-site, specifically to meet the organisation's demand.

6.155 Chapter 4 includes a discussion on green electricity tariffs and funds. These are not without problems, as they do not guarantee that electricity suppliers will exceed their legal requirements to supply renewable electricity under the Renewables Obligation. It is therefore important that when procuring green electricity, organisations obtain clear information from their electricity suppliers on their generating fuel mix, and the status of the green element of that mix in respect of the Renewables Obligation.

6.156 As discussed in Chapter 4, it is preferable to buy electricity under those green tariffs (or funds if a suitable tariff is unavailable), which guarantee that a proportion of the renewable energy is additional to that required

by the Renewables Obligation. Clearly, the size of the proportion will influence the cost significantly, so it is currently very unlikely that any 100 per cent additional renewable electricity supply would be competitive. Nevertheless, the Mayor believes that it is important to use GLA group purchasing power to support growth in demand for renewable electricity, even where this is not entirely additional to the Renewables Obligation. The Mayor wishes to see the functional bodies investigate all these options, as part of a concerted effort by the GLA group to use its collective purchasing power, both to reduce its own CO_2 emissions and in support of the renewable electricity sector generally.

6.157 City Hall's electricity supply contract is sourced entirely from renewable energy. The Mayor also ensured that Romney House, previously home to the GLA, the LDA and the MPA, was completely powered by renewable electricity by the end of 2001. The Mayor expects all the functional bodies to work towards achieving the same, at first in their head offices and eventually in all their buildings.

proposal 38 The Mayor expects Transport for London and the London Development Agency to seek to power all their buildings from renewable electricity by the end of 2005. The Mayor requests the Metropolitan Police Authority and London Fire and Emergency Planning Authority to do the same.

6.158 The Mayor will work with the functional bodies to develop electricity-tendering criteria designed to maximise the amount of power supplied from renewables and, within this framework, to maximise the proportion that is additional to the Renewables Obligation. All members of the GLA group will be expected to apply best value criteria in procuring energy. While accepting that these different organisations have varying requirements, the Mayor will encourage the use of new approaches to securing renewable supply. These will include investigating the feasibility of a pan-GLA group partnership to exploit bulk purchasing power, long-term contracts with renewable electricity generating companies, and investment in green fund tariffs. Any new criteria will need to be compatible both with procurement legislation and with operational requirements.

6.159 The Corporation of London and the London Borough of Lewisham are both large purchasers of renewable electricity in London. Lewisham Council is powering the whole of its estate by green power. The council placed a high priority on this, choosing to pay a premium, where it was necessary, for what it considered best value. For the past few years, the Corporation of London has been powering some of its buildings and services with green power. This has been achieved at little or no extra cost, although the Corporation has a policy of paying up to five per cent

extra for renewable electricity. Green electricity powers the Guildhall (since 1998), the Barbican Centre (since 1999), public street lights (since 1999) and Spitalfields Market (since 2000).

6.160 The functional bodies should consider generating their own green electricity using local, small-scale renewables, such as PV, where circumstances make these options feasible. Many of the functional bodies' buildings offer opportunities to demonstrate PV, funding for which may be available from Government and other programmes. All the functional bodies should actively explore these opportunities.

proposal 39 The Mayor requests all the functional bodies to investigate the feasibility of employing renewable energy technology in their buildings. To facilitate this, the Mayor encourages the functional bodies to conduct surveys of their building stock with a view to identifying those buildings most appropriate for renewable energy installations.

6.161 The Mayor recognises that the ability to meet the objectives of the above proposal will depend on circumstances, which will vary. It is likely to be most economic as part of a building refurbishment. Organisations which rent only a small part of a building may not have independent energy metering, and will in any case need to work through their landlords, and in collaboration with other tenants. In such situations, the Mayor encourages functional bodies to be proactive in persuading their landlords and fellow tenants to investigate all the possibilities for building-based renewables and green electricity supply.

6.162 TfL, MPA, LFEPA all own considerable building stock and fleets. It is important that these are managed to reflect and promote the above aims.

Transport for London

6.163 TfL has published an Environmental Action Plan as a first step toward explicitly managing the environmental effects of its operations. The Mayor's strategies, including the Energy Strategy, provide the policy context. As part of this action plan, the Mayor will work with TfL towards improving the energy performance of its buildings and the proposals in this section of the strategy. This will need to sit within a context of continuing monitoring of performance and review of action to improve performance.

6.164 TfL is investigating the feasibility of powering its buildings and street services by green electricity, as well as directly employing renewable energy technology. This work is described in the following section.

6.165 Responsibility for London's primary road network, known as TLRN or Transport for London Road Network, rests with Transport for London and includes managing the energy supply to support surface transport's road network infrastructure. Most relevant to this strategy are street lights, traffic lights and other street furniture, including direction signs, illuminated bollards and bus shelters. Clearly, essential systems, such as traffic lights, could not operate entirely independently of the local distribution network, and this may affect the economic case for using on-site renewable energy. Nevertheless, it should not preclude the use of green electricity supply via the local distribution network.

6.166 The Mayor believes that there is significant scope for using renewable energy to power TfL operations. The Mayor requests TfL to explore these opportunities, and will support TfL in doing so. The Mayor also expects authorities responsible for maintaining public lighting systems to adopt regular maintenance programmes, which can improve the energy efficiency of those systems. TfL has made progress in this regard by using low energy, LED-based traffic lights when replacing or installing new equipment.

6.167 The guidance given above on purchasing renewable electricity applies equally to power for street furniture. Ten per cent of power to TfL's street lights is currently supplied by a green tariff. The Mayor expects TfL to seek to increase this proportion towards 100 per cent, where this is economically and practically feasible, when renewing the contract for lighting on the TLRN. This process is likely to be managed by London Underground Limited's energy procurement function.

proposal 40 The Mayor requests that Transport for London reviews operational design guidelines and project appraisal methods to ensure that it assesses energy use and considers the use of renewable energy.

6.168 Solar photovoltaics are a cost-effective way of supplying electrical power to remote applications and, for this reason, telecommunications, navigational aides and satellites have been the most common uses to date. However, photovoltaics (PVs) can also be cost-effective in powering more down-to-earth systems, such as bus shelters, in cases where the local electricity distribution network is more than a few metres away. In such cases, the cost of connecting to the existing supply network can exceed that of meeting the supply from an independent PV-based system. There are already several examples of such applications in London. TfL's pilot study of PV-powered bus shelters has proved a success. TfL intends to extend the technology to all shelters that cannot be connected to a mains supply, by 2005.

6.169 In the last six years, London Buses has worked to improve the presentation and quality of information at bus stops to assist the public using the services. This includes night-time illumination of timetables, first tested in Kingston town centre in 1996. Solar power, if carefully coupled with efficient timetable lighting and an effective energy management system, was found to provide night-time legibility of timetables and improved visibility of the bus stop flag.

6.170 The trial suggested that the costs over the whole life of the installation could be up to 36 per cent lower if solar panels were used rather than mains power. As well as the costs and environmental benefits, solar power proved to offer other very practical operational benefits, such as ease of relocation of stops and interchangeability, no reliance on third parties, and intrinsic safety.

proposal 41 The Mayor requests Transport for London to install photovoltaics to power street applications, such as street lights, bus shelters and bus stops, where viable, to avoid costly connection to the national grid and disruption to the roads. All new street lights should be energy efficient and minimise light pollution. The Mayor will work with Transport for London towards powering the street furniture that is not powered by solar from green electricity supply by 2005.

6.171 ETSU (now Future Energy Solutions), in its assessment of the potential for renewable energy in London, observed that 'London has a significant arterial road (owned by TfL) and rail network. Some of these routes, which cut through urban districts, could well represent a noise nuisance to local residents. The east-west orientation of some sections of these transport routes provide an option for south-facing sound barriers - the best orientation for maximum output from PV modules. With careful design it should be possible to eliminate any conflicts between noise and electrical performance. The opening of electricity markets, the facilitation of embedded generation and reductions in PV costs could, when combined with the dual function of the application, make such systems realisable'[20]. Such schemes, provided they are grid-connected, would also be eligible for funding under the DTI's Major PV Demonstration Programme.

6.172 ETSU also reports that 'a number of systems, mounted along a total of 10km of London Transport routes, could contain a total installed capacity of 1.56MW, providing an electricity yield of 1.2GWh/year'. TfL should investigate such potentially sizeable and high-profile schemes, which could be integrated with traffic noise barriers where these are practical. Opportunities for partnerships, for example with utilities etc, should be explored, and funding sought from governmental and other programmes.

proposal 42 The Mayor requests Transport for London to investigate the potential for high-profile schemes integrating photovoltaics into noise barriers along arterial road and rail networks. Partnerships should be sought with utilities, energy companies and advertising agencies.

Metropolitan Police Authority

6.173 The Metropolitan Police Authority publishes an Environmental Strategy, outlining its approach to reducing the environmental effects of its various activities. Through this, the MPA demonstrates its commitment to best practice in environmental issues, while noting that, given its limited financial and staffing resources, there will always need to be a balance between conflicting demands on the authority.

6.174 The MPA publishes an annual Environmental Progress Report. This document reports on strategic targets set for the previous financial year and sets strategic targets for the current financial year. It focuses on the areas in which the MPA has the greatest effect on the environment: the consumption of raw materials and natural resources, atmospheric pollution, social issues such as litter and graffiti, and wildlife crime.

6.175 The MPA comprises 400 sites across London, served by a combination of gas, gas oil and electricity. Electricity consumption totals roughly 130GWh annually, at a cost of around £5 million. Gas consumption is about 165GWh, costing £2 million annually.

6.176 Electricity supply to all MPA sites is managed centrally from Property Services at Cobalt Square. This means that the MPA has tight management control over its electricity supplies, allowing a co-ordinated approach to increasing the proportion supplied from renewables, in line with the objectives of this strategy.

6.177 Currently two sites (Cobalt Square in Lambeth and Orpington police station in Bromley) are powered by renewable electricity, to which London Electricity supplies 4GWh at a cost of £155,000 annually. Switching the Cobalt Square and Orpington supplies to London Electricity's Green Tariff saved the MPA £4,500 and 1,800 tonnes of carbon dioxide.

6.178 The current electricity contracts ran until October 2003 and, after negotiations, London Electricity has, for a small premium over brown electricity, offered to supply the entire MPA estate with renewable electricity. Therefore, the MPA has exercised its option to extend the current contracts for a further year until October 2004. This means that the MPA will achieve the objective of the GLA strategy (supply all of the MPA estate with renewable electricity) well before the target date of 2005.

London Fire and Emergency Planning Authority

6.179 LFEPA occupies more than 130 buildings in London, with 112 fire stations, as well as offices and river stations. Annual electricity costs are approximately £750,000 and gas consumption is about £500,000 per year.

6.180 As with the MPA, energy contracts for all 130 or so sites are managed centrally, simplifying the process of switching electricity sources from traditional to renewable supplies.

6.181 Both gas and electricity contracts were retendered in 2003, and the current non-renewable electricity supply contract (no renewable electricity was offered during LFEPA's tender) will be due for retender in November 2004. LFEPA will work with the Mayor to maximise the renewable proportion of the electricity supply, when the contracts are retendered.

6.182 Implementation of an Environmental Policy and Management System for LFEPA is under way and will enable it to better manage its response to environmental policy and provide a quantified record of its performance in this area. Development of the system recognises the need to address climate change influences and other environmental effects of LFEPA activities.

The GLA group employing hydrogen fuel cells

6.183 As part of the Mayor's efforts to lead London towards a hydrogen economy, he aims to ensure that the GLA employs hydrogen and fuel cells where appropriate. As well giving trials to three fuel cell buses in the capital (described earlier in the chapter), the Mayor will investigate the feasibility of using a fuel cell to provide some or all of the heat, cooling and power requirements of City Hall. A feasibility study for this project will be conducted, and he will deploy other relevant fuel cell technologies, if feasible.

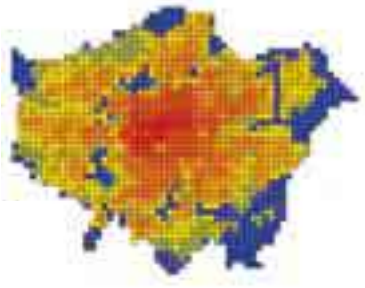
proposal 43 The Mayor will examine the feasibility of using a fuel cell for combined heat and power for City Hall and encourage the functional bodies to do the same in their property.

Providing information on energy in London

6.184 The GLA Act includes a requirement to make available information on energy use and greenhouse gas emissions in Greater London. Section 351.-(1) of the Act states that 'the Mayor shall produce and publish a report on the environment in Greater London to be known as a State of the Environment Report'. Section 351.-3(e) requires that the report contains, among other things, information about 'energy consumption and the emission of substances which contribute to climate change'.

6.185 Along with this statutory requirement, it was necessary as part of the strategy development process to build an accurate picture of current energy consumption patterns, and the direction of certain important trends. Some of this information is presented in Chapter 2, some has been used for background calculations, and some has been published separately to satisfy the requirements of the Act, and to contribute to the State of the Environment Report.

6.186 The Mayor has collated data on two main aspects of energy in London: firstly, actual energy consumption and associated CO_2 emissions, and secondly an analysis of the fuel poverty situation in London. These tie into the main themes of this strategy, namely reducing CO_2 emissions and tackling fuel poverty. The approach taken to developing each of these datasets is outlined below.



6.187 The London Research Centre published the last comprehensive study of energy use in London in 1993. This included data from 1965 to 1991, and dealt extensively with various issues relating to energy and the environment. Using this study as a starting point, up-to-date information on the consumption of fuels was obtained from a range of sources, split into geographical and non-geographical databases. Non-geographical data was used for the analysis of historical and future trends, and fuel/sector patterns, while geographical data has been developed into the London Energy Database. This was published on CD-ROM in June 2003, and is available on request, free of charge to non-profit organisations and for a charge to commercial bodies. This database allows interrogation on the basis of fuel, sector and geographical location, and contains energy consumption and CO_2 emissions data. A set of maps has been included on the CD, although users can create their own maps by using the database in conjunction with GIS software.

6.188 The Energy Strategy provides London with targets for the reduction of CO_2 emissions and increases in the proportion of energy derived from renewable sources, in line with national policy. Energy use and CO_2 emissions data, disaggregated by fuel, sector and geographical location, should allow the identification of problem areas and potential solutions.

6.189 The data will benefit local authorities in the preparation of their own environmental reports and for formulating policy and overseeing planning development. Non-governmental organisations and members of the public will have access to the same data as used by policy-makers, and with it the opportunity to reach informed opinions about the problems faced by London, as well as the potential solutions. These are important

in terms of building support for the strategy's initiatives, from the general public, from specialist organisations, and from other interested parties.

