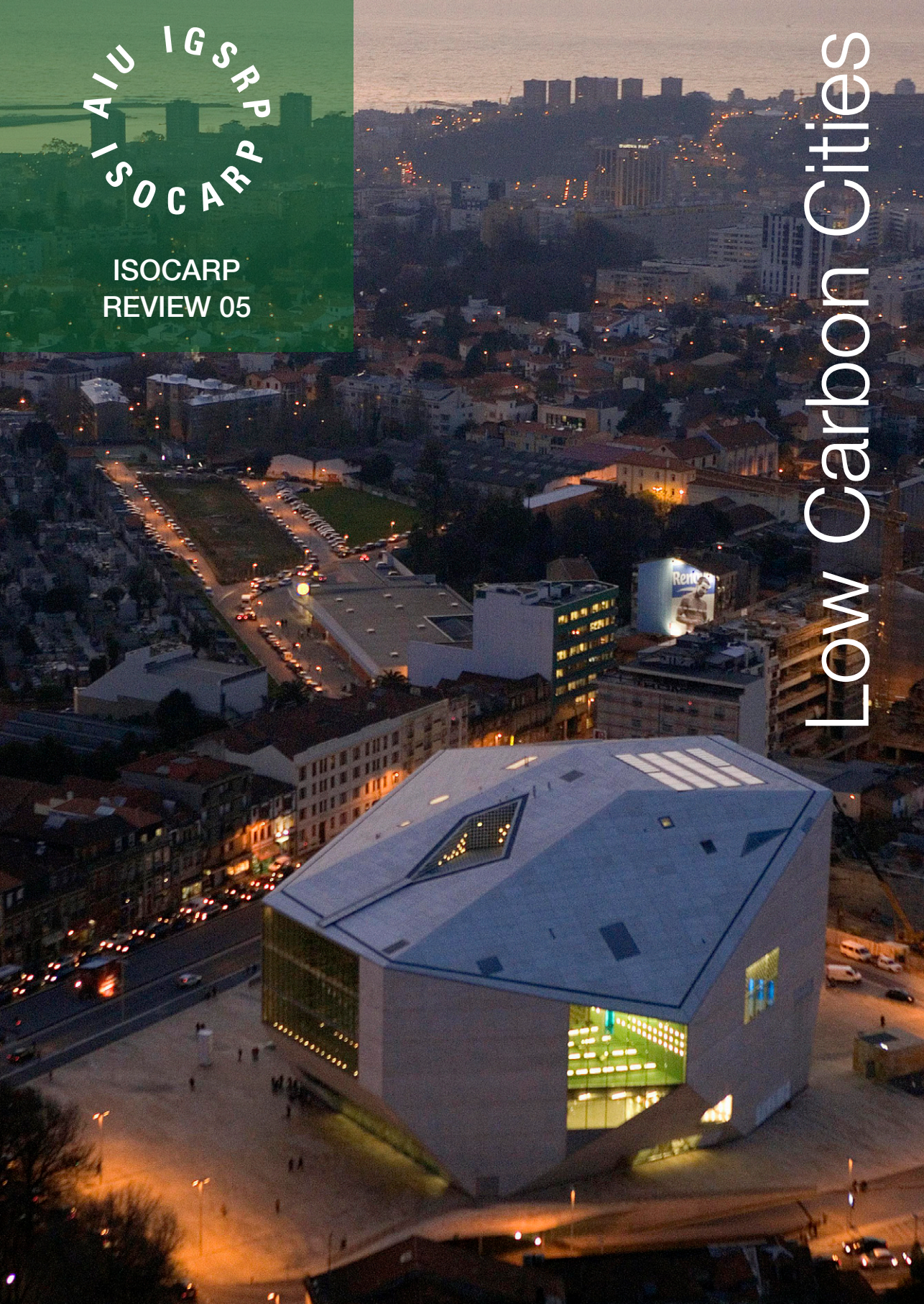
ISOCARP
REVIEW 05

Low Carbon Cities



About ISOCARP

The International Society of City and Regional Planners (ISOCARP) is a global association of experienced professional planners. It was founded in 1965 in a bid to bring together recognised and highly-qualified planners in an international network. Today, the ISOCARP network has individual and institutional members representing more than 70 countries worldwide. As a non-governmental organisation ISOCARP is recognized by the UN, UNHCS and the Council of Europe. The Society also has a formal consultative status with UNESCO.

Although ISOCARP members work in many different fields they share a common interest in the spatial and environmental dimensions of urbanisation. They advise key decision-makers, proposing and supporting projects for intervention in a spatial context through general or specific actions.

The objectives of ISOCARP include the improvement of planning practice through the creation of a global and active network of practitioners. ISOCARP encourages the exchange of professional knowledge between planners, promotes the planning profession in all its forms, stimulates and improves planning research, training and education and enhances public awareness and understanding of major planning issues at a global level.

The association‘s main event is the annual World Congress, which focuses on a globally-significant planning theme and which takes place in a different country each year. Prior to the congress, Young Planning Professional Workshops are organised. This YPP programme seeks to bring together emerging young planning professionals from all over the world to tackle ‘real-world’ planning projects.
Smaller-scale events such as seminars and working groups are also organised.

All ISOCARP activities are covered in publications such as the ISOCARP Review, the International Manual of Planning Practice (IMPP), Congress proceedings and special project reports.

ISOCARP recognises excellence through the Society’s award programme.

ISOCARP Urban Planning Advisory Teams (UPATs) assists sponsor organisations by offering the extensive experience and expertise of ISOCARP members to work on important local or international planning projects, programmes and policy initiatives.

ISOCARP

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Foreword

Pierre Laconte
ISOCARP President (2006-2009)

I am pleased to present this fifth issue of ISOCARP REVIEW, a yearly publication that explores specific facets of the annual ISOCARP Congress theme.

This thematic publication is the result of an initiative taken by my predecessor Alfonso Vegara in 2005. It proved in effect from the outset a remarkable way of providing ISOCARP members a quality publication devoted to the highlights of their congress, without them having to wait for the eventual CD Rom containing the general proceedings. The positive international reactions to ISOCARP REVIEW 01 to 04 have encouraged us to continue what has now become a well-established tradition.

REVIEW 05 contains this time again a selection of studies related to this year's congress theme: "Low Carbon Cities".

May I thank very warmly the contributors of the present issue's different chapters (by alphabetical order):

- Richard Benner, *Portland Metropolitan Region Turns a Climate Change Corner*
- Fernando Brandão Alves, João Granadeiro Cortesão, Joanne Patterson & Joaquim Góis, *Investigation of Potential Bioclimatic Interventions for a Portuguese City*
- Martin Dubbeling & Michaël Meijer, *The Netherlands 2020, Boundless Policies towards Low Carbon Regions and Cities*
- Trevor Graham, *Malmö, Sweden - Towards the Sustainable City*
- Brian Human, *Cambridge: Delivering Smarter Growth*
- Julia Lourenço, Chris Gossop, Fernando Brandão Alves, *Comparative Study of National Responses to Climate Change*
- Julia Lourenço & Fernando Brandão Alves, *Planning and design for Low Carbon Development in a Sensitive Landscape - A Douro Valley Setting for the YPP Workshop*
- Júlia M. Lourenço, Cristina Danko, Ricardo Bento, Paulo Fernandes, Nuno Pereira, Luís Ramos & Isabel Bentes, *Increasing CO_2 Emissions in the Douro Valley – The role of land use changes and fires*

- Judith Ryser, *Low Carbon Cities: Examples from The United Kingdom*
- Robert Shaw, *Energy Planning at the Community Level in England*
- Garry Smith, *From Westernised to Low Carbon City: Climate Change Adaptation Lessons from Perth, Western Australia*
- UN Habitat, *Cities and Climate Change: The Perspective of UN-Habitat - Key to a low-carbon society: cities and local power*
- Ronan Uhel & Birgit Georgi, *Reflections from a European perspective*
- Alfonso Vegara, Judith Ryser, Mark Dwyer & Aaron Kelley, *Ecocity Sarriguren*

As to the congress itself its prestigious keynote speakers include: Paul Taylor (UN HABITAT); Jean Pascal van Ypersele (Intergovernmental Panel on Climate Change), Eduardo de Oliveira Fernandes (Portugal Energy); Jacqueline McGlade (European Environment Agency); Richard Rosan, (Urban Land Institute ULI) and Mr Mah (Ministry of urban Development Singapore).

Carefully selected papers and technical session reports cover most aspects of this complex theme.

Preparing the present publication has taken an inordinate amount of time and effort.
May I first of all thank Chris Gossop who, very exceptionally, has assumed the double task of being the General Rapporteur of the whole congress and being responsible for its publications, as Vice President for publications.This double responsibility has internalised the transaction costs that inevitably occur between the two jobs, for the benefit of us all.

Last but not least on behalf of our Society and its Executive Committee I wish to specially congratulate and thank the President and the Chair of the Local Organising Committee, Paulo Pinho and Fernando Brandão Alves as well as their colleagues of the Local Organising Committee:

Luis Valente de Oliveira (Honorary President); Sara Santos Cruz (Secretary General); Isabel Breda-Vázquez; Alvaro Costa; Paulo Conceição; Emilia Malcata; Cecília Silva; Vítor Oliveira. •

Low Carbon Cities: a Southern European Perspective

Paulo Pinho

President of the Local Organising Committee

Throughout the last twenty years the environmental debate was deeply marked by the concept of *sustainable development*. Initially, it was an innovative and inspiring concept. Over the years it became an increasingly eroded and naïve concept, meaning different things according to circumstances, and able to justify different political discourses and actions, some environmentally friendly, others not so much. The attempt to bring together, and make fully compatible, economic, social and environmental sustainability goals, the equally weighted three pillars of sustainable development, proved, in practice, to be like squaring the circle, a rather ambitious if not unrealistic aim to look for.

More recently, with the mounting concern over the extent of the earth's climate change, new paradigms have been emerging and rapidly moving from the academia to the political arena. Among these, the low carbon cities paradigm is standing out as a serious and coherent attempt to introduce in the global environmental debate a more pragmatic approach, based on measurable targets.

Low carbon cities emphasize, in the first instance, the importance of our cities and metropolitan areas as key producers of carbon dioxide in an increasingly urban world. This paradigm also emphasizes both sides of the energy market, the supply and the demand options, and thus energy efficiency, the role of green energy and of decentralized energy production processes, and the importance of changing lifestyles and consumption patterns.

The theme of the congress is well-timed indeed, and not even the worldwide economic crisis seems strong enough to withdraw it from the current international agenda. Many scholars, politicians and practitioners think that the economic recovery has to be based on the new opportunities opened up by the environmental debate, particularly on climate change, in which low carbon cities play a vital role.

In the international political agenda, the European Union has had a long standing tradition of sustaining fairly coherent and ambitious positions as far as environmental policies are concerned. This has certainly been the case in the complex debate around the Kyoto Protocol, benchmarking carbon emissions and, subsequently, targeting and controlling national carbon dioxide reductions.

Over the last thirty years there has been a consistent build up of a comprehensive European environmental policy framework through the approval of numerous directives and decisions covering a wide range of matters and issues, from environmental pollution and nature conservation, to monitoring, environmental assessment and resource management. Over the years,

an increasing number of countries integrated in the European Union have been able to steadily converge into this common framework of environmental policies.

Bearing in mind the economic and social diversities that characterize this set of European countries, as well as the different national public policy traditions and administrative cultures – from North to South, and East to West – one has to conclude that this convergence process, involving tremendous efforts and resources, has been, after all, rather successful, in practice. One of the reasons for this success has been the clear mandate of the Union in environmental matters coupled with the subsidiarity principle which, at the same time, encourages Member States to assume their own responsibilities at national, regional and local levels.

However, the road map to low carbon cities depends not only on environment and energy policies but also, and to a large extent, on the responsiveness of spatial planning policies which, so far, are not within the remit of the Union's intervention. As we know, and despite interesting initiatives such as the ESPON (European Spatial Planning Observatory Network) and the ESDP (European Spatial Development Perspective) and the recent move towards the establishment of a European Territorial Agenda, namely with the back-up and technical work carried out under the last Portuguese Presidency of the Union, the EU has been reluctant to take on board spatial planning as a field of direct intervention. Under these circumstances, the planning systems of Member States have to take the lead, fuelling the debate and providing innovative planning policies.

Building low carbon urban environments depends not only on the energy performance of the new and the existing building stock but also, and to a significant extent, on the energy performance of the urban services and infrastructures that support the urban life and main functions of our cities and metropolitan regions. The moderate climate of Southern Europe and the ready access to solar energy helps to reduce households' energy bills if adequate designs and building techniques and materials are provided. To reduce the transport bill is another matter. To a significant extent, this bill depends on the shape and structure of, and mix of functions in, our urban areas.

Much has already been said about the controversy between compact cities and urban and suburban sprawl. The debate is complex but it seems that, overall, the compact city advocates have a clear advantage, provided this concept is blended with bio-cycle principles. It is true that most Southern European cities are fairly compact but, more recently, are also suffering from unchecked sprawl. Public transport systems are improving but the private car still dominates the modal split in our cities. In many cases mobility policies are still favoured to the detriment of accessibility policies. Urban planning is the essential tool to reduce the current day-to-day need to travel, either in terms of daily frequency and/or in terms of average distances, making walking and cycling most attractive. But as we concluded in our Euro Carbon Atlas presented at this congress, much has to be done. The legal and regulatory foundations for low carbon urban planning are insufficient. Holistic approaches are needed, backed by a more demanding regulatory framework, a sound political commitment and visionary and mobilizing participatory practices. •

Low Carbon Cities – An Introduction

Chris Gossop and Fernando Brandão Alves

Introduction

The prospect for low carbon cities which is the subject matter both for ISOCARP's 45th World Congress in Porto, Portugal and also that of Review 05, is a 'hot topic' for 2009. For in December of that year, the World's Governments meet in Copenhagen with the aim of thrashing out a successor to the Kyoto Protocol which in 1997 started the faltering attempts to curb emissions of greenhouse gases. This is a massive challenge for the world because we have to bridge the gap between our rapid development, on the one hand, and, on the other, the need to prevent the planet's average temperature rising by no more than 2°C above the preindustrial level.

Even were we to stabilise our emissions now, there would still be significant climate change, the effects of warming from the human generated emissions of the past 250 years, starting from the time of the Industrial Revolution. Indeed, those effects are already becoming clear. This is evident from the massive shrinkage of polar ice, the retreat of most of the world's glaciers, and the rising mean sea levels which threaten many of our larger cities. The effects are manifest too in the extreme weather patterns and events that are hitting different parts of the world, for example, the devastating droughts in Kenya and in other parts of Africa. New Orleans was another warning sign.

We face such effects at a time of continuing population growth, that is accompanied, on the one hand, by rising material expectations and, on the other by growing concerns about the adequacy of key resources, especially food and water supplies and energy. Added to this, we have widespread, massive deforestation that reduces the Earth's capacity to absorb carbon dioxide.

There is a growing consensus amongst governments that action has to be taken to halt, and then reduce drastically, those emissions of carbon dioxide and other greenhouse gases. But how to achieve that when we are so wedded to carbon intensive ways of living, especially within the rich developed countries and, to an increasing extent, within with the developing countries? We have to find ways of moving rapidly towards low carbon economies in which emissions are a fraction of what they are now. We are already experiencing climate change but if we fail to take that path, the environmental future will be far worse.

Much of the necessary action will have to take place in and around the world's cities. And given the sea coast locations of many of them, they

are particularly vulnerable to the effects of sea level rise, the communities most at risk often being amongst the poorest. But, more generally, because they concentrate man's activities, the cities place a particular burden on the world's resources. Their future is crucial in the search for that lower carbon pathway. Action at the level of the city and the city region will form a major part of any solution.

ISOCARP Review 05 looks at the role of spatial planning and effective city management in the drive to bring this about. How can we most effectively use planning, how can we best adapt our present planning techniques and how can we secure and deliver the low carbon cities of tomorrow? We present twelve rich case studies which span the various levels, from the national (and international), to the city and its regional hinterland, to local urban areas and individual projects and, in ordering them, we have followed broadly that sequence. The critical point is that progress is called for at all levels, from the global and world regional, to the local. Thus all of the case studies are important, whatever scale they cover and wherever they happen to appear in this book.

Review 05 contains two further chapters. The first of these relates to ISOCARP's Young Professional Planners (YPP) Workshop which took place in Portugal's Douro region, immediately prior to the Congress. The second outlines the main findings of a survey of the policy responses to climate change within a range of individual countries. The work for this comparative study was carried out by ISOCARP's national delegations and individual members.

The Case Studies

We start with two articles presented by international agencies, both of which seek to link action on the cities with the broader picture. Given the choice of Copenhagen for the 2009 climate change summit, it is fitting that the first of these is a perspective from the **European Environment Agency (EEA)** which is based there. It is complemented by an essay from **UN HABITAT** which operates from Nairobi in Kenya. Both focus on the role of the world's cities as being the key to an eventual low carbon society. However, with their burgeoning expansion in many parts of the world, currently they are much more of a threat to such a future than a solution. To feed their energy and other demands, they depend hugely on external resources, often from well beyond their boundaries, and much of their waste is disposed of elsewhere.

On the other hand, as the EEA's contribution by Ronan Uhel and Birgit Georgi demonstrates, the cities of the developed world point to the potential advantages of concentrated forms of living and working. Thus, energy use per capita in the cities of the European Union, for example, tends to be lower than the respective national figure. That finding is explained largely by the higher energy efficiency of housing and the shorter commuter distances. It contrasts with the situation in China where urban energy use currently exceeds that of the rural areas, a finding which derives from the comparative affluence of urban dwellers, facilitating higher levels of consumption.

The UN HABITAT essay highlights the inextricable link between urbanisation and climate change and the likelihood that the vast majority of

climate impacts will fall upon the most vulnerable populations, especially those in the developing world. With three quarters of the world's largest cities located on the coast, they will be disproportionately affected by actual and future sea level. An increasingly unpredictable climate characterised by extremes of flooding and drought threatens food security, further unplanned urbanisation and the creation of a new type of migrant, the climate change refugee.

A key message of both articles is of the need to identify suitable adaptation and mitigation strategies if the world is to cope. And those must lead to rapid, concerted action.

However, while suitable action based on our cities and towns offers the best hope for living more sustainably, the sad fact is that far too little is being achieved on the ground. There are a some clear success stories, for example in Barcelona and Malmö to cite two European examples, but these successes are all too few. Generally, the trends are in the wrong direction with urban expansion happening at a faster rate than the growth of population. But the cities must ultimately be the way forward and that role must be recognised in national, regional and international policy making. This will require new forms of governance, broad participation and appropriate structures for making those decisions. It will require a commitment to new ways of planning and to forms of plan that emphasise low carbon approaches, notably by means of the compact city, that create cities without slums and that integrate the green and the brown agendas, i.e. the natural and the human environments.

In their paper, **The Netherlands 2020**, Martin Dubbeling and Michaël Meijer review the efforts of a medium sized European nation to plan at various levels for a lower carbon future. As a country that has been built to a substantial extent by holding back the sea, The Netherlands is now contemplating what it will have to do to prevent those gains over centuries being rapidly eroded through seal level rise and the increased risk of flooding from its many rivers. With much of the 'Randstad', the core metropolitan area, below sea level, the country is developing advanced adaptation policies to reduce its vulnerability to climate change induced flooding. This is in tandem with mitigation policies to reduce greenhouse gas emissions, and the related energy transition plan which involves a switch from reliance on dwindling indigenous natural gas reserves to the use of renewables.

But lingering doubts remain about the ability of The Netherlands to deliver upon the aspirations of national plans, especially those on mitigation. Slow progress is being made in terms of the energy transition plan and a recent study for the housing, planning and environment ministry VROM concludes that the aspiration of a carbon neutral country by 2040 would require far more ambitious measures than are being contemplated at the moment. This is the nub of the low carbon cities challenge. For developed countries, such targets seem such a long time away, and the achievement of an 80% reduction in greenhouse gas emissions is much easier to talk about than it will be to achieve. It's just that The Netherlands, as one of the frontrunner countries in tackling climate change, is one of the first to be confronting the realities.

Encouragingly, the authors are able to counter their doubts about the

deliverability of the policies established at national level with some greater optimism about the strategies that are being pursued by some of the country's largest cities. Thus Amsterdam and Rotterdam, respectively, have set themselves targets to secure 40% and 50% reductions in CO_2 emissions by 2025. For its part, The Hague is about to start on a major operation to become climate neutral by 2050. In each case the plans are impressive in their breadth and vision, and they appear not unrealistic because there is a committed authority on the spot to coordinate their delivery. Time will tell, of course, whether the targets can be met.

An interesting conclusion of this Dutch essay, though, concerns the role of the region. The question is asked, do those city policies and targets 'make sense without a regional context and without close and boundless cooperation between cities, businesses and institutions?' The country's Energy Valley Region which is developing itself as a centre of knowledge and innovation for the energy industry is a striking example of what can be achieved at this level.

The next three case studies of Portland, Oregon, Perth, Western Australia, and Cambridge, England explore what can be achieved at this intermediate level. Richard Benner's essay on **Portland Metropolitan Region** describes the impressive achievements of the Metro authority in bucking the national US trend towards increased greenhouse gas emissions (GHG). Thus, between 1990 and 2007, despite faster growth than in the US as a whole, GHG emissions declined by 0.7% and per capita emissions by 17%. By contrast, they increased by 17% in the US, overwhelming the 3% per capita improvement.

The differences are put down to a variety of measures, in particular a commitment to a regional framework plan and clear development boundaries coupled with the more efficient use of land within those boundaries, a switch in emphasis from the building of freeways to comprehensive mass transit and cycleways, and the encouragement of more compact forms of development within defined centres and along corridors served by public transport. They were influenced by Portland's adoption in 1993 of the USA's first carbon dioxide reduction strategy. The results of this strong spatial planning approach are striking with the core city of Portland growing as fast as its suburbs and a downward trend in vehicle miles travelled per capita; in both respects the metropolitan area is in sharp contrast with the patterns elsewhere within the USA.

In his essay on **Greater Perth, Australia**, Garry Smith charts the progress being made towards more sustainable forms of development. This work is highly pertinent in a continent that has been experiencing some of the severest effects of climate change. This is manifest in the extreme drought that has afflicted large areas of southern Australia, devastating parts of the agricultural industry, and in the bushfires that have destroyed vast swathes of the natural environment. And in the record breaking heat wave of February 2009, the associated waves of flame were responsible for the country's worst recorded loss of life in peacetime.

Australia has been experiencing the effects of the world's addiction to fossil fuels and it is to be hoped that an outcome of the recent disasters will be a strengthen commitment to climate change policies and related action. In terms of spatial planning, it is encouraging to learn about the

efforts that are being made in at least one area, the metropolitan area of Perth to foster more compact, less car dependent forms of urbanisation. The achievements so far, in terms of reduced emissions, may seem modest but it is good to see the new emphasis on brown field development, that public transport has been expanded and that there is increasing public awareness of the issues.

In his case study of **Smarter Growth in Cambridgeshire**, Brian Human charts the way that the planning system has responded to meet the challenge of a fast growing sub region centred upon the historic university city of Cambridge and it looks ahead to the challenges of reconciling increased urbanisation with the new imperative of reducing greenhouse gas emissions. In planning terms, by the 1990s, Cambridge was increasingly becoming a victim of its university led success, the rapid expansion of science parks and the related employment creating a demand for housing that could not be met within a long established Green Belt. In turn, that was leading to increasing daily commuting. And now there is a broader context, whereby the sub region will need to accommodate many more homes, meeting the requirements of the East of England Regional Spatial Strategy in one of England's fastest growing regions.

Human identifies three themes within the complex process that has evolved to deliver smarter growth, these being spatial planning, transport planning and energy use and generation. Under the first, there is to be a planned expansion of Cambridge's built up area together with a new settlement just beyond the now slackened Green Belt; an important aim is to bring jobs and homes closer together. On the second, there is a heavy emphasis on the resolution of the medieval city's traffic problems through a 'carrot and stick' approach involving an expansion of park and ride and the development of a guided busway and further measures to restrain the use of the car.

What is also interesting – as well as sobering – about this study is the conclusion of the carbon appraisal that has been used to test the long term delivery plan (LTDP) for the Cambridge sub region. The results show that while moves towards zero carbon homes in the new build areas (Human's third theme) and the package of innovative transport proposals will achieve some reductions, relatively speaking the savings will be small. The LTDP is not on track to meet the regionally set carbon reduction targets for 2031 and 2050. Far more radical measures will need to be set in train, embracing local low carbon energy solutions and the existing built environment as well as what is to be built.

Carbon dioxide, and its emission and sequestration (the removal and storage of carbon from the atmosphere in carbon sinks) within the study area of the **Douro Valley, Portugal** is the theme of a study by Julia M. Lourenco, Christina Danko, Ricardo Bento, Paulo Fernandes, Nuno Pereira, Luis Ramos and Isabel Bentes. This is an area that has sought to build upon its diversity of resources, its historic vineyards and its status as one of UNESCO's World Heritage Sites. The study has sought to chart the effects of urbanisation and other land use changes upon the carbon dioxide/ sequestration balance of this area.

This area of local carbon budgeting is a complex one where there remain many unknowns. However, this study has been able to establish

what is broadly the balance between the quantum of emissions and that of sequestration. While, unsurprisingly for a predominantly rural area, the latter exceeds the former for the Douro Valley as a whole, the calculations point to wide variations within this region. The level of urbanisation is one major factor but changes from forest to other rural uses can also affect the balance. And in this era of rising temperatures, the growing incidence of wildfires can negatively affect the local carbon balance. There is little doubt that carbon appraisals and budgeting will become increasingly important tools in land use planning. It will be an area where planners will have to learn important new skills.

The same applies to the field of local energy planning which is addressed in the essay by Robert Shaw on **Energy Planning at the Community level in England**. Shaw's paper charts the range of measures that the UK Government has introduced, from the Climate Change Act 2008 with its legally binding commitments to reduce CO_2 emissions by 80% against 1990 levels by 2050, to a radical increase in renewable energy generation, to changes in the building regulations to require zero carbon new homes by 2016. Crucially, however, can these ambitions be delivered?

As we can see from the Cambridge case study, the message is that the planner will need to become much more involved in energy planning and in working with a range of partners. Shaw succinctly describes a process for local energy planning; this includes the setting of a baseline in respect of energy use and CO_2 emissions, the identification of local opportunities for reducing energy demand, the creation of scenarios for decentralised renewable and low carbon energy and then testing these for their feasibility and viability. In practice, zero carbon developments will often require solutions beyond site boundaries, for example, through connection to a district heating or combined heat and power (CHP) system. Ultimate success will entail new forms of working, with management possibly through a public private energy services company. Just as they once did a century ago when they were suppliers of local energy, the cities will need to be empowered to take a leading role in energy matters, although this time a key objective will be to reduce carbon.

In their essay, '**Investigation of Potential Bioclimatic Interventions for a Portugese City**' F. Brandão Alves, Granadeiro Cortesão, Joanne Patterson and Joaquim Góis address an important component of the livability of cities, namely the thermal comfort of outdoor spaces in this era of climate change. Through their investigation of two contrasting open spaces, they investigate how urban design and landscaping, including the choice of materials, can radically affect the usability of such spaces during hot periods. Comparing these two spaces, though they are of similar size, the effects could scarcely be more different. Thus the largely open, hard surfaced Poveiros Square stores solar energy within the urban fabric during the day and releases it at night. In turn, that heat storage increases the demand for cooling in buildings and thus triggers increased CO_2 emissions. Thus a space of this type has negative bioclimatic characteristics. By contrast, the second space is a public garden in which the trees and other vegetation provide thermal comfort both outdoors and indoors.

The study findings have important implications for urban renewal in

traditionally hot countries, for example those bordering or close to the Mediterranean. However, with increasing global temperatures the factors identified are of growing relevance within cities generally, particularly as the urban heat island effect is becoming a more common phenomenon. Thus for the planning and design of new urban quarters it will be vital to incorporate spaces with strong, positive bioclimatic characteristics and authorities will need also to look at their existing spaces, and indeed streets, with a view to upgrading them following the same principles.

