METREX
The **network** of
European Metropolitan Regions and Areas

InterMETREX project extension
Climate Change/Urban Change

Discussion Note 1

EU Energy and climate change policy (January 2007),
Subsidiarity, mitigation and the InterMETREX project extension

Measures for mitigation

for the consideration of
GCVSPJC, Stockholm County Council,
Regione Emilia-Romagna,
Regione Veneto, Vilnius, GLA and the Tyndall Centre

METREX
Nye Bevan House,
20 India Street,
GLASGOW, G2 4PF
T. +44 (0) 1292 317074
F. +44 (0) 1292 317074
secretariat@eurometrex.org
http://www.eurometrex.org

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Introduction

The context for the InterMETREX project extension is the now recognised need to reduce greenhouse gas emissions effectively and urgently in order to avoid a rise in global temperatures that will prejudice life on earth, as we know it.

The parameters are that greenhouse gas levels in the atmosphere were about 280 parts per million (ppm) prior to global industrialisation in the nineteenth century, were 380 ppm in 2000 and are rising at some 2 ppm a year. Average global temperatures have risen by 0.6 degrees over this period and are likely to rise by 2 degrees if greenhouse gas levels rise to 440-450 ppm over the next thirty years. Beyond this point the risk to the stability and sustainability of the global eco-system becomes acute. For example, a temperature rise of 3 degrees could bring the risk of the collapse of polar ice and the prospect of sea rises of 7 metres.

The world is now highly urbanised and urban life in the most prosperous areas is highly dependent on fossil fuels, the use of which is responsible for greenhouse gas emissions, particularly carbon dioxide. Greenhouse gas emissions, including methane and HFC's, are measured in carbon dioxide equivalents. It is in areas such as the European Union that urban mitigation measures have to be taken.

The UK Stern Report has established that action to mitigate the emission of greenhouse gases makes economic as well as environmental sense. It has been said that the economy is a wholly owned subsidiary of the environment, meaning that the environmental consequences of economic activity now have to be taken fully into account in business decision making.

It has also been established that action taken quickly and effectively will be of much more value than action taken later. It is estimated that there is now perhaps a 30-year window within which to establish effective global mitigation measures. The EU target/aim is a 60-80% reduction in 1990 levels of greenhouse gas emissions by 2050. There are those who argue that these targets need to be achieved much earlier.

This Discussion Note has looked at the EU Energy and Climate Change policy documents, published on 10 January 2007, and sets out for consideration by InterMETREX extension project partners and associates, the range of measures that might be available to achieve high levels of reductions, on the basis of subsidiarity. By subsidiarity is meant the measures that have to be initiated and progressed at EU and international level, national level and the metropolitan level.

This approach has been taken on the supposition that that the InterMETREX project extension will have to take as its brief the need to persuade decision makers at the metropolitan level that,

1 There is a feasible package of measures that can be taken, at all levels, which cumulatively will enable the targets to be achieved.

2 There is a range of effective measures that can be taken at the metropolitan level to make the required metropolitan contribution.

This Discussion Note explores responses to these two points. It also provides material that might be reflected in a Benchmark addition to the InterMETREX Practice Benchmark.

EU energy and climate change policy

The component parts of the January 2007 EU integrated energy and climate change package are,

- A target/aim of cutting EU 1990 level greenhouse gas emissions by 20-30% by 2020 and 60-80% by 2050 (it should be noted that EU levels in 2005 were slightly lower than 1990 overall, with industry lower but transportation higher).

- Measures to create an EU internal market in energy by improving transnational grid connections and separating energy production from distribution.

- A target of 20% of EU energy from renewables by 2020, including the three sectors of electricity, bio-fuels and heating and cooling.

- Nuclear energy makes up 14% of EU energy consumption and 30% of EU electricity generation. There are over 150 nuclear plants in the EU many of which will come to the end of their 40-year lifespan in the period to 2020 and beyond. If they are not replaced then this will increase the need for low carbon alternatives.

- A target of saving of 20% of primary energy consumption by 2020 through efficiency savings. It should be noted that some 35% of primary energy consumption is lost through inefficiencies such as electricity generation, transmission and distribution. Measures envisaged include acceleration of the use of fuel-efficient vehicles, energy efficient appliances (standards and labeling) and energy saving buildings (through national Building Regulations).

- It is recognised that coal is a major long term EU energy resource and that *clean coal,* that is, coal that is used with carbon capture technology and sequestration (underground storage of captured carbon dioxide) will probably play a major role in future EU electricity generation. The EU will support a trial programme for 12 clean coal power stations.