6.190 Regularly updated versions of the London Energy Database will be needed for monitoring long-term progress in reducing carbon emissions and increasing the share of renewable energy resources. For this task, the GLA will need to enter into long-term agreements with the suppliers of energy data in order to obtain regular updates on energy use and associated carbon emissions in Greater London. The organisations include electricity distribution network operators in London, Transco, TfL, the Environment Agency and others.

6.191 As discussed in Chapters 2 and 4, the Mayor commissioned research to analyse the London portion of the 1996 English House Condition Survey. This was done because the Mayor believed it necessary to begin developing accurate London-specific data on fuel poverty. When the 2001 English House Condition Survey data becomes available, the Mayor will seek to repeat this exercise, although the methodology used may be updated. The Mayor will make these reports available on the GLA website.

policy 31 As part of his obligation under the GLA Act to inform policy development and to raise awareness, the Mayor will make available data on London's energy supply and use, the associated emissions of carbon dioxide, and the number of households in fuel poverty.

References and notes

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2 Based on 1999 energy consumption in London as a proportion of the UK total: Greater London Authority calculations using data from Department of Trade and Industry, Digest of United Kingdom Energy Statistics, Her Majesty's Stationery Office, 2000
3 Greater London Authority, 2001
4 About half of the UK car fleets, and 70 per cent of the van fleets, are fully expensed. This means that the employer is responsible for fuel costs as well as expenses such as depreciation, maintenance, insurance etc. For the remainder of the fleet, the organisation normally pays for at least the fuel needed for business use
5 Energy Efficiency Best Practice Programme, Energy Consumption Guide 64: Fuel Consumption on UK Car and Van Fleets, 1998
6 For information on the guidance available through the Energy Efficiency Best Practice Programme, call the Information Line on 0800 585794
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17 Department of the Environment, Transport and the Regions, Air Quality for England, Scotland, Wales and Northern Ireland, Her Majesty's Stationery Office, 2000
18 The ActionEnergy homepage is at http://www.actionenergy.org.uk/
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20 Energy Technology Support Unit, commissioned by Government Office for London, Development of a Renewable Energy Assessment and Targets for London, 2001

7 Working together

7.1 Earlier chapters describe the policies and proposals on which the Mayor and GLA Group will lead. However, there are a number of further issues that need to be tackled through wider action. This chapter highlights the key cross-cutting and specific issues that require effective collaboration and includes proposals for a major new initiative to achieve this - the London Energy Partnership.

The key cross-cutting issues

7.2 The Mayor has identified four strategic, cross-cutting issues that require effective collaboration: delivering major projects, for example through Energy Action Areas; funding major projects; communication and education.

Delivering major projects - Energy Action Areas

7.3 London needs major energy projects implemented on the ground which tackle a range of energy issues all at once. The Mayor proposes Energy Action Areas as a mechanism to enable this.

7.4 Energy Action Areas will be well-defined geographical areas which can act as showcase low-carbon communities, demonstrate a range of sustainable energy technologies and techniques, and provide a means of targeting resources. They could act as a focus for improving energy efficiency in buildings, for example, integrating sustainable technologies and incubating local skills development. This approach would add value and profile to projects, generate nodes of good practice, and provide models for the rest of London and other urban areas to follow.

7.5 Energy Action Areas could develop on the basis of local need and opportunity, to tackle the diversity of energy challenges facing London. They could be located in areas where new construction is planned, or where there is a high incidence of fuel poverty in existing housing, or a mixture of the two. This approach would focus on assisting areas of social deprivation in tackling fuel poverty, and integrating this work with regeneration and major developments in London. There should eventually be enough Energy Action Areas to represent a diverse cross-section of London.

proposal 44 The Mayor wants a number of Energy Action Areas established in London to act as showcase low-carbon communities, delivering a range of sustainable energy technologies and techniques across a number of applications.

7.6 Energy Action Areas could link with the LDA's work and the Mayor's implementation of the London Plan - for example, the regeneration, opportunity and intensification areas defined in the London Plan and sub-regional planning frameworks - and build on existing local initiatives

and networks. There is also scope for links with the Mayor's Architecture and Urbanism Unit through master planning frameworks, particularly in east London and the Thames Gateway. London boroughs will be fundamental to the success of Energy Action Areas. The Mayor will therefore work with the boroughs, the LDA, the London Energy Partnership and other key players to identify, define and implement Energy Action Areas in London. The Mayor is supporting a partnership bid led by the LDA to the EU Concerto Programme, which could represent a first opportunity to pilot the Energy Action Area concept.

7.7 Experience gained in Energy Action Areas should be applied to widen the implementation of the Energy Strategy across Greater London as a whole.

Proposed framework for developing and implementing Energy Action Areas

7.8 Public consultation responses showed broad support for the Energy Action Area concept and several boroughs expressed an interest in participating. The Mayor will ask the London Energy Partnership to develop and implement Energy Action Areas as a priority project. A draft framework for developing the concept is presented below. This builds on comments received during consultation.

Box 13: Energy Action Areas - a draft framework

Objective

To establish a small number of neighbourhoods in London with exemplary sustainable energy systems.

Criteria for Energy Action Areas

- Exemplary at London, national and international levels.
- Deliver a range of objectives and targets of the Energy Strategy and the London Energy Partnership.
- Integrate a number of sustainable energy technologies.
- Developed, delivered and managed using a partnership approach.
- Large scale, ranging from neighbourhood to district.
- Involve and benefit the community and promote community-building.
- Include diversity of economic and organisational sectors.
- Demonstrate long-term viability.
- Demonstrate replicability to other areas of London.

Benefits to participating organisations

- Enhance the project profile, including at international level.
- Receive support in promoting work.
- Attract partners and improve funding opportunities.
- Receive support when applying for planning permission.

Benefits to London

- Large-scale demonstration of sustainable energy technology in London's neighbourhoods.
- Encourage complementary energy technologies and partnership working.
- Demonstration of sustainable developments and associated CO_2 emission reductions.
- Attraction of external funds (net economic benefit).
- Enhanced international reputation.
- Development of essential skills and businesses.

Funding major projects

7.9 Adequate funding will be necessary to deliver Londonwide energy initiatives successfully and disseminate the outcomes. Strategic work on funding will benefit project delivery across the range of energy issues in London.

7.10 There is a range of grants currently available to fund energy projects in London, particularly energy efficiency projects. Currently, the process of identifying and applying for suitable funding is unnecessarily onerous, as demonstrated by the fact that London currently has the lowest take-up of Warm Front grants in the UK.

7.11 The Government continues to initiate new and bigger programmes to stimulate the take-up of energy efficiency and renewables. A selection can be found in the London Assembly's scrutiny report on the draft Energy Strategy[1]. London should receive its fair share of the grants available from European and national sources, which could be particularly advantageous for large-scale projects. Co-ordinating funding could open up opportunities for exploiting synergies between grants to generate cross-funding and partnership projects.

7.12 In the longer term, as recommended by the London Assembly's Environment Committee[2], the Mayor and partners may wish to become involved in procuring and co-ordinating funds from a range of sources for energy projects.

proposal 45 Adequate funding is needed to deliver major energy projects across London. This should be pursued through the development of innovative finance packages, and increased take-up of European, Government and other funding programmes.

Communication and education

7.13 People need to link their day-to-day use of energy with the effects of fossil fuel consumption and climate change. This strategy will have a role to play in promoting an understanding of this link to the public, as well as to the Government, corporations and institutions.

proposal 46 The Mayor wants to see improved promotion of exemplary energy projects in London, in order to raise awareness of their benefits, and promote them as best practice.

7.14 Many organisations already work in London to promote messages similar to those of the Energy Strategy. The Mayor supports and encourages this, but thinks that more could be done to add value to existing work. He would like to see action to:

- Developing and disseminating best practice in communication and education.
- Supporting national public awareness or education campaigns in London.
- Providing advice and technical information to stakeholders and/or maintaining a system for referring people to technical experts for information.
- Building links between London and other cities to learn lessons from elsewhere and to promote the Mayor's work.

7.15 The education sector has a key role in applying energy efficiency, demonstrating renewables, and raising awareness of their benefits. The sector stands to benefit greatly from energy efficiency in terms of costs saved. The Government has commented that this work could be promoted through the 'healthy schools initiative'[3].

proposal 47 The Mayor wants there to be a stronger message across London about the importance of minimising wasted energy and using cleaner energy, delivered particularly through the work of established groups, schools, colleges and universities.

7.16 The role of involving local communities in furthering the deployment of energy efficiency and renewable energy should not be underestimated. Local authorities are preparing Community Strategies - statutory documents promoting the economic, social and environmental well-being of the area - in consultation with their communities. Community Strategies should give local communities the opportunity to work with Local authorities on action to mitigate climate change and fuel poverty.

7.17 Government advice to local authorities on including energy issues in Community Strategies is too brief. It should, as a minimum, highlight the major considerations of climate change: energy efficiency, renewable energy and transport[4].

proposal 48 The Mayor encourages boroughs to ensure that energy issues are fully considered when Community Strategies are prepared and revised. Boroughs are encouraged to highlight the well-being (economic, social and environmental) benefits of sustainable energy and encourage related action plans for the area. The Mayor urges the Government to include consideration of energy efficiency and renewable energy in its guidance on Community Strategies.

The key specific issues

7.18 In addition to the cross-cutting issues identified above, this chapter introduces six specific issues, taken from the strategic framework set out in Chapter 4, as suggested priorities for partnership working in London. These are energy services; energy efficiency in housing and fuel poverty; energy efficiency in commercial and public sector buildings; renewable energy; combined heat and power (CHP) and community heating; and hydrogen and fuel cells.

7.19 Key stakeholders are identified under each issue. These lists are not intended to be exhaustive, and do not cover the range of partners found within organisations, such as planners in local authorities.

Energy services

7.20 As outlined in Chapter 4, the energy services approach can represent an effective means of delivering sustainable energy and addressing fuel poverty.

7.21 Key partners for the development of energy services include the Energy Saving Trust (EST), The Carbon Trust, energy supply companies, boroughs, energy agencies and networks such as the Greater London Energy Efficiency Network (GLEEN), the London Development Agency (LDA), industry representatives such as the Energy Systems Trade Association (ESTA), the Combined Heat and Power Association (CHPA) and existing energy services schemes, such as the operators of Barkantine CHP.

7.22 Energy services can be taken forward in a number of different ways. The various schemes funded by the EST differ in their approach to energy services delivery and the degree to which they have taken forward a complete energy services package. Four models have been or are being tried, and have potential to be developed and replicated by others across

London: affinity-only schemes, affinity schemes with integrated billing, CHP joint venture schemes, and utility-led schemes.

7.23 The Mayor would like to see action to deliver the energy services approach in London. He would like the London Energy Partnership to work with others to review the relative benefits of each of the schemes outlined above and consider how best to roll them out.

Energy efficiency in housing and fuel poverty

7.24 To help meet the Mayor's CO_2 and fuel poverty targets, action on domestic energy efficiency will be a priority partnership activity, focusing first on the most inefficient dwellings that house the most vulnerable or hard-to-reach fuel poor.

7.25 Many organisations will need to be brought together to improve the co-ordination, marketing and delivery of energy efficiency measures. Depending on the nature of the project being taken forward, these will include the boroughs, funding bodies such as the EST and Eaga (manager for Warm Front in the London area), energy supply companies, energy efficiency industry (insulation and boilers) and organisations such as GLEEN, public and private housing providers, managers and tenants groups, the health sector, and specific organisations such as Age Concern, the London Fuel Poverty Forum, and the London HECA forum. Partners from similar projects in the UK should be brought in to provide best practice.

7.26 There are a number of important issues to consider when taking action on energy efficiency in housing and fuel poverty.

- A key challenge is accessing fuel-poor households to direct them towards the relevant grants programme and energy efficiency advice as well as advice on financial and debt management, competitive fuel tariffs and welfare entitlements. Effective partnerships and referral networks are vital for this. The work of EEACs, Warm Front and energy supply companies is important in this area.
- Health professionals are important as they are in contact with many individuals living in poor housing conditions, who often do not access many other services and are unlikely to be aware of the support that is available. There are examples of successful referral networks in London with partners from the health and voluntary sectors. The Fuel Poverty and Health Toolkit is a practical guide on the area[5].
- Not all of London households are literate, and English is not the first language for many, with some unable to understand any English. These hard-to-reach households often live in poor housing. There are also different approaches required to communicate information to groups

such as disabled and older Londoners. Good communication is therefore important.

- Private rented housing is traditionally difficult to access, with a resulting low up-take of energy efficiency measures. In central London, this sector has a very high proportion of inefficient housing (see Chapter 2). There is a lack of energy-related regulation, and little incentive for either property owners to pay for energy efficiency improvement that will save their tenants money or for tenants to invest capital in property that does not belong to them. There are lessons to learn from London and UK examples of existing work.

7.27 Through the Energy Efficiency Commitment, 2002-2005, (EEC), the Government requires energy suppliers with more than 15,000 customers to save, between them, 62TWh of energy by providing energy efficiency measures to households across Great Britain. Eighteen months into the three year programme, suppliers had achieved almost half of the required savings.

7.28 When setting the scheme up, the Government estimated[6] that the EEC would lead to an investment of approximately £500 million in energy efficiency measures. London's fair share of this would be about £60 million over the three years, since about 12 per cent of British households are in London. But the terms of the Commitment do not specify where this money should be spent. As a result, London has not received its fair share of the funding.

7.29 It is vital that London does receive its fair share of current and future Energy Efficiency Commitment spending. The Mayor is already working with the energy supply industry and local authorities in London to develop a long term programme for improving domestic energy efficiency.

proposal 49 The Mayor will work with London Boroughs, other local organisations, and energy suppliers to ensure that London receives a fair proportion of Energy Efficiency Commitment funding.

7.30 The Mayor has identified additional actions that are needed to make progress on this issue. Some of these could be funded through an increase in London's allocation of Energy Efficiency Commitment funding.

- Initiate a Londonwide fuel poverty programme, building on existing networks to co-ordinate the range of relevant stakeholders and funding, learning lessons from the Newham Warm Zone.
- Tackle the most energy-inefficient housing stock across London, as well as hard-to-heat housing stock such as solid-walled housing and

homes off the gas network. Consider the potential for renewables.

- Support the boroughs in implementing the Home Energy Conservation Act, and promote Affordable Warmth Strategies to the boroughs which have yet to compile one.
- Facilitate the co-ordination of information and advice on energy efficiency and the alleviation of fuel poverty.
- Engage private owners of rented property, for example through the Small Landlords Association, large property management agencies and university accommodation offices, on upgrading dwellings in the worst condition and installing energy-efficient heating systems and measures.
- Consider how fuel-poor households which are not eligible for 100 per cent grants could be assisted, and encourage such schemes across the city.