Three further papers explore a range of specific schemes, both built or in planning, all demonstrating low carbon approaches. In their case study of **Ecocity Sarriguren**, Alfonso Vegara, Judith Ryser, Mark Dwyer and Aaron Kelly describe a new community located on the edge of Pamplona in northern Spain. Completed in 2007, the ecocity comprises some 5200 housing units, over 90% of which are affordable, significant employment opportunities in the fields of alternative energy and environmentally friendly technology and a range of community services, all in an attractive parkland setting. The buildings are characterised by their high energy performance, deriving from their thermal efficiency coupled with the use of solar collectors, and their careful orientation to maximise solar gain in the winter while protecting the inside of the buildings from overheating in the summer.

In the view of the authors, this is a true ecocity with a close, integral relationship between homes, places of work and the activities of learning and play, and the enveloping natural environment. In these terms, this inherently low carbon development is a striking example of what can be achieved, given the vision and the commitment.

In her essay on **Low Carbon Cities: Examples from the United Kingdom**, Judith Ryser looks at the programme for a number of English ecotowns. Controversial from the start, several of those that emerged from the bidding process have been abandoned or put on hold, in some cases because they failed to perform sufficiently well against the challenging criteria set by the sponsoring Ministry. There has also been much criticism from local authorities because they have usually emerged from outside the development plan system. Time will tell if any of these small new towns emerge as successful demonstration projects for a low carbon future.

Ryser also looks at a experience of an existing, much bigger new town, Milton Keynes and its successful pioneering of energy efficient buildings. Among her other examples are the groundbreaking BedZed housing/workplace scheme that is still unrivalled since its completion in 2002 and the ambitious plans for the transformation of parts of East Manchester under the Millennium Communities Programme.

We have left one of the most fascinating of the case studies to the end. In **Towards the Sustainable City,** Trevor Graham describes how the Swedish city of **Malmö** has transformed itself from a city that was until quite recently characterised by a declining ship building industry into a place that has set international benchmarks for sustainable development.

The essay focuses first on two case study areas, the first of these being the 1950s Augustenborg housing estate which has been strikingly regenerated on both social and environmental lines. And in the West Harbour area, former wasteland around the old shipyards has become an exciting new urban quarter based upon ‘green design’, and some of the most energy ef-

ficient buildings anywhere. The next steps for this ambitious authority will be to make such developments mainstream, to exploit renewable energy on a much bigger scale and, in terms of transport, to shift the modal split of the city so that an increasing proportion of travel is by public transport.

The Douro YPP and Comparative studies

In their text on the **Douro Valley and the YPP Workshop,** Julia Lourenço and F. Brandão Alves describe not only the high value of this Portuguese region as a UNESCO natural site but also the specific reasons that explain why it was chosen to become the study area of the 2009 ISOCARP Young Professional Planners Workshop. Starting with a description of the morphology and development of the Douro region they discuss the potential for using sustainable energy in the built up areas in Douro Region, given the constraints imposed by the area' world heritage area designation. Some key questions are posed, for example: 'What do you need to create the sustainable energy landscape of the 21st century? How should energy plants, photovoltaic and solar power, electricity pylons and wind turbines best be located? How well do renewable forms of energy fit in the landscape of Douro?'

The challenge for those young planners is to reconcile the need to move towards lower carbon forms of development with the need to protect the natural and cultural assets of this area.

The **Comparative Study** was based upon a questionnaire exercise which was sent to the heads of ISOCARP's national delegations. The main findings of this survey are set out question by question in the final chapter of this book. They are reinforced by the national summaries which are contained in the accompanying CD (inside the back cover of this book). We had a gratifying response to the questionnaire which has provided much useful information. This included some very interesting case studies of individual cities; some of this information, notably that relating to examples in The Netherlands and the United Kingdom, is contained in other essays within this Review. On behalf of ISOCARP, we extend our thanks to everyone who participated in this work.

We do hope that you will enjoy reading this latest issue of our popular publication on international planning.•

Ronan Uhel
Birgit Georgi

Key to a Low Carbon Society: cities and local power

Reflections from a European perspective

Abstract
This article reflects on the important role of cities and towns in overall energy consumption and their responsibility for climate change and energy security. It explores the question whether current urbanisation trends are a threat or an opportunity towards a low-carbon society. In general, urban areas provide, due to their density and proximity of services, a potential for high energy-efficiency in the areas of transport and housing. Whether cities realise this potential depends on different factors as the examples of frontrunner cities show. Based on the European situation, the article draws conclusions on cities' barriers against acting more effectively towards a low-carbon future and stresses the necessary changes to overcome them.

Photo: City of Malmö

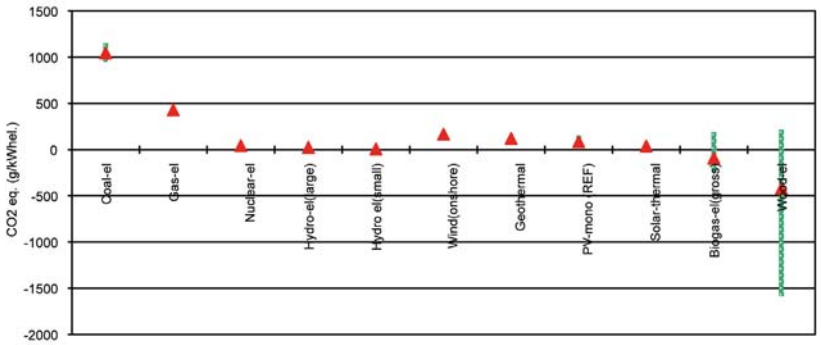

Figure 1 | Life cycle analysis of greenhouse gas emissions of various energy systems, 2000. *Source: EEA, 2008*

It is All About Carbon

Carbon is the backbone of our economies. Energy consumption and production have been the motors of material wealth in Europe and have enabled our current lifestyles. More than 90% of energy consumed in Europe comes from fossil sources.

But carbon is also the heart of mankind's probably most challenging problem. 20 years ago, when the Inter-Governmental Panel on Climate Change was first set up, climate change was the realm of scientists and statisticians, and still at the periphery of public consciousness. But recently when pictures from 2002 showed the flooded Dresden and other German cities, when the 2003 summer heat wave killed 14 800 people in France, 18 000 in Italy, and all together around 52 000 across Europe (EPI, 2006), or when in 2008, Barcelona ordered huge quantities of water delivered by tanker to serve its population and tourists, climate change is of broad public concern also in Europe (EEA, 2009a) and climate change is now recognised as the most pressing environmental question the world has so far faced.

In its Fourth Assessment, the Intergovernmental Panel on Climate Change concluded that the emissions of greenhouse gases from anthropogenic activities are the root cause of global warming (IPCC, 2007). The source of much of this excess in carbon emissions comes from energy consumption and production and transport.

On the economic and social side, our carbon-dependent life styles and consumption patterns have driven many countries into an unhealthy dependency on distant energy sources. Around half of Europe's fossil energy comes from sources outside the continent.

This economic dependency and the expected serious environmental impacts of climate change put our quality of life at risk. Fundamental reforms to build a low-energy and low-carbon economy are, therefore, urgently needed. Policy-decisions and citizens' actions need to be based on a clear

Region	Percentage of city primary energy demand in the region	Percentage of urbanisation	Per capita energy consumption of city residents	Ratio of city per capita primary energy demand to the region's average
EU	69%	73%	3.5 toe	0.94
USA	80%	81%	7.6 toe	0.99
Australia & New Zealand	78%	88%	5.0 toe	0.88
China	75%	41%	2.6 toe	1.82

Table 1 | Primary energy demand of cities in different regions of the world. Source: IEA, 2008

understanding of the true costs of using our natural resources and ecosystems. Considering the impact of our excessive energy consumption and the impacts of different energy sources (figure1), we need to massively reduce our consumption and shift to renewable energy sources, even going far beyond current targets.

Urbanisation a Threat ...

Cities, although occupying just 2 % of the world's surface, are responsible for two thirds of global energy use and are thus the major contributor to the emissions of greenhouse gases and climate change; they emit 76% of the world's energy-related CO_2 Meanwhile, they house half of the world's population. Their responsibility will even grow with continuing urbanisation. Urban energy use is set to increase significantly through to 2030, by which time 73% of the world's energy will be consumed in cities (IEA, 2008).

In Europe, already three quarters of the population choose to live in cities, covering 4% of its surface. As the European population is about to increase slightly over the next 20 years and also urbanisation is further increasing to a share of 80% by 2020, the cities' current share of 69% energy consumption (IEA, 2008) might further increase. To feed such a demand, cities rely hugely on regions and nations well beyond their own boundaries and have many interactions with local and global hinterlands. They depend on resources produced outside the city and transported to the city for consumption, and the waste products of consumption in the city are disposed of elsewhere. London alone is thought to have a footprint almost 300 times its geographical area corresponding to nearly twice the size of the United Kingdom.

In conclusion, cities substantially determine the potential for sustainable development and quality of life for both urban and rural areas, in Europe as well as worldwide. Their action is crucial in shifting to a low-carbon society.

… or a chance?

Are cities to blame for their huge impacts? Interestingly, taking another perspective can change the image. Thus in developed regions like the US, the EU, and Australia and New Zealand, energy per capita of city residents is lower than the national average (table 1). This means if all city residents decided to leave the cities and spread over the countryside, impacts would be even bigger.

In contrast, city residents in China use almost double the energy per capita compared with Chinese rural dwellers, although at a much lower level than in developed countries. The causes are better access to modern energy services and higher average incomes, which are spent in consumption of goods and services. Back to developed

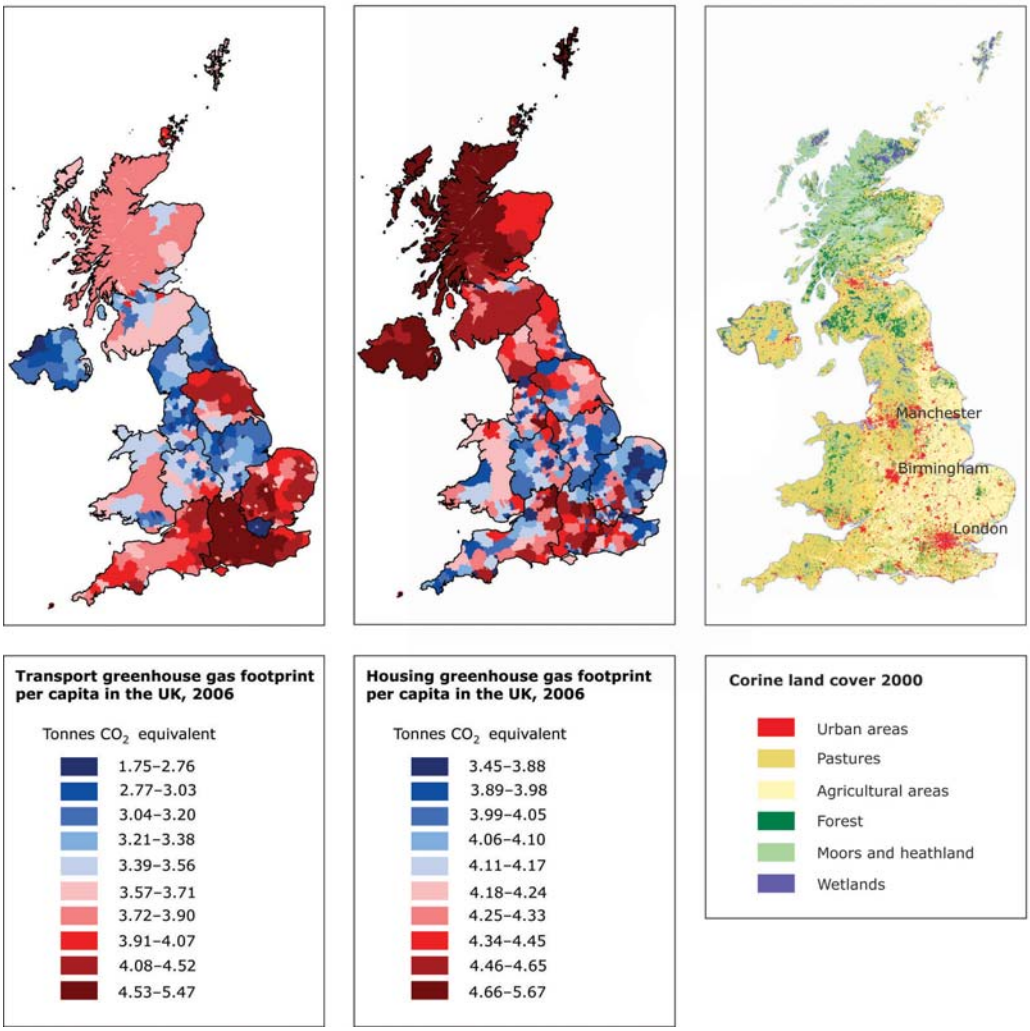

Figure 2 | Greenhouse footprints per capita for transport and housing in UK local authorities. *Sources: Stockholm Environment Institute (2009): footprints; European Environment Agency (2009): Corine Land Cover 2000*

countries, income levels do not differ that much. Most people in rural areas have also adopted urban lifestyles with having similar living standards and broad access to typical urban services; they just commute farther. It will be a matter of time until the same pattern probably occurs in China.

The main carbon-relevant differences between urban and rural areas in most developed countries are traced back to two areas where cities have specific function – transport and housing, which belong to the consumption categories with the highest impacts: most city residents have shorter distances to travel to work and urban housing is normally more efficient in terms of energy consumption.

However, cities worldwide followed different development paths. Hence, city residents in the European Union tend to use less energy than in US, Australia and New Zealand (table 1). This is assumed to be a result of higher population densities, more extensive urban public transport systems and more district heating systems (IEA, 2008), but probably also as they, as well as cities in

Figure 3 | Examples of a cul-de-sac system (left) and a grid network (right). *Source: Google Earth*

other developed countries, shifted much of their energy-intensive production to countries like China.

Density and Urban Design EnablesTransport

In contrast to other sectors, greenhouse gas emissions from transport have steadily grown in the EU – 28% between 1990 and 2006 (EEA, 2009b). Thereby, urban transport accounts for 40 % of the CO_2 emissions arising from road transport (EC, 2007). This is a high share and responsibility. On the other hand as mentioned before, considering the transport impacts per capita, already a quick glance at the example of the United Kingdom regarding the relative carbon footprints arising from transport reveals pockets of low footprint activity in the cities - although not in every urban area (figure 2).

It is important to note that not the urban area itself, but its design and the urbanisation pattern play an important role in reducing the transport demand and enable an efficient organisation of the necessary urban transport. In a denser and compact city, public transport can be organised more efficiently. Meanwhile the short distances encourage walking and cycling. In contrast, a dispersed city is more likely to depend on the car. However, the reality is more complex; besides the structure of the city, other strong social and economic factors, such as income, car ownership, family size and structure, and employment influence travel and need to be considered (Bannister, 2007).

Accordingly, the length of the journey and vehicle-kilometres seems to depend primarily on the design of the built environment; meanwhile, journey frequency is most likely caused by the socio-economic characteristics of the inhabitants. The transport modal choice depends on both characteristics. Clifton et. al, (2008) mention speed regulation and traffic calming as well as life styles and behaviour as further determinants of transport demand.

In the UK, for example, travel is related to the size and organisation of the city according to Bannister (2007). In a centralised city like London commuting distances increase in a linear manner from the centre, which can also be seen from figure 2; meanwhile in other cities like Birmingham or Manchester, there is a threshold after which commuting distance levels off or even falls depending on the patterns of location, access to transport and diversity of the job market. Mogridge (1985) discovered that people living in Paris and London within 15 km distance of the centre consume twice the energy for transport compared

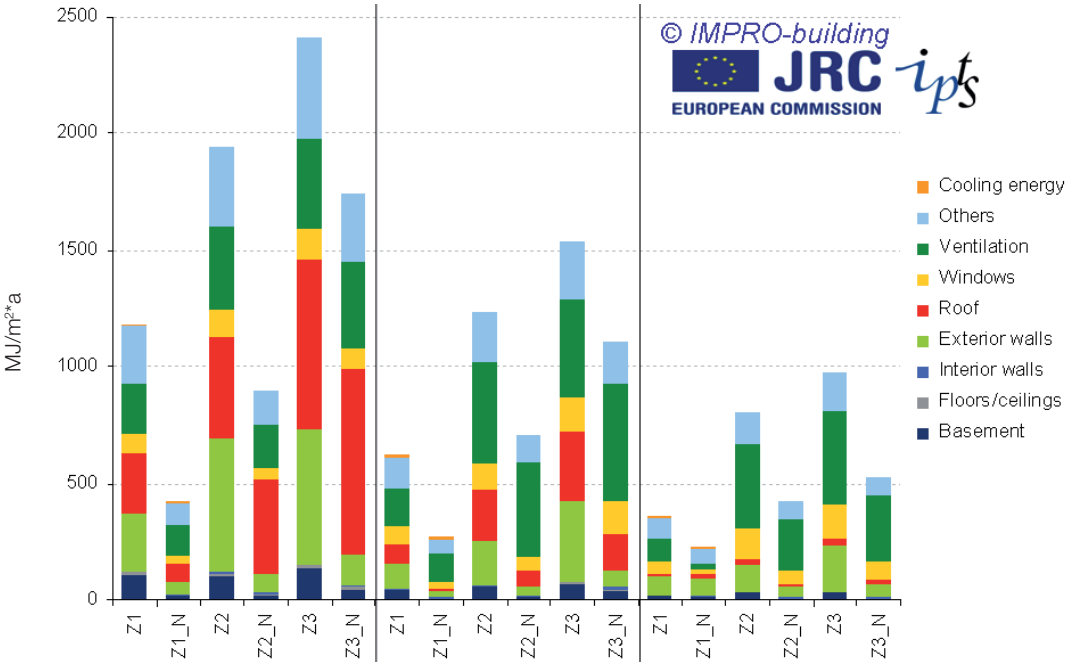

Figure 4 | Contribution of the individual construction elements to the environmental impacts of the use phase of houses (total Primary Energy) according to zone and building group (weighted average)
Z1: South Europe; Z2: Middle Europe; Z3: North Europe; N denotes new buildings.
Source: IPTS-JRC, 2008

with people living within 5 km . Furthermore, density matters. In the UK car journeys account for 72% of journeys in areas with less than one person per hectare and 51% in areas with more than 50 persons per hectare as the proportion of journeys by public transport, cycling and walking increases. However, measures towards more density need to be combined with efforts to improve the quality of the urban design and environment as a whole. Mixed uses, design at human scale, safe and secure places, community, open space, green spaces, and quality of development are necessary to realise the potential of density and enhance the positive effects (Bannister, 2007).

Accessibility is another influencing factor. Short distances from home to the highway network seem to increase travel distances (Calthorpe, 1993). Meanwhile distance to the nearest public transport stop influence the modal choice of people (Cevero, 1994).

With regard to local residential design, a transport network with loops and cul-de-sac systems probably increases slightly the usable land for houses, but a traditional grid network provides more direct access to a wider choice of routes and better potential for public transport (figure 3); it seems, therefore, rather to reduce transport demand (Bannister, 2007).

Housing

Higher population densities in cities make the best use of available land and save land for other uses like green areas for recreation, biodiversity and ecosystem services, areas for agriculture and forestry. Multi-family houses and high-rise buildings constitute typically the biggest share of housing in core-cities; single-family houses – comprising European-wide the biggest proportion - are the typical form in areas with urban sprawl and rural area.

Figure 5 | Green walls help to save energy and create attractive places. *Photo: Birgit Georgi*

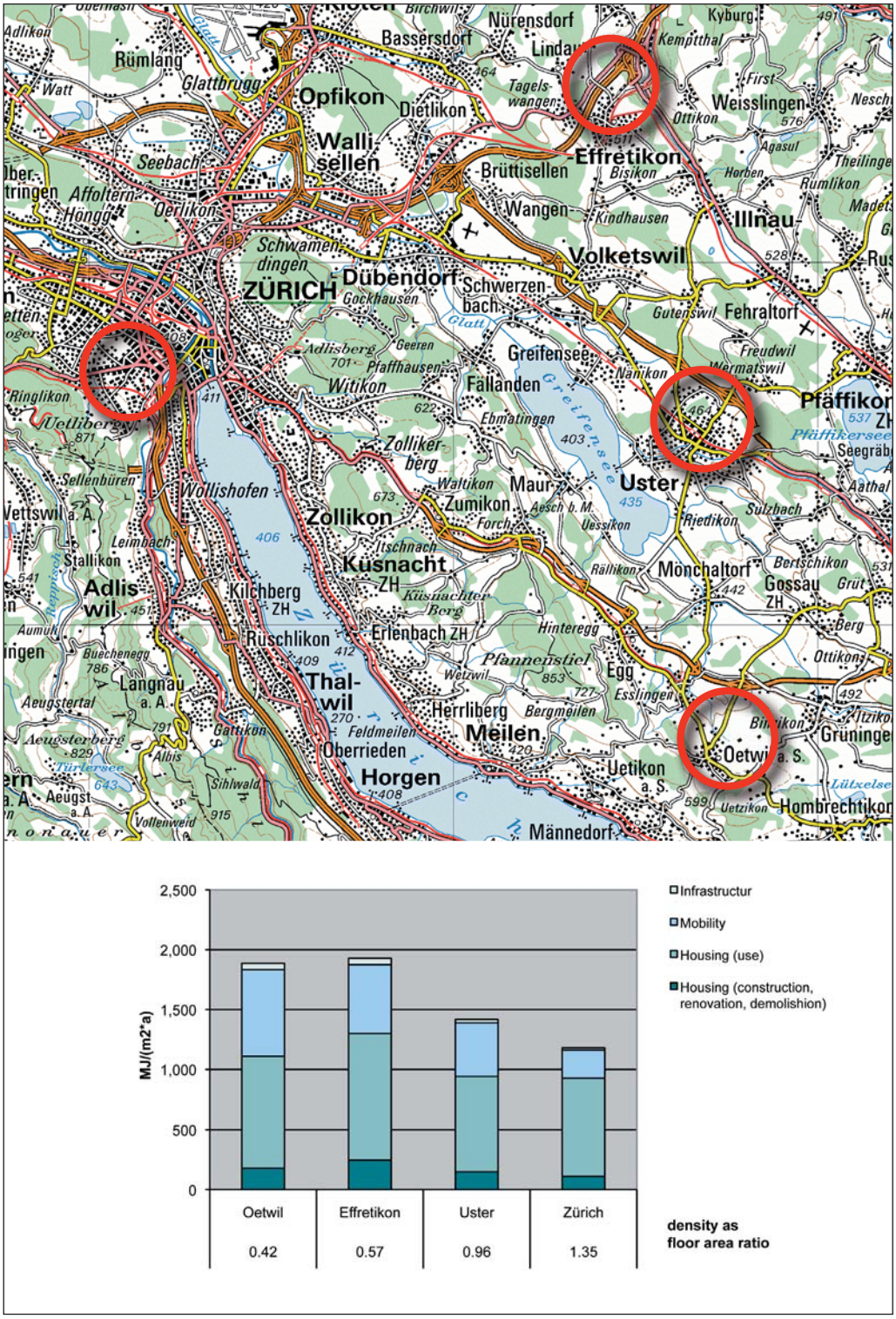

Figure 6 | Location of 4 urban area in Switzerland and their primary energy demand per gross floor area and year (2005). *Source: Ott, W. et. al, 2008*

The different building types have not only a different demand for land per floor area but also for energy for heating and cooling. As figure 4 shows, this demand is higher per floor area in single-family houses in all European regions than in multi-family houses and lowest in high-rise buildings. As European cities move from industrial production centres towards centres of services, the housing stock accounts for the major share of energy consumption and related emissions, e.g. in London, the built environment causes around 75-80% of CO_2 emissions (Bosteels, T., 2008; Siemens, 2008).

As most of our cities are already built, energy-efficiency measures for the existing housing stock could reduce noticeably the energy consumption of cities. For example, in Nyíregyháza, a city of about 120 000 inhabitants in Hungary, energy savings of 26.8 TJ/year were achieved, when the city modernised its district heating system and housing stock of 12 800 flats in multi-story concrete blocks from communist times. An evaluation of the retrofitting measures has shown that an overall energy saving of 68 % can be achieved. The measures were considered as highly cost-effective (Energie-cités).

Even simpler and well known measures like greening facades (figure 5) and roofs reduce not only the energy demand but contribute to balancing local climate extremes, increase the attractiveness of places, and compensate for less green spaces in cities. Such measures are currently experiencing a renaissance in new ecological urban design in the development towards vertical or roof gardens including even food production. It is the sum of many small creative measures that reduce the overall energy demand.

Although the building design has a major impact on the land take and energy demand per floor area, even the most environmentally friendly building can cause additional demand for transport and infrastructure resulting in greenhouse gas emissions, air pollution, noise and land take when it is placed at a greater distance from common services and facilities and when convenient public transport is not available. Generally, the more compact and dense an urban area is, the lower is the energy demand for technical infrastructure for supply and disposal.

The example of Zürich (Switzerland) comparing the energy consumption of 4 urban areas shows that the primary energy demand per floor area in different settlements is higher in the areas with lower density (figure 6) (Ott, W., et. al, 2008). Other case studies (Lanzendorf, M. 2008; Lehmann, B., 1999) come to similar conclusions and show that not only the energy for housing differs depending on the house type but also the energy demand for urban transport is higher in the low density areas. However, the studies also indicate that the relations are complex and interfere with impacts arising from different socio-economic conditions and adopted life styles.

Dense Cities – Still a Place to Live?

Summing up the facts above, cities and urban lifestyles can offer the potential to lower the overall regional or national footprint and environmental impact. This conclusion is critical to the arguments that cities and towns offer the best hope for living more sustainably and reinforce the argument for compact cities.

A further important result of different studies is that only the right combination - not density or building design alone - can mobilise the efficiency potentials of urban areas. The position and accessibility of services, the living quality, a healthy environment, and attractiveness of urban areas for different social groups, their cultural behaviour, and socioeconomic status as well as demographic trends are major determinants to attract people to live in more dense urban areas instead of spreading over the countryside. Urban design enables certain travel behaviour and lifestyles, although one needs to consider that people will choose their location because they want to adopt a particular lifestyle (Ewing, R. et. al 2007; Bannister, D. 2007; Clifton, K. 2008).