The EU established an Emissions Trading Scheme (ETS) in January 2005 to run to 2007. The scheme is now rolled forward at 5-year intervals to set national *Cap and trade* limits. The scheme was introduced to support the EU in reaching its Kyoto target of a 12% reduction, over 1990 levels of emissions, in the period to 2012.

The ETS includes energy activities (boilers, electricity generation, combined heat and power), production and processing of ferrous metals, mineral industries (cement manufacture is particularly energy intensive) and pulp and paper industries. In due course it may be that other activities will be included such as commerce (tourism and hotels, retailing) and aviation.

In effect, the EU ETS is a first step to an emissions rationing/trading system by economic sector.

EU energy and climate change policy continued

Personal carbon rationing and global trading has been recommended by a number of commentators as the only fair way of allocating the remaining available atmospheric greenhouse gas capacity. This would underpin an international agreement on Contraction and Convergence, which will have to await action at this level to succeed the Kyoto Protocol.

The EU energy and policy statements essentially concentrate on the practical measures that can be taken immediately, such as efficiency savings and the development of renewable sources of energy. In a sense these are the obvious steps to take from our present fossil fuel based ways of life and energy use. However, such measures may only take the EU up to its 20% target by 2020.

To achieve the 60-80% by 2050 target would seem to require consideration of a structural shift toward a hydrogen economy and significant attitudinal and behavioural changes. It is at the metropolitan level that behavioural change has a significant role to play.

Because of the very limited scope that there is for further green house gas emissions into the atmosphere and bearing in mind that carbon capture and sequestration is essentially a measure to buy time, it seems that a longer term move from a carbon based economy to a hydrogen based economy is inevitable. There would be advantage in making such a move sooner rather than later.

Subsidiarity and climate change

It is clear that the emission reductions that are required will require effective action at international and EU levels, the national level and the level of the metropolitan region and area. In general terms the allocation of functions and responsibilities might be as follows.

International and EU

- Research
- Awareness
- Visions and integrated frameworks
- Treaty
- EU Directives, regulation and control
- EU Standards, including trading standards
- Markets, including carbon
- Incentives, including support for programmes and projects

National

- Research
- Awareness
- Visions and integrated frameworks
- Legislation, regulation and control
- Standards
- Markets
- Obligations, including energy use and carbon capture
- Incentives, including taxation and tax relief
- Pricing, including financial regulation

Metropolitan region or area

- Awareness
- Visions and integrated frameworks
- Spatial planning, including integrated land use and transportation planning and development (that is, reducing the need to travel and promoting and enabling carbon light connectivity and accessibility)
- Spatial planning for the use of renewable sources of energy
- Spatial planning for the use of micro sources of renewable energy generation and combined heat and power (new and existing areas of potential)

It will be difficult to quantify the contribution that these measures will make at each level and particularly at the metropolitan level. However, at the metropolitan level they will have social (cohesion and quality of life), economic (secured energy supplies and competitiveness) and environmental (emission reduction) benefits that are desirable whether greenhouse gas emission reductions were needed or not.

EU energy mix and emissions

EU energy mix

The 1990 (base) global and EU energy supply mix is as follows.

	World %		EU%		EU % electricity
Oil	35		38		4
Gas	21		24		20
Coal/solid fuels	25		18		30
Nuclear	4		14		31
Hydro	2		2		15 renewables
Biomass and waste	11		5		
Geothermal/solar/wind	1		1		
Other					1
Primary supply (Mt OE - oil equivalent)	11223		1815		
Final consumption	7644		1177		
Loss	3579	(39%)	638	(35%)	

EU emission sources

The 1990 (base) EU greenhouse gas emission levels in Mt CO2 are broadly as follows.

Electricity/heat/other energy supply	1650	(41%)	Decreased with gas for coal
Transport	750	(19%)	Increasing
Industry	750	(19%)	Decreased and stable
Households/services/other	850	(21%)	Decreased and stable
Total	4000		

Mitigation measures

When the full spectrum of EU mitigation measures is assessed it is clear that the strategy broadly comprises,

- Efficiency savings
- Renewable energy
- Clean coal
- Review/replacement of nuclear power

However, it is also clear that in parallel with these savings there will need to be,

- Attitudinal and behavioural change
- Steps toward a hydrogen economy

Measures need to be taken under all these headings because of the limited time available to meet EU and national targets and the practical uncertainties involved.