7.31 The Mayor recommends that the London Energy Partnership gives priority to fuel poverty work, building on research and best practice already available in the area, such as that commissioned by the Energy Efficiency Partnership for Homes and the Eaga Partnership.

Energy efficiency in commercial and public sector buildings

7.32 The organisations currently involved in this area of work are to be commended, but further steps could be taken to help to increase the rate of progress. This includes, for example, work to co-ordinate and consolidate energy advice to business and the public sector; taking sustainable design and construction principles to non-domestic buildings.

7.33 Key partners include the Carbon Trust, the LDA, London First, the Corporation of London, boroughs, developers, the construction industry, providers of business and environmental advice/facilitation (for example Business Link for London, London Sustainability Exchange, EEACs and non-governmental organisations), ESTA and other energy efficiency industry representatives, and sector representatives - business (corporate and SME), public sector building managers, facilities management industry and Visit London.

7.34 Although there are numerous initiatives promoting energy efficiency in commercial and public sector buildings, take-up is fairly low. There are a number of specific problems which make it difficult to access energy efficiency improvements in commercial and public sector buildings. These consist primarily of the high proportion of tenants and poor information on energy costs. Some particular challenges are listed below.

- More than half of commercial offices (by value) are owned by

institutional investors. Only ten per cent of offices are occupied by the freeholder, and 70 per cent of offices are multi-tenanted, which creates the same landlord-tenant barrier to improving energy efficiency as private-rented housing; tenants are unable or unwilling to invest in improving the efficiency of buildings that are owned by another party, and the owners have no incentive to do so as the tenants pay the fuel costs. Property professionals often believe that the additional cost of environmentally friendly buildings cannot be recouped in higher rental values and investment yields. Yet, sustainable building design is becoming increasingly important for organisations, particularly those with corporate social responsibility agendas.

- Even with the Climate Change Levy, energy costs are often trivial for large corporate organisations compared to other expenditures, providing little incentive to rethink the way they use energy. However, as energy costs are low compared to a business's total operational costs, energy efficiency measures and renewables tend to cost relatively little too.
- Tenants are often not aware that a significant proportion of their service charge is made up of energy costs.

7.35 The Royal Institute of Chartered Surveyors produces guidance on valuing buildings and so influences the level of investment by long-term institutional investors. The Mayor would like those involved with commercial buildings, including surveyors and investors, to value the positive aspects of sustainable buildings. This will help landlords who have environmental and social responsibility agendas.

7.36 The Mayor will work with others to find solutions to these challenges and to assist the LDA in its work to improve the provision of energy advice to businesses in London. For example, the Mayor would like stakeholders to consider how to encourage:

- freeholders of offices in London to work to voluntary standards to improve the energy efficiency of their buildings, utilising the support that is available from the Carbon Trust and ActionEnergy
- building owners to negotiate with tenants to develop the means by which the costs and financial benefits of energy efficiency improvements can be shared between owners, occupiers and/or energy service companies
- owners of existing buildings to consult with occupiers before refurbishment plans are made, so that energy efficiency improvements can be made.

7.37 Public sector buildings, such as schools, places of higher and further education and hospitals, require their own approaches to information provision. Whitehall and central Government's estate represents a significant proportion of public sector buildings in London, and its energy consumption is being addressed through the Greening Government project and the Whitehall community heating scheme, which provides energy-efficient heating.

7.38 The Mayor recognises the excellent and long-standing work of the boroughs on energy. They are vitally important in enabling improvements in public sector organisations, not just because of their responsibility for managing energy use in their own building stock, but also because of their close relationships with schools, leisure centres and other public buildings. The Mayor encourages action to build on these activities and relationships and requests the support of the EST and the Carbon Trust.

7.39 Social housing providers have substantial buying power and can lead the way in sustainable energy through exemplary schemes in new and existing housing, encouraging innovation in the sector in general. Boroughs and housing associations can use general housing funding as well as energy grants to progress this work. Programmes of improvement, which are not primarily energy related, can be used to promote energy issues. The Housing Corporation provides support to housing associations on sustainability and could play a key role in speeding up change in this area. Useful guidance is provided by the ActionEnergy programme.

proposal 50 The Mayor requests boroughs and social housing providers to advocate and promote energy best practice in their own housing stock, corporate buildings and energy-consuming services. He encourages use of the Energy Hierarchy and the heating/cooling ranking as a guide.

proposal 51 The Mayor encourages boroughs, other public sector organisations and the business community to use their purchasing power to stimulate demand for energy-efficient buildings and renewable energy, for example through leasing arrangements and design specifications for buildings.

Renewable energy

7.40 Meeting London's challenging renewable energy targets will require the collaboration of a range of sectors. Key partners needed for the development of renewable energy in London include the energy supply companies, the renewable energy industry, a range of departments in boroughs, Government Departments, the EST, Carbon Trust, the LDA, providers of business and environmental advice, voluntary sector organisations and energy agencies.

7.41 In order to meet national targets, the Government is encouraging the regions to increase their take-up of renewable energy. This has involved an award of £230k from DTI to London, which will be managed by a new initiative called London Renewables. This sum has been matched by the project partners.

7.42 London Renewables is chaired by the GLA, with representatives from Government Office for London, Association of London Government, the LDA, London First, London Sustainability Exchange, London Electricity, Renewable Energy Advice Service in south-west London, Imperial College, and London boroughs. Its work programme aims to facilitate a step change in the installation of renewable energy in London through raising awareness and providing the necessary support to those stakeholder groups involved. One key group will be planners as new developments represent the greatest, most economic opportunity for renewables in London. The programme will run until September 2004. The work programme and the results of London Renewables' work can be found on the Mayor's website.

7.43 The widespread installation of renewable energy in London will require greater access to funding and the creation of innovative financial packages. The London Sustainable Development Commission considers that the collective purchasing capacity of individuals should be used, for example, to buy renewables in bulk through a central exchange and transfer bulk contracts for electricity to a renewable supply. Another idea received during consultation was to assist renewables by investing the green tariff premium, making it available as new or top-up funding for existing capital and maintenance programmes. The Mayor encourages London Renewables and other initiatives to consider these and other options and take forward work in this area.

7.44 The Mayor strongly urges each borough to use their land and property management remit, as well as their advocacy role, to increase the sustainability and energy performance of their area and establish well-founded 'showcase' projects. This will support the work of London Renewables. Showcases enable local communities to see, experience and understand projects and generate local pride.

proposal 52 The Mayor requests each borough to seek to establish at least one well-founded 'showcase' renewable energy project in their area, to raise the profile of renewable energy best practice and help to bring it to the mass market.

Combined heat and power and community heating

7.45 Combined heat and power (CHP) linked to community heating/cooling has the potential to reduce London's CO_2 emissions substantially. Heating represents London's single largest energy demand and the high heat density here lends itself well to CHP and heat distribution networks. Heat distribution networks can be connected to homes, where they can provide affordable warmth, as well as businesses and public sector buildings, such as hospitals. CHP can also address the growing demand for electricity for air-conditioning, as the heat produced can be used for cooling via absorption chillers.

7.46 The key partners for taking forward CHP and community heating include the Carbon Trust, the EST, the CHPA, London boroughs, the LDA, community liaison groups, the developers and the construction industry. The development of community heating, in particular, requires the involvement of a large number of stakeholders, including the local community and businesses.

7.47 The Government is currently providing support for the development of community heating through its Community Energy programme. The high capital cost of community heating schemes is one of the main barriers to their development and the Community Energy programme aims to cover a significant proportion of this cost. London needs to move quickly to take advantage of funding through this programme, while it is still available.

7.48 As an important first step, the Mayor, with the support of the Government's Community Energy Programme and London boroughs, will undertake an in-depth study of potential community heating and CHP schemes across London. This will identify the most promising developments in terms of new or extended community heating schemes, heat supply options, and interconnections, forming the basis of a strategic and long-term perspective that has been lacking in this area. It is anticipated that the results of the project, known as the London Community Heating Development Study, will be available in late 2004, and will include:

- A thorough review of existing and potential new schemes, including a range of heat generation technologies, where heat is currently being dumped and the potential for supplying cooling.
- Prioritisation of new schemes, taking into account the scope for extension and interconnection with other schemes in the long term.
- Whole life cost appraisal of schemes identified as promising, including the annual heating/cooling cost per connected user.
- Social and environmental appraisal, to assess the contribution of new

schemes to the alleviation of fuel poverty, carbon savings and impacts on air quality.
- Detailed consideration of how the 'winners' would be implemented. This should include a range of possible institutional structures and sources of funding, along with analysis of the main obstacles to implementation, such as consent requirements.

proposal 53 The Mayor will strongly support the development of community heating networks in London, building on the results of the London Community Heating Development Study.

7.49 In order to enable CHP and community heating schemes, the Mayor would like to see further action taken to:

- Increase awareness of CHP and community heating, involving assistance to the national information and education networks and programmes, co-ordination of local authority planning effort, and the development of a new action programme that focuses on London. This is required to persuade people that community heating schemes can be well designed, efficient and provide services at low cost.
- Assess the Government's trial of 6,000 micro-CHP units, working with the LDA to identify opportunities for further testing of the technology in London.
- Trial pre-commercial fuel cell micro-CHP in London as soon as units become available.

Delivering decentralised generation and distribution of electricity

7.50 The benefits of increasing the proportion of electricity supplied to London from decentralised generation include increased security of supply, reduced transmission losses, and reduction of CO_2 emissions through locally embedded generation from renewables and CHP.

7.51 The Mayor would like to see a review of the potential for the local distribution networks to respond to the twin challenges of population growth, and the need for more decentralised generation in London. Energy distribution companies in London should have a key role in this.

7.52 The electricity distribution system will need to evolve to accommodate and facilitate increased local generation. The current regulatory framework and physical configuration of the network are not conducive to delivering increased levels of local generation. Unless these network issues are taken forward proactively, they may act as a barrier to the growth of decentralised generation. To ensure that London remains at the forefront of these changes, the Mayor will encourage trials and pilot studies that

seek to develop the ability of London's local distribution network to accommodate decentralised generation, including micro-CHP with net or two-way metering.

Hydrogen and fuel cells

7.53 There is general agreement that while hydrogen may well become a mainstream fuel, with fuel cells the established energy conversion technology, the timescales involved before substantial penetration are long. It is, however, essential that action is taken now to prepare the ground for large-scale take-up, and to ensure the informed development of strategy. This means dealing with planning and regulatory barriers, applying incentives to encourage development and early adopters, and changing any unjustified perception of hydrogen as an unsafe fuel.

7.54 The GLA group can influence the development of clean fuel for London, as outlined in Chapter 6. However, developing a hydrogen economy - a national energy infrastructure based on hydrogen from carbon-neutral, primary energy sources - will depend on partnerships between stakeholders from a range of sectors. The key partners for delivering the hydrogen economy include representatives of the energy and gas supply and distribution industry, fuel cell industry and component manufacturers, automotive industry, stationary and portable power industry, the Government, academia, environmental and other non-governmental groups, and the finance sector. The involvement and support of local communities will also be crucial.

7.55 Much of this work is currently taken forward by the London Hydrogen Partnership, which is described later. Other partnerships and networks also have a part to play.

Delivery: Working in partnership

The London Energy Partnership

7.56 London currently lacks an adequate mechanism to enable the broad collaboration that is required in London on energy issues. The Mayor is working to facilitate the establishment of a London Energy Partnership, in order to drive progress where the work requires multiple partners to collaborate. Such a partnership can offer several important benefits, including the following:

- **Co-ordination and synergy** There are a considerable number of organisations, networks and groups working in energy in London. However, they tend to be split by sector and there is currently no means by which different stakeholders in energy meet specifically to address Londonwide issues. Consequently, although stakeholders

may share common interests, work in the field is often disparate and unco-ordinated.

- **Mechanism for delivery** Full delivery of the Mayor's strategic policies requires a wide range of organisations to work together. A partnership can facilitate this through a consensual approach and by bringing in funding for projects.

7.57 Consultation on the draft Energy Strategy showed strong support for a new energy partnership for London. The London Assembly's Environment Committee saw partnership working as essential to achieve the targets contained in the final agreed version of the strategy,[7] and said that they 'support the Mayor's proposal to set up a London Energy Partnership as the mechanism for delivering this strategy'.

7.58 The proposals for a London Energy Partnership outlined in this strategy developed with input from the London Assembly's scrutiny process[8], and discussions with managers of relevant UK energy partnerships and other stakeholders. The Mayor used the consultation period on the draft Strategy to bring a wider cross-section of stakeholders together, and begin work to establish the Partnership and clarify its role.

proposal 54 The Mayor will facilitate the establishment of a London Energy Partnership to bring together a range of sectors and organisations to deliver energy action more effectively in London.

7.59 Consultation on the strategy showed considerable support for the targets proposed by the Mayor. If they are to be achieved, widespread commitment is needed. The Mayor will therefore invite the Partnership to adopt the targets and develop a vision and Action Plan showing how it will work towards them. This will ensure that stakeholders across London are all focused on working towards the same goal.

proposal 55 The Mayor will invite the London Energy Partnership to adopt the objectives and targets in the Mayor's Energy Strategy. The Mayor suggests that the Partnership takes forward the key issues of energy services, fuel poverty, energy efficiency in housing and commercial and public sectors, renewable energy, combined heat and power and community heating, and hydrogen and fuel cells, by implementing major projects, securing project funding, and effective communication.

Role of the London Energy Partnership

7.60 The London Energy Partnership would be an independent body comprising a consortium of partners working to a programme defined and

agreed by its members. The Mayor would expect to have an equal role in decision-making.

7.61 The Mayor considers that the role of the Partnership should be to:

1 Adopt the objectives and targets set out in the Energy Strategy
2 Develop a London Energy Action Plan to take forward the Partnership's Vision, and address the key issues set out in the Energy Strategy
3 Initiate and support projects to implement the Action Plan, including providing a platform for funding bids
4 Co-ordinate activity on energy in London
5 Monitor progress on delivering the Action Plan and inform the review of the Energy Strategy
6 Provide a forum for raising awareness and information exchange on key energy issues.