Despite the fact that urban areas in Europe perform relatively well, looking at cur-

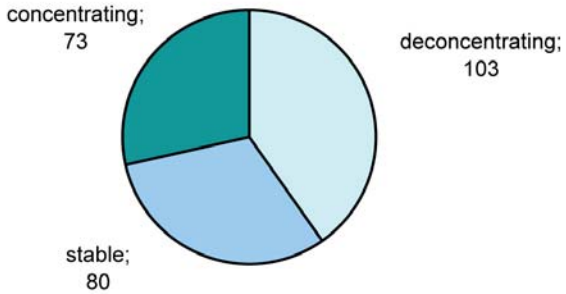

Figure 7 | Concentrating, deconcentration and stable major city regions in Europe – population shifts between core cities and larger urban zones between 2001 and 2005. Data *source: EUROSTAT, Urban Audit database*

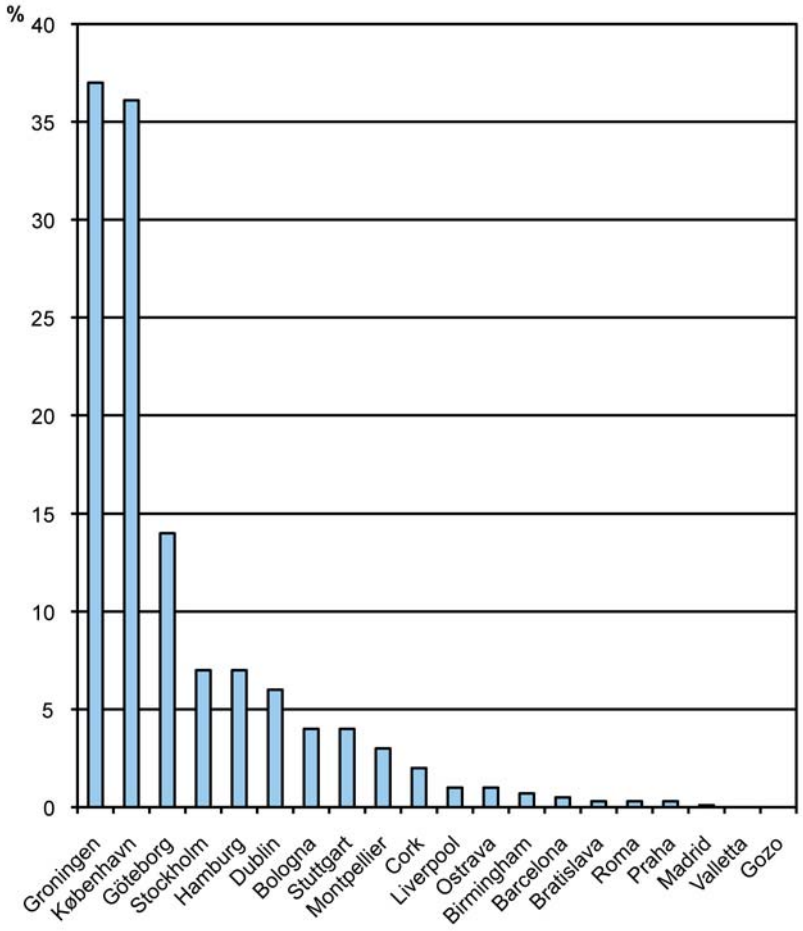

Figure 8 | Proportion of journeys to work by bicycle in a selection of European cities (2004)
Data *source: EUROSTAT, Urban Audit database*

Figure 9 | Bicycling in Barcelona. *Photo: Birgit Georgi*

rent urbanisation trends leads to the assumption that Europe's cities are losing ground. Urban areas are expanding and increasing at a much faster rate than the growth of population. In particular due to lower housing prices, but also lifestyles, culture and better environmental conditions, city dwellers move outwards from the city centres into the low density urban hinterland. Nevertheless, they continue to live an urban lifestyle facilitated by car-based mobility. Urban sprawl coupled with an increasing transport demand, in particular road transport, as well as current urban lifestyle choices demanding goods and services from a global hinterland tend to increase the ecological footprint of cities in Europe. Yet, very recent trends give some hope. A couple of European cities show again centralisation tendencies (figure 7). It seems that the many efforts for the rehabilitation of city centres over the last decades are beginning to be successful. However, it is too early to speak of a reversion of the general trend.

More Drivers

Apart from variations in density and urban-rural differences, cities show a different environmental performance across Europe, for example, the share of walking and cycling (figure 8). This variability is in some cases explained by geographical features such as high elevations, but comes mostly from other factors such as urban design including transport infrastructure, lifestyles and culture. For example, the introduction of easily rentable and also fancy city-bicycles in Paris, Barcelona (figure 9) and other cities has changed the culture and people's attitude towards cycling. In Barcelona, over 150 000 people subscribed to the system within only 1.5 years (Froehlich, J. et. al, 2008). Suddenly cycling became an accepted mode.

The variation between the cities indicates the potential that many cities can perform even better than they actually do by learning from the experience of frontrunners - after all, still more than half of all car trips in Europe are of cycling distance but are done by car.

Urban Europe Carbon Neutral – A Realistic Vision?

As much as we know that cities still need some energy to function, we know that we have to make the vision of carbon-neutrality reality over the next decades or we will face changes of unknown dimensions. The current energy generation is neither environmentally sustainable nor is its provision secure. In recent years, renewable energy in Europe has accomplished high rates of growth, but its share is still very low. Are shares close to 100% realistic? Only 19% of the EU energy subsidies in 2001 went to renewable energies, the rest to fossil fuels and a small part to nuclear power (EEA, 2004), although there has been some increase in the subsidies and support mechanisms for renewable energies over the last years. A further shift of priorities could bring a major change.

To achieve the necessary, even higher rates than the currently proposed EU goal of a 20% share by 2020 we need innovative approaches not only at the national and EU level but, in particular, at smaller scales – the community level. Some cities have already shown their potential: Thisted in Denmark with a population of 46 000 has achieved 100 % of its power consumption, and more than 80 % of its heat consumption, without the use of fossil fuels (http://climate.thisted.dk/da/).

But isn't a share of 100% renewables for a whole city a matter of space – space for windmills, dams, huge solar panels, and thus a high share only achievable by municipalities with a wide rural hinterland (figure 10)? Other cities and city districts demonstrate that they can provide effectively renewable energy themselves on their own territory almost without any additional ground space. A big advantage is also that infrastructure losses are usually low, as energy is produced close to the consumer. Producing and using renewable energy locally in small packages is therefore even more efficient than producing it in huge amounts somewhere else.

In Malmö (Sweden), the city decided to build a new, attractive and sustainable residential area in a former harbour area - Västra Hamnen. Part of the concept included the aim of providing 100 % of the energy for the area with 1000 homes from locally renewable sources i.e. solar energy (figure 11), wind power and water, the latter through a heat pump that extracts heat from seawater and an aquifer — a natural water reserve in the bedrock that facilitates seasonal storage of both hot and cold water. The 100 % renewable energy equation is based on an annual cycle, meaning that at certain periods of the year the city district borrows energy from the city systems and at other times the Västra Hamnen area supplies the energy systems with its surplus.

To achieve 100%, an important part of the concept was to design low energy houses and enable low energy use in the buildings by many technical solutions, but also urban density and a sustainable transport concept. Today, most houses have reached the target or are close to it. Furthermore, it is perceived as a very attractive urban area by inhabitants and thousands of international visitors. A major factor in the success of the project was also the early and open dialogue with the construction companies as well as the people. (EEA, 2009a).

Integrating the production of renewable energy and making thus a big difference might be relatively easy in new quarters, but Barcelona (Spain) shows that much can also be achieved in the already built environment. The city had recognised that a shift towards sustainable energy systems in cities was urgently required, and the promotion of a rational use of energy together with the development of renewable energy strategies became a clear priority in the City's Plan for Energy Improvement in Barcelona 2002–2010.

Probably the most innovative initiative within the plan has been the implementation of a Solar Thermal Ordinance. This local regulation requires that new buildings and

buildings undergoing major refurbishment must use solar energy to supply at least 60 % of their running hot water. Within the first 6 years, a total of 40 095 m^2 of solar panels have been installed with annual savings of 32 076 Megawatt hours per year, corresponding to the amount of energy needed to provide hot water for 58 000 inhabitants per year. The generation of renewable energy produced by both thermal and photovoltaic solar power installations in Barcelona has increased dramatically (figure 12).

The communications program has been crucial in encouraging adoption of the different measures and of the Solar Thermal Ordinance. The plan has turned Barcelona into one of the cities that make most use of solar energy and its Solar Thermal Ordinance has become a model for more than 50 Spanish municipalities and was a major input to the new Spanish building code. On the other hand the current situation shows also that despite these remarkable achievements on renewables, further efforts are necessary to reduce and reverse the trend of increasing energy consumption and greenhouse gas emissions in Barcelona (EEA, 2009a).

These examples show the excellent potential of cities not only for energy-efficiency but also the production of renewables in particular, as small-scale measures often turn out to be the most efficient measures. It demonstrates further that actions to increase the share of renewable energy need to be combined with measures for higher energy-efficiency.

What Hinders Cities to Act?

Despite such valuable action, only a couple of frontrunner cities are really making progress. The question is therefore, what hinders other cities from acting properly? Don't they understand the urgency?

In contrast to the general awareness of the challenges ahead, there is less of the concrete effects of climate change on cities and what they must do to reduce emissions and adapt to these impacts. The Eurobarometer (2008) – a European opinion survey - shows that 75 % of the population believes that climate change is a very serious problem, but only just over half of the people feel informed about the causes and consequences. In addition, precise information on energy consumption, greenhouse gas emissions and their sources exist for only a few cities, and this clearly complicates target setting and action.

Apart from the impacts and possible effects of climate change, decision-makers need to understand the challenges in tackling climate change. As the sources of greenhouse gas emissions are widely distributed, they are related to multiple actors at all societal levels, and effects and impacts are cross-border. Decision-makers need to acknowledge that the problems cannot be solved with a few major measures and at just one administrative level.

Furthermore, current challenges are at a scale previously unimagined and individual cities may feel that acting alone will have limited effect and that they are not in a position to implement all the changes they need to make. Climate change is a global challenge and must be addressed through the United Nations, the EU and national governments, so the actions taken by cities also depend on national actions and actions by other cities and regions worldwide.

Seen from the opposite direction, 'Europe cannot expect to achieve its major climate change objectives without contributions from the major European urban centres towards achieving these goals', said Ronan Dantec, Vice Mayor of Nantes, in 2008. Hence, the World Energy Outlook 2008 sees in its Outlook's scenarios, that around 70% of the total global energy savings will occur in cities through national policies. Moreover, cities could go further than national savings because many policy options to reduce energy consumption and decrease CO_2 emissions are under the authority of local governments (IEA, 2008).

Despite this notion, the role of urban areas in mitigating climate change is not yet reflected in current policy documents, such as those within the framework of the

Figure 10 | Windmill park. *Photo: Pawel Kazmierczyk*

Figure 11 | Västra Hamnen, Malmö. *Photo: Birgit Georgi*

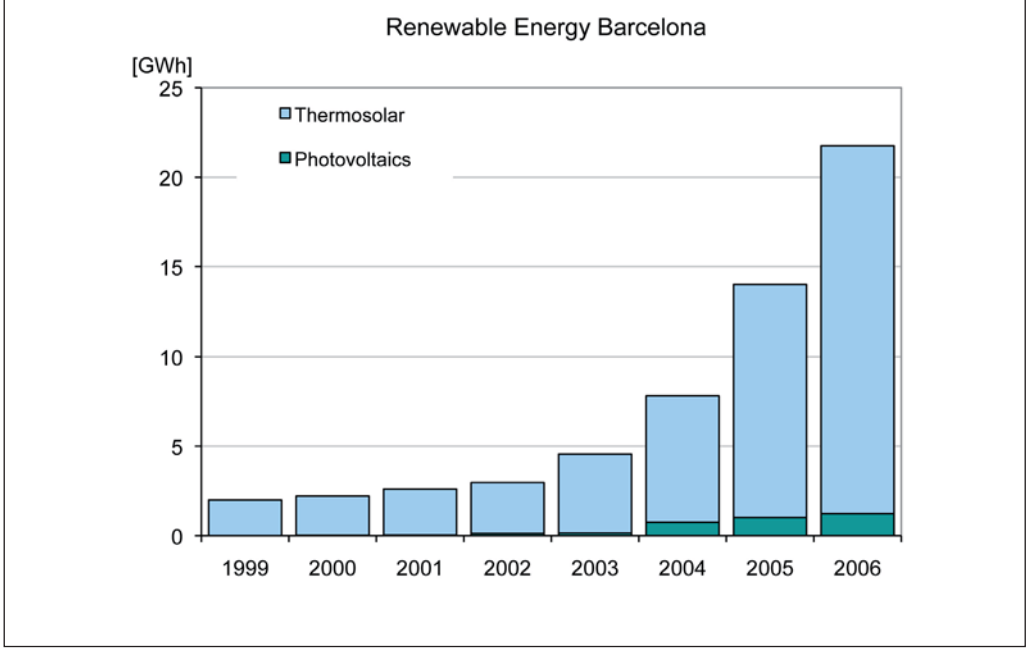

Figure 12 | Renewable energy development in Barcelona. *Source and photo: Agència d'Energia de Barcelona*

United Nations Framework Convention on Climate Change, the European Climate Change Programme, and is rarely included in national strategies and plans. The current approach – and related administrative structures - to tackle climate change and dependency on fossil fuels is mostly top down from the national, European and global level and concentrated, in particular, on big measures that can be steered by these levels. This approach negates the diversity of factors driving energy consumption and climate change which appear at all levels down to the individual citizens. The challenge is too complex to be tackled at higher administrative levels only.

Overcoming Barriers

A proper understanding and awareness of the challenges is crucial. Still, many gaps need to be closed and targeted information needs to be provided. Moreover, when asking the frontrunner cities about the factors in achieving commitments and results, they all mention a strong political will as indispensable. A strong political will and leadership is necessary to change governance, structures and take the risk of even offending some lobby groups in order to overcome the current lack of sufficient long-term commitments and ensure a future for all groups. An example of such vision and strong leadership is the London Climate Change Action Plan. The Mayor's target for London is to stabilise CO_2 emissions in 2025 at 60 % below 1990 levels (Greater London Authority, 2007).

Feeling the urgency and the lack of local action against climate change and high energy dependency and acknowledging the fact that one city alone cannot tackle the challenge of climate change, cities themselves have started to develop joint actions. Examples are the C40 Large Cities Climate Leadership Group or, at European level, the Nottingham Declaration on Climate Change, the Local Government Climate Roadmap process, and other initiatives within the major city networks. Finally, the importance of cities' action has reached the European level. On 29 January 2008, EU-Commissioner Piebalgs launched the Covenant of Mayors initiative. It is an ambitious Commission initiative that seeks to bring together the mayors of Europe's most pioneering cities in a permanent network to exchange and apply good practices to improve their energy efficiency and promote low-carbon business and economic development. Already more than 500 European cities have joined the initiative. They have formally made a commitment to reduce their CO_2 emission by more than 20 % by 2020 and develop and implement Sustainable Energy Action Plans. This initiative is a first step in closing the gap between the local and higher level's action towards a multi-level and cross-sectoral integrated approach.

As important as support of the exchange and networking is, in an integrated, multi-level approach, the European Commission needs to consider the role of cities in its daily work and supplement local action with European level measures. It must create the conditions whereby cities can act efficiently by, e.g., providing the right legislation on building standards, vehicle standards, electrical appliances etc. and by avoiding conflicting effects of EU policy at the local level, such as inducing urban sprawl and additional local transport demand by major European infrastructure projects (figure 13). Also, European funding needs to take into account the fact that not only big projects but the sum of small actions is often most efficient and probably the only way to achieve high energy-efficiencies and a large share of renewables (EEA, 2009a). Thus, until recently it was very difficult for local actors to gain Structural Funds for energy-efficiency measures – they were simply too small to receive the necessary attention; however, additional efforts have led to a change.

In tackling the challenge towards a low-carbon society, the question remains whether today's model of governance and investment is really appropriate for a post-carbon society in which using resources locally, more efficiently, consuming less and

co-operating and sharing resources will be the norm. Ever since the first national grid was constructed in Europe in the 1930s, governments have sought to maximise centralisation: it has always been seen as easier to build a few large power plants that rely on a large number of smaller ones. Energy-efficiency and renewable energy production, however, comes in small packages and is distributed for free: the diffuse nature of the energy from the sun, winds, waves and tides means that it is far better suited to a decentralised generating system. Decentralised energy is not only more efficient and suffers fewer distribution losses, but is cheaper and paradoxically more secure. It also represents the democratisation of energy. Changing current governance forms and empowering local communities and citizens to play an active role in the low carbon economy is key as the examples of Malmö and Barcelona have shown.

Figure 13 | Major transport infrastructure encourages the development of business and residential areas. *Photo: Birgit Georgi*

Conclusions

Our commitment to a low carbon economy, via a shift towards higher energy efficiency and sustainable renewable energy is essential for energy security and tackling climate change. But we must also introduce our natural world into our policy and economic responses. Nature underpins our economies and the price of losing it dwarfs the financial crisis. We must remember that there are no societies without environments, but there are environments without societies.

We know our environment is influenced by massive global and national factors, but it is also affected by the daily actions, no matter how small, of each and every European municipality or single citizen.

In conclusion of the evidence, cities have an enormous responsibility and potential to reduce energy consumption, carbon dependency and climate changes worldwide; they are decisive for the development towards a low-carbon society and we must recognise their role in national, European and global policy-making. On the other hand, they cannot solve the challenges alone and need supplementing measures from national and supra-national governments and Europe as part of an integrated, multi-level approach.

The complexity and the dimension of the challenges ahead and the fact that only the sum of many small and large-scale measures of different actors can bring the necessary reduction of energy consumption and decoupling from fossil energy sources requires new forms of governance, broad participation, and new structures for decision-making.

Urbanisation is not necessarily a threat to this way; it depends on urban design and organisation. Then, urbanisation can realise its important potential for a low-carbon society. Europe's cities, with their historically developed compactness and density, have a good starting position. If they maintain this potential and reverse current unsustainable urbanisation trends by designing cities the right way, they will be a role model for a sustainable Europe and the world. They are the centres of human activity and innovation. Cities are our chance. •

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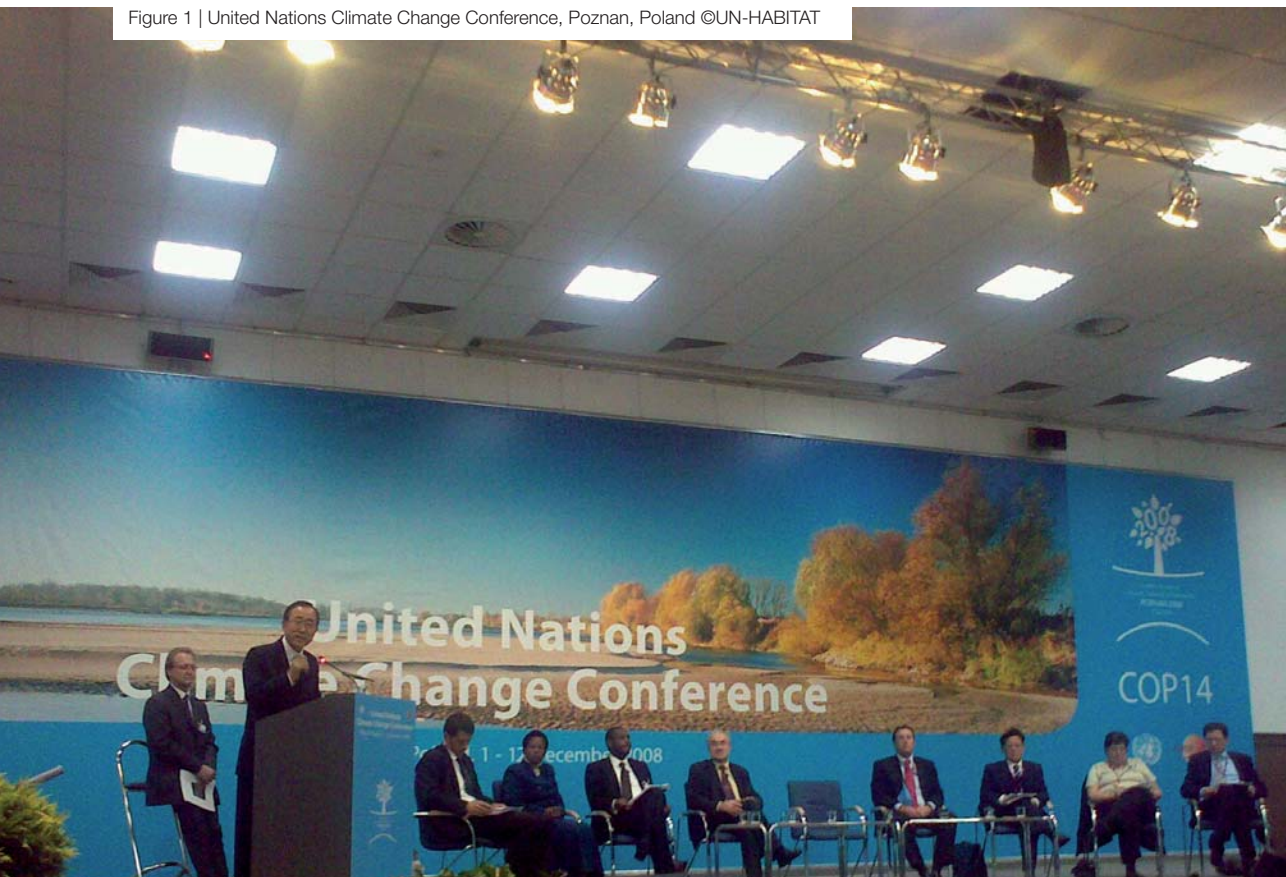
Cities and Climate Change: the Perspective of UN-HABITAT[1]

Figure 1 | United Nations Climate Change Conference, Poznan, Poland ©UN-HABITAT



Climate change is recognized as one of the defining problems of the 21st century. Emissions of carbon dioxide (CO_2) and other greenhouse gases (GHGs) caused by human activity are already bringing a rise in air and sea temperatures that cause unpredictable and often disruptive climate changes. The vast majority of the climate impacts, it is believed, will be negative and will severely affect those most vulnerable and less able to adapt, especially in developing countries. The future of hundreds of millions of people in urban areas across the world will be affected by the impacts of climate change and the overall vulnerability of human settlements will increase.

The relation between urbanization and climate change is inextricable and the role of cities in addressing climate change is of crucial importance. Our understanding of the dynamics of climate change and of the strategies for response is also evolving rapidly, bringing to the fore the urgency to address the sustainability of the world urbanization patterns. UN-HABITAT has embarked on designing an agency- wide strategy aimed at providing support to local governments and other local actors in promoting the urban sustainability agenda within climate change discussions as well as build local capacities to address climate change challenges across the urban sector.

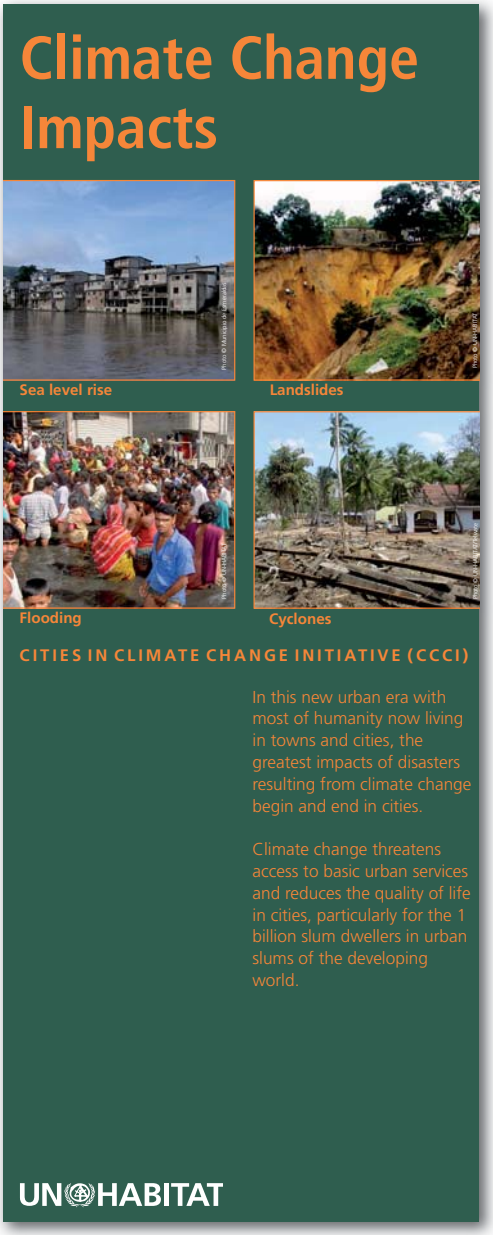


Figure 2 | Climate Changes Impacts - Cities and Climate Change Initiative

Cities Contribute to Climate Change

Urbanization and climate change are virtually inseparable. In thermodynamic models of the atmosphere, cities appear as heat islands. This is due to the high density of concrete and asphalt, as well as to the high energy consumption and the high GHG emissions occurring in cities with large populations. Energy for heating or cooling, and lighting residential and commercial buildings account for a quarter of GHG emissions globally while transport accounts for 13.5 %. CO_2 is mainly emitted in urban areas and it is urban and inter-urban activities that lead to the emission of significant amounts of other GHG. Together, energy for electricity, heating, transport and industry generates more than 60% of greenhouse gas emissions. Rich cities produce more greenhouse gases than poor cities as increased income and changing lifestyles increase consumption and energy dependence.

Approximately, within the city, half of the GHG emissions are from energy in-use in buildings and the operation of appliances, a situation symptomatic of our built environment and our quest for quality-of-life in urban places. The other half is due to the use of fossil fuel for transportation. Where there is reliance on private cars for transport, there are typically, exceptionally high levels of emissions.

In addition, due to continuing global urbanization, a reduction in the amount of green cover, parks, trees and agricultural surfaces in urban areas, reduces a city's ability to absorb CO_2. Moreover, poor waste management releases chlorofluorocarbons (CFCs) and gases such as methane into the atmosphere.

Cities are Affected by Climate Change

The impact of climate change on cities will be severe. It will include higher temperatures and pollution, with consequential risk to human health and human activities. Severe weather events, including tropical storms and drought will contribute to an increase in local and inter-urban migration

Figure 3 | Industrial emissions in Rotterdam, Holland ©UN-HABITAT

and add new challenges for urban development including, for example, issues of land use and land tenure. The impacts of climate change may negatively affect the infrastructure, worsen the access to basic urban services and unfavourably affect the quality of life in cities.

Abrupt and large scale climate change could lead to a loss of 5-10% of GDP, with developing countries at the higher end of that estimate.

While demand for potable water rises, so climate change will adversely impact the supply and quality of water resources. Most affected will be the urban poor – the slum dwellers in developing countries. Climate change may create conducive conditions for the spread of vector-borne diseases such as malaria and dengue fever, impacting human health well beyond the current range of such diseases.

Three quarters of all large cities are located on the coast, with 60% of the world's population living in Low Elevation Coastal Zones (LECZ) (less than 10 metres above sea level). The rise in sea level will threaten coastal infrastructure and pollute groundwater resources through salt intrusion and the inundation of water supply and sewage disposal facilities. In polar regions, thaw will reduce the stability of cities located on permafrost.

Food security in cities may also be affected due to changing weather patterns and reduction of agriculture production. Changes in the patterns of energy use for heating and cooling will also impact on emissions of GHG.

The impact of climate change on political and personal security is also of particular concern. Forced in-migration caused by drought, or sea-level rise will contribute to unplanned urbanization, create disputes on access to land, services and other resources. The rule of law will be threatened by statelessness and other security threats in human settlements where existing capabilities are constrained by development chal-

Figure 4 | Costal erosion in Sorsogon, Philippines ©UN-HABITAT, Bernard Barth

lenges, skill shortages and economic limitations. In certain countries, migrants are the most vulnerable population, marginalized in informal settlements and living outside the formal economy. It will be important to ensure that "climate change refugees" are not reduced to extreme urban poverty in host cities and countries.

Climate Change Cannot be Prevented – Adaptation and Mitigation

Historical greenhouse gas emissions have committed the world to a measure of global warming greater than any in human history and exceeding 2 degrees Celsius by the end of the century, irrespective of what global reduction strategies are implemented. Global temperatures are projected to rise even in the presence of strong mitigation measures – however, these, if implemented early, can reduce the speed and ultimate extent of climate change.

Under the United Nations Framework Convention on Climate Change (UNFCC), global strategies to limit and slow climate change have been agreed. The extent to which the measures are implemented will ultimately determine the range and level of adaptation strategies that will be necessary.

Preparation for a changing climate, including the identification of appropriate mitigation and adaptive strategies needs to commence immediately if humankind is to survive and thrive. In this regard, special attention must be allocated to especially sensitive and vulnerable natural and human systems.

The growing urbanization trend, especially in developing countries and in coastal cities, makes the search for policy solutions acute. With 60% of the world population projected to be living in cities within two decades, and urbanization possibly accelerated by climate change itself, the need for formulation and implementation of rational adaptation strategies is urgent.

