MITSUBISHI ELECTRIC
AIR CONDITIONING SYSTEMS

Information Guide

Sustainable Cities

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Issue Nineteen >

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Information Guide

This is an independent guide produced by Mitsubishi Electric to enhance the knowledge of its customers and provide a view of the key issues facing our industry today. The guide accompanies a series of seminars, all of which are CPD accredited. The changing face of construction in the 21st Century demands that designers, specifiers and suppliers work as teams to create better buildings - for occupants and the environment. Mitsubishi Electric aims to be a part of this by encouraging employees and customers to work together to increase their knowledge of the latest technology, legislation and markets.

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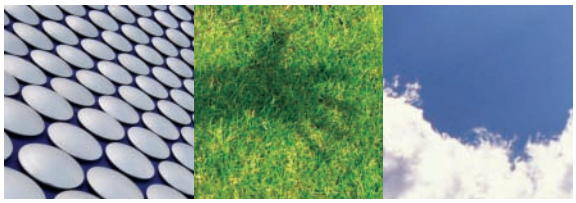
How cities are leading the way on energy efficiency, renewables and sustainability.

Cities consume 75% of the world's energy and produce 80% of its greenhouse gas emissions. However, whilst the activities and buildings within cities contribute heavily to carbon emissions and climate change, they are also proving that they can be part of the solution. In the UK, our major conurbations are leading the way by cutting energy use, reducing CO_2 emissions and supporting the growth of the country's renewable and low carbon industries.

The city regions of England are responsible for approximately 30% of our carbon emissions, which represents 140 million tonnes annually. Although these figures seem high, the potential to make cities more environmentally friendly is relatively high. Carbon emissions per person are 20% lower in cities than the average for England, because of high density living and also supported by higher than average incomes. The Core Cities Group is a network organisation which links some of the UK's major cities together to pursue economic development and related issues such as sustainability. These cities include Manchester, Birmingham, Liverpool, Leeds, Bristol, Nottingham and Sheffield.

By increasing renewable energy supplies within cities and addressing the energy efficiency of buildings, the Core Cities have the potential to make a large contribution to the UK's overall carbon emission reductions. More than 16 million people live in the Core City regions, so other elements of sustainability can also be addressed on a large scale including water use, waste management and accessibility of public transport. Cities can also lead the way for less densely populated regions with exemplar programmes and opportunities for learning new skills.



At the end of 2007 Bristol, Leeds and Manchester became part of the Low Carbon Cities programme, working with the Carbon Trust and the Energy Saving Trust. The programme aims to develop city-wide action plans to achieve low carbon economies which are both sustainable and economically successful. Backed by £250,000 funding from DEFRA, the scheme will introduce new measures and initiatives which could include renewables, trigeneration (producing power, heat and cooling from a single source) and measures such as greater insulation.

Another important aim of the Low Carbon Cities programme is to establish a city-wide CO_2 baseline, show emission totals and provide a detailed breakdown of where emissions originate. This information will help to identify where the most impact can be made to reduce carbon emissions. Research is still underway to identify and set this baseline.

Manchester City Council recently announced plans to be a low carbon city by 2020 by adopting the UK's target of a 60% carbon emission reduction. The city's annual emissions are just over 3 million tonnes, around half of this from commercial buildings. The 60% target would mean a cut of 1 million tonnes of carbon dioxide each year. The council aims to do this with a number of schemes including a move which would put the local authority in control of all aspects of the city's energy supply.

Table 1 shows the total annual carbon output by ten of the UK's largest cities (excluding London). The different carbon performances of cities depend on a number of factors, including housing density, use of office space and key industries. However, it is clear that local councils are keen to be seen driving down the size of their cities' carbon footprints and in our next feature we will look at some of the methods that are being considered and how London is setting the pace in the move to 'green' cities.

Table 1: **Total Carbon Output from Cities**

City	Total CO_2 tonnes
Birmingham	6,586,090
Leeds	5,614,534
Sheffield	4,453,795
Glasgow	4,118,108
Manchester	3,230,697
Edinburgh	3,168,861
Liverpool	2,678,629
Cardiff	2,370,940
Bristol	2,339,170
Newcastle	1,908,469
Total	**36,469,295**

(Figures from the GVA Grimley 2007/2008 report 'How Green is my City?')

Creating a Green Capital - The London Plan 2008

As a capital city, with a place on the world stage, London is keen to be at the forefront of the climate change mitigation challenge. This is not simply an environmental goal, but is part of a drive to build businesses in the 'renewables' and CO_2 reduction sector in and around the London area. As a result, London has the highest energy efficiency standards of any in the UK and is leading the way on low and zero carbon development.