This Discussion Note goes on to consider the position with regard to the range of measures that appear to be in prospect to achieve the greenhouse gas emission reductions that are required by 2050.

Carbon economy

There are still huge reserves of available fossil fuel resources. The global eco-system has the capacity to cope with greenhouse gas emissions, for example, through the carbon capture mechanisms of the oceans and plants. However, global population and economic growth and urbanisation have now reached a point where the level of use of fossil fuels is well beyond the global eco-system to sustain. Sustainability would therefore seem to require carbon capture and sequestration and a move to a hydrogen fuel based global urban economy.

Carbon capture and sequestration

The EU documents note that coal and gas provide the energy for some 50% of the EU's electricity supply and that these sources will remain an important part of the energy mix. It is noted that twice as much energy will be produced globally from coal by 2030 as is produced today. It concludes that carbon capture and sequestration is a fundamental requirement and a major economic opportunity. It will support, *12 large-scale demonstrations of sustainable fossil fuel technologies in commercial power generation in the EU.* It concludes that, *after 2020 near zero emission power generation can be systematically used in the EU and in the world.*

Bio-fuels

The EU documents conclude that, *today bio-fuels are the only way to reduce oil dependence in the transport sector*. Transport curently produces over 25% of EU greenhouse gas emissions and relies 98% on oil. The EU proposes a minimum 10% market share for bio-fuels by 2020, rising to 14%.

Bio-fuels include,

- Bio-diesel, made from oil rich plants such a sunflower and rapeseed
- Bio-ethanol, made from sugar and starch crops such as beet and cereals

So called second generation techniques include the use of wood material, grasses and wastes of various kinds.

It is clear that the climate changes that are now inevitable, of themselves, will diminish global arable resources and that to use these to grow fuel would be unsustainable. There are examples of the use of South American and South East Asian resources, such as former forests, to grow sugar cane and palm oil for energy use that will not be sustainable.

In Sweden forestry resources allow a surplus of timber production and recycled wood waste to provide bio-ethanol feed stocks on a sustainable basis. I due course much of Europe's arable and forestry crop wastes may be able to be used as bio-fuel feed stocks. However, bio-fuels clearly have a limited capacity to replace oil.

It appears that the future replacement for oil for transportation is more likely to be hydrogen and hydrogen fuel cells.

Carbon off setting

There are international schemes to provide a means of investing in projects that will help to lower greenhouse gas emissions, including forestry planting to wind farms. However, all mitigation measures will be needed to achieve the necessary global targets and off setting would seem to simply speed investment rather than compensate for emissions.

Hydrogen economy

Hydrogen can be produced in three ways without releasing much carbon.

- Natural gas and steam, carbon capture and sequestration
- Pulverised coal, steam and oxygen, carbon capture and sequestration
- Electrolysis of water

Electrolysis of water is the most sustainable, if the source of electricity is renewable or nuclear energy. Those countries with surplus renewable power, for example, countries with solar resources, may find that hydrogen production is economic especially if combined with desalination and water as a by-product. It would also be possible to use off peak, overnight, wind power electricity generation for hydrogen production. Hydrogen could be transported globally as is natural gas today. However, renewable energy resources will be needed primarily to replace fossil fuels and nuclear (or eventually fusion or fission) may be the only practical longer-term source of electricity for global scale hydrogen production.

Hydrogen can be used to power hydrogen fuel cells (a form of gas battery), which might replace domestic boilers and provide heat and power. They might also power cars or hybrid cars. Hydrogen can power vehicles but a distribution network would be required (filling stations) and vehicles would carry large and heavy gas tanks. Truck and buses may be best suited to hydrogen use. Hydrogen can be piped, as is natural gas, but the pipes would be 50% wider and existing networks would have to be modified accordingly.

Metropolitan areas offer the compact urban forms that could lend themselves to the introduction of local hydrogen economies. This is an area for possible EU pilot support.

Efficiency savings

The figures on page 7 show that, in the EU, 35% of primary energy is lost. There is therefore great scope for efficiency savings both to reduce losses and to make more efficient use of energy that is consumed. The EU target is a 20% efficiency saving by 2020.

Electricity generation

Energy loss through the generation, transmission and distribution of electricity is significant. It is for this reason that local power generation (so called embedded power) is attractive. It offers the opportunity to reduce such losses and to contribute any surpluses to the grid system.