Figure 5 | Risk area in Esmeraldas, Equador ©UN-HABITAT

Cities are Part of the Solution

Cities and local authorities have the potential to influence both the causes and consequences of climate change. They can also contribute to national and international strategies to prevent unacceptable climate change impacts. Currently, urban transport, the construction industry and shelter-related energy are the principal contributors of greenhouse gases to the atmosphere. On the other hand, cities offer opportunities to reduce emissions through economies of scale interventions and the numbers of communities involved in reduction strategies. The obligation consequently falls on cities to provide leadership and direction and implement practical initiatives for the communities and citizens they represent. In a participatory manner, they can develop local strategies towards a sustainable future, addressing climate change impacts, mitigation and adaptation through good governance, urban planning and management **including** the application of new building codes and other appropriate laws designed to ensure minimal GHG emissions.

Already, cities around the world are carrying out a vast range of activities related to energy efficiency, renewable energy, cleaner production and the application of regulations to control industrial emissions and to improve architectural designs for energy efficiency. Efforts to reduce traffic, improve traffic flow and improve public transportation are just but a few local authority actions which significantly reduce CO_2 emissions.

It is crucial that successful measures and good practice are shared through effective information dissemination. To this end, many cities have linked with others to form “cities in climate change networks”, sharing experiences and information, and learning from each other on the planning and management implications of climate change, including preparation for, and implementation of, municipal climate change action plans. However, in the developing world, local authorities are in need of further support relating to capacity building, infor-

mation acquisition and exchange, technology transfer, technical support and establishing an enabling environment.

Responding to Climate Change from a Planning Perspective

The challenges highlighted earlier do require a rethinking of the role of planning in orienting and supporting development, responding at the same time to the challenges posed by climate change.

It is important to first of all recognise that urban planning models and approaches may be completely inappropriate to respond to climate change. In fact, it is possible to say that some of those do in fact largely contribute to the climate change crisis now faced by humanity.

It is therefore imperative that urban planning looks at climate change as an opportunity to reassess itself, the models that it has promoted across the globe in the past, and looks at responses that fully recognises the mistakes of the past and the new trends in city growth.

A Changed Context of Planning

Global changes in the physical environment and related to climate change are happening in a context where other phenomenal changes are taking place: in the economy, in institutional structures and in civil society that shape urban growth. Processes of globalization and economic restructuring have increased polarization of occupational and income structures. The international financial crisis has had a particularly acute impact on city dwellers, and has resulted in growth of the informal economy, making the context of inequality and poverty more entrenched and solutions even less evident. Significant changes in local government have expanded the space for consultation and partnerships, while democratization and decentralization are in progress in many countries, particularly in the developing world. However many such institutions continue to have limited capacities, be ineffective and not accountable. The civil society is also more and more reluctant to accept plans and decisions that are led by politicians or technocrats. There is also more recognition of the effectiveness of participatory processes for achieving implementation and sustainability of urban development plans.

Changes in the economy, government and civil society, and in the nature and scale of the environmental challenge brought about by the progression of climate change, have had a major impact on processes of urbanization and urban growth, and socio-spatial dynamics in urban settlements. New spatial forms and processes in the direction of fragmentation, separation and specialization have taken solid root in urban areas. In particular, efforts by low-income residents to secure land are resulting in rapid urbanization of peri-urban areas. Spatial specialization driven by investment has resulted in increased segregation and reduction of access for the poor.

The Key Elements of Today's Environmental Challenge for Urban Planning

The authoritative Stern Report[1] on the economics of climate change concludes that it will 'affect the basic elements of life for people around the world – access to water, food production, health and the environment. Hundreds of millions of people could suffer hunger, water shortages and coastal flooding as the world warms.' Moreover, it will be the poorest countries and people who are most vulnerable to this threat who will suffer the most. Current forms of urbanization are pushing the lowest-income people into locations that are prone to natural hazards, in areas threatened by floods, landslides and other natural disasters.

The global use of oil as an energy source has both promoted and permitted urbanization, and its easy availability has allowed the emergence of low-density and sprawling urban forms – suburbia – dependent upon private cars. As prices of oil increases dramatically and use of oil is reduced considerably in the future to mitigate climate change, perspectives of a post-oil era, in the form of public transport- and pedestrian-based movement systems, more

compact and integrated cities, and more localized food and production systems (reducing the ecological footprint of cities) all present new imperatives for planning .

Urbanization and city growth are also causing, and are subject to, a multitude of environmental impacts. The 2007 UN-HABITAT Global Report – Enhancing Urban Safety and Security[2] – makes the point that cities are inherently risk prone due to the concentrated nature of settlements and the interdependent nature of the human and infrastructural systems. Urban settlements are increasingly becoming 'hot spots' for disaster risk. Urban development also results in negative environmental impacts through the consumption of natural assets and the overexploitation of natural resources. It also generates new hazards such as landslides and flash flooding. The world's 1 billion urban slum dwellers are also far more vulnerable, as they are usually unprotected by construction and land-use planning regulations. Climate Changes is likely to compound such a situation.

Significantly, such disasters are only partly a result of natural forces. They are also the products of failed urban development and planning. It is therefore important to take a risk-reduction approach which views such disasters as problems of development, requiring new approaches to the planning of urban growth and change.

But can Planning Take up the Challenge?

At certain times in the last century, planning has been seen as the activity that can solve many of the major problems of urban areas, while at other times it has been viewed as unnecessary and unwanted government interference in market forces, with the latter able to address urban problems far more effectively than governments. More recently, it has been argued that systems of urban planning in developing countries are also the cause of many urban problems, and that by setting unrealistic standards of land and urban development, and by encouraging inappropriate modernist urban forms, planning is promoting urban poverty and exclusion.

Revisiting urban planning to see if it is able to play a role in addressing issues in rapidly growing and poor cities seems to be a crucial step to respond to this question[4].

The 2009 *Global Report on Human Settlements*[5] considers the importance of urban planning as a significant management tool for dealing with the unprecedented challenges facing 21st-century cities and attaining the goals of sustainable urbanization. There is now a realization that the positive management of urban change cannot be left only to the market or governments.

Governments, together with other important urban stakeholders, will have to jointly agree on the long-term objectives of urban change. These objectives will need to include ways of achieving socio-spatial equity, environmental sustainability and economic productivity in urban areas. But if planning is to play a role in addressing the major issues facing urban areas, then current approaches to planning in many parts of the world will have to change.

Whil the forces impacting upon the growth and change of cities have changed dramatically, in many parts of the world planning systems have changed very little and are now frequent contributors to urban problems rather than functioning as tools for human and environmental improvement. However, this does not necessarily need to be the case: planning systems can be changed so that they are able to function as effective and efficient instruments of sustainable urban change. Given the enormity of the issues facing urban areas in the coming decades, there is no longer time for complacency: planning systems need to be evaluated and, if necessary, revised; the training and education of planners need to be re-examined; and examples of successful urban planning need to be found and shared worldwide .

Realising the weaknesses of the traditional master planning approach, which spread from Western Europe to almost every part of the world during the 20th century, in some parts of the world process and plans that are

more participatory, strategic, flexible and action oriented have been developed. But in many regions, particularly in the developing world, master planning and land use zoning, used together to promote modernist urban environments, still persist.

Planning and Climate Change - a Revived Interest in Urban Planning

The present urban challenges, and in particular Climate Change, but also rapid urbanization, global recession, and resource shortages, are currently leading to a worldwide return to planning, as they have significant implications for the spatial structure and functioning of urban areas .

Essentially, they demand state intervention to fundamentally change the nature of cities, and this implies a need for planning. Several issues have refocused attention on planning – urban poverty and the growth of slums; the need to address insecurity and enhance safety; the post-disaster situations that offer unique opportunities to rethink past development; and finally the issue of Climate Change, which is of particular relevance for this discussion.

As countries urbanize, the issue of sustainable urbanization becomes crucial. Urban planning can play a vital role in ensuring sustainable urbanization. Achieving sustainable cities and contributing to climate protection requires planned change to the way in which cities are spatially configured and serviced. Urban planning can help mainstream climate change considerations into urban development processes.

Innovations in Tackling the Urban Environment and Lessons for Climate Change Efforts

Although climate change is a new issue for planners and international development alike, urban planners have been faced with the practical dilemma of how to integrate the two different sets of concerns of the 'green agenda' and the 'brown agenda', i.e. the natural environment and the human environment.

The brown agenda is essential for making a city work, for a healthy and livable environment and for creating the human and economic opportunities which have driven cities throughout their history. All cities consume land and resources such as energy, water and materials, which they use for buildings and transport. In the process of making a city functional, these resources are turned into wastes. It is now possible to quantify this impact in one parameter called ecological footprint.

The brown functions of a city generally consume and degrade its green resources and processes, respectively, unless the city intervenes through processes such as urban planning and environmental management. The green, natural systems of a city have real limits and capacity issues associated with their use. The challenge for urban planning is to find ways in which cities can integrate these two agendas – to respect the natural environment and to improve the human environment, at the same time.

A number of key, but overlapping, innovations are occurring globally in order to synergize the green and brown agendas. They are briefly presented mainly to indicate the rich range of options and avenues being explored.

Development of Renewable Energy - Renewable power enables cities to create healthy and livable environments while minimizing the use and impact of fossil fuels. A number of urban areas are now partly powered by renewable energy techniques and technologies, from the region to the building level and there are significant opportunities to harness solar, wind, hydro and geothermal power for urban use. However, breakthroughs in technology need to be carefully examined and supported by urban planning to ensure that cities use it to be fully sustainable and not justify further urban sprawl.

Striving for Carbon-neutral Cities - Carbon neutral cities are able to reduce their ecological footprint through energy efficiency and by replacing fossil fuels, thus providing a basis for ecological regeneration by creating offsets in the bioregion. Although there is evidence of a growing com-

mitment to minimizing carbon footprint in cities, this needs to become a feature of whole neighbourhoods and even complete cities if the world is to move to 'post-carbon cities'.

Distributed Power and Water Systems - The development of distributed power and water systems aims to achieve a shift from large centralized power and water systems to small-scale and neighbourhood-based systems within cities. The distributed use of power and water can enable a city to reduce its ecological footprint, but utilities will need to work with city planners to develop models for local energy and water planning through community-based approaches and local management.

Increasing Photosynthetic Spaces as Part of Green Infrastructure - Growing energy and providing food and materials locally is becoming part of urban infrastructure development. There has been a positive trend in planning in the direction of an expanded notion of urban infrastructure that includes the idea of 'green infrastructure' based on photosynthetic processes. Green infrastructure refers to the many green and ecological features and systems, from wetlands to urban forests that provide a host of benefits to cities and urban residents.

Improving Eco-efficiency - Cities and regions are moving from linear to circular

Figure 6 | Planning of public space in Bogota city centre, Colombia ©UN-HABITAT, Laura Petrella

or closed-loop systems, where substantial amounts of their energy and material needs are provided from waste streams. Cities are seen as complex metabolic systems with flows and cycles and where, ideally, outputs traditionally viewed as negative (e.g. solid waste, wastewater) become productive inputs to satisfy other urban needs, including energy.

Increasing Sense of Place - When communities relate strongly to the local environment, the city's heritage and its unique culture, they develop a strong social capital of networks and trust that forms the basis of a robust urban economy. This approach to local economic development, which emphasizes place-based social capital, can also promote energy efficiency through producing power from solar, wind or biomass in the locality or region, as part of local economic development strategies.

Sustainable Transport - Cities, neighbourhoods and regions are increasingly being designed to use energy sparingly by offering walkable, transit oriented options, often supplemented by vehicles powered by renewable energy. Cities with more sustainable transport systems have been able to reduce their ecological footprints from their reduced use of fossil fuels, as well as through reduced urban sprawl and reduced dependence on car-based infrastructure.

Urban Form and Density Planning - The feasibility of different types of transport systems and services is influenced by the density of a city. Transit Oriented Developments reduce ecological footprint in cities and undermine the kind of car-based sprawl that eats into the green agenda of cities. Thus Transit Oriented Developments can enable a city to put in place a clear urban growth boundary and to build a green wall for agriculture, recreation, biodiversity and the other natural systems of the green agenda. In the US, for instance, shifting 60 per cent of new growth to compact patterns would reduce CO_2 emissions by 85 million metric tons annually by 2030.

Infrastructure Priorities and Transit Planning - Investing in viable, accessible transit systems is the most important component for cities to become resilient to waning oil sources and to minimize their contribution to climate change. Modern rail is now seen as a major strategy for reversing the proliferation of the private car and for its density-inducing.

Street Planning and Mobility Management - Sustainable mobility management is about 'streets not roads' – the streets are used for a multiplicity of purposes, not just maximizing vehicle flow. The emphasis is on achieving efficiency by maximizing people movement, not car movement, and on achieving a high level of amenity and safety for all street users. This policy also picks up on the concept of integration of transport facilities as public space.

Figure 7 | Collective transport ©UN-HABITAT

Figure 8 | Urban vulnerability - slum in Kampala, Uganda © UN-HABITAT

Developing Cities Without Slums - 'Cities without slums' is presently one of the most important goals of urban planning in developing countries. Attaining the goal of cities without slums will require innovative approaches that can enable slums to be upgraded, if not as models of sustainability, certainly in ways that address the most pressing brown and green agenda challenges of poor access to safe drinking water and sanitation as well as degrading environmental conditions.

Governance and Planning at the Forefront of Urban Sustainability

Despite the many examples that could illustrate the approaches presented above, linking the green and brown agendas is a relatively new challenge for cities and none are able yet to fully demonstrate how to improve human health and livability whilst simultaneously reducing their ecological footprints and improving the natural environment. This will not be possible without a revived and regenerated approach to urban planning. Urban planners now need to find ways of creatively integrating these innova-

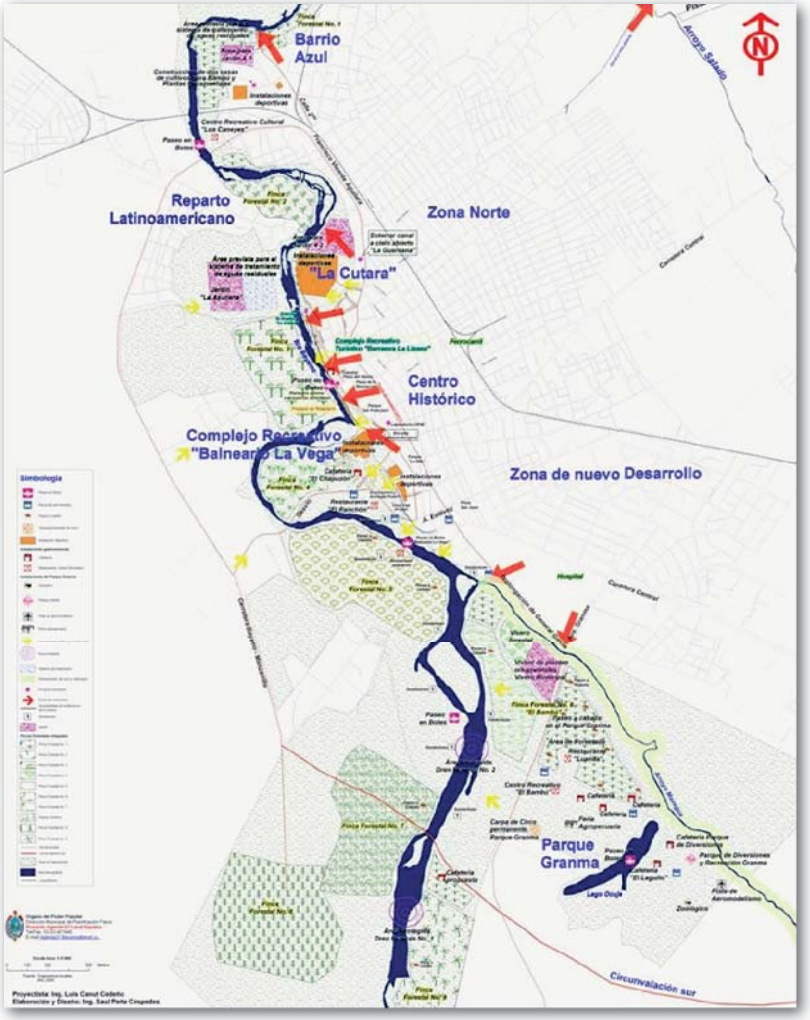


Figure 9 | Bayamo River Strategic Project, Bayamo, Cuba © UN-HABITAT/Local Agenda 21

tions into mainstream urban planning and governance systems.

The recent global financial down turn, may slow down some of the major green and brown agenda integration programmes, such as slum upgrading. However, government-funded green infrastructure and energy programmes currently being initiated in some developed countries in order to stimulate economic activity and generate jobs may offer significant opportunities for cities to implement some of the innovations described above.

Sustainable urban development planning, like all long term planning, requires governance that goes beyond market forces and can help to create widely accessible infrastructure and community services.

The challenges outlined cannot be effectively addressed without a regional plan which incorporates the whole city and its region. Cities have grown everywhere to engulf local authorities in surrounding rural areas and, in many countries, there is now a need for a metropolitan-wide perspective on most of the issues raised above.

There is also need for an effective statutory process to enable key land use decisions and regulations to be made legally enforceable. Urban planning has become enmeshed in regulations from the past and needs to revise these at the same time as it faces the new challenges of climate change.

To balance this kind of regulatory approach, urban governance should also include a development facilitation function to ensure innovations and demonstrations are set up in partnership with government, industry and the community.

The glue that will make this all work will be a development financing function that can tap old money sources, such as rates and taxes, and new money sources, such as public-private partnerships, development bonuses and capture of increased land value. The Carbon Credit Market and Clean Development Mechanism should also be considered as additional sources of funding.

Finally, there is need for a participatory process that can help develop and deliver sustainability visions. The social capital of the city needs to be strengthened as these new challenges are faced. That cannot happen without deliberative processes engaging communities on their future. Many cities' sustainability strategies now include goals of equity and social justice. Urban planning has experimented with emerging engagement processes and must now seek to make them part of day-today governance systems.

The Mandate and Role of UN-HABITAT on Cities in Climate Change

The crucial role of cities and of urban planning in addressing climate change has been largely demonstrated, and paths of change that need to be undertaken to achieve results are becoming more and more widely accepted. How, then, is UN-HABITAT deploying its support to the Climate Change agenda?

It is important to recall that since its creation in 1978, UN-HABITAT has supported hundreds of cities in improving their living environment. This has been achieved through its various programmes, including, but not only, the Sustainable Cities Programme, Localizing Agenda 21, Disaster Management Programme, Safer Cities Programme, Water for African Cities, Water and Sanitation Programme the Lake Victoria Initiative and others. Designed and implemented in close collaboration with various partners, these programmes provide a wealth of experience and lessons on building local capacity for improved urban management, planning and governance, which inform UN-HABITAT's current work on climate change.

In its 63rd session, the UN General Assembly adopted a resolution[6] that makes the link between sustainable urbanization and climate change. This resolution encourages Governments to promote the principles and practice of sustainable urbanization as a major contribution to mitigating the causes of climate change, adapting to the effects of climate change and reducing

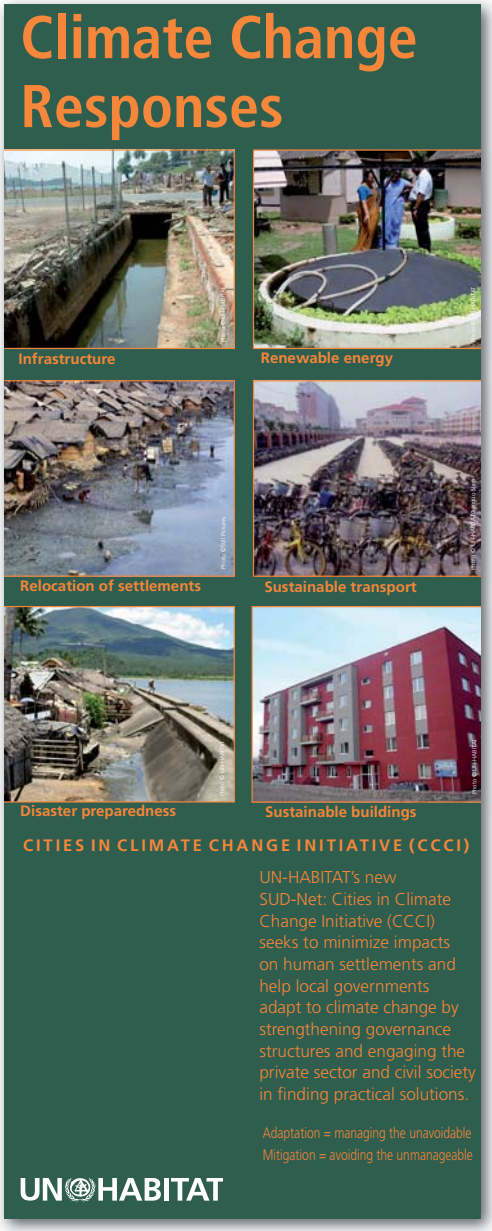


Figure 10 | Responses - Cities and Climate Change Initiative

risks and vulnerabilities in a rapidly urbanizing world.

The UN-HABITAT 22nd Governing Council (GC22) adopted a resolution on cities and climate change[7], which reflects the increasing recognition of the relation between urbanization and climate change. It also recognizes that proper adaptation and mitigation actions taken at the local levels and being integrated into national policies will be of importance in tackling the global challenge of climate change. This resolution lays the foundation for UN-HABITAT's further work in this field and calls on governments, amongst others, to widen the geographical scope of the ongoing work on cities and climate change and to expand the range of capacity-development approaches in order to support local authorities in addressing climate change.

UN-HABITAT Work related to Climate Change

UN-HABITAT has embarked on developing a strategy on Climate Change to institutionalize concrete and practical support to local governments, city networks and associations, among others, to address climate change and its implications at local, regional and global levels.

Key concern for UN-HABITAT is the achievement of better management of urbanization to prevent uncontrolled urban sprawl, pollution and unsustainable consumption of land, water and other natural resources, that accelerates environmental degradation and the negative impacts of climate change.

This broad approach towards climate change action is meant to contribute to the overall aim of achieving decentralized, reactive, livable, productive and inclusive cities, towns and villages through an ecologically sound growth that is people-centric and embraces social harmony, economic vitality and environmental sustainability.

For this reason, climate change is addressed across the agency and within its different focus areas. At the same time, the

agency is engaged in the UN-wide efforts.

In order to maximize synergies and reduce wastages of resources, concrete approaches for synergies and strategic partnerships are being developed between UN-HABITAT and other UN bodies[8], building on the common UN rationale which recognizes the increased vulnerability of human settlements as one key impact of climate change.

Besides UN agencies, it is important for UN-HABITAT to cement existing partnerships, and forge new ones within government, non-governmental organizations, educational establishments, scientific institutions and financial bodies that have the collective resources, infrastructure, expertise and the financial power. Through such involvement, it will also be possible to sensitize and enlist the support of the general public and informal communities, including the youth and women, to mitigate and adapt to climate change.

Key among such partners are the associations of local governments at global and regional level, specialized non governmental organizations and professional associations.

The Framework for Action: the Cities and Climate Change Strategy

Four key strategic areas have been identified through consultation with partners and building on the past experience in promoting sustainable urbanization. These key strategic areas are listed below:

Policy Dialogue and Advocacy: promoting the crucial role of cities in climate change strategies at global as well as national level; advocating for the consideration of the extreme impact of climate change on the urban poor, youth and women**;** promoting the participation of cities in national and international dialogue and policy making**;** and including ministries of housing and construction in such dialogue.

Institutional Strengthening: strengthening capacities in promoting pro-poor clean and affordable technological options; promoting innovative approaches to urban

Table | Climate Change Across UN-HABITAT Focus Areas

Focus Area
1 *Advocacy, monitoring and partnerships* in promoting sustainable urbanisation through education, communication, evidence-based information through data collection and analysis, policy dialogue and strategic partnerships
2 *Participatory urban planning, management and governance* to strengthen the performance of national governments, local authorities and other stakeholders to engage in developing more liveable, productive and inclusive cities.
3 *Pro-poor land and housing*: assisting national governments and Habitat Agenda partners to adopt pro-poor, gender and age-sensitive housing, land management and property administration through enabling policies and improved regulatory frameworks
4 *Environmentally sound basic infrastructure and services* to expand access to, and to sustain provision of, adequate clean water, improved sanitation, waste management, and ecologically sound transport, energy and appropriate technologies in urban and suburban areas.
5 *Strengthened human settlements finance systems* to improve access to finance for housing and infrastructure, particularly for the urban poor. Innovative finance mechanisms and institutional capacity will leverage the contributions of communities, local authorities, the private sector, government and international financial institutions.
6 *Excellence in management* to improve the effective implementation of the organisation's work through Results-based Management, improved communication, and better financial, human and knowledge management systems.

Climate Change Interventions

- Climate data collection and assessment, appropriate age sensitive climate change pre-assessment.
- Global advocacy on the role of cities in climate change, in collaboration with other international organizations.
- Involvement of local institutions in promoting sustainable urbanisation and advocating appropriate climate impact strategies through policy dialogue.
- Partnerships with youth and women organizations to enhance community involvement and contribution.

- Promote policy dialogue and innovation for the incorporation of climate considerations within laws applicable to urban planning and management
- Strengthening of governance structures and the institutional capabilities of national and local administrations for adaptation and mitigation

- Planning and building regulatory frameworks; legal framework of land use and a wide range of areas where land legislation and policies impact on climate change
- Addressing land degradation and desertification in connection with droughts, floods, erosion, sea level rise and inundation, as well as induced migrations.
- Developing new and appropriate technologies for building materials, efficient energy production and use and renewable energy resources.
- Pro-actively integrate climate change adaptation and mitigation elements in settlement planning and shelter reconstruction

- Basic infrastructure and services including storm water drainage, water and sanitation, waste management, road design, efficient and renewable energy, transportation, city biodiversity and ecosystems are highly relevant for climate change adaptation and mitigation strategies.

- Leveraging new sources of finance to support climate change strategies and actions.
- Providing the support necessary for strengthening capacities in promoting pro-poor clean and affordable technological options through education and training on climate change mitigation and adaptation strategies.
- Supporting activities to address green economy concerns.

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planning and management based on a participatory decision-making approach; conducting vulnerability assessments and risk mapping at the local level; expanding the range of capacity-development approaches in order to support local authorities in addressing climate change; and providing support to the building design and construction sectors aiming at mitigating climate change.

Promoting Innovative Implementation Partnerships: strengthening existing cooperation with the United Nations Framework Convention on Climate Change, with other UN agencies and with Cities Associations on issues of cities and climate change; facilitating cities' access to financial resources for urban mitigation and adaptation including utilizing the Clean Development Mechanism in the construction sector in developing countries; and exploring new partnerships with the private sector and with networks of community based organizations

Awareness, Education and Networking: fostering the implementation of awareness and education strategies targeting the general public including the youth and women, formal education and continued learning institutions; increasing awareness of the role of cities in addressing climate change, with particular emphasis on the impact of climate change on the urban poor and in achieving the Millennium Development Goals for sustainable development; encouraging Habitat professionals to integrate climate concerns in architectural design, urban planning, environmental technology, financial management and local economic development; and collecting and sharing case studies on good practice, amongst others, on promoting energy efficient buildings and settlement structures and on mechanisms to assist cities in preventing land-use conflicts arising from relocation of human settlements.

UN-HABITAT Activities on Cities and Climate Change

Climate Change is definitively an issue that calls for an integrated and multidimensional approach, where mitigation and adaptations measures are equally important are addressed through advocacy, tools development, networking and capacity building. Therefore, UN-HABITAT's work on climate change cuts across the focus areas of UN-HABITAT Medium Term Strategic and Institutional Plan (2008-2013). Some planned and ongoing activities that relate closely to urban planning are the following:

The Global Report on Human Settlements 2011 focusing on **Cities and Climate Change** will be an important endeavor aimed at improving evidence-based knowledge, among Governments and Habitat Agenda Partners, on current conditions and trends with respect to the links between cities and climate change, and how cities can mitigate and adapt to climate change impacts. The report will identify and highlight effective city level policy responses to climate change that need to be promoted.