The London Plan was launched in 2004. It is a wide-ranging document which deals with all aspects of London life, including communities, open spaces, employment and education. It is also a significant policy document for the construction industry as it sets out goals for energy reduction in domestic and commercial buildings and outlines objectives for greater use of low carbon and renewable energy sources within the city itself. The Plan is updated regularly with new targets and feedback for relevant sectors. The latest version is the 2008 London Plan.

The Challenge

As might be expected, London's buildings are responsible for a large amount of CO_2 emissions. There are 3.1 million dwellings in London and over 100 million square meters of commercial and industrial floor space. Domestic buildings account for 16.7 million tonnes of CO_2 per annum and commercial for 17.9 million tonnes. The London Plan makes significant growth projections in domestic and commercial building sectors up to 2025 and predicts that if this stock is constructed at current CO_2 levels (the 'business as usual' scenario) this could lead to an increase in 5.1 million tonnes of CO_2 per annum.

Clearly, the challenge is enormous. National planning and building regulations, as well as London-specific targets, are pushing the construction industry to ever-more energy efficient buildings and greater use of low and zero carbon energy sources. The London Plan aims to ensure that, at minimum, new-build will be 30% more efficient than the city's existing building stock by 2025. If these targets are met, there could be a CO_2 saving of 1 million tonnes per annum.

The Mayor of London has set a long-term target of a 60% reduction in CO_2 against 1990 levels by 2050.

There are also targets set for intervening years:
15% by 2010
20% by 2015
25% by 2020
30% by 2025

Since the launch of The London Plan, the policies it established have produced overall CO_2 emissions savings of around 210,000 tonnes per year, representing a saving of 28% on 2004 levels.

Achieving the targets

Since buildings account for such a large slice of London's CO_2 output, they are being targeted as key sources of improved sustainability for the city. Against a background of national legislation and regulation, including Part L and the European Energy Performance of Buildings Directive, the Mayor and London's boroughs play an important part in driving energy efficient design and construction. The Mayor directly reviews planning applications for larger developments. These are small in number (less than 300 per year) but have a significant impact because they are large scale.

The Mayor can therefore directly enforce targets on use of renewable energy sources and require designers to demonstrate the sustainable characteristics of any proposed development at an early stage of design.

The other applications which number 87,000 a year on average, must be made initially to the London boroughs. A number of boroughs have their own renewable energy use targets (including Merton and it's '10% Rule'), which they enforce through their planning powers.

The London Plan outlines a number of 'expected' design characteristics for buildings. All buildings should incorporate and demonstrate passive design measures such as natural ventilation, passive solar design, use of sustainable drainage, and rainwater harvesting. The Plan document summarises its approach to reducing carbon as "Be lean, be green and be clean" which is translated as using less energy, using renewable energy and supplying energy efficiently.

The London Plan favours decentralised energy supply as a mainstay of its carbon reduction policies. This includes the use of combined heat and power (CHP) as well as combined cooling, heat and power (trigeneration). Passive design to reduce the need for heating and cooling is also encouraged, along with use of other low carbon and renewable technologies including wind power, photovoltaics and biomass.

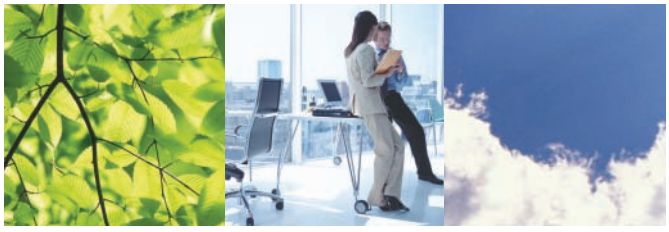
The vision for a sustainable capital includes some very specific targets for use of renewable energy sources. Table 2 shows the timetable for renewables set out in the 2008 London Plan, with an indication of the ambitious plans for extending use of such technologies around the capital.

Table 2

Energy Source	2010 Number	2010 Total Installed Capacity (MW)	2010 Total Output (MWh)	2020 Number	2020 Total Installed Capacity (MW)	2020 Total Output (MWh)
Single large wind turbines	6	15	26,280	18	45	78,840
Small stand-alone wind turbines	50	10	13,140	150	30	39,420
Building integrated micro-wind turbines	2,000	5	3,066	6,000	15	9,198
Biomass-fuelled CHP/electricity	8	24	126,144	24	72	378,432
Solar PV (domestic) (MWp)	7,000	15	10,500	21,000	45	31,500
Solar PV (commercial) (MWp)	250	12	8,400	750	36	25,200
Anaerobic digestion	4	1.2	9,460	25	7.5	67,050
Sewage gas	2	10	31,124	6	30	93,372
Gasification/Pyrolisis	1	6.8	42,048	11	94.6	662,957
Total	9,321	99	228,114	27,984	375.1	1,385,969

Going green - Renewables in the city

London faces enormous challenges in increasing the city's use of renewable energy sources. Building integrated renewables are an obvious option for new buildings, although they must be viewed as secondary to constructing more energy efficient homes and commercial buildings. However, these strategies will not meet the energy needs of a growing city.