The introduction of gas for coal power stations has also resulted in efficiencies (more modern plant) and emission reductions. This has helped the EU to move towards its Kyoto targets but has been a once and for all benefit. Such benefits now look as though they will be eroded by growth in transport emissions (see page 7)

Embedded local energy plants

As mentioned above, hydrogen provides the most sustainable prospective source of power for local and domestic heat and power. Combined heat and power (CHP) means that the heat available as a by-product of electricity generation can be captured to provide heat (or cooling). This requires a local distribution network and a compact form of urban development.

However, prior to the widespread availability of hydrogen, natural gas and high efficiency boilers can provide the basis for local and domestic combined heat (or cooling) and power generation. Local renewable energy and bio-wastes/products can also provide alternative power sources.

Heating and cooling

Buildings that do not retain their heating or cooling because of low insulation are a primary source of energy wastage. In northern climates building standards (for example, in Sweden and Germany - the Pasivhaus) can ensure that buildings require no heating because they trap solar gain and retain heat from people and appliances. In southern climates, traditional buildings were constructed to provide shade and natural cooling (plants, water and evaporation).

In much of urban Europe the older building stock will require modification to higher standards of insulation to adapt to climate change and new building will have to meet higher standards. It will be necessary to return to traditional low energy forms of development and to utlise modern technologies and materials. However, it will also be necessary to have information and understanding on the full life time carbon cost of modern materials and equipment.

Appliances

Electrical appliances of all kinds have limited lives and there will be scope to introduce higher efficiency EU standards. However, the use of efficient products requires well-informed consumers and greater awareness of carbon costs. Electrical metering and billing that shows carbon and cash costs will help. Switching that automatically turns off appliances, or space, not to in use will also help.

Energy savings continued

Vehicles

The EU anticipates the progressive introduction of higher vehicle emission standards to reduce greenhouse gas emissions. Hybrid vehicles (batteries and petrol) can also increase fuel efficiency. However, the longer-term, sustainable, response must be to introduce electrical, fuel cell or hydrogen powered vehicles.

Aviation

Aviation is major problem sector because, although greenhouse emissions are not yet at high levels, emissions from planes are more damaging (being discharged in the higher atmosphere). Aviation is growing and, on present trends, will become a major source of greenhouse gas emissions.

There does not yet appear to be an alternative to kerosene as the fuel for aviation. Planes have become more fuel-efficient but still use long established design principles and propulsion systems. Innovation breakthroughs do not seem to be in prospect. Modern planes also have life spans of 25 years plus.

In consequence, EU policy is to include aviation in the EU ETS. The implication would appear to be that aviation will become a more limited and expensive service in the future because of its high carbon costs.

Renewable energy

Renewable energy can be considered as a source of electricity or heating/cooling.

Renewable sources of electricity include,

- Wind - offshore and onshore
- Tidal and wave

- Hydro - large scale
- Hydro - small scale

- Solar thermal electricity
- Photovoltaics
- Geothermal electrical

- Bio-waste
- Bio-mass - wood and chip pellets
- Bio-gas - methane

Renewable heating and cooling sources include,

- Solar thermal heat
- Geothermal heat pumps
- Geothermal cooling pumps
- Bio-mass heat

Renewables can also be used in combined heat and power (CHP) plants, as mentioned on page 10.

The EU target is a 20% contribution to the EU energy mix, by renewables, by 2020. It is estimated that renewables could increase their contribution to electricity generation from 15% to 34% by 2020, with wind power contributing 12%. Renewables in the heating and cooling sector could increase from 8% to 16%, largely through the use of bio-mass.

Metropolitan regions and areas can clearly assess their renewable energy potential but this is most likely to be through large scale electricity generating schemes (wind and solar etc.) and local, embedded, power generation plants and combined heat and power. Bio sources have potential for electricity, heating and cooling where they use urban waste.

Behavioural and attitudinal change

The over arching reality that is not clearly made public is that the global eco-system has a limited capacity to absorb greenhouse gas emissions and that population levels and human activities are now responsible for emission levels that are beyond this. They are not sustainable.

In consequence, the route back to sustainability has been described as Contraction and Convergence. Contraction of emissions to levels that will, in the short term, avoid global warming that prejudices life on earth as we know it and, in the longer term, Convergence of emissions to a sustainable level. As global greenhouse gas emission capacity is limited it is a global resource that should, in equity, be universally and equally shared. This implies personal emission rights, which can then be traded. This is the logical extension of the EU's sectoral trading scheme.