7.62 More detailed recommendations for a Partnership Action Plan are set out in Chapter 8.

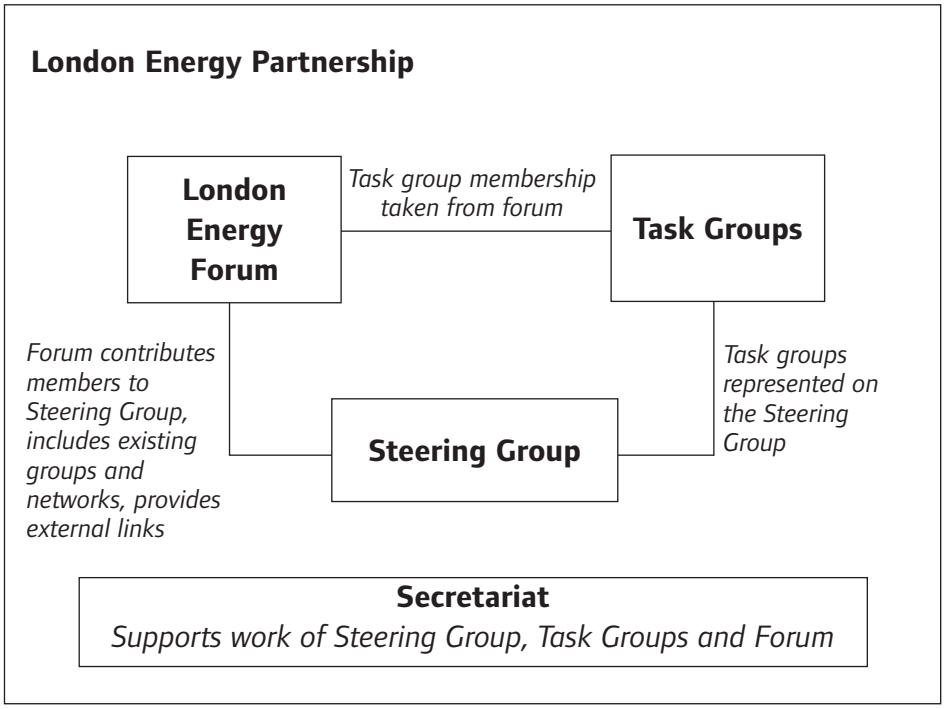
Structure of the London Energy Partnership

7.63 All the relevant stakeholders in London should have the opportunity to be involved in the Partnership, and the structure should seek to ensure that stakeholders are actively engaged in the formulation and delivery of the Partnership's Action Plan.

7.64 A suggested outline structure for the Partnership is shown in the figure below. This initial structure can be modified as the Partnership and its work evolve. It may be agreed that there are advantages to a formal constitution, for example to access and hold funding and employ staff. Status as a charity, and/or company limited by guarantee, has certain advantages, and the Nottingham Energy Partnership is one example of a partnership that has followed this particular model.[9]

7.65 Existing energy partnerships, and other initiatives such as London Waste Action and London Remade, could provide useful models for the development of the London Energy Partnership. London Remade, for example, is a subsidiary not-for-profit company of a wider organisation London Waste Action, which enables pan-London action on waste to benefit from a business-minded approach to large-scale project delivery. The pursuit of any such model for energy would require careful collaboration with existing companies.

Figure 22 London Energy Partnership suggested initial structure



7.66 It is suggested that the Partnership initially comprises a small executive Steering Group, a number of task-based working groups or 'task groups' and a stakeholder forum, the London Energy Forum. The London Assembly's scrutiny of the draft Energy Strategy recommended forming initial task groups around existing projects in order to achieve early momentum. The suggested role of the various constituent parts of the London Energy Partnership, their membership and how they would interact with one another, is shown in the table below.

7.67 The Steering Group should establish a process of reviewing the activities of the Partnership. There should be a major review of its structure and function at the end of the first year, at which time the Steering Group should recommend what changes, if any, should be made. The Steering Group may wish to set up more frequent reviews, and should consider how to make the review process transparent to external partners. Should the Partnership decide not to take forward any particular work area, the Mayor will consider other mechanisms for delivery - through other partnerships, for example, or through lobbying.

7.68 A secretariat will be required to develop the Partnership's identity, service the various working groups, maintain an overview of strategy and progress, and act variously as broker, mediator, advocate and interpreter[10]. Initially the secretariat is likely to be small, but is expected to develop as the Partnership becomes more successful and expands its

workloads. This is certainly the experience of the UK's existing energy networks and partnerships[11].

proposal 56 The Mayor will provide an interim secretariat for the London Energy Partnership while it works to secure independent core staff. During that time the Partnership should work to develop the London Energy Action Plan.

Table 9 Suggested role and membership of constituent elements of the London Energy Partnership

London Energy Partnership body	Role	Membership	Relationship to rest of London Energy Partnership
Steering Group	1 Determine and maintain the strategic direction of the Partnership's activities. 2 Agree, co-ordinate and monitor the Partnership's Energy Action Plan. 3 Set up and oversee task groups and facilitate prioritisation of their work in line with the Action Plan. 4 Ensure proper representation on task groups and London Energy Forum. 5 Discuss strategic issues and work towards solutions, resolving conflict between key decisions made by the task groups if necessary. 6 Work to secure necessary core funding. 7 Conduct review of structure and function at end of first year.	Representatives of major energy sectors in London, central and local government, industry, energy supply, construction, academia and the voluntary sector	Co-ordinate work of task groups and Forum meetings
Task groups	1 Take forward the development of relevant sections of the London Energy Action Plan. 2 Initiate and oversee projects identified in the Action Plan and monitor their progress. 3. Involve a broad range of partners, including members of the London Energy Forum.	Experts in subject area	Drawn from Forum. Representative attends Steering Group

London Energy Forum	1 Pool of membership for task groups. 2 Networking and discussion forum. 3 Advise on priorities and actions in the London Energy Action Plan. 4 Inform/input to monitoring and review of London Energy Action Plan and the strategic objectives of the Energy Strategy. 5 Raise awareness and knowledge of London energy issues among Forum members. 6 Feedback on progress in other countries/areas - act as a resource.	Broad and open to all active in energy in London	Provides pool of members for task groups and Steering Group
Secretariat	1 Provide central contact point and represent the Partnership where necessary. 2 Service the Steering Group, Forum and task groups. 3 Maintain an overview of strategy and progress.	Core staff and admin support	Services the Partnership

Getting started

7.69 The Mayor set up a shadow steering group to pave the way for setting up the London Energy Partnership. Good progress has been made and the Mayor launched the Partnership at the first meeting of the London Energy Forum on 26 January 2004. Chapter 8 outlines a recommended partnership development process in more detail, taking account of the London Assembly's recommendations[12].

Links to existing networks

7.70 Although there is no precedent for an energy partnership in London with the breadth of remit suggested here, a number of well-established groups and networks currently operate in the capital. To be most effective, the Partnership should support, not duplicate, the work of existing organisations; and it should build on existing networks and work with them where possible.

7.71 The London Energy Forum is expected to play a major role in enabling the Partnership to learn from the experience of others, and share experience and information. Steering Group members are also likely to be members of other relevant boards or networks, and can bring in experience in this way. It is important that clear links are made between the Partnership and relevant national, regional and local initiatives. For example, the Energy White Paper states that the relevant Departments would set up a

Sustainable Energy Policy Network that would develop partnerships with local and regional bodies to assist in the delivery of the White Paper.

7.72 The proposed task groups offer a direct mechanism for ensuring effective linkages between the London Energy Partnership and other groups. It is unlikely that the Partnership would want to set up a task group on hydrogen, given the existence of a London Hydrogen Partnership. However, for other issues, representation from existing networks would minimise duplication of effort. For example, GLEEN and London's EEACs could be represented on task groups that are dealing with energy efficiency projects.

7.73 The Mayor recognises the excellent and longstanding work of the boroughs. Many local authorities have been actively promoting and implementing energy efficiency and renewable energy for a number of years and have built up significant expertise. The Energy Strategy should not duplicate or conflict with the activities of the boroughs. Instead, the Mayor aims to work with the boroughs through the Energy Strategy and the London Energy Partnership to support, enhance and strengthen their work across London.

7.74 The boroughs are represented by a number of sector-specific groups. Given the difficulty of representing all 33 boroughs individually on a single partnership body, groups such as the London Boroughs Energy Managers Group (LBEMG) provide a useful way of securing borough input. A representative of LBEMG could be invited to a task group dealing with energy efficiency projects, for example, where this would be appropriate.

7.75 The table below shows possible indicative relationships between a number of existing, active groups and potential task groups.

Table 10 Example relationships between London Energy Partnership and existing networks

Relevant network	Relevant work areas
London HECA Forum	● Fuel poverty ● Energy efficiency in homes
London Boroughs Energy Managers Forum	● Energy efficiency ● CHP and community heating ● Renewable energy
Central London Energy Managers Group	● Energy efficiency ● CHP and community heating
Energy agencies	● Energy efficiency ● CHP and community heating
London and South-East Region EEACs (Energy Efficiency Advice Centres)	● Energy efficiency advice and promotion

7.76 It will be important for London Renewables to be represented on the Partnership, so that the momentum of current projects can be harnessed. The Partnership could consider taking forward initiatives that would build on the London Renewables project, and London Renewables would be provided with an extended environment in which to conduct and promote its work after the close of current funding in 2004.

The London Hydrogen Partnership

7.77 The then Deputy Mayor launched the London Hydrogen Partnership in April 2002. The Mayor continues to lead the development of the London Hydrogen Partnership, of which the purpose is to:

1 produce and implement the London Hydrogen Action Plan - the Partnership's work programme
2 establish and maintain dialogue among all the sectors and actors relevant to a hydrogen economy
3 provide a platform for funding bids and initiation of projects
4 disseminate information and advice.

7.78 A broad range of stakeholders agreed the basic set-up of the Partnership at the launch event, and fed into a Hydrogen Action Plan drafted beforehand by the Mayor. The London Hydrogen Action Plan needs to be developed further by the Partnership so that it contains targeted objectives and specific actions to guide the Partnership's work. It is vital that this work integrates with, and is supported by, the relevant activities of Government departments, particularly DTI, DfT, DEFRA and the Treasury. An effective hydrogen economy is likely to rely to some extent

on national networks of supply, and certain important barriers, such as safety and regulation, are best addressed nationally.

policy 32 The Mayor will continue to facilitate the establishment of the London Hydrogen Partnership, which will work to deliver a hydrogen economy through the development and implementation of the London Hydrogen Action Plan.

Structure of the London Hydrogen Partnership

7.79 The structure of the London Hydrogen Partnership is similar to that proposed for the London Energy Partnership described above. There is a co-ordinating body, the Steering Group, several task groups that will develop specific parts of the action plan, and a forum - the London Hydrogen Forum - which enables a broader range of stakeholders to feed into the development of the Partnership and Action Plan.

7.80 The Steering Group of the Partnership is chaired by a representative of the Mayor of London, and contains representatives of Air Products, Association of London Government, Baxi Group, BMW, BOC, BP, Carbon Trust, DTI, Energy Saving Trust, Fuel Cell Europe, Health and Safety Executive, Imperial College, Intelligent Energy, Johnson Matthey, London Development Agency, London First, Rolls Royce, Thames Water and Transport for London.

7.81 The GLA is currently acting as interim secretariat to the Partnership. However, it is important that the Partnership has its own staff in order to be able to make rapid progress. The Mayor will encourage this by working with the LDA to establish the initial staff to co-ordinate the Partnership and the development of the London Hydrogen Action Plan, and enable partners to deliver 'quick win', high-profile projects. After this initial development phase, the other members of the Partnership should contribute to core costs.

7.82 Adequate funding will be necessary for the London Hydrogen Partnership to deliver its objectives, engage stakeholders, promote Londonwide energy initiatives and disseminate the outcomes of its work. The Partnership will need to secure necessary resources for its core operation - staff, publicity, office space and so on - as well as to fund projects it will carry out. The Mayor will work with the Partnership to secure this funding.

proposal 57 The Mayor will work with the London Development Agency and the London Hydrogen Partnership to appoint initial development staff for the London Hydrogen Partnership, and will work with the partners to secure

funds to deliver projects and carry out its core operations in the long term, including staffing capacity.

Links with existing networks

7.83 The London Hydrogen Partnership was established as an independent initiative in 2002, before work began to set up the London Energy Partnership. However, hydrogen issues are highly relevant to the work of the London Energy Partnership and it will be necessary to consider carefully how the two initiatives fit together as they develop. Initially, it would be sensible to provide representation of the London Hydrogen Partnership at the Partnership Steering Group and, where appropriate, in the task groups and London Energy Forum. Synergies between the partnerships should be explored during their development and the potential for their integration should be examined.

7.84 Several members of the Hydrogen Partnership Steering Group also sit on the steering groups and boards of relevant UK partnerships and networks, such as the Low Carbon Vehicle Partnership (LowCVP), Fuel Cells UK and the Fuel Cells Forum. These members are expected to be a link to other networks, feeding back, for example, on potential for collaboration and information sharing. As part of its role and remit, the London Hydrogen Forum is an opportunity to share information and expertise from other networks and organisations on a larger scale.

Going to work on hydrogen: the London Hydrogen Action Plan

7.85 The London Hydrogen Partnership is working to a London Hydrogen Action Plan, which is currently in its second draft. The Partnership's task groups will identify project-based actions or opportunities that need to be undertaken to achieve the action plan objectives, and attach timescales to them. In addition, the Action Plan will identify ways in which the Partnership can enable its partners to deliver future action, such as through raising awareness among local authority planners. The California Fuel Cell Partnership, US Government, European Commission and others have produced similar plans.

7.86 The agreed aims of the Action Plan (see Box 14) are compatible with the Mayor's vision for London.

Box 14: Aims of the London Hydrogen Action Plan

1 Support the development of a hydrogen economy for the UK.
2 Contribute to the growth of London's green economy through the development of hydrogen and fuel cell-related industry and employment.
3 Improve air quality and reduce greenhouse gases and noise in London.
4 Improve energy security for London.

Setting targets through the London Hydrogen Action Plan

7.87 When the Action Plan is published in its final form, it will contain a number of objectives for industry development, public awareness, technology demonstration and so on. In turn, it will contain an indication of the measures required to achieve each objective, and what broader action the Partnership will take to enable its partners to deliver projects. The Mayor recommends that the objectives and actions incorporate targets to act as a driver for the hydrogen economy - a 'route map' that enables progress to be measured.

7.88 However, predicting technology take-up in the future is complex and a wide range of estimates for vehicle and CHP penetration and fuel cell market value have been made. Japan has stated that it hopes to have 50,000 fuel cell vehicles on its roads by 2010 and five million by 2050. They are also aiming for 2,100MW of installed stationary fuel cell capacity by 2010, and 10,000MW by 2020.

7.89 Fleet vehicles will begin to increase from early 2003 as pilot schemes with dedicated infrastructure become established. This will be achieved initially through bus fleets, and then gradually through light-duty and other vehicles, Private cars are not expected to become widely available until after 2005, with 2006-2007 viewed as more likely. This will necessarily limit the take-up by 2010, although cars for fleet purchasers should be available from 2003-2004.