The **World Urban Campaign** is a new systemic approach towards partnership, advocacy and networking, through unique and periodic events (such as World Habitat Day and the World Urban Forum); the publication of magazines and reports and the development of television content and educational tools. Cities and climate change will be one of the key entry points for the Campaign.

In the area of participatory urban planning, management and governance, the **Sustainable Urban Development Network (SUD-Net)** is a global network of partners designed to further the understanding and application of the principles of sustainable urbanization, at global, regional, national and city levels. Within SUD-Net, the **Cities and Climate Change Initiative (CCCI)** aims at enhancing climate change mitigation and preparedness of cities in developing countries. This initiative aims to enhance policy dialogue between various levels of government with a view to improv-

ing strategic response with a clear urban dimension. It also provides support to selected local governments and encourages innovation and reform. The initiative has a strong awareness, education and capacity development component, focusing on tertiary learning institutions and professional associations.

UN-HABITAT aims to integrate climate change concerns in its **urban planning** work, building on past experience with the Localising Agenda 21 Programme, the Lake Victoria City Development Strategies and spatial planning initiatives and various other technical cooperation activities. Introducing strategies for responding to climate change in cities will not be possible without viable and appropriate urban planning systems.

The strengthening of **urban governance** structures and of adaptive capacities of governments and communities as well as their preparedness and responsiveness is a key ingredient for ensuring effective responses to climate change. This involves detecting institutional gaps and needs, within local government, and in its relationship with citizens and other spheres of government.

UN-HABITAT is also strengthening the emphasis on climate change in **other areas of work**, including sustainable buildings and construction, post-disaster shelter reconstruction, urban transport, urban energy, review of building regulations, and climate change adaptation in the water and sanitation sector.

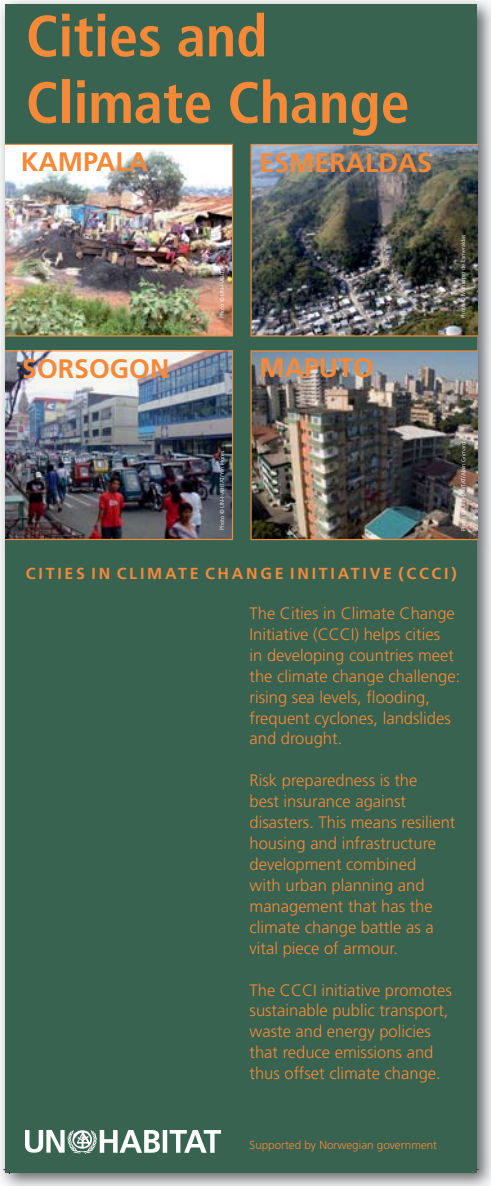


Figure 11 | Pilot Cities - Cities and Climate Change Initiative

Way Forward

UN-HABITAT is committed to further incorporating climate change concerns into its work, recognizing that the rethinking of the built environment, services and urban activities is crucial to respond to climate change.

It will also focus on building local government capacity to design and implement adaptation and mitigation strategies through sound urban planning, management and governance, and to participate in the national and international debate, as the key to making innovations in services, building technology and transport, vital elements of more sustainable and equitable cities.

The urban planning profession has a lot to contribute to these reflections and efforts and is called to take up this challenge and devise mechanisms to continue interrogating itself on its role and impact. •

1 This article draws on key elements of the UN-HABITAT Climate Change Strategy, 2nd Draft, August 2009 as well as parts of the UN-HABITAT (2009) Global Report on Human Settlements– Planning Sustainable Cities, London, Earthscan

2 HM Treasury (2006) ***Short Executive Summary: Stern Review on the Economics of Climate Change***, Cambridge University Press, Cambridge, www.hmtreasury.gov.uk

3 UN-Habitat (2007) ***Enhancing Urban Safety and Security: Global Report on Human Settlements 2007***, Earthscan, London, www.unhabitat.org/grhs/2007

4 This argument was strongly made at the joint meeting of the UN-Habitat World Urban Forum and the World Planners Congress in Vancouver in June 2006, where it was suggested that the profession of urban planning needs to be reviewed.

5 UN-Habitat (2009) ***Planning Sustainable Cities: Global Report on Human Settlements 2007***, London, Earthscan

6 A/63/221, Op. Para 3; December 2008

7 HSP/GC/22/CRP.3/Rev.1, 3 April 2009

8 In particular, United Nations Environment Programme (UNEP), the United Nations Development Programme (UNDP), the Intergovernmental Panel on Climate Change (IPCC), the World Bank, the Cities Alliance, the Global Environment Fund (GEF), the United Nations Framework Convention on Climate Change (UNFCCC), the World Meteorological Organization (WMO), the United Nations Food Programme (UNFPA) and United Nations Children's Fund (UNICEF)

Martin Dubbeling
Michaël Meijer

The Netherlands 2020

Boundless Policies towards Low Carbon Regions and Cities

Introduction: The Dutch Context

The Netherlands is a densely populated, low-lying coastal country and besides that it is the delta of the rivers Rijn, Maas and Schelde. There are also many smaller rivers and some 3000 polders. The metropolitan area 'Randstad', the heart of the Dutch economy, is largely situated below sea level. All these factors make our country vulnerable to rises in the sea level and periods of extreme rainfall or drought. The history of the Netherlands is characterized, among other things, by the 'struggle against water'. The prognosis of the rise in the sea level due to climate change has made the Netherlands sit up and pay attention. Alongside the existing *mitigation* policies (reducing greenhouse gas emissions), *adaptation* policies (reducing vulnerability and risks that arise from climate change) are now being developed. The Netherlands must also confront an approaching energy problem. Since 1960, the extraction of gas from underneath Dutch soil has greatly stimulated the economy and made the country relatively independent in the supply of its own energy needs. It is estimated that the Netherlands can draw on its gas reserves for the next 20 years. After this time, it wants to continue to supply its own gas requirements while continuing to play an important role in the supply of gas in Europe. To achieve this in a sustainable and durable way an *energy transition* (switching from fossil to sustainable energy) was formulated several years ago.

Boundless Policies

With these policies on mitigation, adaptation and energy transition, the central government would appear at first glance to react adequately to the climate issue. The Dutch government endorses the global and European climate treaties and also the resulting objectives. Through its climate policy, the Netherlands even aspires to act as an example in Europe. However, it is doubtful whether the Netherlands will be able to meet its own targets with the current efforts, let alone achieve the tougher targets that will likely be decided at the coming climate summit in Copenhagen. If the central policy is studied more closely and the results of previous efforts are analysed, it would appear that a great deal of work still needs to be done.

Much more effort is required before the Netherlands can actually develop in a way that it can become climate-proof in the very long term, will be protected against flooding and will remain an attractive place for investment and a healthy place to live, work and recreate. To achieve this, new policy is required at various levels; from national level, regional level, urban regional and city level, district level, down to the level of housing estates and industrial estates. This new policy needs to be boundless; boundless in the sense of looking beyond the limits of regional or urban areas, working on ideas and projects that break new ground and representing interests that go further than the borders. Certainly, the Dutch government has made a start with its (recent) policies for mitigation, energy transition and adaptation, but it is not enough. Fortunately certain regions, provinces and cities in the Netherlands have developed their own poli-

cies and plans which go beyond the national policies.

There even seems to be a race between various local authorities to become the most sustainable region in the Netherlands. Countless news items can be found on the Internet from towns claiming to be the most sustainable, whether it be in a specific area such as sustainable procurement, a sustainable housing estate or the reduction of CO_2 emissions in the entire municipality. Specific joint agreements on this exist at European level. Thirteen larger Dutch towns have pledged, via the European 'Covenant of Mayors' [1], that they will have reduced their CO_2 emissions by more than 20% in 2020 through a formal commitment to go beyond this target with the implementation of their Sustainable Energy Action Plan. The cities of Amsterdam, Rotterdam, Utrecht, Den Haag, Haarlem, Den Bosch, Delft, Heerlen, Helmond, Zoetermeer, Breda, Nijmegen and Tilburg have already signed up. Amsterdam was one of the eight finalists for

Illustrations: Examples of past end present "energy landscapes" in The Netherlands. From top to bottom: the Loosdrechtse Plassen remained after the exploitation of peat in the 16th century, the Beemster Polder was pumped dry with windmills in the 17th century, late 20th windmills in the Flevo Ploder and the storage of natural gas in emty gasfields in Langelo (Pandion, Peter van Bolhuis).

the European Commission's Green Capital Award 2009 [2]. The provinces in the Netherlands also pay attention to the reduction of CO_2 emissions. The cars of the Province of Utrecht drive on green gas and the province gives climate subsidies to companies, municipalities and foundations that develop or share knowledge and techniques for mitigation and adaptation. Four other more northerly provinces even work jointly on this issue under the name Energy Valley.

The policies and plans of the region Energy Valley and the cities of Amsterdam, Rotterdam and The Hague are well documented and will be explained in this paper. Before we expand on these promising local policies, we will explain the national policies on adaptation, mitigation and energy transition and the criticism that exists on this. This paper will look at the approach of the Energy Valley region in particular. It is on such a regional scale, that the Netherlands is best able to effectively respond to the climate problem.

Dutch Adaptation Policies

The 'Delta committee 2008' was asked by the government to advise on how to protect the Netherlands against the consequences of climate change. In its vision, the Delta Committee also addresses the relationship between housing and employment, agriculture, nature, recreation, the countryside, infrastructure and energy. Security and sustainability are the two pillars for the strategy in the coming centuries [3]. Besides protection from water, the committee's advice emphasizes and points out opportunities for Dutch society. The urgency of the advice and its implementation is considerable. The Netherlands has a lot of catching up to do because it does not meet the current standard on acceptable flood risks. Furthermore, these standards have been superseded and should be adjusted upwards. On top of this, the climate is changing quickly, the sea level is probably rising faster than was first thought and it is expected that fluctuations in river outflow, sometimes extreme, will increase. The interests of the Netherlands in areas like the economy, social aspects and nature are significant and will continue to increase; if a dike were to burst, the resulting disruption would be tremendous. The Delta Committee takes the view that we must be prepared for an increase in the sea level measuring 0.65 to 1.30 metres in 2100 and between 2 and 4 metres in 2200.

The Dutch adaptation policy does explicitly consider spatial planning. In 2006 the ministries for Housing, Spatial Planning and the Environment (VROM), Transport, Public Works and Water Management (VenW), Agriculture, Nature and Food Quality (LNV) and Economic Affairs (EZ), together with umbrella organisations for the Dutch provinces and municipalities and district water boards, launched the programme 'Adaptation to Climate Change in Spatial Planning' (ARK). The parties aim to make the Netherlands climate-proof, an aim that is expected to be one of the greatest challenges in spatial planning in the twenty-first century. An important impetus for the ARK programme was a parliamentary motion dated 2005 which requested the government to develop a long term vision on spatial planning in the Netherlands [4]. Furthermore, spatial planning investments do not take sufficient account of the consequences of climate change, such as the rise in the sea level and increased outflow from rivers. In 2007 the cabinet established the National Adaptation Strategy [5]. The National Adaptation Agenda, which will contain concrete projects to be carried out, will be presented in 2009. Then it's also possible to debate the effectiveness of the adaptation policy.

Dutch Mitigation Policies

The mitigation policy of the Netherlands is linked to EU policy and aims at a 30% reduction in the emission of greenhouse gases by 2020, compared to 1990. This objective is in agreement with the course outlined by the IPCC in 2007 to limit the rise in the temperature since 1990 to 2 degrees Celsius. Besides this, the Netherlands aims to have 20% renewable energy by 2020. In the long term, up to 2050, the European Parliament advised on 4 February 2009 that the emission of CO_2 must be 80% lower than in 1990. The Dutch government has drawn up policy for 2050, but has not yet set definite targets. These depend partly on the results of the climate change summit in Copenhagen.

The Dutch mitigation policy on climate change in the short term, up to 2020, was formulated in the 2007 'Clean and Efficient'

programme [6]. This programme was headed by the Ministry of Housing, Spatial Planning and the Environment (VROM) and implemented in cooperation with the Ministries of Economic Affairs, Transport, Public Works and Water Management, Agriculture, Nature and Food Quality, Finance and Foreign Affairs. By applying market incentives, standards, innovations and temporary incentives, the government wants to steer five sectors towards achieving climate targets. Examples of activities carried out, or intended to be carried out by the relevant Dutch ministries, in each sector are given below. These sectors are Industry and Energy, Traffic and Transport, the Built Environment, Agriculture and Horticulture and Other Greenhouse Gases.

Small-scale sustainable energy generation in the sector of **Industry and Energy** will be stimulated with limited specific subsidies and fiscal measures in 2008. New combined heat and power systems have been encouraged from 2008 onwards. Hot water supply in buildings and industry is to be made more efficient from 2008 onwards. Extra wind turbines are to be located on land and at sea between 2008 and 2011. The use of sustainable biomass and biofuel will be increased from 2008 onwards. The energy infrastructure will be improved before 2011. Fossil energy is to be made as clean as possible through the capture and storage of CO_2 from 2012. In the case of large-scale, energy-intensive industries, the emission trading system (ETS) will be applied.

There will be a greater use of sustainable bio fuels and other climate neutral fuels by 2020 in the sector **Traffic and Transport**. A target of 20% will be discussed. Kilometre pricing and volume policies will be introduced in phases until 2020. The energy efficiency of vehicles will be improved in phases until 2020. Changes in attitude concerning passenger and goods transport have been stimulated from 2008 onwards. In the sector of the **Built Environment**, ex-

Box 1: How much CO_2 is emitted in the Netherlands?

In the Netherlands, 210 to 220 Mt* CO_2 is emitted each year. In 1990 this figure was 215 Mt; in 1996 it peaked at more than 230 Mt CO_2; in 2005 the figure was 212 Mt CO_2. The current Dutch climate policy is founded on the reduction of greenhouse gas emissions, and in particular CO_2. By 2020 the level must be thirty percent lower than it was in the reference year 1990. This translates into an emission level of 150 Mt CO_2 in 2020. If no adjustment was made to policy, the level in 2020 would be 245 Mt CO_2. The intentions of the G-8 countries and agreements reached in Copenhagen will perhaps necessitate a reduction of 50% by 2020 and 80% by 2050 for industrial countries. For the Netherlands this would then be 110 Mt CO_2 by 2020 and 45 Mt CO_2 by 2050.

In 2005 the emission was 212 Mt CO_2. Of this amount, 29 Mt CO_2 was attributed to the built environment, 101 Mt CO_2 to industry and the generation of electricity, 39 Mt CO_2 to traffic, 7 Mt CO_2 to agriculture and 36 Mt CO_2 was made up of other greenhouse gasses (H_2O(g), CH_4 en O_3). According to the government's programme Clean and Efficient, in 2020 this figure must be 150 Mt CO_2, which will be comprised of 15 to 20 Mt CO_2 from the built environment, 70 to 75 Mt CO_2 from industry and the generation of electricity, 30 to 34 Mt CO_2 from traffic, 5 to 6 Mt CO_2 from agriculture and 25 to 27 Mt CO_2 from other greenhouse gasses.

* One Mt (Megaton) equals one billion kg or one million tonnes.

isting housing will be provided with an energy label and made more energy efficient as of 2008. Energy performance standards (EPC) will be gradually increased in new buildings until they become energy neutral by 2020. The generation of sustainable energy in existing buildings will be stimulated through the provision of subsidies from 2008 onwards. Agreements with housing corporations will be entered into regarding improvements in energy performance in rented accommodation as of 2008.

Energy consumption and the emission of greenhouse gases in the sector of **Agriculture and Horticulture** will be reduced between 2008 and 2011 by using more efficient techniques and fermentation. From 2008 onwards, the agricultural processing industry will save energy by implementing innovations. In the greenhouse farming industry, energy-saving techniques will be applied between 2008 and 2011. Greenhouse farms and other functions will be clustered together to develop the 'energy generating' greenhouse as of 2010. Emissions of **other greenhouse gases**, such as nitrous oxide and methane from the chemical, agricultural and other sectors, will be limited from 2008 onwards. From 2008 onwards, the possibility of taxes on the gases HFC (fluorocarbon) and SF_6 (sulfur hexafluoride) will be considered.

The Dutch Energy Transition

In the long term, up to 2050, the Netherlands is working on a programme called 'Energy Transition'. Energy Transition originated from the fourth National Environmental Policy Plan in 2001 and its objective is to bring parties together and combine know-how [7]. It deals with the streamlining of legislation and regulations and the provision of financial support to viable projects. In the coming years, the Netherlands wants to develop into an 'innovative engine' in order to achieve the transition towards a system of sustainable energy management. This ambition will be supported in the long

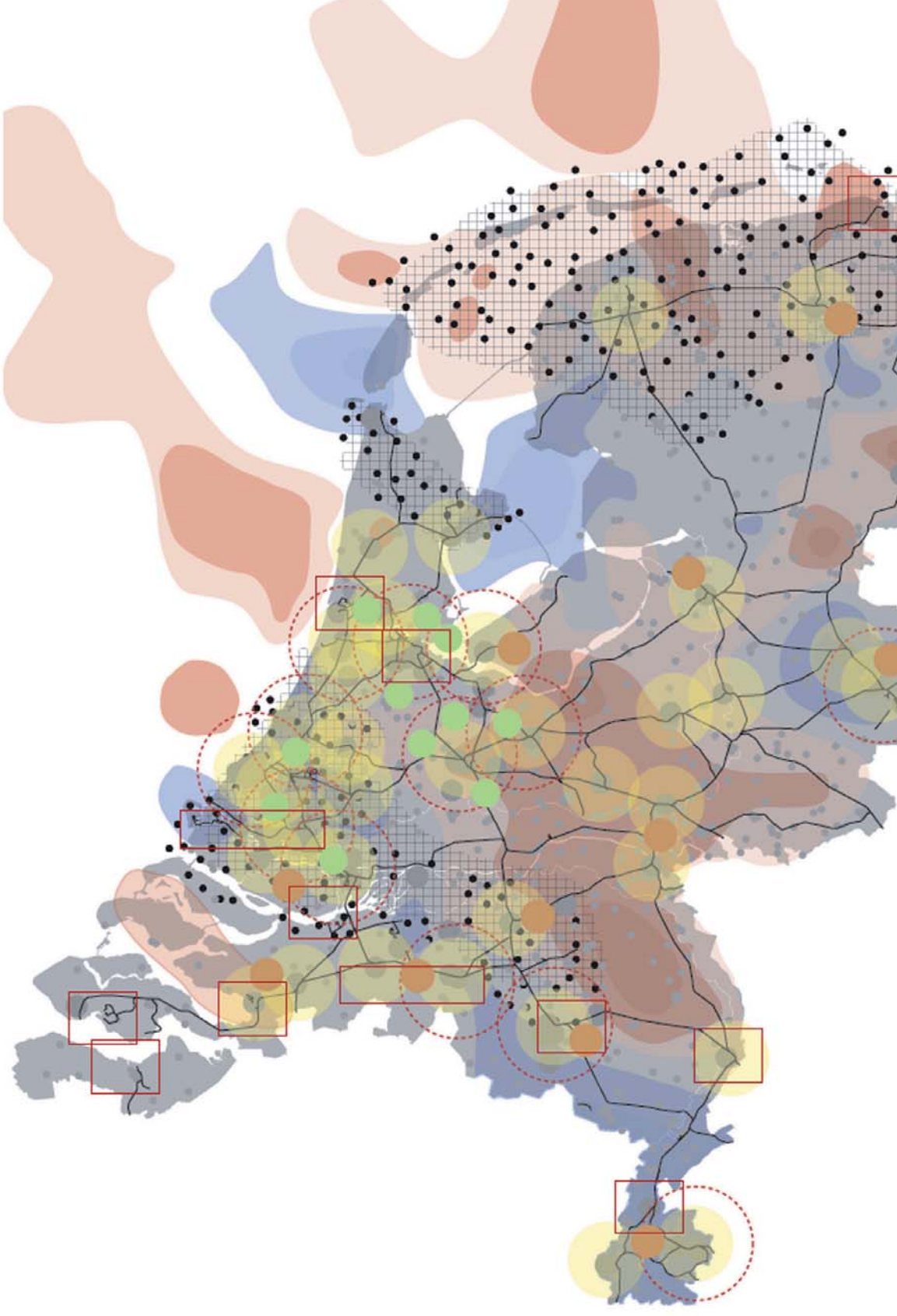
Box 2: Definitions and ambitions

The following three ambitions are often voiced in the Netherlands: CO_2 neutral, climate neutral and energy neutral. These terms are often used interchangeably as if they mean the same thing, though this is most certainly not the case. CO_2 neutral is understood to mean: a situation where fossil energy consumption (and related CO_2 emissions) measured throughout a year is no more than zero and no energy is consumed that is not put back into the system from a renewable source. Climate neutral refers to a situation where the above definition of neutrality encompasses all greenhouse gasses. Energy neutral goes one step further because in this case the total energy requirements of a company or a whole area must come from renewable sources and the storage of CO_2 in new forestry areas or underground is not permitted.

term through cooperation between the government, the business sector, institutes of knowledge and social organisations. Ensuring that our energy supply becomes sustainable is a global process. The Netherlands recognizes the opportunity to participate in this process. If the country were to miss this opportunity, it will lose out on economic activities in the coming years. In the long term it will have to pay and continue to pay for an out-dated energy system.

The ultimate objective of the Dutch Energy Transition is rather vague: “A fully sustainable energy supply by 2050 in the Netherlands. Renewable energy sources will then supply the majority of our energy. The emission of waste products will be in balance with what the ‘system earth’ can absorb.” The Transition action plan will be amended annually according to current developments and new insights. Besides a technological component, the plan also has a clear social component that will require a substantially new attitude in society towards energy production and consumption and that will lead to different and new relationships. The Energy Transition programme is split into seven platforms: Mobility, Bio-based raw materials, Chain Efficiency, New Gas, Sustainable Electricity Supply, Built Environment and Greenhouses as Energy Source [8].

Illustration: The Netherlands becoming CO_2-neutral according to Posad and Except is the result of many different projects like exchanging waste heat in industrial areas and using geothermal energy (Posad and Exept, 2009).



Critics of the Dutch Mitigation Policies and the Energy Transition

The above mentioned mitigation and transition plans would seem to address a broad scope of climate issues in the long term, although they seem to lack much commitment. Various parties in the Netherlands are even quite critical of the government's policies. Among other things, they have considered the present state of the country's knowledge infrastructure and the probability of success if this course of action is adopted.

In May 2009, at the request of the Ministry of Housing, Spatial Planning and the Environment (VROM), the agencies Posad and Except published the strategic study 'CO2040', on the Netherlands becoming CO_2 neutral by 2040 [9]. The study indicates that the measures the Netherlands will take to become CO_2 neutral within thirty years, will have to be far more wide-reaching and far more radical than they are at present. Firstly, we need to make clear how much energy we - society, households and individuals – actually consume and how much CO_2 we produce. The study also demonstrates that the serious objective of achieving a CO_2 neutral built environment will require far more than merely the application of standard measures and technologies such as lowering the EPC of individual (new) houses. Spatial planning and the choice of locations for functions and buildings must be geared to a far more intensive and intelligent use of residual heat and geothermic conditions in urban areas. In addition, the study calls for a revolution in the field of public transport. As an example, they point to the scope and the reliability of the metro network in Stockholm compared to the public transport network in Dutch urban regions.

Figures provided by Statistics Netherlands (CBS) also demonstrate that the underlying situation with regard to 20% sustainable energy by 2020, for example, is not satisfactory. In 2006 only 2.7% of the total energy consumption in the Netherlands came from renewable energy sources. This is significantly lower than the 'EU-15' average which was 6.8% in 2006. [10] The Netherlands Environmental Assessment Agency (PBL) and the Netherlands Energy Research Centre (ECN) predicted in 2008 that under the current policy, only 7% sustainable energy will be used in the Netherlands by 2020 [11]. The two advisory bodies mentioned above also cooperated via the Platform Communication on Climate Change (PCCC) with three Dutch universities, the Royal Netherlands Meteorological Institute (KNMI) and the Netherlands Organisaton for Scientific Research (NWO) to produce the report 'The state of the climate 2008'. This report is critical of the Dutch cli-

Illustration:
The Energy Valley Region

mate policy. It places a few question marks against the technology for CO_2 Capture and Storage (CCS). This technology has not yet been sufficiently developed for large-scale deployment and could be at the expense of investments involving energy saving and renewable energy. In spite of this, the government continues to pursue this technology in order to achieve its objectives and even to justify the current development of two coal-fired power stations [12].

The Energy Valley Region

The region known as Energy Valley comprises the provinces Friesland, Groningen and Drenthe and the northern half of the province Noord-Holland. Since the extraction of natural gas 50 years ago, this northern region of the Netherlands has developed a substantial energy sector with 400 companies, 25,000 jobs and 350 projects being developed in both the public and private sector [13]. In October 2007, Minister Van der Hoeven of Economic Affairs and Minister Cramer of the Ministry for Housing, Spatial Planning and the Environment, signed an energy agreement with the provinces of the Energy Valley. This agreement is based on the objective of 40

to 50 Petajoules sustainable energy and a 4.5 Megaton reduction in CO_2 emissions by 2011. This is to be achieved by implementing a wide range of projects in the built environment involving energy infrastructure and storage. By doing this, the region will make a substantial contribution to the achievement of the national objectives on climate and energy by 2020. The main objective of Energy Valley is to reinforce the economy and employment prospects in the north of the Netherlands by further stimulating sustainable energy activities. The emphasis is on energy conservation, the production of clean fossil energy, the development of sustainable mobility and new energy technologies.

Achieving environmental advantages, such as the reduction of CO_2 emissions, is not an objective in itself, but a welcome consequence of the sustainable energy economy. Energy Valley does not only address and implement the national energy transition policy, but it also has the ambition to develop into an internationally leading energy region through its integral approach to conventional energy activities, knowledge, innovation and energy transition. In addition, the organisaton representing Energy Valley functions as an information centre and intermediary for businesses, government bodies and institutes of knowledge. One of the most interesting working themes of Energy Valley is the Smart Power System. A broad syndicate of companies and institutes of knowledge is working on the enhancement of efficiency and intelligent linking of the many small decentralized energy generators in the north of the Netherlands. Electricity generation by a combination of wind turbines, cogeneration and solar energy jointly form a potential power station. Important features of the Smart Power System are the large-scale introduction of the High Efficiency Boiler and the development of a Smart Power Grid. The High Efficiency Boiler is a steam producing central-heating boiler which, compared to current technologies, gives a saving on energy costs and which can achieve a substantial reduction in CO_2 emissions. The Smart Power Grid is an intelligent and fine-meshed electricity network that links energy generators and energy consumers. The Energy Valley is involved in the development of applications for the Smart Power Grid, tests them in practice and deploys them on a large scale in five large housing estates.