The London Energy Partnership (LEP) has explored a number of options for increasing use of renewables, with particular emphasis on wind turbines and biomass-fuelled combined heat and power systems. A key problem for London is that it must produce a lot of renewable energy from very little available space, and the city also creates challenges for particular technologies. For example, use of wind turbines in an urban environment is notoriously difficult. Biomass too has its issues.

Biomass plants use a variety of natural processes to produce gases such as methane and carbon dioxide from a wide range of organic products. Anaerobic digestion is one of the most commonly used processes, in which micro-organisms break down biodegradable materials in the absence of oxygen.

The most commonly used 'feed' for this sort of plant is waste water sludge and organic waste (such as chicken droppings) because this provides much-needed volume and the input material is reduced in mass by the process. Any solids remaining at the end of the process can be used as fertiliser. Other biodegradable matter which can be used includes waste paper, grass clippings and food waste. Anaerobic digesters can also use energy crops for biogas production.

A similar process is pyrolysis, which can work on synthetic materials such as rubber and plastics. This is not such a commonly used technology however developments are being made to increase its commercial viability.

The London Energy Partnership 2006 study into the feasibility of biomass solutions for London concluded that biomass CHP could displace 15% of conventional energy needs for buildings and reduce CO_2 emissions by over 5 million tonnes per year. However, London already uses a large proportion of the materials that would be used in this process. Taking this into account, assuming that all material not currently used elsewhere is put into biomass CHP, then this would displace 10% of conventional sources and save around 3.5 million tonnes of CO_2 per annum.

It is clear from the various studies which explore renewable energy options for cities that there is no single solution to the problem. And each technology can create its own problems, for example sourcing material to feed biomass CHP plants and transporting it to the required locations; or finding appropriate sites for wind turbines which do not interfere with existing buildings.

This is why in the London Mayor's statement about energy in the capital, 'Be Lean' appears at the top of the energy hierarchy. It is clear that in order to match renewable energy output with requirements, those requirements must be carefully managed. Even if the on-site renewables obligation rises to 30% , this still leaves 70% of the energy requirement to be sourced largely (at least for the next few years) from fossil fuels.

The London Plan is important for the construction and property sector for a number of reasons. Firstly, the capital's projected growth is very large and every building whether domestic or commercial will fall under its new targets for energy efficiency and use of renewables. Secondly, we are already seeing other UK cities setting their sights on the goal of sustainability and adopting similar targets for use of on site renewables. But perhaps most importantly, the London Plan is yet another layer of regulation and direction affecting the design of buildings and the hvac services within them. Even if it complies with Part L and the EPBD, is the design sustainable enough to pass the planning stage?

The loopholes available for those who think that the minimum is good enough as far as energy use goes are shrinking and a close examination of all aspects of energy use is required by everyone in the construction team. Each specified item should make some contribution to reducing the energy load of a building – and plenty of people will be checking that they do.

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Further information

If you missed the CPD seminar on **Sustainable Cities**, you can call your Mitsubishi Electric Regional sales office to arrange an in-house presentation of this information.

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MITSUBISHI ELECTRIC
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Regional Sales Offices

Birmingham
Tel: 0121 7412800
Fax: 0121 7412801

Bristol
Tel: 01454 202050
Fax: 01454 202900

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Fax: 0870 3300348

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Fax: 01689 881031

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Tel: 01707 282480
Fax: 01707 282481

London Central Region
Tel: 01689 881030
Fax: 01689 881031

MITSUBISHI ELECTRIC
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Telephone: **01707 282880**

email: air.conditioning@meuk.mee.com web: www.mitsubishielectric.co.uk/aircon

UNITED KINGDOM Mitsubishi Electric Europe Air Conditioning Systems Division
Travellers Lane, Hatfield, Hertfordshire, AL10 8XB, England.
General enquiries Telephone: 01707 282880 Fax: 01707 278674

IRELAND Mitsubishi Electric Europe Westgate Business Park, Ballymount, Dublin 24, Ireland.
Telephone: Dublin (01) 419 8800 Fax: Dublin (01) 419 8890 International code: (003531)

Issue 19 Version 1 (June 2008)

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