7.90 International estimates such as these should be considered when developing targets, as well as targets recommended by Government, the Mayor (for example by TfL through the London HFC Bus Project) or other organisations. The European Commission recently appointed a High-Level Group on Hydrogen and Fuel Cells to produce a European Vision - including a road map to drive the development of an internationally competitive hydrogen and fuel cell industry in Europe. The current proposal estimates a full hydrogen-oriented economy by 2050, with a number of landmarks on the way[13]. These estimates should be considered by the Partnership when setting their route for London.

7.91 In the UK, the EST is calling on the Government to establish targets for fuel cell buses and consider setting targets for the introduction of other hydrogen fleets, private cars and a refuelling network by 2020[14]. The Department for Trade and Industry is developing a fuel cell vision for the UK, with an identification of 'appropriate routes for evolution and development which will have the support of industry'[15]. The Partnership should consider how targets for London would complement targets set by the Government.

proposal 58 The Mayor encourages the London Hydrogen Partnership to establish realistic targets as part of the London Hydrogen Action Plan. Where relevant, these targets should be informed by the Government and other organisations, such as the European Commission, Low Carbon Vehicle Partnership, Carbon Trust, Energy Saving Trust, and the Mayor's broader energy targets.

7.92 The Mayor's high public profile is advantageous to raising awareness among the public and other sectors, and promoting behaviour change. He and the London Hydrogen Partnership will utilise this publicity to increase knowledge and acceptance of hydrogen as a fuel and appropriate technologies.

proposal 59 Through the London Hydrogen Partnership, the Mayor will use his high public profile to build understanding and support for hydrogen as a clean fuel.

7.93 The Government has programmes to stimulate the development of fuel-cell technology, but they are largely academic and research-based. More funding is needed to demonstrate and monitor the performance of the technology in different applications - this is addressed in the lobbying section below.

Lobbying for action

7.94 The Mayor will lobby others where necessary to drive change and deliver the Energy Strategy. Supportive national energy policy and legislation is particularly important, as it provides the context for this strategy.

policy 33 The Mayor will lobby Government and others on specific issues, as a means to achieve change and help to deliver the Energy Strategy.

7.95 The section below sets out key areas in which the Mayor considers national policy and legislation should be improved to assist sustainable energy in the capital. These will, in turn, help the Government to deliver its energy policies. Key policies and actions of other organisations that could take forward achievements in London are also highlighted.

7.96 These recommendations are by no means exhaustive and only cover issues particularly pertinent to London. The Mayor will take advantage of other opportunities to influence Government policy as and when they arise.

Box 15: The Mayor's view on the Energy White Paper

The Mayor welcomes the Energy White Paper as a significant step forward in the development of a coherent national energy strategy and commends many of its objectives. In particular, the Mayor supports the endorsement of the Royal Commission on Environmental Pollution's recommendations. The Mayor shares the view that the required CO_2 emissions reductions can be achieved through a combination of energy efficiency and renewable energy, rather than from new nuclear power stations. The Mayor also welcomes the support for the development and implementation of regional and national energy policy.

However, the White Paper is weak on specific measures to deliver its goals. Furthermore, carbon reduction 'aspirations' are no substitute for firm targets and make it more difficult for regions to gain support for long-term, regional carbon reduction targets. The Government does not help long-term investment in renewables by avoiding a firm commitment to extend the Renewables Obligation, and this position is made worse by its ambiguous position on nuclear power.

One particular area of the White Paper that lacks clarity is how the Government will support regions in developing and implementing their energy strategies. The Mayor believes that his Energy Strategy meets all the criteria for regional energy strategies, as described in paragraph 9.21 of the White Paper. The Government should therefore recognise it as the first UK comprehensive regional energy strategy, and support it as the vehicle for delivering the Government's energy objectives in the Greater London region.

The Mayor notes that the principles and targets of the Energy Strategy are consistent with those of the Government's Energy White Paper, and looks forward to participating actively in the Sustainable Energy Policy Network. However, on his own, the Mayor lacks sufficient power and resources to guarantee effective delivery of important aspects of both his and the Government's agenda. The Mayor believes it would be in the Government's interest to give its full backing to the implementation of the Energy Strategy. There is therefore a need to strengthen the relationship between the Mayor and central Government on energy policy delivery.

7.97 In PPG 11 and the draft PPS 22, the Government requested planning authorities to use their powers to increase the generation of renewable energy in their areas, but gave no guidance on how to do this. Because energy is not a conventional land-use planning issue under the Town and Country Planning Act, and despite the London Borough of Merton having support from the Planning Inspectorate for making energy a relevant

planning matter, planning authorities are hesitant about going beyond established boundaries. The Mayor is taking a lead in this respect in London through the London Plan, but the acceptance of energy as a material consideration by planning and development professionals will help give energy a higher profile and wider acceptance by all relevant professions, as well as by the general public. To assist this, additional guidance or training for planners is needed.

proposal 60 The Mayor strongly urges the Government to raise the profile of energy in national planning policy and planning law and ensure that energy and carbon dioxide emissions are considered to be material planning consideration; alongside such issues as transport and the built environment.

7.98 The Government currently funds some public awareness programmes on sustainable energy[16], but more work is needed. This could link with a range of public activities, such as inclusion in the schools curriculum, television shows on home improvement, and appropriate funding programmes.

proposal 61 The Mayor believes that the Government should do more to educate the public about the importance and applicability of energy efficiency and renewable energy.

Lobbying for action on energy efficiency in homes and fuel poverty

7.99 As HM Treasury acknowledged in its work on economic instruments for household energy efficiency, current instruments do not always successfully encourage householders to invest in energy-efficient equipment and insulation[17]. The Treasury is consulting on ways to promote energy efficiency further using economic instruments. However, the message is confused, especially as gas and electricity tariffs are structured so that the more you use, the cheaper they become. The Government needs to give careful consideration to ensuring that all economic instruments convey the same message. Changes to energy pricing structures suggested below would be consistent with the Government's commitment not to introduce further taxes on domestic energy consumption. This may be effective in correcting the market failures identified in the Treasury's consultation and is worth investigation[18].

proposal 62 The Mayor urges the Government to adopt a co-ordinated approach to the full range of economic instruments relating to household investment in energy and energy efficiency, including electricity and gas tariff structures, energy efficient appliances, and improvements to household building fabric.

7.100 In the liberalised energy market, suppliers charge a lower tariff for customers paying by direct debit because it is a cheaper payment system to manage. However, lower income households tend not to use direct debit or are on prepayment meters, and therefore pay higher unit costs for energy (see Chapter 2). A standing charge is also added under many tariff structures, to reflect the cost of maintaining a household's connection to the local distribution network. A fixed charge has the effect of significantly increasing average unit energy cost for low-use consumers, including those in fuel poverty.

7.101 Some utilities have abolished standing charges, recouping the lost revenue through increased unit prices. Typically, the charges have been replaced with a two-tier price structure, under which a lower unit price is charged above a certain level of consumption. This eliminates most of the benefits of the removal of standing charges, while rewarding high energy consumption. This reflects common business practice in which the unit price of large quantities is lower than that of small quantities. In this case, however, the lower price fails to take account of the environmental consequences of high consumption. Serious consideration therefore needs to be given to whether standing charges should be abolished and the tiers reversed, such that units of energy become more expensive at higher rates of consumption. Both the Government and energy suppliers need to investigate this.

7.102 As outlined later in the chapter, a gap exists in funding for a key section of fuel poor households. The fuel poor who do not claim benefits (approximately 40 per cent of fuel poor households) are not eligible for Warm Front grants and are often unable to match-fund Energy Efficiency Commitment (EEC) grants. However, a proportion of these are not claiming the benefits to which they are entitled, and which would make them eligible for Warm Front. While there are schemes that tackle this benefits issue, there are people in fuel poverty who are not entitled to benefits, or not eligible for aid due to their age, or house or heating type. The Government is currently reviewing Warm Front, including eligibility criteria.

proposal 63 The Mayor calls on the Government to address the funding gap for a key proportion of fuel poor households in London and the rest of the UK.

7.103 This issue is relevant to London's solid-walled housing, which is missing out on EEC funding. There are now a small number of EEC schemes in London that have benefited from funding for measures to insulate solid walls. However, energy suppliers generally concentrate on funding the less expensive energy efficiency measures, such as cavity wall and loft

insulation, which are not always suitable for the solid-walled older housing stock in London.

7.104 There is a disparity between the boroughs and other local authorities whose regions receive Warm Front grants from Eaga. Both the number of households with measures installed and the average cost of installation per household are lower in London. On average, more than 80 per cent more is spent in local authorities outside London. Birmingham receives eight per cent more in Warm Front grants than the whole of London. The borough with the most Warm Front installations in 2002-2003 is the only London Warm Zone. While Ofgem requires energy supply companies to achieve a certain energy saving target rather than a certain spend, the reviews of EEC and Warm Front need to ensure a fairer proportion of spending in London. Otherwise, the capital's worst properties will be left behind.

proposal 64 The Mayor urges the Government and, where appropriate, Ofgem to ensure that a fairer proportion of funding is spent in London when reviewing the Energy Efficiency Commitment and Warm Front.

7.105 The Building Regulations govern the energy efficiency standards of all new buildings in the UK and raising these standards is the simplest and most effective way of improving their energy efficiency. As with any change to the Building Regulations, compliance is likely to incur additional cost. However, it is more cost-effective to deliver such savings through new build than through retrofit.

proposal 65 The Mayor urges the Government to use the next review of the Building Regulations to improve energy efficiency standards in line with the best in Europe and to include renewable energy.

Lobbying for action on renewable energy

7.106 The Mayor supports the Government's programme to demonstrate PVs and solar water heating, but would like the Government to explore other financial mechanisms to support renewables. These could include a review of how it provides 'gap' funding. For example, in a commercial building where PV is feasible, but its cost is greater than a certain proportion of total development costs, the Government could provide the difference in funding. This places grants in the context of total development costs. Another possibility is for the Government to include the deployment of renewable energy as a criterion for grants in a range of areas other than energy.

proposal 66 The Mayor urges the Government to include the contribution to furthering renewable energy deployment as a criterion in the assessment

of applications for a range of project grants, such as regeneration funding or lottery funding for community projects.

7.107 As outlined in Chapter 4, green tariffs may not necessarily increase generation of renewables and could lead to double counting of carbon savings across the UK. This situation could dissuade customers from buying them. A subsequent decline in demand could lead to a false interpretation that the demand for renewable energy is lower than it really is.

proposal 67 The Mayor strongly urges the Government, Ofgem and electricity supply companies to ensure that the green electricity purchasing system is simple and transparent and to ensure that any possible double counting of carbon dioxide savings is avoided.

Lobbying for action on hydrogen and fuel cells

7.108 Many people consider that the emerging hydrogen economy will constitute the next industrial revolution, replacing the fossil fuel economy of the 20th century. It is imperative that the Government does not let this opportunity pass us by, and that it provides support for the development of a hydrogen infrastructure and its component industries.

7.109 The Government has recently made some positive statements on hydrogen, particularly in its Energy White Paper, Powering Future Vehicles Strategy[19] and Fuel Cell Vision[20]. However, stronger leadership is required to stimulate investment and growth in hydrogen technologies.

7.110 There are many potential benefits to society of fuel cell applications, and early, smaller applications such as small portable and stationary fuel cells are needed as the foundation for the process of cost reduction and wider commercialisation. Current levels of Government support for fuel cell and hydrogen research and demonstration are small in comparison to that in other countries. A stronger role is needed in market development of early applications, particularly in supporting demonstration projects, and supporting the particular skills of British companies. Increased funding is also essential to the development of technologies for mainstream applications, such as larger stationary fuel cells and vehicles[21]. In addition, the Government should publish firm targets to drive the industry towards a UK hydrogen economy.

proposal 68 The Mayor will seek to persuade the Government to introduce strong policy statements and increased funding in support of a UK hydrogen economy.

Lobbying for action on spent nuclear fuel

7.111 One particular area of concern in London regarding nuclear power is the regular transportation of spent nuclear fuel on the capital's overground rail network. Although the exact routes that these trains take are not publicised, it is known that they travel from nuclear power stations in Suffolk, Essex and Kent to the Sellafield reprocessing plant in Cumbria, via north and south London, and that they use the Willesden Junction depot. Concerns about terrorist attacks, vandalism and derailments led members of the London Assembly in October 2001 to commission a review of the risks surrounding the transportation of spent nuclear fuel through London. Outcomes of the study are available on the GLA website[22]. The Mayor supports further work on the issue. The London Plan indicates that the Mayor will work with the Government and other partners to develop proposals with neighbouring regions to allow long-distance traffic, especially rail freight, to by-pass London.

proposal 69 The Mayor urges the Strategic Rail Authority to carry out a full risk assessment of the transportation of spent nuclear fuel by rail through London, including consideration of the risk from sabotage or terrorist attack.

proposal 70 The Mayor welcomes the assurance given to the London Assembly by British Nuclear Fuels Limited (BNFL) that there will be no increase in the frequency of transportation of spent nuclear fuel during the decommissioning of Magnox power stations, and expects BNFL to abide by this assurance.

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8 Implementation and monitoring progress

An Energy Strategy Implementation Plan

8.1 The Mayor will publish an Implementation Plan for this strategy. This will include actions, actors, targets, timetables and priorities for implementing all the proposals over the next ten years. This will be made available on the web shortly after the publication of the Energy Strategy. It will be regularly updated to ensure that it continues to reflect changing circumstances and priorities.

8.2 The London Energy Partnership should produce its own Action Plan, as described in the section below, 'Implementing the London Energy Partnership'.

Partners in implementing the strategy

8.3 The means of implementation have been considered throughout the development of the strategy and this is reflected in the structure of the document. Chapter 4 proposes a strategic policy framework, including targets, for the Mayor and the rest of London to work towards. Chapters 5 and 6 set out the ways in which the Mayor and the GLA Group will act to deliver the strategic framework. Chapter 7 proposes the establishment of a London Energy Partnership to formulate common objectives and deliver action on the ground by working together, where the Mayor cannot act alone.

Partners within the GLA and GLA Group: the Mayor's Strategies

8.4 The Energy Strategy has strong links with other Mayoral Strategies. Furthermore, the Mayor is required by the GLA Act to have regard to consistency between his Strategies. When other Mayoral Strategies are updated, they will further integrate the Mayor's energy policies.

8.5 The Mayor has undertaken a health, equality and sustainability appraisal of the Energy Strategy.

London Plan (Spatial Development Strategy)

8.6 The Mayor's London Plan sets out an integrated social, economic and environmental framework for the future development of London. Energy supply and consumption are major influences on, and are themselves influenced by, population density, the location of new buildings and other features of spatial development. London's currently increasing and forecast population growth of some 800,000 by 2016 is driving increased consumption. The London Plan therefore includes planning policies intended to integrate energy considerations with other spatial policies, for example on transport, and to promote energy efficiency and the provision of renewable energy. Chapter 5 provides details about the Mayor's

planning and energy policies, his role in the planning system and the resulting links between the Energy Strategy and the London Plan.