What makes Energy Valley so interesting is the way in which a whole region of the country on the one hand, and the business sector on the other hand, both benefit from the boost to the economy as a result of initiatives from Energy Valley. Opting for the largest possible scale and actively searching out favourable combinations of existing activities and new technology has led to forces combining to form a joint identity that stimulates the imagination. This insight shows us that effective energy policy goes hand in hand with economic development and does not automatically stop at the administrative and governmental borders of towns, municipalities and provinces. The large-scale wind farms at sea, in the northern area of this region, the three new power stations at Eemshaven and the development of the regional Energy Transition Parks illustrate that Energy Valley represents a powerful economic structure. Den Helder, Harlingen and Delfzijl are the designated home ports for the construction and maintenance of wind farms at sea. The three power stations will deploy the latest techniques in the area of Carbon Capture and Storage (CCS), achieved among other things by the application of pre combustion. During pre combustion, fuel is first converted to CO_2 (carbon dioxide) and H_2 (hydrogen). H_2 is passed to the gas turbine and CO_2 is separated, captured and stored in empty gas fields. In the regional Energy Transition Parks, businesses and institutions exchange flows of energy and heating. This is done, for example, in the south east of the province of Drenthe where links are set up between the renewed oil extraction in the old oil field at Schoonebeek, the

exploitation of soil warmth, greenhouse farming in the region and building work at the Noorderdierenpark Zoo in Emmen.

The Energy Valley Foundation was set up in 2003 by the government, the business sector and knowledge institutions to develop the economy and increase employment opportunities in the energy sector in the north of the Netherlands by applying sustainable innovations that are linked to regional opportunities. It supports initiators by assisting them in setting up projects, finding partners for cooperation and obtaining access to available funding. The Foundation receives financial backing from sources including the European Community, the Ministry of Economic Affairs, the four provinces concerned and the four biggest municipalities in the north: Assen, Groningen, Emmen and Leeuwarden. The purpose of Energy Valley is to reinforce the economy and increase employment opportunities by stimulating more energy activities in the north of the Netherlands. Its objective is to steer the region towards becoming a prominent international energy region through an integral commitment to conventional energy activities, energy transition, knowledge and innovation. To achieve this, Energy Valley functions as a contact and intermediary for businesses, government bodies and knowledge institutions.

When conventional energy activities and energy transition are combined with businesses, government bodies and knowledge institutions that act together, the result is a remarkable number of initiatives and insights. For example, the gas fields in the north of the Netherlands that will soon be empty are to be used for the temporary storage of gas that is extracted elsewhere. Besides this, the gas fields are used to store large amounts of CO_2. Yet another initiative is the overlap of energy

Illustrations: The Oosterdokseiland is one of the metropolitan projects with which Amsterdam presents itself as a leading city in sustainability (Bouwfonds MAB Ontwikkeling, Erick van Egeraat Architects, CIIID Visualisations).

production from fossil sources and from biomass. Biogas still needs to be generated to be added to the natural gas network. The use of so-called “Green Gas” from biomass in pipes where until recently only natural gas flowed, will quickly increase in volume. Not only will many agricultural business that are established in the north of the country profit from this, but also businesses that have organic waste products.

‘Amsterdam, leader in sustainability’

At present, Amsterdam has two main climate-related objectives. It is aiming for a 40% reduction in CO_2 emissions for the entire city by 2025 compared to 1990. The municipal organisation itself will be climate neutral by 2015. In the ‘Environment Plan Amsterdam 2007-2010, Amsterdam: leader in sustainability’ dated April 2007, climate policy is considered together with policy in the areas of air, sound, sustainable consumption and manufacture, soil and public

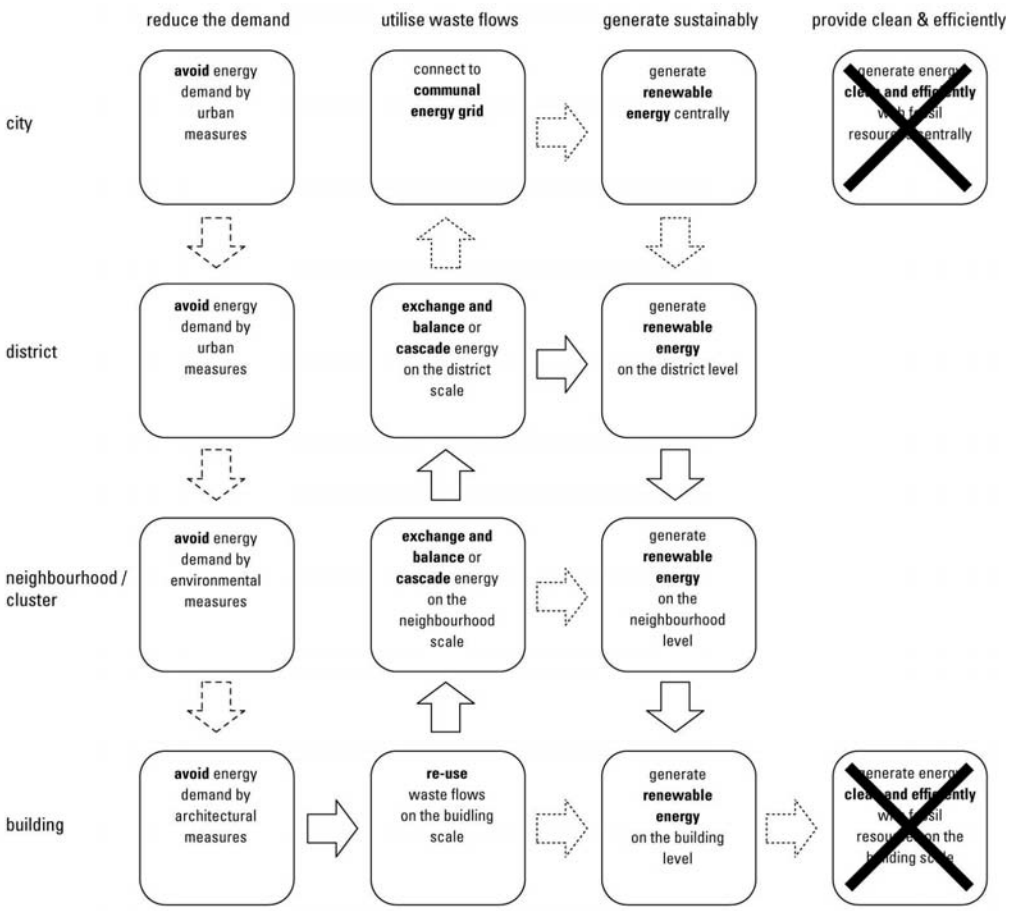


Illustration: Diagram of the REAP methodology (DSA Doepel Strijkers Architects and JA Joubert Architecture)

parks [14]. The objective is a clean, compact, healthy and liveable city. As part of the Clinton Global Initiative, Amsterdam has been cooperating since 2007 on a programme called Connected Urban Development. The measures should be reproducible in other cities and countries. In the report 'Amsterdam's new climate' dated August 2008 [15], the achievements up to now of the current climate projects are outlined and new projects are listed that the city has planned or set up in cooperation with business and social organisations since 2007. These include enhancing the efficiency of city buildings, street lighting and council vehicles and using sustainable energy.

In cooperation with key parties in the building sector, Amsterdam will make 40% of its newly built houses climate neutral by 2010 and 100% by 2015. To achieve this, standard building procedures will be amended. When the development of an area com-

Box 3: Serious business or window dressing ?

For a city that wants to brand itself as a vital and exiting city, it is sometimes hard to be unequivocally consistent with its own policies and ambitions. Once a year, racing cars such as Formula One cars, parade and race on a 4.600 m long racing track in the streets of down town Rotterdam. On this track the former Formula One driver David Coulthard and the twofold world champion Fernando Alonso raced their Formula One cars with at speeds of up to 250 km/h (150 mph) through the streets of Rotterdam. This popular burning rubber event attracts half a million visitors, among which was prime minister Jan Peter Balkenende, who in August 2009 opened the fifth Bavaria City Racing event with the mayor of Rotterdam, Ahmed Aboutaleb, driving a Ferrari California. In its very essence, this racing event is in sharp contrast to the climate programme of the city of Rotterdam. The event is not quite an example of promoting Sustainable Mobility or the acclaimed focus on the behaviour and changes in attitude of the people who live, work or visit the Energizing City of Rotterdam. Earlier that August, researchers of the Wageningen University and Research Centre started to measure and map the city climate of Rotterdam on a carrier tricycle loaded with measuring instruments. The aim of their research is to get a comprehensive picture of the so called 'heat islands' in the city. This research is commissioned by the Climate Adaptation Programme of the city of Rotterdam. This programme also stimulates the installation of green roofs on a large scale in Rotterdam. Roof gardens have a renowned positive effect on CO_2 emissions as they insulate the building and thus save energy. In addition, the plants extract CO_2 from the air and particulate matter adheres to their surface, resulting in cleaner air. Organising a racing event and promoting green roofs at the same time raises an awkward question. Becoming a climate proof city, is it serious business or is it window dressing ?

Illustrations: City Racing and research for 'heat islands' in August 2009 in Rotterdam.

mences, an energy vision will be drawn up. This will include the best measures for that particular location concerning urban heating and cooling, underground storage of heat and cold, sustainable energy generation, favourable positioning of buildings in relation to the sun. The answers to these criteria will play a role in the award of projects to developers. In the case of existing buildings, of which only 8% were built after the implementation of the energy performance standard and 50% are owned by housing corporations, much can be achieved with CO_2 emission reduction. Agreements were made in 2009 to achieve a 31% reduction by 2018 through maintenance and renovation work. Amsterdam is as well striving for reduction in small to medium-sized businesses and in the ICT, transport, harbour and education sectors.

Illustrations: Collages of different sustainable techniques and prototypes of residential areas in Erasmusveld. Bottom left: infrastructure and biogas. Top right: autarkic clusters. Bottom right: bioclimatic high rise buildings. (Atelier 2T Architects, 2008).

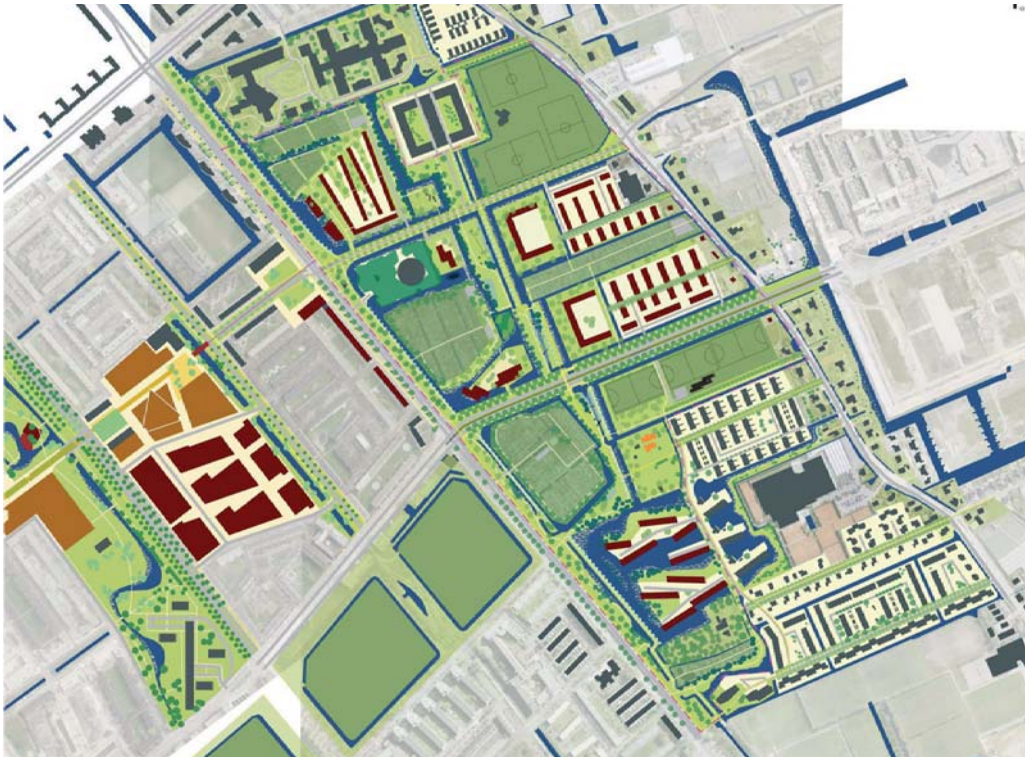

Erasmusveld
autarke
cluster


Erasmusveld
bioclimatische
toren

Illustrations: Collages of different sustainable techniques and prototypes of residential areas in Erasmusveld. Top left: intensive and dense low rise housing (Atelier 2T Architects, 2008). Top right: Ereasmusveld in The Hague, designed by H+N+S landscape architects. Bottom right: bioclimatic tower for Erasmusveld, as sketched by Atelier 2T Architects.

The Rotterdam Climate Initiative

The Rotterdam Climate Initiative is the climate programme of the city of Rotterdam. It was launched in 2006 and its aim is to achieve a 50% reduction in CO_2 emissions by 2025 compared to 1990, preparing for climate change and reinforcing the Rotterdam economy [16]. The Rotterdam Climate Initiative is founded on five pillars. The pillar Sustainable City focuses on the use of sustainable energy in the built environment. The aim is to make this built environment energy neutral by 2025. The aim of the pillar Energy Port is a harbour and industrial area that is clean and sustainable and which acts as a junction point for the collection, transport and storage of CO_2. According to the pillar Sustainable Mobility, all traffic and transport must be made as clean and sustainable as possible. The pillar Energizing City focuses on the behaviour and changes in attitude of the people who live, work or visit Rotterdam. The pillar Innovation Lab is concerned with innovation and the development of



know-how. In the international arena, Rotterdam must present itself as ***the*** city in the areas mitigation and adaptation.

One of the achievements of the Innovation Lab is a new methodology that enables designers and clients to develop a CO_2 neutral city. The Rotterdam Energy Approach and Planning (REAP) project propagates the optimum use of residual heat and waste products [17]. Its methodology links houses, shops, offices, sports facilities, schools and other amenities located in one neighbourhood to each other in order to utilize residual heat and cooling. One example is the utilization of residual heat from a supermarket or office block to heat adjacent apartments. The project also investigates the possibilities of producing biogas from residual water or waste streams of homes and gardens. According the REAP methodology, achieving an energy neutral built environment is a simple and cost effective way to tackle the climate issue, cheaper even than CO_2 storage, for example. The methodology provides a step-by-step procedure to make all housing estates in the Netherlands energy neutral.

The Hague, the 'Sustainable Global City by the Sea'

The Municipality of The Hague is on the verge of a large-scale operation to ensure that the city becomes climate neutral by 2050. The Hague has the best prospects of all the cities in the Netherlands to become climate neutral, because it is situated on the coast and it has the most hours of sun and wind. Below the city there are endless opportunities for the extraction of geothermal energy. In the recent paper 'The Hague: towards sustainability' sustainability has become one of the pillars of 'Global city by the sea' [18]. This is an enthusiastic spatial vision that has given the city great self-confidence and a new identity. The Hague is an internationally orientated city and wants to achieve a global climate improvement with these objectives. This is to be achieved with six wide-ranging, integrated themes: the council as a sustainable organisation; energy; urban development; public areas; mobility; and the international city The Hague.

The achievements in The Hague can be seen in Duindorp, a redeveloped residential estate situated in the dunes at Scheveningen, between The Hague and the North Sea. Around 800 newly built houses in Duindorp utilize the temperature of the seawater for heating - a world première. One of the recent spearheads of the city is the future residential estate Erasmusveld which will have 600 to 800 houses [19]. The office Atelier 2T Architects was assigned by the Municipality of The Hague to broadly investigate how the housing estate could become the most sustainable residential area in the Netherlands. Under the motto 'ignorance is one of the most significant threats to sustainability', the assignment led to an encyclopaedic and visionary report on opportunities and possibilities for sustainable and self-supporting environments. Atelier 2T Architects believes that strong ambitions in the area of sustainable spatial planning can only be implemented in cooperation with new visions involving the ecological infrastructure, energy, water and waste. The numerous impressions and collages in the report 'Sustainable Erasmusveld' strikingly demonstrate that sustainability must run parallel to new and convincing urban development and architectural typologies.

Illustration: The Climate Neutral Region, one of the perspectives for the Amsterdam Metropolitan Area (Development Scenario 2040 Amsterdam Metropolitan Area, 2008).

Towards Low Carbon Regions and Cities

The studies and initiatives mentioned above demonstrate that spatial planning and urban planning can contribute significantly to climate-proof cities and a CO_2 neutral built environment. Through urban restructuring, the use of intelligent links in the local generation of sustainable energy, the utilization of residual heat and drastic improvements in public transport, it is possible to effectively reduce greenhouse gas emissions. The beckoning perspective of Low Carbon Regions and Cities is certainly attractive, but a great deal will have to happen to achieve this. Available knowledge, speed of action and a degree of enthusiasm are all areas that require attention; not only from administrators, managers, designers, engineers and builders but also from consumers. This is sometimes forgotten.

The Netherlands needs to make a number of mental leaps. You don't build a city with bricks, but with people [20]. Attention needs to be shifted away from energy efficient houses and towards energy generating housing estates. A lot is happening in the Netherlands, but the approach is more that of 'all for one' instead of 'one for all'. Cooperation and renewed concepts, innovation without restrictions and, in particular, investment in creative processes are needed for taking the next steps towards Low Carbon regions and Cities. Achieving *Low Carbon Regions and Cities* is not just a question of technology, but it requires taking a fresh look at sustainable regional development and communication with its inhabitants and its businesses - regional development and communication that are actually effective and that will help the Netherlands on its way to becoming a more sustainable society.

The road to Low Carbon Cities goes through Low Carbon Regions. The case of Energy Valley makes perfectly clear that in The Netherlands the size and scale of a region offer more opportunities than the size and the scale of a city. It justifies the questions whether the policies for 40% reduction in CO_2 emissions in 2025 (Amsterdam), 50% reduction in CO_2 emissions in 2025 (Rotterdam) or becoming climate neutral in 2050 (The Hague) make sense without a regional context. Looking for the answers

and solutions for dramatic CO_2 reductions in cities in the next decade and becoming CO_2, climate or energy neutral cities by, say 2050, you will need more than the city on its own. The network of energy will have to provide individuals, businesses and institutions with the possibility of generating and exchanging energy.

Spatial and strategic visions on a national and regional scale for The Netherlands, as described in the National Spatial Strategy [21], and the 'Randstad 2040 Structural Vision' [22], are clear and straightforward on the topic of adaptation but vague and noncommittal on the topics of mitigation and energy transition. The Randstad 2040 Structural Vision was presented as a stimulus for a Randstad Metropolitan Area that can measure up in all respects to other urban areas in Europe, while at the same time being sustainable and climate resilient. The Randstad 2040 Structural Vision is being worked out in more detail in two parts. The northern wing of the Randstad, with Haarlem, Amsterdam and Almere, is considered as The Amsterdam Metropolitan Area [23]. The southern wing of the Randstad, with Leiden, The Hague, Delft, Rotterdam and Dordrecht, is considered as the Gateway of the Delta [24]. Both wings of the Randstad could take Energy Valley as their example in how to cope with mitigation and energy transition. Similar to the Internet Revolution, the Energy Revolution might change society and the governance of regions and cities in the Randstad in particular. Smart innovations and combining sustainable energy solutions in housing with industry, agriculture, water and waste management, offshore activities and public transport systems requires changes in attitude and behaviour as well as acting and cooperation on a regional scale. •

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Richard Benner

Portland Metropolitan Region Turns a Climate Change Corner

MULTNOMAH COUNTY CARBON EMISSIONS, BY SECTOR
(Metric Tons, CO_2-equivalent)

	1990	1995	2000	2005	2006	2007
Residential Energy Use	1,770,974	1,758,764	2,015,339	1,722,750	1,772,171	1,759,674
Commercial Energy Use	1,885,692	2,036,343	2,380,636	2,086,743	2,142,319	2,132,798
Industrial Energy Use	1,540,295	1,757,799	1,935,596	1,367,695	1,398,802	1,367,204
Transportation Fuel	3,441,087	3,385,929	3,369,741	3,418,793	3,424,911	3,483,801
Waste Disposal	237,691	226,778	147,349	82,954	79,362	66,153
Total (Relative to 1990)	**8,875,739**	**9,165,613 (+3.3%)**	**9,848,661 (+11.0%)**	**8,678,935 (-2.2%)**	**8,817,565 (-0.7%)**	**8,809,630 (-0.7%)**

City of Portland Bureau of Planning and Sustainability

Figure 1 | Multnomah County Carbon Emissions, by Sector

Between 1990 and 2007, total emissions of greenhouse gasses (GHG) rose 17 percent in the U.S. In Portland and surrounding Multnomah County, during the same period, total GHG emissions dropped to 0.7 percent below the 1990 level. A three percent decline in per capita emissions nationally was overwhelmed by population growth. Meanwhile, Portland and Multnomah County grew faster than the U.S., yet experienced a 17 per cent decline in per capita emissions.[1] Figure 1

Why has Portland bucked the national trends? Those of a spiritual bent might attribute Portland's success to residents' superior virtue, noting that Portlanders own more hybrid cars per household than residents of other U.S. cities[2] and sport one of the highest recycling rates in the nation (64 per cent in 2007).[3] Descendants of settlers from the puritan Northeast U.S. may believe Portlanders' legendary frugality is responsible, citing the $2.6 billion residents save every year by commuting shorter distances.[4]

Planners of the region take a different view. Citing total and per capita emissions numbers, they contend that people of the region achieved this success by attending countless and long meetings during the cold, wet times of the year (September through June), huddled with their neighbors, contemplating the future.[5] This argument is well-received by spiritual leaders and local economists because this odd behavior suggests both higher virtue and lower consumption. The author, having spent more than 30 years in planning, most of it in meetings, endorses the planning theory: the region's growth management – from the statewide planning goals, to Metro's Growth Concept, to city and county comprehensive plans – deserves most of the credit. Growth management is changing the urban form of the region and yielding dramatically lower driving per capita.

Figure 2 | Map of Metropolitan Regions in Pacific Northwest Context

Regional Setting

The 1.4 million people of the Portland metropolitan region reside at the confluence of two great rivers of the West, the Columbia and the Willamette. Mount Hood rises to the east, with the Columbia River Gorge National Scenic Area adjacent to the eastern edge of the urban growth boundary. The Tualatin Mountains on the northwest side constitute a significant wildlife corridor between the region and the Coast Range. The region's natural beauty and bounty have cultivated among residents a fierce devotion to the landscape and the lifestyle it affords them.

Figure 2

The lush northwest forests in the larger region played a dominant role in the economy and culture of settlers, from the mid-1800s until the 1980s, when over-harvesting led to changes in federal forest policies that reduced harvest levels. The rich soils and abundant rainfall in the valley of the Willamette yield a cornucopia of crops and made agriculture the second pillar of the settler economy (agriculture now leads forestry in economic impact). The landscape and natural resources of the region led settlers to develop trade between Portland and its hinterlands and a system of navigable waterways, railroads, roads, bridges and airports to facilitate international trade. The resulting economy and culture stimulated the emergence of a regional identity that led, in turns, to regional thinking, regional governance and regional growth management.

Political Context

Metro, the nation's only popularly-elected regional government, is chartered by voters to protect the region's quality of life. But it is intentionally lodged between state and local governments, in the political middle of an overall framework that is essential to the achievement of the region's vision. In 1973, the Oregon Legislature enacted Senate Bill 100, which set the state on its unique planning course. The law requires every city

Figure 3 | Photo of edge of urban growth boundary

and county to adopt a comprehensive plan that meets nineteen statewide planning goals (which have the force of law). These goals address issues ranging from citizen involvement to housing, the economy and protection of farm and forest land.

Upon its founding in 1979, Metro, too, became subject to the statewide planning goals. For Metro, the most important is the Urbanization Goal. It requires every city and urban region to establish an "urban growth boundary" (known as the "UGB") to limit the extent of urbanization. The Urbanization Goal and the statewide goals that protect farm and forest land outside UGBs establish the fundamental growth management strategy for the state and the Portland metropolitan region.

Metro assumed responsibility for the UGB surrounding 25 cities and the urbanized portions of three counties that comprise the urbanized region. As discussed below, Metro's growth concept calls for a compact development form. The "compactness" of the region is measurably improving. It owes much of this success to three critical roles played by the state-required regional UGB: (1) ensuring that cities near the Portland metropolitan area don't sprawl onto rural land between the cities and the metro (they have their own UGBs); (2) strictly limiting ex-urban development on these same rural lands; and (3) allowing Metro and "neighbor cities" to expand their UGBs only if they can demonstrate that they have taken all reasonable actions to use land inside their existing UGBs more efficiently.
Figure 3

Formation of Metro

Concern about regional issues in the Portland area reaches back to 1925 with the formation of a legislative committee to study problems of local governments in the metropolitan area. Over the next five decades, regional governance evolved into two agencies, the Metropolitan Service District (MSD) and the Columbia Region Association of

Governments (CRAG). Both were created under a typical model for associations of governments. MSD was created to deliver regional services efficiently and assumed responsibility for the zoo and the solid waste disposal system. CRAG was created to coordinate planning for land use, transportation, water quality and criminal justice. Each had a governing body of predominantly local elected officials, with significant cross-over between them.

By the mid-1970s Oregon and the Portland area were going through a significant shift in policy direction. The state had established the statewide planning program described above. The City of Portland was aggressively working to reverse the decline of its downtown and retain strong, family-oriented neighborhoods. The region was embroiled in controversy over proposed urban freeway construction that would have had dire effects on neighborhoods. And the nation was beginning to tackle significant environmental issues, particularly air and water pollution.

A "good government" coalition of representatives from government, business and civic organizations called for a new regional governance structure with authority to tackle these issues and be accountable to the public. Assisted by a grant from the National Academy of Public Administration, the Tri-County Local Government Commission drafted a proposal that was adopted largely intact by the 1977 Oregon Legislature.

The new law authorized a regional government to be elected by voters of the three-county region. The law provided for a 12-member council elected by districts and an executive officer elected at-large to manage the organization. It assigned the duties of CRAG and MSD to the new entity and gave it power to tax and ensure local plans are consistent with regional plans. It shrank the boundaries of CRAG and MSD to the area of contiguous urbanization. In May, 1978, people of the region voted 55 to 45 percent to create a new regional government, now called Metro. That November voters elected the first Metro Council and Executive Officer. The change in government went into effect in January, 1979.

After a decade of operation, it became apparent that the region needed authority to make governance decisions on its own, without having to seek state legislation for every change. The Oregon Legislature authorized, and voters statewide approved, a change to the Oregon Constitution allowing Metro a home-rule charter. A commission drafted a charter for consideration by Metro's voters that declared livability of the region to be Metro's primary responsibility. It required Metro to adopt a 50-year "future vision" and a long-range regional framework plan with which city and county comprehensive plans would have to comply. It also called for establishment of the Metro Policy Advisory Committee (MPAC), composed predominantly of local elected officials, to advise the Metro Council on any land use requirement that would apply to local governments. The charter was approved by the region's voters in 1992.

2040 Growth Concept: the Region Charts a Course

Metro established the UGB for the region in 1979, surrounding a land area intended to accommodate 20 years of growth (229,000 acres). A recession that ran into the early '80s slowed development inside the UGB. But the region's economy came roaring back in the late '80s and its population grew faster than the rest of the nation. Leaders in the region understood that the UGB would not, by itself, stop sprawling development patterns *within* the boundary. Metro developed a "base case" scenario in 1992 to show what the region would look like in 2040 under existing zoning in the UGB. Development at low densities would exhaust the remaining supply of land inside the UGB and force expansion onto 120,000 acres, much of it productive farmland. Dependence upon the auto and the length and number of trips would rise. Air quality would decline and infrastructure costs, especially for new roads, would be daunting. In 1992,

Metro had neither the knowledge nor the technology to determine the effect of the "base case" on GHG emissions. It was not even a subject of public discussion.