Such an approach would, in the longer term, create a global emission market that would make high emission activities expensive. Personal choices would have to be made on the basis of priorities and luxuries. It is unlikely that unnecessary travel would rank highly in personal or business terms. It is probable that local goods and services, with low emission costs, would become more valuable. These circumstances would revalidate the traditional, compact, European urban form.

It is in this longer term context that metropolitan regions and areas might exercise foresight to structure their urban areas to enable them to function with a low greenhouse gas emissions or in *carbon light* way.

Reducing the need to travel

Metropolitan areas might be reassessed in terms of their ability to reduce the need to travel.

- Enable people to make multi purpose trips

  Progressively developing higher density, mixed use urban forms and supporting multi purpose town and city centres well connected by public transport. In effect, supporting the traditional European urban model.

  It could mean, for example, using regulation (planning and building control) and incentives (urban and building development and improvement grants) to influence investment and personal and business choices.

- Enable people and goods to move around in a carbon light way

  Progressively developing integrated pedestrian movement/cycling, public transport, modal connectivity and interchange at terminals and gateways. In effect, considering comprehensive, carbon light, urban connectivity and accessibility. If travel is necessary it should be efficient and direct.

  It could mean, for example, using regulation (parking and road pricing) and incentives (low carbon cost public transport) to influence behaviour and personal and business choices.

Behavioural and attitudinal change continued

Increasing the opportunity to use low carbon energy

Metropolitan areas might be reassessed in terms of their ability to enable low carbon energy use.

- Enable local, embedded, power generation for electricity and heating/cooling or combined heat and power (CHP).

  Progressively developing an urban network of local generation plants, linked to each other and the grid system.

- Enable the development of renewable energy resources (see page 13), particularly on and offshore wind and bio-resources such as wastes.

  Progressively linking local renewable resources to local generation plants. This will help to secure local, carbon light, energy supplies.

Pioneering a hydrogen economy

Human civilisation has evolved through the use of fossil fuels, particularly since the industrial revolution in the nineteenth century. The global capacity to emit carbon into the atmosphere is now limited and further human development will have to be powered from non fossil fuels. It will be possible to extend fossil fuel use through carbon capture and sequestration but, in the longer term, it seems inevitable that a hydrogen economy will arise.

Forward planning for the progressive introduction of a hydrogen economy could begin with public transport and local embedded power generation (hydrogen and hydrogen fuel cells). Local hydrogen production could be linked to new development that has a hydrogen gas supply and hydrogen filling stations.

Awareness

Climate change has not yet been universally recognised as a metropolitan issue, even though metropolitan areas are the primary source of greenhouse gas emissions. The issue of the urban change that will be required in response will require a process of awareness raising at the metropolitan level. It is always important for metropolitan issues, and the political responses to them, to be widely discussed and understood to provide the necessary climate of public opinion for supportive participation and action.

Visions and integrated strategies

All European metropolitan regions and areas are seeking, in various ways, to identify and address their prospective problems and realise their opportunities. It is now common practice to express the integrated response to problems and opportunities as a Vision for the future and to realise this through an Integrated Metropolitan Strategy. The issue of climate change will be a cross cutting issue affecting social, economic and environmental aspects of the strategy.

A metropolitan Vision will enable policy makers to look to the longer term, as is required to realise the greenhouse gas emission reductions that are required over the next 30-40 years and to anticipate and plan for the changes that will be required.

Subsidiarity mitigation scenario

The table below summarises the measures that could be taken, on the basis of subsidiarity, to provide a framework of confidence. Those climate change issues that can only be addressed effectively international/EU, national and metropolitan levels have to be identified, recognised and measures taken. The table provides an EU/international/national context for action at the metropolitan level.

Measures are considered in terms of foresight and supply and demand and might be reflected in InterMETREX extension project mitigation scenarios.

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European metropolitan climate change/urban change

Mitigation measures and subsidiarity

International - metropolitan advocacy

Foresight

1 Kyoto Protocol
2 EU Carbon Trading Scheme
3 Contraction and Convergence

Supply	Demand
1 Carbon capture and sequestration research and development	1 Carbon pricing - the EU CTS (Carbon Trading Scheme)
2 Clean coal technology and development (EU project)	2 Industry and commerce in the EU CTS
2 Hydrogen economy research and development	3 Surface transport in the EU CTS
3 Fusion/fission research	4 Aviation in the EU CTS
	5 Product standards - emissions, efficiency and recycling
	6 EU car manufacture fuel efficiency agreements
	7 Short haul aviation (under 400km) to high speed trains
	8 Carbon off setting?