Economic Development Strategy - working with the London Development Agency

8.7 London is a powerhouse for the UK economy, creating a proportion of the national wealth far in excess of its population. Reducing energy use has clear benefits for London's economy as it reduces costs.

8.8 There is widespread recognition that if economic development impacts negatively on society and the environment, it will not be sustainable in the long term. This is reflected in policy at national and international levels, and provides the policy context of the Economic Development Strategy. A principal aim of the strategy is to ensure that London's future economic regeneration and development takes place within a framework rooted in the principles of sustainability. The Economic Development Strategy presents significant scope for the LDA to take a lead in supporting the growth of the sustainable energy sector. More detail on how this will happen is set out in Chapter 6.

Transport Strategy - working with Transport for London

8.9 Clear links exist between transport and energy. Energy is required for all modes of transport - although walking and cycling are powered by renewable energy supplied by people themselves. The issue of significance for other modes is the source of energy and how it is used, and a key objective is to reduce the growth in vehicle movements in London and the amount of greenhouse gases emitted. To achieve this, the Mayor's Transport Strategy sets out policies and proposals that encourage sustainable travel. These relate to policies in the Mayor's Air Quality Strategy and this strategy on using alternative fuels and sustainable technologies.

8.10 The Transport Strategy aims to ensure that public transport is improved and traffic congestion reduced. As a result, energy consumption and CO_2 emissions per passenger kilometre will be lower than would be the case in the absence of the programme set out in the Transport Strategy.

8.11 The Transport Strategy contains measures to improve public transport and encourage drivers to switch from cars to trains, buses and trams, and also to facilitate walking and cycling. Measures include a 40 per cent increase in bus services, the Central London Congestion Charging Scheme, London Underground's line upgrade programme, CrossRail 1 and 2, and extensions to the East London Line. Overall, the programme will offer more and better public transport, encouraging a greater proportion of trips to be made by public transport, and discouraging the use of private

cars within the Central London Congestion Charge area. Discounts for certain alternatively-fuelled vehicles encourage more of these to be used for journeys into the charging zone and consequently for trips elsewhere in London.

8.12 Specific energy proposals for TfL to implement are set out in Chapter 6.

Air Quality Strategy

8.13 Air quality is strongly influenced by the ways in which energy is generated and used. The generation of energy from fossil fuels releases local and regional air pollutants as well as greenhouse gases, thereby affecting air quality.

8.14 Many of the measures to reduce greenhouse gases will also reduce air pollution, and vice versa. Nevertheless some measures to reduce the occurrence of local air pollutants can reduce fuel efficiency. Care has been taken in the Air Quality Strategy to ensure that, where possible, policies to reduce air pollution do not increase CO_2 emissions.

8.15 Road traffic is the primary cause of air pollution in London. There are two ways of reducing emissions from this source. The Mayor's Transport Strategy concentrates on reducing the number of vehicles in the central area and reducing the growth in Outer London, whereas the Mayor's Air Quality Strategy concentrates on reducing emissions from road vehicles themselves, targeting those vehicles that are most polluting. This will also contribute to implementing the Mayor's energy objectives.

Municipal Waste Strategy

8.16 There are three principal links between waste and energy: the embodied energy within waste[1], waste as an energy resource and energy consumed in the collection, reprocessing or disposal of waste.

8.17 There are often energy benefits from recycling waste materials, due to the embodied energy within materials and products, and the saving in primary material production elsewhere. The Mayor's Municipal Waste Strategy recommends that the Best Practical Environmental Option should be considered for particular materials, taking into account the life cycle, local circumstances and other sustainability objectives.

8.18 The incineration of mixed waste is not eligible as a renewable energy source under the Government's Renewables Obligation, however, the separate combustion of non-contaminated biomass is eligible. The Renewables Obligation recognises the biomass component of energy derived through alternative 'advanced conversion technologies' and will accept the energy

output from the biomass proportion of mixed waste facilities. Anaerobic digestion and pyrolysis plants can be linked to conventional CHP, community heating facilities and, in the future, fuel cells.

8.19 The Renewables Obligation provides an incentive for the development of advanced conversion technology plants. It will also encourage the separation of recyclable wastes prior to processing, as processes such as anaerobic digestion are well suited to deal with the biodegradable fraction of waste after other materials have been recycled.

8.20 Waste collection places a significant demand on transport, often using vehicles that are heavy and large-engined with high energy consumption. Many boroughs have led the way in adopting cleaner fuels for their refuse vehicles, and some authorities use rail or water to transport the waste to its place of final disposal. Through the Municipal Waste Management Strategy, the Mayor is encouraging more efficient use of refuse vehicles and the application of the Proximity Principle - that waste should be disposed of as near to its place of production as possible.

8.21 More details about the links between energy and waste are set out in Chapter 5.

Ambient Noise Strategy

8.22 In principle, ambient noise is wasted energy. In practice, the amounts of energy used in generating sound are minute in relation to the total energy used by the equipment. However, noise reduction measures can have energy costs. For example, encapsulating a diesel engine can add to the weight of a vehicle, and sealing pubs and clubs to contain noise can increase energy consumption for ventilation and cooling. Noise reduction measures will need to be carefully planned to limit these potential energy costs.

8.23 The Mayor's Ambient Noise Strategy encourages noise-reducing road surfaces and tyres, which can offer less rolling resistance and potential energy efficiency benefits. Measures to improve energy efficiency and reduce noise can and should be integrated. For example, draught proofing and loft insulation can, in general, reduce exposure to external noise. However, specifications for 'double glazing' can differ depending on whether the primary purpose is reducing noise or saving energy. These two objectives need to be combined when undertaking installations.

Biodiversity Strategy

8.24 London's demand for energy generates pollutants locally and elsewhere that can harm biodiversity. Climate change is likely to have a significant effect on biodiversity in London, as it will throughout the world. These

effects will be assessed as part of an overall appraisal of the impacts of climate change in London, and how we should respond to the challenges it raises. The implications for the River Thames are likely to be particularly significant. The role of trees and woodlands in London in fixing atmospheric CO_2 as a carbon sink is likely to be minor, but these will nevertheless contribute so long as there is a net increase in the amount of vegetation.

8.25 London's agricultural land, woodlands, and street trees can be managed for the production of biomass fuel for power generation. This will be encouraged through the Biodiversity Strategy.

8.26 The Biodiversity Strategy contains policies and proposals to increase the biodiversity value of the built environment, including incorporating natural features onto buildings themselves. Green roofs, climbing plants and other natural features on or adjacent to buildings can provide opportunities for improving thermal efficiency while benefiting biodiversity. Examples include reducing air conditioning costs by providing summer shade, reducing wind-chill, and incorporating insulating layers to improve insulation. Widespread establishment of such features may also help reduce any negative effects of the urban heat island.

Culture Strategy

8.27 Many people visit London from around the UK and from across the world because of its huge range of cultural activities. Energy has the potential to affect the attractiveness of London through the links with the more tangible policy areas described above, particularly air quality. Conversely, the amount of tourism London receives will influence the amount of energy it uses.

8.28 The solutions proposed in the Mayor's Energy and related Strategies may contribute to making London more attractive to visitors. However, there is no doubt that tourism and visitors do impact on London's energy use, particularly through travel patterns and accommodation needs. The measures outlined in the Energy Strategy and London Plan, such as integrating transport and land use considerations, improving energy efficiency in buildings and increasing CHP and renewable energy utilisation, will all help to improve the sustainability of tourism in London. Implementation of the Culture Strategy and the organisation of culture events will consider and promote sustainable energy.

Links with the Mayor's cross-cutting themes

8.29 The GLA Act requires the Mayor to have regard to health, equalities and sustainability in all his policies and actions. A formal appraisal of each

strategy was carried out during the London Assembly and Functional Bodies' scrutiny period.

Health

8.30 Health issues surrounding energy in London provide a key motivation for this strategy. Primarily, these relate to the large number of Londoners suffering from 'fuel poverty' - an inability to heat their homes properly, with consequential effects on their health.

8.31 Fuel poverty impacts on the National Health Service, although the overall cost has not been established. It has been estimated that the cost of treating illnesses caused or exacerbated by dampness alone amounts to more than £1 billion per year, and the Department of Health allocated £250 million in the winter of 1999 to cope with increased demand on health and social care[2]. Speaking to the Electricity Association in March 2001, the then Energy Minister, Peter Hain, said "Ensuring that everyone has a warm and comfortable home actually benefits us all, because warm people are healthier people, and healthier people make fewer demands on the National Health Service, especially in winter when cold-related illness claims tens of thousands of lives[3]."

8.32 A second important health issue for Londoners is the capital's poor air quality. It is estimated that air pollution causes 1,600 premature deaths and 1,500 additional hospital admissions in London every year. As the air quality problems are due to the use of particular fuels, this can be interpreted as a health effect of energy.

8.33 Quite a different link with health is the amount of energy consumed in the capital by the health sector. London has a large NHS estate that consumes a considerable amount of energy. Accordingly, potential exists to save a proportion of this energy with a range of energy efficiency measures across the sector. The GLA aims to work with the NHS on realising such opportunities.

Equalities

8.34 One of the most prevalent equalities issues relating to energy is fuel poverty. People on low incomes tend to live in poorly insulated homes, spending the greatest proportion of their income on energy, and so are more likely to suffer from fuel poverty. Measures to eliminate fuel poverty will therefore help to address target groups that are outlined in the Mayor's equalities framework - especially children, women, black and minority ethnic groups, older people and disabled people. The issues facing these target groups are closely related to low income. For example, 41 per cent of children in London live in households with incomes below

60 per cent of the national average[4]. Sixty five per cent of lone parents in London, 92 per cent of whom are women, are reliant on income support, as well as 18 per cent of Londoners over 60[5].

8.35 Unemployment is two and a half times higher for black and minority ethnic groups than for white people in London, and disabled people's average earnings in London were 16 per cent below those of non-disabled people in 2000/01[6]. Elderly and disabled people tend to spend more time at home, further exacerbating the situation as the need to keep their homes warmer for longer increases their fuel costs. The health problems resulting from fuel poverty predominantly affect older and disabled people. There are also barriers to energy efficiency grants, mainly reducing access to these for older people and people who do not read or speak much English.

8.36 Energy use has global impacts through the process of climate change. The use of energy in London will contribute to some of the impacts experienced in other parts of the world, often home to the poorest communities. However, because the ethnic base of London is so diverse, events happening around the world could have an indirect affect on family and friends based in London. One example of this is the vulnerability of Bangladesh to the sea-level rise expected to result from global warming. This link brings London's global responsibilities back home.

8.37 While energy issues can impact disproportionately on certain sectors of the community, they can also bring social benefits. Certain sustainable energy measures, such as CHP, community heating and local renewable energy plant, once established, can bring cheap energy to households, benefiting those on low incomes and those most in need of affordable warmth.

8.38 In delivering local energy solutions, such as insulation measures, CHP, community heating and solar energy, jobs can be created where they are most needed. These job opportunities range from less skilled, manual work to skilled trade, and can provide employment within local communities where jobs are needed, appropriate skills are available, and where there is greatest need for the services or products that the jobs will deliver. This could benefit those black and ethnic minority groups living in deprived areas who tend to be disproportionately affected by unemployment.

Sustainable Development

8.39 The GLA Act requires that the Mayor's Strategies include policies aimed at contributing to the achievement of sustainable development in the UK. Energy is fundamental to this, and this strategy provides an

important vehicle for helping to deliver the Mayor's sustainable development responsibilities.

8.40 London's ecological footprint - the amount of land needed to supply our resources and soak up our wastes and emissions - is estimated to be around 293 times the size of London, which is twice the size of the UK[7]. Along with a range of other partners, the Mayor published a study on London's ecological footprint, entitled *City Limits* in September 2002. By working to minimise London's consumption of resources and reduce CO_2 emissions, the Energy Strategy will be key to reducing London's footprint - and thereby reducing our negative impact on the rest of the UK and the globe.

8.41 The Mayor has established the London Sustainable Development Commission to ensure a coherent approach to sustainable development across London, and to oversee the integration of these principles and objectives within the Mayor's Strategies and work.

8.42 The Commission has drawn up a London Sustainable Development Framework, consisting of high-level objectives and is producing sustainability indicators for the capital that will not only provide the context for future policy formulation, but also serve as a tool to assess Londonwide strategies and programmes.

8.43 The Sustainable Development Commission has undertaken research and consultation on a London CO_2 emissions reduction target, which informed the targets adopted in this strategy. The Commission is also responsible for undertaking a sustainability appraisal of the Energy Strategy.

Partners with London's energy stakeholders

8.44 Successful implementation of each proposal in the strategy is dependent upon different bodies. The key actors will include the Mayor and the GLA group, London boroughs, the energy agencies and the energy supply companies. Nevertheless, many other partners will also be needed to deliver the strategy, and their enthusiastic involvement is essential.

8.45 Chapter 7 introduces the London Energy Partnership as a key vehicle for implementing sustainable energy in partnership across London. It also lists a number of the key bodies that are responsible for delivering energy activity in London, and those partners that need to be more involved in order to take forward the objectives of this strategy effectively.

8.46 The Mayor launched the London Energy Partnership at a meeting with key stakeholders in January 2004. He will now work to facilitate the

Partnership, and the London Energy Partnership section below sets out proposals for carrying forward the preparatory work already in hand.

8.47 London boroughs will be critical to the success of the strategy and the Mayor wishes to gain the support and commitment of Leaders and Chief Executives.

8.48 The operation of the London Energy Partnership is expected to involve the boroughs. This should not only assist the Partnership in delivering its priorities but should, in turn, help boroughs to meet their own objectives.

8.49 The Mayor will also invite all London boroughs to sign a declaration of commitment to the Energy Strategy's policies and targets as proposed in Chapter 4. He will follow this up at his meetings with Leaders and Chief Executives and through boroughs' involvement in specific activities that form part of the strategy's implementation programme.

Partners with Government

8.50 Chapter 7 discusses the need for Government to support the implementation of regional energy strategies to help it deliver its own objectives and targets. This is important because the Government is increasingly looking to regional and local action to deliver its policies. However, even where there is regional or local commitment to act, without adequate powers and resources, implementation at this level on the scale that is needed is an unlikely prospect. For full implementation of the Energy Strategy, the Government's political and financial support is necessary.