Leaders in the region rejected the base case as the region's future and called for new policies to "build up, not out." Polling showed a majority of residents would accept slightly higher densities in their neighborhoods if necessary to avoid expansion onto farmland. After unprecedented public involvement, Metro composed the "2040 Growth Concept," a long-range regional plan adopted by the Council in 1995. The plan relied upon a "tight" UGB to encourage more efficient use of land, and for new policies in city and county comprehensive plans to allow higher densities in focus areas. Despite opposition from development interests whose principal market was land close to the edge of the UGB, cities and counties of the region embraced the Growth Concept and began to implement it.

The 2040 Growth Concept merges land use planning and transportation planning to reinforce the objectives of both. It concentrates mixed-use and higher-density development in 38 "centers"; 33 "light rail station communities"; and 400 miles of "corridors" that connect many of the centers. The Growth Concept then plans high-capacity transit (principally light rail) to connect the "central city" (Portland) and seven "regional centers (Hillsboro, Gresham and Beaverton among them)." Bus service, often with 10-minute headways, connects 30 "town centers" with the central city and regional centers.

The Growth Concept builds upon this fundamental land use and transportation superstructure. The central city serves as the hub of business and cultural activity in the region. The regional centers provide commercial and civic services in a market of hundreds of thousands of people. Town centers offer localized services for tens of thousands within a three- to five- mile radius. At a finer grain, the Concept recognizes the importance of "Main Streets" as traditional neighborhood commercial hubs within walking distance of surrounding residential districts. The Growth Concept has brought infill and a mix of uses to some residential areas, mostly in centers and along Main Streets and corridors. But an estimated 80 percent of traditional residential areas have not been significantly affected by these changes.

To bring the Growth Concept to life, the Metro Council relies upon traditional land use and transportation strategies and new tools developed with cities and counties in the region. These strategies and tools are collected in Metro's over-arching Regional Framework Plan (RFP), adopted in 1997. The Council adopted an Urban Growth Management Functional Plan to implement land use strategies in the RFP through city and county comprehensive plans and zoning ordinances. The Council adopted a Regional Transportation Plan to implement transportation strategies and build the multi-modal transportation system called for in the Growth Concept. The Council also adopted a Metropolitan Greenspaces Master Plan to guide investments in parks and greenspaces. Each of these implementation plans is part of, and must be consistent with, the framework plan. Recognizing that plans and regulations alone do not, themselves, build better communities, the Council aligned its transportation and other investments to encourage development in centers, corridors and Main Streets.

Regional Transportation Planning

The mid-70s also brought a shift in regional transportation policy. The initial segments of a regional freeway system had been built, but there were dueling visions for expansion of the region's transportation system. The pre-Metro regional planning organization, CRAG, had adopted a major freeway expansion plan developed by the state highway department. Three new segments of the interstate system were mired in controversy. Meanwhile, TriMet, the newly-creat-

Figure 4 | Photo of Eastside Light Rail, Gresham

ed public transit agency, called for significant transit expansion.

To overcome a stalemate, a Governor's Task Force on Transportation was formed to sort out the region's policy direction. The overall freeway expansion plan was cancelled. Policies were re-directed toward a multi-modal transportation system. The role of Metro staff and elected levels was strengthened.

Since this shift, regional collaboration on multi-modal transportation issues has been centered at Metro. A dual decision-making structure was established to meet the federal requirements for a metropolitan planning organization: a Joint Policy Advisory Committee on Transportation (JPACT), composed of elected officials representing cities, counties and Metro, and representatives of transportation agencies, and the elected Metro Council. A professional staff at Metro carries out regional transportation planning, light-rail project development, travel-demand forecasting, land use planning, economic and demographic forecasting and, more recently, transit-oriented development and demand management.

A critical Metro/JPACT responsibility is to allocate flexible transportation funds. Throughout the late '70s and '80s most of these funds came from the transfer of federal funds from the canceled freeways to other projects. After 1991, they flowed from new flexible funds provided by federal transportation legislation. Figure 4

For a sustained 30+ year period, Metro and its regional partners have aggressively developed a regional light rail and streetcar system, numerous smaller projects to support a more compact urban development pattern and an expanding system of bus, bike, pedestrian and trail projects.

Building a Compact Urban Form

The fundamental growth management strategy in the 2040 Growth Concept is

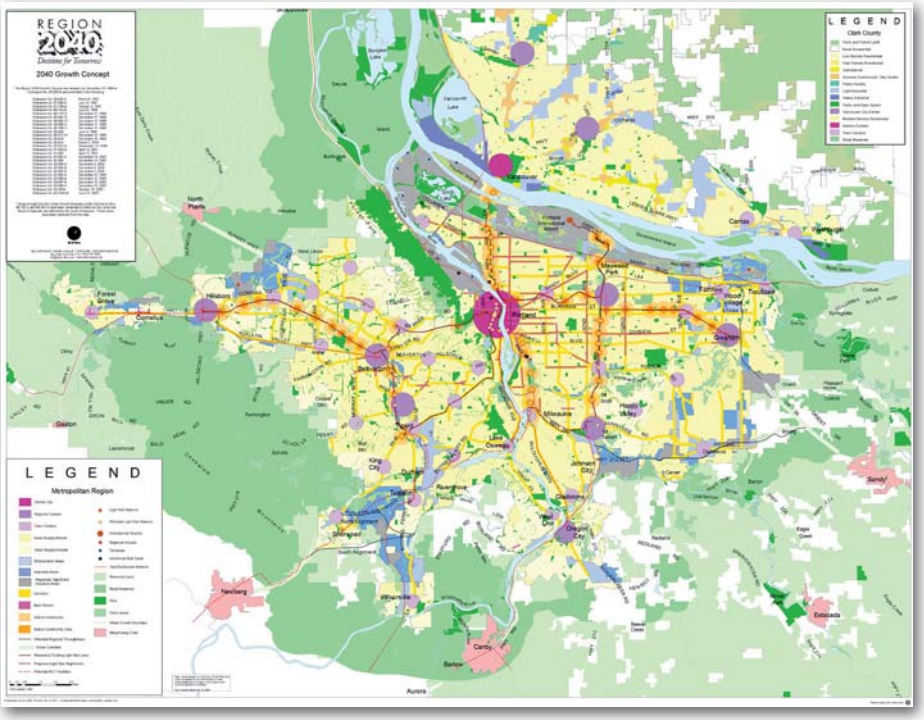


Figure 5 | Map of the 2040 Growth Concept

to develop a compact urban form, using lands inside the UGB as efficiently as possible. Maintaining a tight UGB has generally succeeded in channeling market forces from a sprawling edge to the designated centers. State law requires Metro to review the capacity of the UGB every five years to ensure it provides a 20-year land supply. But the law directs Metro to seek needed capacity from more efficient use of existing urbanized land before expanding the UGB. This requirement reinforces the 2040 Growth Concept, which stresses redevelopment and infill (dubbed "refill" locally). Metro has developed a detailed and sophisticated land-monitoring process to inventory vacant land and track the rate of refill. Metro's most recent process provided a 20-year development capacity (2002-2022) by relying upon refill at the rate of 29 percent for residential, 45 percent for industrial and 52 percent for commercial, plus a modest expansion of the UGB (20,000 acres, 8.7 percent). This means Metro expects the region will accommodate 29 percent of new households, 45 percent of new industrial jobs and 52 percent of new commercial jobs through refill. Figure 5

The UGB is only one tool available to Metro and its partner local governments. The region employs a wide array of regulatory, incentive and investment tools, and constantly seeks new tools. The first Metro action after adoption of the 2040 Growth Concept in 1995 was, with the urging of MPAC, to call for removal of zoning barriers to higher densities in centers. City and county elected officials at the MPAC table negotiated a series of household and employment growth targets, with regional equity in mind. The targets evolved into Metro requirements: each city and county undertook a re-zoning process to provide the targeted capacity. Cities and counties can distribute and re-distribute residential capacity as they choose, but they cannot reduce zoned capacity below

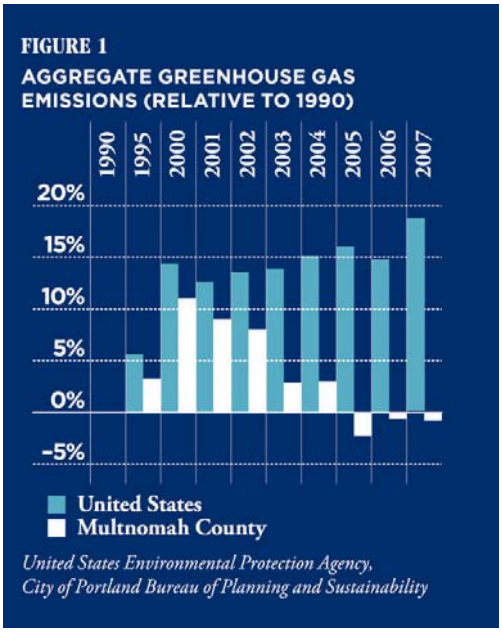


Figure 6 | Aggregate Greenhouse Gas Emissions

the targets. To help concentrate development in centers and corridors, Metro also set housing unit and employment targets for them and ratios for city and county minimum and maximum parking standards.

This widespread re-zoning generated opposition. In 2002, an anti-planning group gathered sufficient signatures to place a measure on the regional ballot that would have repealed Metro's authority to require up-zoning. The measure was voted down by the region's voters, but only after the Metro Council placed an alternative measure on the ballot – which passed – limiting its own authority to require cities and counties to increase density in certain single-family neighborhoods. Because the 2040 Growth Concept focuses high density in nodal centers rather than single-family neighborhoods, passage of the measure has not impeded progress toward compactness.

Metro encourages cities and counties to use non-regulatory tools to encourage development in centers and corridors, such as prioritization of transportation improvements to support development in those areas. Foremost has been the steady expansion of the regional light rail system. The goal is to connect the central city and all regional center by light rail and make the area around every station a high-density "Station Community." Recently, the expansion of the system has been supplemented by a central city streetcar system that provides local circulation and leverage for high-density residential and mixed-use development.

The region also places a priority on allocating certain categories of federal highway funds to projects that leverage development in centers and corridors. The result has been more than a decade of improvements to downtown Main Streets, sidewalks, bike paths and trails, bus stops and accessibility in centers and corridors. Of particular note is the conversion of flexible federal highway funds to federal transit dollars to help fund transit-oriented development through the Federal Transit Administration's Joint Development regulations. The most common use of this tool has been land value "write-downs" for developments that include higher density and mixed-use beyond what the market would support.

Although the region's long-range vision emphasizes "refill" in centers and corridors, action has been taken to affect the broader landscape. When the Growth Concept was adopted in 1995, 7,500 square feet was the smallest single-family lot zoning allowed in the urban areas around Portland. Re-zoning to meet the statewide planning goal on housing and Metro housing targets yielded a large supply of 3,500-5,000 square foot lots, which the market quickly absorbed. Metro also requires cities and counties to allow accessory dwellings in their single-family zones. These provide an affordable housing opportunity with minimal effects on neighborhoods. To ensure efficient use of

industrial land and protect freight transport facilities, Metro requires cities and counties to prohibit large-scale retail and certain types of offices in the region's most important industrial areas. Figure 6

When Metro and the cities and counties of the region committed to more efficient use of land in centers and corridors, they recognized that more intensive development must be matched with better access to parks and open space. Learning to think of the region's floodplains, wetlands, streams and riparian areas as "greenfrastructure," the region developed complementary greenspaces strategies using land acquisition, regulation, and a broad program of public engagement and incentives. In 1995 and 2006, voters passed measures sponsored by Metro and a coalition of local governments, businesses and conservation organizations to authorize a combined total of $364 million in general obligation bonds to purchase land for parks and greenspaces. A portion - $69 million – is allocated to cities, counties and park districts to protect water quality and habitat and park and open space improvements. Metro has acquired over 8,000 acres across the region and expects to add another 3,500 to 4,500 acres to the region's parks, trails, greenspaces and natural areas.

Region Becomes More Compact; Emissions Drop

It was not a stated objective of the 2040 Growth Concept (1995) to reduce greenhouse gas emissions. In the years leading to its adoption, air quality, costs of public infrastructure, protection of farmland outside the UGB and re-vitalization or downtowns of the region were uppermost in the minds of regional leaders. But cities and counties, especially Portland and Multnomah County, began to address emissions reduction on a track that paralleled development of the Growth Concept.[6] The city led the way by adopting the nation's first carbon dioxide reduction strategy in 1993. Eight years later, the county joined the city in a joint Local Action Plan on Global Warming (2001), setting a CO_2 reduction target of ten percent below the 1990 level by 2010. Each of these efforts identified the links among development patterns, vehicle miles traveled (VMT) and GHG emissions. Each called for more compact development as a principal strategy to reduce VMT and emissions. These efforts not only complemented and reinforced implementation of the 2040 Growth Concept, they also added a compelling new reason to "build" the Growth Concept. New people and new organizations have enlisted in the drive toward compact, mixed-use, walkable communities and investments in transit, bicycle and pedestrian infrastructure.

From the beginning of implementation of the Growth Concept, Metro and many observers outside the state - from the U.S. Census Bureau to university researchers and the Brookings Institution - have been measuring the results of the region's growth management efforts. The data show that the city of Portland, surrounding Multnomah County and the entire region are all becoming more compact. Between 1982 and 1997, the amount of land consumed nationally for urban development increased by 47 percent while the nation's population grew only 17 percent.[7] From 1990 to 1996, Portland spread just 13 percent, the same as its growth rate.[8] Each new person moving into the Washington, D.C metropolitan area used 480 yards of space in 2000. Each person moving into the Portland metro area used 120 yards.[9] Between 1990 and 2000 population density in the region (including Clark County, Washington, with less rigorous growth management) increased by 13 percent. In contrast with most metropolitan regions in the U.S., the center of this region (city of Portland) grew as fast as its suburbs - about 43 percent – from 1980 to 2000. In the same period, Seattle grew 14 percent while its suburbs grew 46%; for Denver it was 12 percent to 47 percent.[10] Between 1990 and 2000, 88 percent of the Portland region's growth (again, including Clark County, Washington's growth) occurred in high-density urban

areas, compared to 7-63 percent for four other metropolitan statistical areas of comparable size (Charlotte, Columbus, Orlando, and San Antonio).[11] Figure 7

The region's trend toward greater "compactness", complemented by investments in non-auto modes, appears to be reducing vehicle miles traveled (VMT). The Federal Highway Administration's Highway Performance Monitoring System (HPMS) shows the Portland metropolitan area's average daily vehicle miles traveled per capita is lower than the national average for urbanized areas and declining while the national trend continues upward. Average U.S. VMT is increasing by 1.8 percent per year, 2.5 times the rate of population growth. Residents of the ten most-sprawling communities in the U.S. drove an average of 27 VMT/capita/day. Residents of the ten least-sprawling communities average 21 VMT/capita/day.[12] In the Portland-Vancouver region it was 19.5 in 2007.[13]

Trips by transit, on foot and by bike are replacing and shortening auto trips. Transit ridership in the region (excluding Clark County, Washington) rose from 58 million in FY 1995 to 96.9 million in FY 2007.[14] According to the Federal Transit Administration, the Portland metropolitan area ranks 23rd in population while TriMet ranks 10th in overall annual ridership and 8th highest in annual ridership per capita. Transit ridership and mode share continue to increase.[15] Only six of the nation's 41 metropolitan statistical areas (MSAs) saw an increase in trips per revenue mile, including the Portland MSA.[16] Figure 8

Data show a modest increase in walking work trips within the city. Planners attribute the increase to infill housing in the central city.[17] The Brookings Institution (2007) rated metropolitan areas for walkability and found the Portland metro area to be the 5th most walkable region in the country.

Most impressive, however, has been the remarkable growth in bicycle trips. The number of summer-day trips on the four principal bridges across the Willamette River to downtown Portland from the east side rose from 2,855 in 1991 to 16,700 in 2008, a 584 percent increase. The number of auto trips across the bridges did not increase over that same period. Bike trips now comprise 13 percent of all trips across the bridges.[18] Of all trips in the U.S., 0.4 percent are by bicycle. In 2005, Portland had a bicycle commute mode share of 3.5 percent.[19] As evidenced by the bridge counts, the bicycle share continues to grow.

Emerging data also indicate that the region is experiencing some of the hoped-for benefits of its planning efforts. The shift from auto travel is saving people of the region a considerable amount of money. Because commutes in the Portland area are four miles shorter than the national average (20.3 miles/day v. 24.3 miles/day), households in the region spent seven percent less on transportation in 2004 than households in other western metropolitan statistical areas.[20] A report for CEOs for Cities estimates that the region's residents save $2.6 billion per year, $800 million of which would otherwise leave the state.[21]

The CEOs for cities report cites data showing that people "trade" housing costs for transportation costs, suggesting a new dimension of the land use-transportation connection: compact development encourages walking, biking and transit use, thereby saving travel dollars, thereby freeing household income for mortgage or rent payments. The combination of household income for housing and transportation (the two highest costs typically faced by a household) shows the Portland region to be among the lowest of all regions studied.[22] Figure 9

	Charlotte	Columbus	Orlando	San Antonio	Portland
Urban	7%	31%	64%	63%	88%
Suburban	50%	45%	23%	8%	9%
Exurban	45%	18%	12%	12%	1%
Rural	-1%	7%	2%	17%	3%

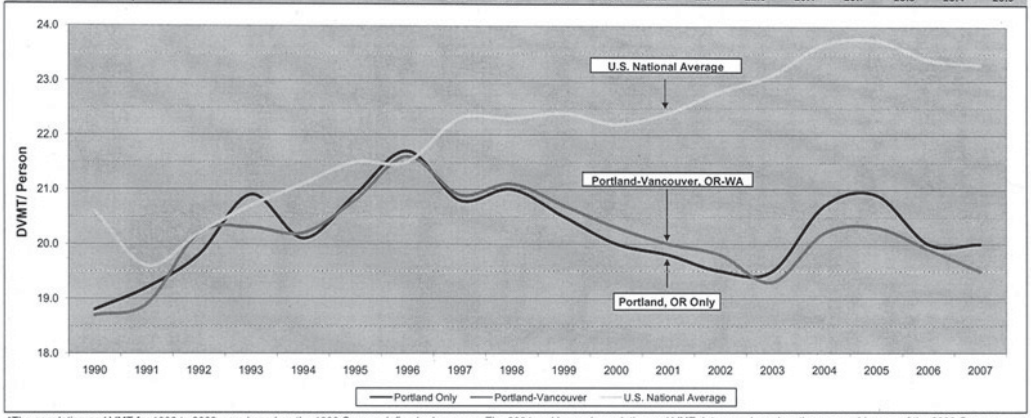
Source: Nelson and Sanchez, 2003

Figure 7 | Population Growth in Portland and MSAs with Similar Populations

Daily VMT (Vehicle Miles of Travel) Per Person - 1990 To 2007
Portland, OR Only, Portland-Vancouver OR-WA, And The U.S. National Average Data

(Revised 5-21-09)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Portland Only	18.8	19.2	19.8	20.9	20.1	20.9	21.7	20.8	21.0	20.5	20.0	19.8	19.5	19.5	20.7	20.9	20.0	20.0
Portland-Vancouver	18.7	18.9	20.2	20.3	20.2	20.8	21.6	20.9	21.1	20.7	20.3	20.0	19.8	19.3	20.2	20.3	19.9	19.5
U.S. National Average	20.6	19.6	20.2	20.7	21.1	21.5	21.5	22.3	22.3	22.4	22.2	22.4	22.8	23.1	23.7	23.8	23.4	23.3



*The population and VMT for 1990 to 2003 were based on the 1990 Census defined urban area. The 2004 and beyond population and VMT data were based on the geographic area of the 2000 Census defined urban area. This change in the Census defined urban area may be responsible for the uptick in the graphs of the Portland and Vancouver data after 2003.

Urban Area Sources: 1990-2007 data are from the FHWA in Washington, D.C.
DVMT/ Person data can be located in the FHWA webpage; '2007 Highway Statistics'; 4.4.5. Urbanized Area Summaries, Section 4.4.5.2, Selected Characteristics , Table HM-72.
The internet website location of the 'Highway Statistics' series (as of Feb 12, 2009) is: http://www.fhwa.dot.gov/policyinformation/statistics/2007/

National Average Source: The National Average of DVMT/ Person is calculated from 'Total DVMT,' for all Federal-Aid Urban Areas, divided by total 'Estimated Population,' as it appears on Sheet 9, of Table HM-72; which lists all the Federal-Aid Urbanized Areas in the U.S. The 1990-2007 data is located in the above cited website.

"Federal-Aid Urbanized Area is an area with 50,000 or more persons that, at a minimum, encompasses the land area delineated as the urbanized area by the Bureau of the Census" (from Sheet 9 Table HM-72). Portland-Vancouver, OR-WA is a Federal-Aid Urbanized Area.

If you have any questions, contact David Horowitz: David.Horowitz@oregonmetro.gov or phone, 503-797-1769.

Figure 8 | Daily VMT (Vehicle Miles of Travel) Per Person – 1990-2007

Conclusion

Be it residents' superior virtue, their historic frugality, or their dedication to planning, the region has corrected its greenhouse gas emissions course.[23] But this success has drawn attention to how far the region must yet come. The city will not reach the goal set in its 1993 CO_2 reduction strategy (20 percent below the 1988 level). Despite efforts to re-develop into a compact, mixed-use pattern, fewer than 25 percent of Portland neighborhoods receive a "Walkscore" of 80 points or higher (Sightline Institute indicator of walkable neighborhoods).[24] Fully 69 percent of the city's population live in neighborhoods that do not have the characteristics of "20-Minute Neighborhoods", a goal of the city's overhaul of its comprehensive plan.[25] The region is becoming more compact. But it faces the same challenge nearly all U.S. cities face: reversing 60 years of auto-oriented development by refitting suburban land use patterns. Figure 10

Nonetheless, success has whetted the region's appetite for further reductions. The draft City of Portland and Multnomah County Climate Action Plan 2009 proposes a 2050 reduction goal of 80 percent and an interim 2030 goal of 40 percent, with 64 actions to be taken by 2012. In the category of Land Use and Mobility the Plan sets two 2030 objectives:

- 90 percent of city residents and 80 percent of county residents can easily walk or bicycle to meet all basic daily, non-work needs.
- Reduce per capita daily vehicle miles traveled by 50 percent from 2008 levels.

Legislation passed by the Oregon Legislature (House Bill 2001) directs Metro to use its sophisticated modeling capabilities to develop a growth management scenario that would meet state emissions reduction goals (similar to Climate Action Plan goals). This work will provide residents of the region ample opportunity for their much-loved winter pastime – huddling in countless, long meetings peering into the future. •

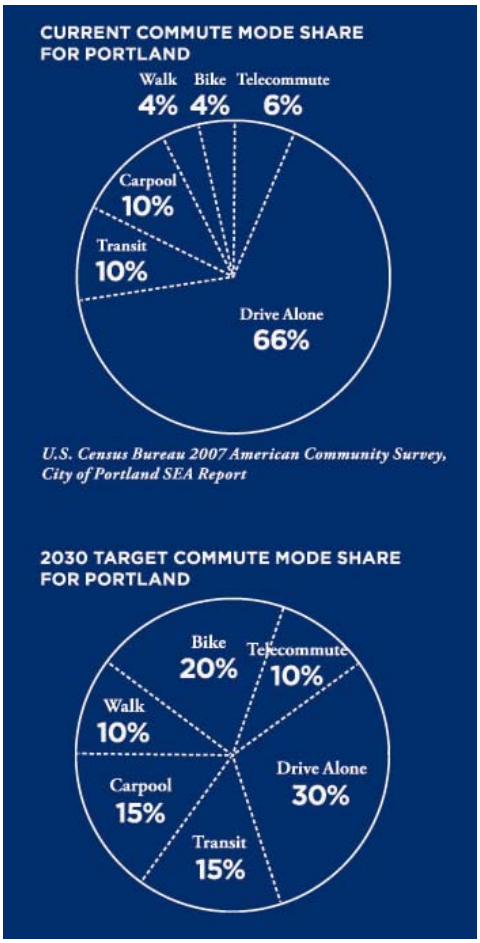


Figure 9 | Current Commute Mode Share for Portland

1 City of Portland and Multnomah County DRAFT Climate Action Plan, 2009, pp. 5; 23-24.

2 www.hybridcars.com Dashboard, October, 2008.

3 City of Portland and Multnomah County DRAFT Climate Action Plan, 2009, pp. 34; 39.

4 Cortright, Joseph (2007) 'Portland's Green Dividend' *Impresa Economics, White Paper for CEOs for Cities* (July).

5 *See* Putnam, Robert D., (2000) *Bowling Alone: The Collapse & Revival of American Community*, New York: Simon & Schuster.

6 In 2005, Portland signed the U.S. Mayors' Climate Protection Agreement. Since then, the metropolitan cities of Lake Oswego, Oregon City, Beaverton, Milwaukee, Hillsboro and Gresham have also signed. In 2007, Multnomah and Clackamas Counties joined the Cool Counties Initiative. In 2008, the Metro Council 'resolves' to adopt a regional climate change plan.

	1990	2007	2030	Percent change from 2007	2050	Percent change from 2007
Total carbon emissions (metric tons)	8,875,739	8,809,630	5,283,000	-40%	1,756,000	-80%
Population	584,000	702,000	967,000	+38%	1,276,000	+82%
Per person carbon emissions (metric tons)	15.2	12.	5.5	-56%	1.4	-89%
Passenger miles per day per person	17.4	18.5	13.2	-29%	6.7	-64%
Electricity (kWh per person)	13,046	12,300	8,319	-32%	4,146	-66%
Natural gas (Therms per person)	391	383	320	-16%	104	-73%

Figure 10 | Budget for a Low-Carbon Future (Multnomah County)

7 Fulton, William, Pendall, Rolf, Nguyen, Mai and Harrison, Alicia, (2001) 'Who Sprawls Most?', *Center on Urban & Metropolitan Policy*, The Brookings Institution, Survey Series (July).

8 Lacayo, Richard, (1999) 'Before America Turns Into One Giant Paved-Over Subdivision', *Time Magazine*, March 22.

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10 Lewyn, Michael, (2007) 'Debunking Cato: Why Portland Works Better than the Analysis of its Chief Neo-Libertarian Critic', *Congress for the New Urbanism* (September).

11 Nelson and Sanchez, (2003) 'Lassoing Urban Sprawl,' *MetroScape,* Portland State University Institute of Portland Metropolitan Studies, Winter. Nelson and Sanchez treat 3,000 persons/square mile as 'urban.'

12 Ewing, Reid, Bartholomew, Keith, Winkelman, Steve, Walters, Jerry, and Chen, Don, (2007) 'Growing Cooler: The Evidence on Urban Development and Climate Change', *Smart Growth USA*.

13 Horowitz, David, *Metro Research Center*, 2007.

14 Selinger, Phil, (2007) 'TriMet Review of 'Debunking Portland: The Public Transit Myth", *TriMet*, (September).

15 Federal Transit Administration, Annual Transit Ridership 2005.

16 American Community Survey, 2005 (www.census.gov), cited in *Metropolitan Briefing Book*, Institute of Portland Metropolitan Studies, Portland State University, 2007, p. 52.

17 Central City Plan Update, Pedestrian White Paper, 2008; *2005-2007 American Community Survey Three-Year Estimates*; U.S. Census Bureau, Census 1990 and 2000;

18 'Portland Bicycle Counts 2008', (2008) *Portland Bureau of Transportation*, (October).

19 'Bicycling and Walking in the U.S.' (2007) *Thunderhead Alliance Benchmarking Report*, p. 8, and U.S. Census Bureau, 2005 American Community Survey.

20 Bureau of Labor Statistics, 2005.

21 Cortright, Joseph (2007) 'Portland's Green Dividend,' *Impresa Economics, White Paper for CEOs for Cities* (July).

22 'Driven to Spend', (2005) *Center for Neighborhood Technology and Surface Transportation Policy Project*, (June), p. 7.