National - metropolitan advocacy and action

Foresight

1 EU Carbon Trading Scheme
2 EU Eenergy and Climate Change targets
3 National climate change strategies - mitigation and adaption

Supply	Demand
1 Support for the development of renewable energy sources - wind, solar, geothermal, hydro	1 Building Regulations - energy and water efficiency
2 Renewables obligations for suppliers (UK 20%)	2 Building Regulations - CO2 zero homes and buildings
3 Support for of micro-renewable energy sources	3 Energy efficiency - improved metering and billing
4 Support for carbon capture and storage (CCS)	4 Home insulation programmes
5 Support for a hydrogen energy supply system - using gas or electrolysis (hydrogen gas supply system for heating and transport)	5 Short haul aviation (under 400km) to high speed trains
	6 Renwable transport fuel obligations (RFTO) - bio-fuels/hydrogen
	7 Public transport powered from renewable energy sources
	8 Vehicle taxation to promote emission reductions
	9 Traffic management and road pricing
	10 Personal carbon rationing
	11 Public procurementt policies (awareness raising)

Metropolitan - action

Foresight

1 Metropolitan vulnerability to climate change - adaptation
2 Metropolitan contribution to climate change - mitigation
3 Green house gas emissions assessments and inventories
4 Green house gas emission reduction scenarios
5 Low or zero carbon metropolitan vision
6 Integrated metropolitan strategy - including adaption and mitigation
7 Awareness raising and stakeholder involvement

Supply	Demand
1 Renewable enery supply sources	1 Reducing the need to travel - centres and multi purpose journeys
2 Micro-renewable energy sources - hydrogen fuel cells and CHP	2 Reducing the need to travel - location and linkage of traffic generators
3 Combined heat and power (CHP) - developer obligations	3 Reducing the need to travel - higher density, mixed use urban form
4 Micro-renewable energy sources - solar and wind	4 Enabling walking and cycling - metropolitan networks
5 Waste to heat and power generation	5 Integrated public transport - connectivity and accessibility
	6 Integrated freight transport - connectivity and accessibility
	7 Traffic management and road pricing
	8 Public transport management and dedicated routes
	9 Public transport powered from renwable energy sources
	10 Water supply powered from hydro, solar and wind energy sources
	11 Waste treatment powered from biogas sources
	12 Reducing the urban heat island effect
	13 Public procurement policies (awareness raising)

Achieving a 60-80% greenhouse gas emission reduction by 2050

Mitigation package

The table below shows the components of a mitigation package comprising international/EU, national and metropolitan measures. The need will be to start all measures as soon as possible to maximise the chances of success. The table indicates the scale of contribution that appears to be necessary from behavioural and attitudinal change at the metropolitan level in the transport, industry and households/services sectors and through local embedded power generation.

European metropolitan climate change/urban change

Mitigation scenarios based on EU targets and measures

		Mitigation mesaures				Mitigation targets			
EU 27 Energy realted CO2 emissions MtCO2 - 1990	**1990**					**Mitigation** 80%	**2020** 20%	**2030** 30%	**2050** 60%
Electricity/heat/other energy supply	1650	20% efficiency savings in all sectors	20% renewables	40% carbon capture	20% grid/ imbedded	100%	1320	1155	660
Transport	750		10% bio-fuels		30% behavioural attitudinal and rationing	60%	600	525	300
Industry	750		20% renewables			70%	600	525	338
Households/services/other	850		20% renewables			70%	680	595	340
Targets	4000					**780**	**3200**	**2800**	**1600**

Discussion points arising from the above are,

- Electricity/heat/other energy supply makes up some 40% of emissions. Would it really be possible to reduce these 100% by the measures shown?
- If so, then this would make the targets for transport, industry and householder/services/other easier to achieve.
- Nevertheless, behavioural and attitudinal change, which may fall largely to metropolitan level measures, would still require to contribute 30% of the reductions in these sectors. Carbon rationing may have to be part of this package if it is to be successful.
- Behavioural and attitudinal change will be vital component of the overall mitigation effort because without it there would be a real risk of emission reductions simply being taken up with emission increases.
- At the metropolitan level efficiency savings and renewable energy resources would contribute as part of national programmes.
- The 30% savings on transport, industry and households/services etc. would amount to 2350/4000@30% or about 18% of the total savings required. This gives an order of magnitude of the potential contribution that metropolitan areas, of themselves, might make.