The London Energy Partnership

8.51 Chapter 7 sets out proposals for the role, structure and membership of the Partnership. This section provides some detailed implementation proposals. It recommends a draft vision for the Partnership, the production of a Partnership Action Plan as a mechanism to deliver the key energy issues set out in Chapter 7, and describes how the Action Plan and Energy Strategy relate. Finally, it outlines how these elements could fit into a phased process for setting up the London Energy Partnership.

A Partnership vision

8.52 The Mayor set up a Shadow Steering Group to undertake the groundwork for the launch of the Partnership on 26 January 2004. Members were selected for their expertise in partnership development and knowledge of energy policy across a range of sectors.

8.53 Through consultation with key stakeholders, the Group drafted a five-year vision, which captures views on the role of the Partnership, its resources,

and outputs for partners and others. The Mayor recommends that the Partnership agrees this vision as the basis for setting its direction, and monitoring its work programme. The key elements are presented in the box below.

Box 16: Elements of a proposed five-year vision for the London Energy Partnership

By 2009, the London Energy Partnership will be:

- a platform for partnership working to deliver the strategic energy targets for London, facilitating the growth of a strong sustainable energy sector and delivering economic, social and environmental benefits for London
- bringing in significant new money to enable projects, meeting the London Energy Action Plan objectives and targets for the first five years
- a high-profile initiative, with a long-term future and sufficient core staff in place, that has achieved national and international recognition for its good work
- sharing information, skills and responsibilities, and raising awareness.

A Partnership Action Plan

8.54 The Mayor recommends that the Partnership adopts the strategic framework of issues set out in Chapter 7, summarised in the table below. He considers that an Action Plan should be developed which defines through agreed objectives, targets and actions, how the Partnership will work towards achieving London's energy targets.

Table 11 Summary of suggested framework for the activities of the London Energy Partnership

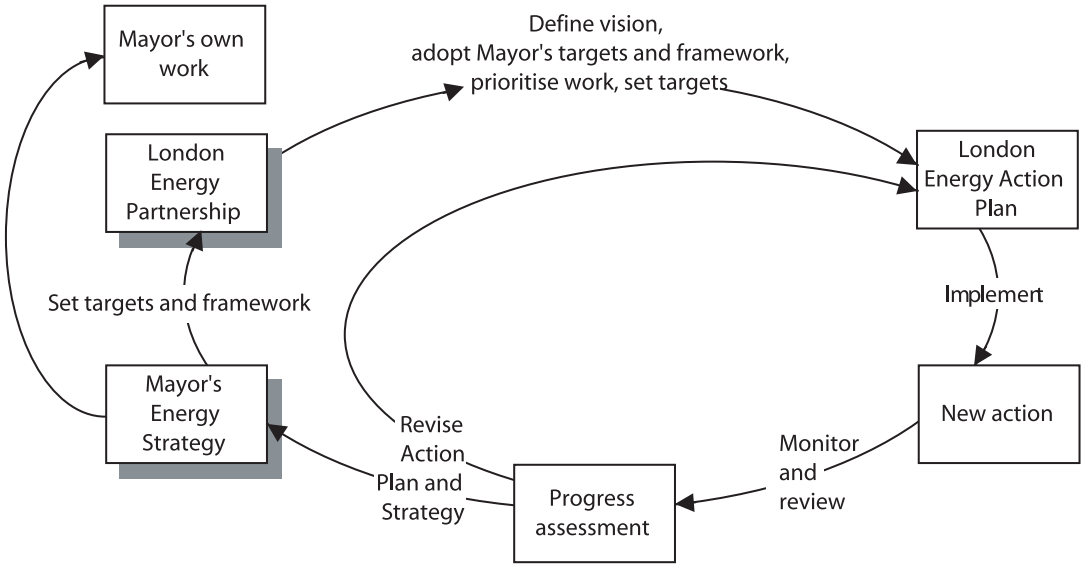
	Issue	Partnership work area
Cross-cutting issues	Delivering major projects, e.g. Energy Action Areas	● Large scale, cross-cutting projects to address a range of specific issues
	Project funding	● Strategic fundraising to implement the Energy Partnership's work. Increasing access to grants and uptake of available grants
	Communication and Education	● Education, awareness-raising and information provision
	Adopting and reviewing the Energy Strategy	● By adopting and monitoring targets in the Mayor's Energy Strategy, the Partnership will contribute to reviewing the strategy's strategic objectives and targets
Specific issues	Energy services	● Develop energy services schemes
	Energy efficiency in housing and fuel poverty	● London Fuel Poverty Programme, including development of affordable warmth strategies and support to boroughs to meet HECA obligations ● Co-ordinate and integrate funding streams, promote better access to funding and low cost installation
	Energy efficiency in commercial and public sector buildings	● Encourage energy efficiency in new and existing commercial and public sector buildings
		● Expand the Mayor's Green Procurement Code to include CO_2 emissions
	Renewable energy	● Installation of renewable energy technology, for example, through bulk purchase
	Combined heat and power (CHP) and community heating	● Increasing CHP and community heating, incineration and biomass
	Hydrogen and fuel cells	● Covered by London Hydrogen Partnership

8.55 The Action Plan should set out arrangements for monitoring and reviewing progress. Other energy partnerships, such as the Cornwall Sustainable Energy Partnership, have developed action plans for similar reasons[8]. The success of partnership action planning has also been demonstrated in other fields, such as biodiversity[9].

8.56 Funding for specific projects is likely to come from a variety of sources, including money from within partners' existing budgets, grants and contributions, and major national and European funding schemes. Further information is given in Chapter 7.

8.57 By monitoring its progress through the Action Plan's objectives, targets and actions on a regular basis, the Partnership's work will inform the review of the Mayor's Energy Strategy. The figure below illustrates this process.

Figure 23 Links between the strategic framework of the Mayor's Energy Strategy and the London Energy Partnership's work



A Partnership development process

8.58 It is recommended that the Partnership's Steering Group agrees a phased development process for the Partnership, as outlined in the table below. Realistic timings should be established for each phase. The London Assembly's recommendations on the Partnership's developmental sequence[10] were used as a basis for drawing up these proposals.

Table 12 Recommended phases in setting up the London Energy Partnership

	Partners involved	Outputs
Phase 1: Groundwork.	Shadow Steering Group	● Formulate an initial development process for the Partnership, and a draft aim and vision in consultation with key stakeholders. Completed December 2003. ● Prepare for launch of partnership and first London Energy Forum, secure initial secretariat. Completed December 2003.
Phase 2: Launching and establishing the Partnership	Secretariat London Energy Forum Steering Group task groups	● First London Energy Forum held to launch Partnership. Completed January 2004. ● Adopt vision and role. Completed January 2004. ● Adopt Mayor's framework and targets. Completed January 2004. ● Agree initial Partnership structure and Forum and Steering Group role and remit agreed. Completed January 2004. ● Priority work areas agreed. Completed January 2004. ● Steering Group and task groups established. Begin work on London Energy Action Plan and enabling projects. ● Agreed principles for relating to existing organisations and networks. ● Timetable for phases 3-5 agreed.
Phase 3: Development of London Energy Action Plan	Steering Group task groups Secretariat	● Development and production of action plan and review mechanism. ● Further work by task groups towards enabling projects. ● Secretariat augmented as required.
Phase 4: Review	Steering Group task groups Secretariat London Energy Forum	● Second London Energy Forum. ● Review of progress. ● Continuing project work. ● New task groups established.
Phase 5: Full	Steering Group task groups Secretariat	● Full core staffing in place as necessary. ● Action Plan being implemented. ● Development plan in place and work continuing to establish desired partnership status (eg not-for-profit company etc).

8.59 A range of approaches has been taken across the UK in establishing and running energy and other partnerships. Examples include Nottingham Energy Partnership, Cornwall Sustainable Energy Partnership, Thames

Valley Energy, Regen South West, Renewables North West, Western Isles Alternative and Renewable Energy Partnership, London Waste Action, Energy Efficiency Partnership for Homes, London Hydrogen Partnership, London Biodiversity Partnership, and Thames Estuary Partnership. The London Energy Partnership should consider these and other relevant models as it develops.

Costs of implementing the strategy

8.60 Prior to the publication of the Mayor's Draft Energy Strategy, a detailed cost-benefit assessment was undertaken by ERM Energy of the different energy measures and renewable energy technologies promoted in the draft strategy. The cost-benefit analysis attempted to place a monetary value on the environmental and social benefits of the proposals, using the database ExternE used, for example, by the European Commission.

8.61 The study has helped to illustrate the feasibility of the strategy by demonstrating that the majority of the measures and technologies that the strategy seeks to take forward in London are cost-effective and should bring net financial benefits to households, businesses and public bodies in the short to medium term. It will be used to prioritise the implementation of proposals. The Mayor will only expect action to deliver the strategy where this incurs no or little (reasonable) cost and has demonstrable benefits.

8.62 Implementing the strategy will incur staff costs. ERM Energy carried out a qualitative assessment of the costs and benefits of the proposals in the strategy that are related to the staff or implementation costs. The assessment allocates a low, medium or high rating to costs and benefits based on the likely resource costs of implementation as compared to potential scale of impact.

Financing the strategy

8.63 Many of the proposals in the strategy require action by London households, businesses and public sector organisations outside the GLA group. In many cases, Government grants are available to support implementation (see the section on the co-ordination of grants and funding in Chapter 7). These funding programmes, such as the DTI's funding for the London Renewables programme, grants for fuel poor households, solar energy grant programmes and the Energy Efficiency Commitment obligation on energy supply companies, are essential to the delivery of this strategy.

8.64 There are already many organisations, structures and networks, resourced by central Government and others, working to take forward sustainable energy improvements, and the Mayor recognises that the boroughs have

few resources to commit to assisting to deliver the strategy, other than those they already deploy. However, boroughs and other organisations could capitalise more on existing national and European funding initiatives, as well as stimulating the Government to provide new opportunities. The Energy Strategy aims to provide impetus and co-ordination to achieve this.

8.65 The London Energy Partnership will need to secure finance to allow it to operate as an independent body and to fund any projects that it undertakes. This will require a business plan and finance strategy to be prepared and implemented by the Partnership.

8.66 The GLA Act requires the Mayor's Strategies to take account of resource availability. The plans and budget for the implementation of the Mayor's Strategies will be set out each year in the annual business plans of the GLA group.

Monitoring progress and reviewing the strategy

8.67 Implementation of the strategy will include the need to monitor outcomes and review progress. This will enable further refinement of policies, proposals, priorities and the Implementation Plan and provide important feedback about the impact of the strategy's policies.

8.68 A key performance measure will be success in meeting the targets set out in the Energy Strategy. Although most of these targets relate to 2010 and beyond, the GLA holds information on the trend lines that will be necessary for London to follow in the shorter term if it is to hit these targets. The GLA will monitor progress according to these. This exercise calls for reliable data on energy use, renewable energy generation and carbon dioxide emissions. Chapter 6 introduces the Mayor's plans to collect, analyse and make available data relating to London's energy consumption and CO_2 emissions. Other key milestones, targets and performance indicators to judge progress will be contained within the Implementation Plan.

8.69 The London Energy Partnership will also need to develop and undertake a similar process of monitoring and review. The London Energy Forum will have a key role in this by informing the priorities of the Partnership and reviewing the Partnership's Action Plan (see Chapter 7).

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annex 1 glossary

Affordable warmth The provision of warm living conditions for people for whom fuel costs represent a large proportion of their disposable income. The converse of fuel poverty.

Airside That part of the airport operation which passengers do not normally enter until they have cleared passport control and customs.

Ambient noise Persistent, unwanted sound in the environment such as from transport and industry, as distinct from individual events, such as a noisy all-night party. Unless stated otherwise, noise includes vibration.

A-rated (white goods) All new domestic fridges, freezers and fridge-freezers, washing machines, electric tumble dryers, combined washer-dryers and dishwashers, as well as light bulbs, must carry labels indicating their energy efficiency. Appliances are rated A to G, with A being the most efficient.

Association of London Government (ALG) The Association representing all the London boroughs and the Corporation of London.

Best value A Government programme to seek continuous improvement in service quality in the way in which authorities exercise their functions.

Biodiversity The diversity, or variety, of plants, animals and other living things in a particular area or region. It encompasses habitat diversity, species diversity and genetic diversity. Biodiversity has value in its own right and has social and economic value for human society.

Biogas Energy produced from the anaerobic digestion of sewage and industrial waste.

Biomass The total dry organic matter or stored energy of plant matter. As a fuel it includes energy crops as well as forestry and agricultural residues.

BREEAM The Building Research Establishment Environmental Assessment Method is a comprehensive tool for analysing and improving the environmental performance of buildings from design through to management.

Calorific value (CV) The amount of heat given out by complete combustion of a unit weight or volume of a solid, liquid or gas fuel. For example, coal has an average calorific value of 28 gigajoules (a unit of energy equal to 109 joules) per tonne.

Carbon dioxide (CO_2) A naturally-occurring gas comprising 0.04 per cent of the atmosphere. The burning of fossil fuels releases carbon dioxide fixed by plants many millions of years ago, and this has increased its concentration in the atmosphere by some 12 per cent in the past century. It contributes about 60 per cent of the potential global warming effect of man-made emissions of greenhouse gases.

Carbon Index Based on the *carbon dioxide* (CO_2) emissions associated with space and water heating. It can be used to demonstrate that dwellings comply with Part L1 of the Building Regulations. The range of the index is 0 to 10 and new dwellings should not have an index of less than eight.

Combined heat and power (CHP) The combined production of electricity and usable heat. Steam or hot water, which would otherwise be rejected when electricity alone is produced, is used for space or process heating.

Community heating Distribution of steam or hot water through a network of pipes to heat a large area of commercial, industrial or domestic buildings or for industrial processes. The steam or hot water is supplied from a central source, such as a heat-only boiler or a *combined heat and power* plant.

Compressed natural gas (CNG) Natural gas that has been compressed to reduce its volume and make it easier to transport, for example, as a vehicle fuel. While other petroleum gases can be compressed into liquid form, natural gas cannot be liquefied without very high pressures and low temperatures being used.

Congestion charging Applying charges to reduce the number of vehicles and level of congestion in congested areas.

Embedded generation Electricity generation plants that are connected to the distribution networks of the public electricity distributors rather than to the National Grid transmission systems. These are generally either smaller stations located on industrial sites, *combined heat and power* plants, renewable energy plants such as wind farms, or refuse incineration plants.

Energy efficiency Making the best or most efficient use of energy in order to achieve a given output of goods or services, and of comfort and convenience. This does not necessitate the use of less energy, in which respect it differs from the concept of energy conservation.

Energy Efficiency Commitment (EEC) Energy suppliers with 15,000 or more domestic customers are obliged to achieve improvements in energy efficiency by encouraging and assisting customers to take up energy efficiency measures in their homes. At least 50 per cent of the energy savings must be targeted at customers receiving certain benefits or tax credits.

Environment Agency (England and Wales) The Environment Agency for England and Wales was formed by the Environment Act 1995. It took over the functions and responsibilities of its predecessor organisations, the National Rivers Authority, Her Majesty's Inspectorate of Pollution, the 83 Waste Regulators of England and Wales and a number of smaller Waste Technical Departments from the (former) Department for the Environment, Transport and the Regions.

Final energy consumption Energy consumed by final user. Final energy consumption is always less than the primary energy owing to conversion losses, distribution losses for electricity, and fuel consumed by the energy supply industries. It is sometimes called delivered energy or heat supplied.

Fuel cell Acts like a constantly recharging battery, electrochemically combining hydrogen and oxygen to generate power. For hydrogen fuel cells, water and heat are the only by-products and there are no air pollution or noise emissions. They are suitable for a range of applications, including vehicles and buildings.

Fuel poverty The condition in which people cannot afford to heat their homes to an adequate standard. This is generally defined as households that have to spend more than ten per cent of their disposable income on heating.

Functional bodies The Mayor has responsibility for appointing members to, and setting budgets for, four new organisations: Transport for London (TfL), the London Development Agency (LDA), the London Fire and Emergency Planning Authority (LFEPA), the Metropolitan Police Authority (MPA).

Gigawatt (GW) A unit of electrical power, equal to 109 *watts*.

Gigawatt-hour (GWh) Unit of electrical energy, equal to 0.0036TJ. A 1GW power station running for one hour produces one GWh of electrical energy.

GLA group Comprising the core GLA, Transport for London, the Metropolitan Police Authority, the London Fire and Emergency Planning Authority and the London Development Agency.

Greater London The geographical area encompassed by the 32 London boroughs and the City of London, representing most of the continuous built-up area of London and covering 1,600km^2.

Greater London Authority (GLA) The organisation responsible for carrying out the functions set out in the Greater London Authority Act 1999, including the Mayor, the London Assembly and four functional bodies: the London Development Agency, Transport for London, the Metropolitan Police Authority and the London Fire and Emergency Planning Authority. There is a clear separation of powers within the GLA between the Mayor - who has an executive role, making decisions on behalf of the GLA - and the London Assembly, which has a scrutiny role.

Green electricity Electricity generated from renewable sources such as wind, wave, sun, water and energy from plant material, but not fossil fuels or nuclear energy. Although not strictly renewable, geothermal energy is generally included.

Home Zones Designated residential streets in which the use of street space is shared between motor vehicles and other street users, thereby improving residents' quality of life and reducing risk of accidents.

Joule (J) An international standard unit of energy. Being a small unit it is usually used as a multiple such as megajoule (MJ) which equals 10^6 joules, gigajoule (GJ) which equals 10^9 joules, or petajoule (PJ) which equals 10^{15} joules.

Kilowatt (kW) A unit of power which equals 1,000 or 10^3 *watts*. Domestic electrical appliances have power ratings up to a few kilowatts.

Kilowatt-hour (kWh) The normal unit for the measurement of electricity consumption in the UK. This is the 'unit' used by electricity suppliers in their customer accounts. See *watt-hour*. An electrical appliance with a power rating of one kilowatt running for one hour use one kilowatt-hour of electricity.

Landfill gas The methane-rich biogas formed from the decomposition of organic material in landfill sites.

The LFEPA London Fire and Emergency Planning Authority.

Liquefied petroleum gas (LPG) Propane or butane gas, derived from oil production, and put under pressure so that it is in liquid form. Used as fuel in portable cooking stoves and heaters and to fuel certain vehicles, such as fork-lift trucks. Now increasingly being used by road vehicles.

The London Assembly The directly-elected London regional body comprising 14 constituency members and 11 pan-London members. A component of the Greater London Authority.

London Plan See *Spatial Development Strategy*.

Mayoral strategies The Mayor is required by the Greater London Authority Act 1999 to produce eight strategies which together will lay out a blueprint for the future of London. These are Air Quality, Ambient Noise, Biodiversity, Cultural, Economic Development, Spatial Development (the London Plan), Transport and Municipal Waste. In addition to these eight statutory strategies, the Mayor (using his general power to do anything which he considers will further any one or more of the Authority's three principal purposes) is developing policy initiatives across a wide range of other areas important to Londoners' lives. These include homelessness, domestic violence, drug and alcohol abuse, children and others, as well as the Energy Strategy.

Megawatt (MW) The normal unit of measurement of the electrical generation capacity of power stations which equals 10^6 watts. See also *watt*.

Micro-CHP Small-scale *combined heat and power* plant producing both electricity and usable heat. An adapted vehicle engine, usually running on natural gas, is used to generate electricity. Heat from the engine's cooling system is used for space heating.

The MPA Metropolitan Police Authority.

Natural gas A mixture of naturally occurring gases found in underground reservoirs either in isolation or associated with crude oil. The main component is methane. It is widely used as a fuel and as a chemical feedstock.

Nitrogen oxides (NOx) A general term covering a number of oxides of nitrogen. The principal air pollutants are nitric oxide (NO), produced by the reaction of atmospheric nitrogen with oxygen in high temperature combustion, and nitrogen dioxide (NO_2). Generally, oxides are produced by the addition of oxygen to, or the removal of hydrogen or electrons from, a chemical species (atom or molecule).

Non Fossil Fuel Obligation (NFFO) The 1989 Electricity Act empowered the Secretary of State to make orders requiring the Regional Electricity Companies in England and Wales to secure specified amounts of electricity from renewable sources.

Ofgem The Office of Gas and Electricity Markets, established under the Utilities Act 2000 to regulate the gas and electricity supply industries. This combines the regulatory functions previously carried out separately by OFGAS and OFFER.

Photovoltaics (PV) The direct conversion of solar radiation into electricity by the interaction of light with the electrons in a semiconductor device or cell.

Primary energy Measures the total energy input into the economy in terms of coal, crude oil, natural gas, nuclear or hydroelectricity. Using suitable conversions it can be expressed as a common unit, such as million tonnes of coal equivalent or *mtce*.

Renewable energy Energy derived from a source that is continually replenished, such as wind, wave, sun, water and energy from plant material, but not fossil fuels or nuclear energy. Although not strictly renewable, geothermal energy is generally included. The organic component of municipal waste is also classified as a renewable energy source.

Social exclusion A shorthand term for what can happen when people or areas suffer from a combination of linked problems such as unemployment, poor skills, low incomes, poor housing, high crime environments, bad health and family breakdown.

Social inclusion The ability to access and benefit from the opportunities available to members of society.

Solid fuels Fuels supplied to customers as solids, including coal, coke and solid fuels manufactured from coal, such as Furnacite.

Spatial Development Strategy One of the eight strategies for London that the Mayor is required to produce by the Greater London Authority Act 1999. It will replace existing strategic planning guidance for London (RPG3). The Mayor has chosen to call it the London Plan.

Standard Assessment Procedure (SAP) The Government's Standard Assessment Procedure for the energy rating of dwellings, on a scale of 0

to 120, based on the calculated annual energy requirement for space and water heating. The procedure can be used to calculate the *carbon index*.

Sustainable development Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Sustainable energy Energy that meets current needs without depleting the resources available to future generations. Generally refers to *renewable energy* resources, including wind, wave, sun, water, geothermal energy and energy from plant material.

Tariff A scale of charges for the supply of heat, gas or electricity (or any other service or commodity). It may include a fixed charge for the provision of the supply and a variable charge depending on the amount of energy supplied. 'Tariff customers' refers to smaller gas and electricity consumers who pay for their fuel according to a scale of charges rather than under a contract.

Terawatt (TW) The unit of measurement of the electrical generation capacity of power stations which equals 10^{12} watts. See also *watt*.

Thames Gateway An area extending from Blackwall Tunnel eastwards on both the north and the south sides of the River Thames into Kent and Essex. The Thames Gateway Planning Framework (RPG3A) sets out a broad development strategy to secure the regeneration of the area.

Thermal efficiency The thermal efficiency of a power station, boiler plant or engine is the efficiency with which heat energy contained in fuel is converted into electrical or other usable form. For nuclear stations it is calculated using the quantity of heat released as a result of fission of the nuclear fuel inside the reactor.

Transport for London (TfL) A functional body of the Greater London Authority, accountable to the Mayor for implementing his Transport Strategy, with responsibility for the operation of buses, Docklands Light Railway, Croydon Tramlink and the Underground, and for regulating taxis and private hire vehicles, and operation of the Transport for London Road Network.

Transport for London Road Network (TLRN) This is described in the Greater London Authority Act 1999 as the Greater London Authority Road Network. The Mayor has decided to call this the Transport for London

Road Network. It comprises 550 kilometres of London's Red Routes and other important streets.

Unitary Development Plans (UDPs) or Development Plan Documents Statutory plans produced by each borough which integrate strategic and local planning responsibilities through policies and proposals for development and use of land in their area.

Watt (W) An international standard unit of power, defined as one joule per second. Being a small unit, it is usually used as a multiple such as kilowatts or megawatts.

Watt-hour (Wh) A unit of work, equivalent to 3,600 joules. Usually used as a multiple as with watts.

World city A globally successful location for a range of functions, particularly business, culture and tourism, and headquarters and government functions; currently applying to only a small number of the world's great cities - London, New York, Paris and Tokyo.

Zero Carbon development One whose net carbon emissions are zero. Typically these developments are highly energy efficient and generate their own power from renewable sources. Through exporting to the grid when they are generating more than they need and importing from the grid at times when their renewables, such as photovoltaics and small-scale wind, are not satisfying their demand, the balance across the year as a whole is designed to be at least zero. Biomass-powered combined heat and power is also zero carbon in that the carbon emissions it produces are balanced by the carbon that is absorbed in the growing of the equivalent mass of biomass.

annex 2 acronyms

ALG Association of London Government

BedZED Beddington Zero Energy Development

BETTA British Electricity Trading and Transmission Arrangements

BRE Building Research Establishment

BREEAM Building Research Establishment Environment Assessment Method

BREDEM Building Research Establishment Domestic Energy Model

CCGT Combined cycle gas turbine

CEN Creative Environmental Networks

CHP Combined heat and power

CHPA Combined Heat and Power Association

COP Conference of Parties

CUTE Clean Urban Transport for Europe

DEFRA Department for the Environment, Food and Rural Affairs (formerly DETR)

DETR Department for the Environment, Transport and the Regions (now DEFRA)

DfT Department for Transport

DTI Department of Trade and Industry

DTLR Department for Transport, Local Government and the Regions

EA Environment Agency

EEAC Energy Efficiency Advice Centre

EEBPP Energy Efficiency Best Practice Programme

EEC Energy Efficiency Commitment

ESCo Energy Services Company

EST	Energy Saving Trust
ETSU	Energy Technology Support Unit (now Future Energy Solutions)
EC	European Commission
EU	European Union
FES	Future Energy Solutions (formerly ETSU)
GLA	Greater London Authority
GLEEN	Greater London Energy Efficiency Network
GOL	Government Office for London
HECA	Home Energy Conservation Act
HELPCO	Heat, Light and Power Company
IPCC	International Panel on Climate Change
LCF	London Coach Forum
LDA	London Development Agency
LFEPA	London Fire and Emergency Planning Authority
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
LPN	London Power Networks
LSDC	London Sustainable Development Commission
LSP	London Service Permit
NETA	New Electricty Trading Arrangements
NFFO	Non Fossil Fuel Obligation
ODPM	Office of the Deputy Prime Minister

Ofgem Office of Gas and Electricity Markets

PFI Private Finance Initiative

PIU Performance and Innovation Unit

PPG Planning Policy Guidance

ppm parts per million

ppmv parts per million volume

PV photovoltaic

RCEP Royal Commission on Environmental Pollution

SAP Standard Assessment Procedure

SDS Spatial Development Strategy

SELCHP South-East London Combined Heat and Power

SPG Supplementary Planning Guidance

TfL Transport for London

TGLP Thames Gateway London Partnership

UDP Unitary Development Plan

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annex 6 index

Index entries refer to either policies (Pol), proposals (Prop) or paragraph numbers. 'b' denotes a box, 'cs' denotes a case study, 'f' denotes a figure and 't' denotes a table.

Entries are in word-by-word alphabetical arrangement.

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Chinese

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Hindi

यदि आप इस दस्तावेज़ की प्रति अपनी भाषा में चाहते हैं,
तो कृपया निम्नलिखित नम्बर पर फोन करें अथवा दिये
गये पता पर सम्पर्क करें

Vietnamese

Tiếng Việt
Nếu bạn muốn bản sao của tài liệu này bằng
ngôn ngữ của bạn, hãy gọi điện theo số hoặc
liên lạc với địa chỉ dưới đây.

Bengali

আপনি যদি আপনার ভাষায় এই দলিলের প্রতিলিপি
(কপি) চান, তা হলে নীচের ফোন নম্বরে
বা ঠিকানায় অনুগ্রহ করে যোগাযোগ করুন।

Greek

Αν θα θέλατε ένα αντίγραφο του
παρόντος εγγράφου στη γλώσσα
σας, παρακαλώ να τηλεφωνήσετε
στον αριθμό ή να επικοινωνήσετε
στην παρακάτω διεύθυνση.

Urdu

اگر آپ اس دستاویز کی نقل اپنی زبان میں چاہتے
ہیں، تو براہ کرم نیچے دیئے گئے نمبر پر فون کریں
یا دیئے گئے پتے پر رابطہ قائم کریں

Turkish

Bu brosürü Türkçe olarak edinmek
için lütfen asagidaki numaraya
telefon edin ya da adrese basvurun.

Arabic

إذا أردت نسخة من هذه الوثيقة بلغتك، الرجاء
الاتصال برقم الهاتف او الكتابة الى العنوان
ادناه:

Punjabi

ਜੇ ਤੁਹਾਨੂੰ ਇਸ ਦਸਤਾਵੇਜ਼ ਦੀ ਕਾਪੀ ਤੁਹਾਡੀ ਆਪਣੀ ਭਾਸ਼ਾ
ਵਿਚ ਚਾਹੀਦੀ ਹੈ, ਤਾਂ ਹੇਠ ਲਿਖੇ ਨੰਬਰ 'ਤੇ ਫ਼ੋਨ ਕਰੋ ਜਾਂ ਹੇਠ
ਲਿਖੇ ਪਤੇ 'ਤੇ ਰਾਬਤਾ ਕਰੋ:

Gujarati

જો તમને આ દસ્તાવેજની નકલ તમારી ભાષામાં
જોઈતી હોય તો, કૃપા કરી આપેલ નંબર ઉપર
ફોન કરો અથવા નીચેના સરનામે સંપર્ક સાધો.

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