23 Ewing, Reid, (1997) 'Is Los Angeles-Style Sprawl Desirable?' *Journal of the American Planning Association*, Vol 63, No. 1, Winter, p. 113. A growing body of research supports the author's theory that planning is the prime mover; Ewing, Bartholomew, Winkelman, Keith, Walters, Jerry and Chen, Don, (2007) 'Growing Cooler: The Evidence on Urban Development and Climate Change', *Smart Growth USA*; Federal Highway Administration, Highway Performance Monitoring System; Frank, L., 'Achieving Sustainability through Healthy Community Design,' *King County Land-Use Transportation/Air Quality Health Study*; Arrington, G.B. and Cervero, Robert, (2008) 'Effects of TOD on Housing, Parking and Travel', *Transit Cooperative Program* 128.

24 City of Portland and Multnomah County Climate Action Plan, 2009, p. 35.

25 'Portland Plan Status Report: Twenty-Minute Neighborhoods,' (2009) *Bureau of Planning and Sustainability*, (May), p. 5.

Garry Smith

From Westernised to Low Carbon City: Climate Change Adaptation

Lessons from Perth, Western Australia

Introduction

Greater Perth is a city of some 30 smaller municipalities, including the City of Perth, and a number of vibrant coastal plain townships. The greater city is typical of many Australian capitals which have evolved from coastline settlements populating coastal strips on rivers and harbour regions, and largely shunning inhospitable and less fertile inner continental spaces. Indeed, the original European inhabitants of Perth upon first arriving in Western Australia resided on coastal sandy beaches at the Swan River mouth for many months. Only after some time did colonists move upriver to the proximity of current-day Perth, which derives subsistence from the Swan River valley and adjacent areas. This 'first contact' European settlement on the West Australian beaches faced challenges in winning enough fresh water and food from harsh coastal sand areas. Some 200 years later, and with a population of some 1.5 million people, the city of Perth again is threatened by lack of drinking water. The decreased coastal rainfall over the last two decades in the south-western coastal regions of Australia appears to be an early effect of global climate change. Adaptation to, and mitigation of, further climate change is important to the survival of this city.

Informed Australian planning professionals have identified a characteristic westernised gulf between the planning rhetoric of sustainability and the reality of urban development in most Australian cities, including slow responses of cities to population growth pressures and climate change; ineffective policies pursued by professional planning agencies; and city development in directions contrary to those defined in planning policies. These problems are evident, to varying degrees, in all State capital cities, including Perth. The shortcomings may be attributed at the whole-of-city planning level to factors including the large number of actors, the complex number of planning alternatives, a divergence of views on which direction is 'right', and poor coordination and concentration of power (Dawkins 2009 p39).

Nevertheless, Perth is the single (only?) city in Australia which in the 1990s and 2000s searched for more sustainable growth and for urban renewal when the concept of sustainability emerged on the global stage (Smith and Scott 2006, p250). This paper explores the policy and planning directional change which enabled Perth to pursue a renewed relationship with its environment and its people in the face of challenges such as global warming.

Table 01 | Australian Social Trends - state/territory. *Source: ABS 2009*

	NSW	Vic	Qld	SA	WA	Tas	NT	ACT	Aus.
Renewable Energy									
Households using solar energy, 2008 (%)	5.7	3.0	8.8	6.9	21.8	*3.3	55.0	4.6	7.6
Households aware of GreenPower(a), 2008 (%)	53.9	60.0	43.7	51.1	39.4	n.a.	n.a.	70.8	52.0

** has a relative standard error of greater than 25%*

(a) Households can choose to use renewable energy as part of their electricity supply, via GreenPower.

Is Perth a Low Carbon City?

Perth is pursuing worthwhile goals in utilisation of renewable energy and natural resource opportunities. For example, the City of Perth has been a successful member of the global municipality Cities for Climate Protection (CCP) Campaign for over ten years. After joining the CCP Campaign Perth achieved the following milestones:

- Milestone 1: Calculation of total greenhouse gas emissions for the City's corporate operations and services, and for the community (an inventory of greenhouse gas emissions)
- Milestone 2: Establishment of a 20% reduction target for both corporate and community emissions, by 2010, based on 1996/97 levels
- Milestone 3: Development of a Greenhouse Gas Emissions Reduction Strategy
- Milestone 4: Demonstration of the successful implementation of a number of actions to reduce greenhouse emissions
- Milestone 5: Completion of a re-inventory of greenhouse emissions for comparison to baseline year

The City subsequently participated in the 'CCP Plus' programme for those municipalities which had completed all milestones and who wish to continue to use the CCP framework to reduce greenhouse gas emissions. The City had completed two further corporate inventories by 2005/06. Subsequent to starting to quantify emission reductions in 2000/01, it recorded a projected reduction compared to 'business-as-usual' emissions of 22,936 tonnes of CO2e – made up of 4,424 tonnes CO2e of corporate emissions, and 18,512 tonnes CO2e of community emissions (City of Perth 2009) using methods including:

- running the CitySwitch Green Office program working with commercial office tenants to reduce energy use
- the support of (in conjunction with the Public Transport Authority of WA) the Central Area Transit System (CATS) free local bus services around the central Perth area
- the purchase of several hybrid (dual-fuel) vehicles for the City's vehicle fleet
- the purchase of two electric horticultural vehicles
- participation in a carbon offset program on an ongoing basis to offset the City's greenhouse emissions from its vehicle fleet
- participating in and actively supporting Earth Hour
- the development and implementation of a

workplace Green Transport Plan through the TravelSmart program
- the introduction of LCD screens in Council House (the City's administration building)
- the capture of landfill gas (methane) at the Regional Council landfill site
- the installation of solar powered ticket machines for parking bays throughout the City
- the installation of energy efficient lighting systems to reduce energy use by City of Perth carparks

These reductions represented some 3% of estimated total city community and corporate emissions. Perth municipal policy is also working towards a goal to become a 'solar city', only the sixth such initiative in Australia. In response to the pressing freshwater shortage, however, Perth has chosen an increasingly popular option for Australia capital cities, of desalinating sea water for drinking purposes. This high-energy use option is attempting to offset fossil fuel use, and remain low-carbon emission generating, by using renewable energy technologies to power the desalination plant.

Developments in the City of Perth are subject to a City Planning Scheme requiring inclusion of energy efficiency and environmentally responsible building principles in their design. Specific guidelines under the Planning Scheme include:

- Maximising solar access and natural ventilation
- Minimising the need for energy consumption, by reducing reliance on artificial temperature control and lighting
- Reducing or eliminating unsustainable consumption of resources
- Giving preference to building materials based on thermal insulating properties, low-energy production, and renewable or recyclable resources
- Minimising adverse emissions to air, soil and water
- Aiming to achieve high energy efficiency ratings in an accredited system for energy efficient building design and maintenance, e.g. the Green Building Council of Australia's 'Green Star' environmental rating system.

The guidelines also encourage rooftop gardens which reduce heat generation and the heat loading of building (Green Building Australia 2009).

Some measure of Perth's success in raising citizen awareness of sustainability and energy issues are the statistics on public use of renewable energy and public awareness of energy issues (Table 1). Perth records high proportions of its population both using solar energy and being personally aware of renewable energy issues.

Notwithstanding these successes in awareness and directional change, shared by some other Australian and international cities, emissions at the urban level are continuing to increase, albeit more slowly than would have occurred without these city programmes. The increase in emissions appears to reflect strong corporate and consumer growth in the city.

A key contribution to improved local and global sustainability which Perth has made is reducing urban energy consumption and minimising Perth's urban carbon footprint in the area of integrated transport planning. This area of low carbon activity is arguably one of the most difficult behavioural undertakings for westernised cities. The method which Perth used to address the issue is described later in the present paper.

Recently, coincident with a federal government review (Wilkins 2009), the Australian government announced withdrawal of further financial support for the CCP programme in Australia. The Commonwealth Government in Australia has developed legislation designed to place a price on carbon emissions (the Australian 'Carbon Pollution Reduction Scheme' or CPRS).

The Australian government appears to expect that the scheme will drive market-based reductions in urban and national carbon emissions in Australia beyond 2050, in recognition of the International Panel on Climate Change predictions regarding climate

change effects. Unfortunately the legislation is not receiving bipartisan support in the Australian parliament and may be delayed in its adoption and implementation. The withdrawal of support for programmes such as CCP appears counter to recognition of the role of local government planning in reducing carbon emissions.

In transport planning improvement Perth has supported its four-directional rail system (Figure 1) with targeted educational TravelSmart marketing programs, informing city residents about the impacts of car commuting and about readily available public transport alternatives (Salzman 2008 p61).

The internationally-developed TravelSmart programme when applied to one outer suburb of Perth engaged some 7000 residents to explore alternatives to the car as a primary transport option. This community reduced the number of car journeys by 9% (6,000,000 km) over one year. A 45% increase in walking trips was recorded, a 29% increase in cycling, and an 80% increase in public transport use, reducing greenhouse gas emissions by an estimated 18,000 tonnes of carbon dioxide (CSIRO 2005 p6). Similar results have been achieved in seven other suburbs of Perth over recent years. This represents a considerable achievement in light of the high car dependence of all Australian cities (Newman 1999 p1). The successful TravelSmart program in Perth is considered to be directly linked to the government's commitment to expanding Perth bus (Figure 2) and rail travel options (Figure 3), improving bicycle networks and promotion of transport-friendly development (CSIRO 2005 p6).

Effective urban consolidation planning policies may directly contribute to reducing urban sprawl, and thereby large-scale city carbon emissions, through:

- reducing increases in urban population in suburban and peri-urban communities, thereby reducing car-based commuting
- encouraging infill development within the city's existing boundaries thus enhancing the urban economy and competitiveness

Concern that land in Perth, and adjacent regions would be depleted by provision of only single-lot housing has been addressed by development which both supports the social value of a sense of place, and encouragement of walking and cycling contributing to healthier lifestyles, thereby reducing car congestion, improving air quality, and significantly reducing the Perth energy footprint. A transit-oriented and community-inclusive approach has also been pursued in developments to the north and west of Perth in the coastal region, including coastal towns.

Australia, including Perth, has developed workable legislative and regulatory tools to facilitate local market-driven urban consolidation, including through development of a legislated brownfields development framework. Targeting and facilitation of inner-urban brownfields development is an approach which is directly realising these locational advantages to minimise urban sprawl and to reduce carbon emissions. The activity of remediating and developing sites which are idle, unused, or abandoned after former industrial or commercial use, and which exhibit a legacy of contamination is referred to as 'Brownfields development'. Because of the typical location of historic industry activities adjacent to high density urban areas, Brownfields are often located within active and renewing areas of cities. Their coordinated development represents a highly effective and cost-efficient opportunity to minimise urban carbon emissions through minimising urban sprawl. Reuse of idle industrial facilities also has a positive benefit through enhancing urban commerce and of jobs. Furthermore, utilisation of formerly alienated land areas improves social wellbeing while enhancing public health protection through redevelopment and renewal.

An example of brownfields planning which set an early benchmark for Australian cities, including community involvement, was the urban renewal redevelopment of East Perth (Figure 4). An area of contaminated former industrial land in East Perth was remediated to produce a new residential area. A renewed local rail-bus interlink

Figure 1 | The Perth City rail link to the southern coastal regions

Figure 2 | The free Perth inner-city CAT bus

Figure 3 | People friendly (sub-ground) city rail terminal in Subiaco Perth

Figure 4 | East Perth brownfields site

system was developed. This area of run-down land, warehouses and other buildings, redeveloped under a 1990s federal 'Better Cities' programme by the state-based East Perth Redevelopment Authority (Neilson 1996 p33), became an active property-investment area. A visit to East Perth on a Friday evening reveals a vibrant medium-density residential development, more typical of European than Australian cities.

How Did Perth Make Progress?

Carey (2006 p163) states that Perth since the 1950s embraced the westernised post-war assumption that private car use would deliver accessibility through unconstrained mobility. This resulted in poor land-use transport integration, movement of employment from the central business district to inner and middle suburbs, and difficulties in developing multi-modal transport options. The assumption that the public will adapt to living and working locally in 'self-contained' communities proved, according to Curtis, to be an oversimplification of individual travel patterns and business activity requirements. Curtis 2006 p163) identified movement of transport planning in Perth to a development-oriented transit approach, using efficient public transport as a means of providing urban structuring, responding, in part, to a community-expressed desire to utilise existing infrastructure.

A key factor in initiating the continuing transformation of Perth from westernised to low carbon city was the release in 2003 of Australia's first comprehensive state sustainability strategy by the Western Australia Premier (Figure 5). The strategy followed an election commitment to pursue sustainability as an integrated whole-of-government approach to emerging water shortages, biodiversity loss, and increased energy consumption in Western Australia. The Premier recognised publicly that sustainability was a significant issue, and one which the public, government agencies, and business must recognise as unavoidable. The strategy included a long term agenda to rethink western lifestyles, resource use, governance and business approaches to development. The Premier challenged the state to be innovative, stakeholder partnering was recognised as essential, and the State Government, business and the community were expected to work together towards common sustainability goals.

A primary component of these successful sustainability policies included recognition of the fundamental role of local government in implementation of sustainability decision making. Importantly, too, key state government infrastructure agencies, notably the Western Australian land-development agency, LandCorp, adopted a sustainability-based approach to urban planning including an integrated planning approach to growth corridors to the north and south of Perth, and the adjacent coastal regions.

In response to high population growth pressure, traffic congestion, and problems such as estuarine water pollution in rural regions and townships, the Western Australian government in 2004 developed 'Network City', a metropolitan plan which looked ahead with a 30-year timeframe. The initiative included detailed attention to community views and expert opinion on sustainability and transport topics. The goal of increasing employment and other activities and locating centres on key public transport routes was a key strategic initiative, addressing the environment, employment, heritage and quality of life. The Western Australian Planning Commission (WAPC) drew on the principles of new urbanism, applying the concept of "liveable neighbourhoods" to Perth, including incorporation into a legally binding planning tool around 2007, and encouraging pedestrianisation of the city (Sharp 2008 p457). Pedestrianisation in the westernised sense depends upon efficient public transport infrastructure. Western Australia has been one of the leading states in Australia in implementing Transport Oriented Development (TOD) in urban development planning, particularly in recent greenfields development areas on the periphery of the Perth metropolitan area (Newman 2005).

'Network City' was a planning strategy for metropolitan Perth, designed to integrate land use and transport networks within both

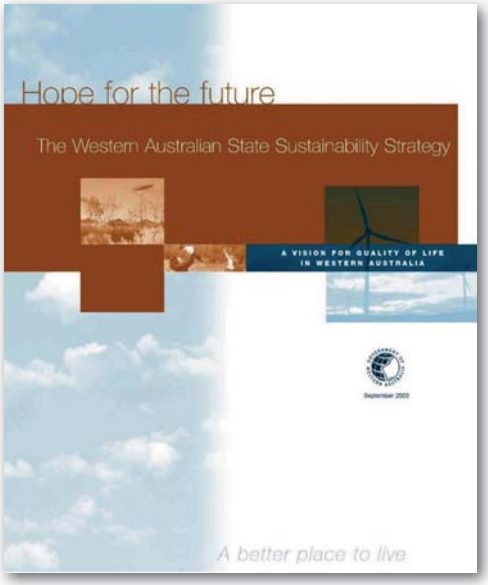

Figure 5 | The Western Australian Sustainability Strategy Document

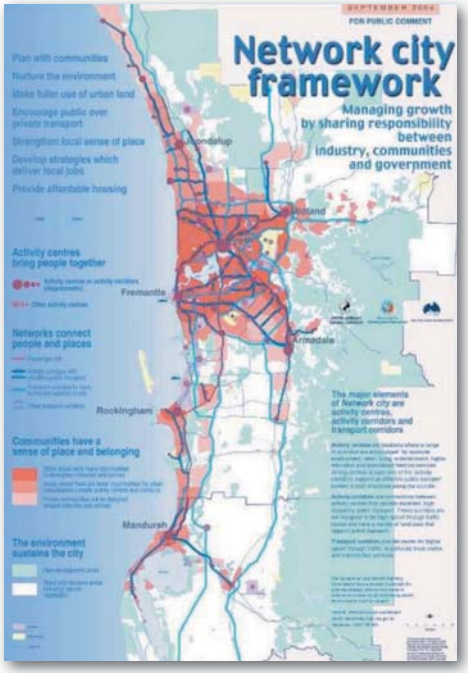

Figure 6 | The Network City Scheme

established and new areas of the city. Single occupant car use dominated the transport node sharing Perth, as it does in most Australian cities. Road networks enjoyed a high proportion of transport expenditure from Australian governments. Network City developed a spatial framework (Figure 6) designed to integrate land use and transport networks with the goal of providing more sustainable travel networks (Carey 2006 p164). It is worth noting that this planning approach, which effectively leads to reduced urban carbon emissions, was possible because sustainability had emerged on the Western Australian political agenda, albeit prior to the coordinated global attention provided to climate change mitigation from around 2008.

The Western Australian government produced its first state-wide State of Environment Report (SoE) in 1992, a reporting system abandoned in 1994 in favour of a more direct policy planning approach that provided feedback on environment performance and policy learning. With the emergence in the late 1990s of a renewed sustainability agenda in Western Australia a regional reporting process was developed, establishing working parties to implement recommendations as a guide for future environmental planning, including the 2002 release of a draft SoE for public comment, in 2003 a final SoE report, in 2004 completion of an audit of the State environmental policy plan, and in 2005 release of a state environmental plan for the 2005-2008 period.

Many Australian state government approaches to sustainable planning models are based on incremental retrofitting of cities. The use in Western Australia of widespread consensus-building based on evidence of the urgency for a sustainability transition has proven the most effective approach. Key components included openness and accountability in government (both political and bureaucratic), improved risk-based planning, sharing of information on risk issues with local communities, and restructuring of government bureaucracies to improve sustainability knowledge.

Did Planning Play a Major Role in Perth's Adaptation?

Kennewell and Shaw (2008 p249) have identified the origins of Australian urbanisation as a 'transplanted colonial planning experiment'. These authors consider that the extensive use of urban grid structures, with surveyors removing limitations from blocks of land, reservation of urban spaces for public buildings, and further development by property owners and the market, has resulted in traditional ad hoc urban development. They note in Perth's evolution evidence of early planning influence from the Garden City concept of Ebenezer Howard and Raymond Unwin, and associated control of housing density, building heights, street layout and open spaces. A Town Planning Board controlled subdivision of land throughout the State of Western Australia including Perth. Kennewell and Shaw (2008 p249) identify a post Second World War revival of metropolitan planning which, unfortunately, seriously underestimated the growth of private car ownership with population growth. A typical decentralisation of residential, commercial and industrial land ensued, and rapidly undermined any concept of self-contained communities.

A permanent city planning authority was established which in 1970 released 'The Corridor Plan for Perth', with the goal of containing urban expansion within designated corridors separated by open space. This led to further low-density development in the city, compounded by the closure of the Perth city centre-to-coastal Fremantle passenger railway. Further government and academic planners in the 1980s, under direct ministerial control, reviewed Perth planning and identified ongoing problems including slow development of subregional centres, continued concentration of employment in Perth Central business district and inner suburbs, long journeys to work, and inefficient traffic congestion. The government responded with Metroplan (1990) providing a strategy that challenged urban expansion and the detached home-on-a-single block traditional residential model (Kennewell and Shaw 2008 p249). The authors describe the planning approach to increased urban consolidation through increased housing densities both in the inner-city and regional centres, and development of new public transport nodes. The planning tools used to achieve this transition included zoning flexibility, variety in housing type, and neighbourhood street design to support small households and affordable housing. Kennewell and Shaw (2008 p251) conclude that this planning approach was maintained through to recent times, despite political and community change. Indeed, the authors identify an extensive community engagement process of a 'Dialogue with the City' in 2003 (some 1000 members of the public were directly engaged) as contributing to an evolution of the metropolitan plan to a new strategy, 'Network City', in 2005, produced by the Western Australian Planning Commission.

Dawkins (2009 p38), formerly chairman of the Western Australian Planning Commission, notes the importance of three core elements in supporting the role of planning in the design and development of Perth as a city, and in Western Australia:

- A binding regional scheme backed by strong legislation
- A regional improvement fund created by levies on land, and
- An independent expert body to manage the planning scheme, which made impartial decisions about development proposals and managed the improvement fund.

Dawkins describes an evolution and transition of this planning approach in Western Australia, with support and input from planning professionals, and involving community consultation as an important component. He sees the alternative, reactive planning as urban challenges arise, as leading to increased land prices and minimisation of effective land-use, and interfering with the certainty required for an ap-

propriate role of private sector investment (Dawkins 2009 p45). Dawkins identifies the networked city ('city of cities') concept as consistent with the need to address lengthening travel times, environment constraints on urban expansion, and the complexities of urban land and property markets. However he observed a struggle within the regional planning function of Perth to maintain momentum following production of the Network City strategy. Dawkins notes the importance of planning and governance corporate knowledge as part of the planning process, particularly given the limited numbers of professionals who drive sustainable planning processes (Dawkins 2009 p48).

The Western Australia Sustainability Strategy produced in 2004 described and explained the concept of sustainability, and identified necessary actions across government to implement a sustainability framework (Figure 7) over a ten year period. These actions concentrated upon:

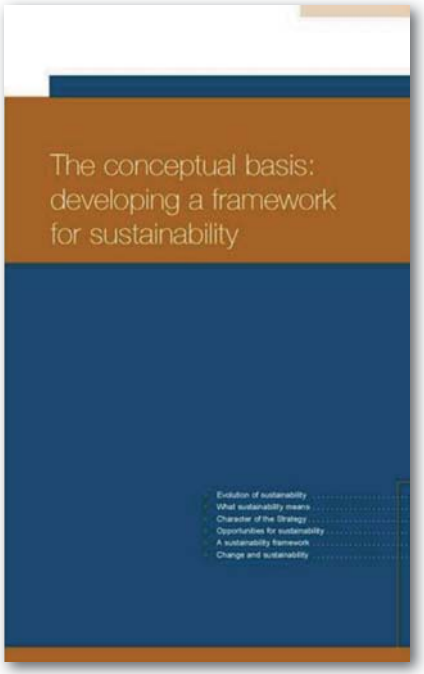

Figure 7 | The Western Australian Sustainability Framework document

- A proposed sustainability Act enshrining sustainability in State law?
- Leadership by government agencies implementing a sustainability code of practice and sustainability action plan
- Measurement of "net benefit" outcomes.
- Creation of a sustainability roundtable with community and industry representatives
- Establishment of a sustainability system though a directorate and a measurement tool.
- Identification of indigenous employment targets.
- Identification of essential local actions.

The Western Australian government in 2005 proposed that the state sustainability strategy be supported by sustainability legislation, the first in Australia, to embed the principals of sustainability in government actions and processes and to support reporting on outcomes in periodic "state of sustainability reports". Unfortunately sustainability legislation has not emerged in Western Australia, probably because various political stakeholders cannot reach consensus on the form of legislation in such a new, multi-subject, and forward-looking subject area (Smith and Scott 2006 p219).

The Western Australian sustainability framework consisted of a set of principles, visions and goals supported by practical examples. Tools for sustainability were described, including ecological economics, ecological footprint measurement, sustainability checklists and community visioning methodologies. An action plan for Western Australian government agencies, including planning agencies, was attached to the Strategy describing key steps in assessment of sustainability, institutional change requirements, sustainability planning tools, stakeholder partnering methods, and sustainability measurement and reporting methods.

While the regional-scale may be the most efficient approach to organisation and delivery of sustainability, most of the requi-

site urban planning steps require well communicated plans for local action by both government and the public. Cities may therefore play a major role in communicating sustainability and low carbon approaches to urban inhabitants, usually on a large scale. Consultation-based urban planning in Western Australia has lead to significantly more sustainable urban form as greater Perth has grown, accompanied by a premium on the value of housing which embraces sustainability-based 'transit-oriented development'. These initiatives are expanding to more regional areas of Western Australia.

Attention to village-based and town-centre neighbourhoods in Perth, and in regional Western Australia, has increased the range of housing options in new population growth and development areas. So called 'TOD neighbourhoods' have been encouraged, accommodating a mixture of residents of all ages, and generating commercial and recreational activities which reflect community needs. For example, and paramount to the transformation to a low carbon city, young Western Australian families, due to the availability of local rail and bus infrastructure, may now choose not to purchase a second car because public transport is at hand adjacent to new residential subdivisions which supports their transport needs.

The Western Australian Planning Commission (WAPC), which was delegated powers and resources from elected government to design and implement Western Australian planning policy, including policies directly affecting Perth, works in partnership with the professional planning and administrative Western Australian Department of Planning and Infrastructure (Dawkins 2009 p38).

What Does the Future Hold for Perth?

A considerable amount of intellectual planning activity is continuing with respect to the further development of Perth as a sustainable city. Attention has been drawn to the challenging transport, mobility and access issues including the effect of gated communities on pedestrian behaviour (Burke 2001 p139). Burke notes that the impacts of gated communities on pedestrian trip-making and activity are negative, particularly for secure suburban estates which are the most common form of gated communities in Australian cities.

O'Garra et al. (2007 p3630) have studied behavioural aspects of sustainable transport options, notably willingness to pay for alternative public transport technologies such as hydrogen buses. Three hydrogen fuel cell buses were introduced in September 2004 and were operated and managed by the Western Australian Government through the Department of Planning and Infrastructure. The 2007 study indicated that in Perth, as in several European cities, bus users exhibit a positive willingness to pay as a measure of public acceptability and preference for new public transport technologies and fuel types. In Perth several local government municipalities are trialling biodiesel trucks, and the policy of the West Australian government has been to replace the existing diesel buses in the public transport fleet with natural gas buses.

Notwithstanding this policy and the transport planning approach which moved Perth more towards a lower carbon footprint, some authors note that Perth continues to attract some adherents to continued urban sprawl, notwithstanding concerns over water supply and adverse impacts on the Swan coastal plain environment (Kennewell and Shaw 2008 p254). Some suburbs of greater Perth continue to expand, together with large population increases in regional centres along the south western coastline to the south and north of Perth. Fortunately these regions are now served by rail and bus to levels not previ-

ously achieved in traditional Australian cities. Nevertheless, Kennywell and Shaw (2008 p254) identify a need for planning also to address related sustainability issues including social polarisation, the important aspect of indigenous land rights in Australia, and the need to improve social capital in Perth city.

Are there any immediately available options for the redesign of urban policies and programs to make them more efficient and effective in the context of carbon pollution reduction? In Perth, as elsewhere, the decline of heavy industries near populated residential areas has frequently led to abandoned and underutilized facilities, sometimes resulting in increased local crime and unemployment. So-called 'Brownfields' urban redevelopment involving clean-up and development of idle, unused, or abandoned urban industrial land has been adopted in several areas of Perth. Large industrial facilities were commonly located in inner urban areas, including valuable foreshore land where waterways were used as key transport routes. Australia is yet to develop policies to maximise the potential for the market to utilise inner-urban sites and thereby to materially reduce diffuse-source carbon emissions from transport, building and infrastructure requirements into the future. Government identification and implementation in Australia of a coordinated Brownfields policy and framework offers an immediate and effective planning approach to minimising urban carbon emissions in an economically and socially cost-effective process (Smith 2008 p19).

Why should Australian and global cities such as Perth not be eligible for carbon credits for their transport planning improvement and for urban renewal approaches which deliver effective anti-sprawl and carbon emission reduction outcomes? •

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Brian Human

Cambridge: Delivering Smarter Growth

Introduction

Cambridge, UK, is known throughout the world as the home of the renowned eponymous University, which is celebrating the 800th anniversary of its founding in 2009, and for its assembly of beautiful and important historic buildings and spaces, but much less is known internationally about the City itself. For a place with a big reputation Cambridge is a comparatively small historic city with a population of 120,000. It sits within the predominantly rural Eastern Region, yet in only 110 km from London. There are a further 200,000 plus people living within the wider Sub-region for which Cambridge is the principal service and employment centre. Around 84,600 jobs are located in the City, 94% in service sectors, and it has a net commuter inflow of 29,000 people a day.

Up until the middle of the 20th century Cambridge was a quiet university-cum-market town enjoying a modest, somewhat introspective, prosperity. However, since then several factors – the emergence of the Cambridge (high-tech) Phenomenon, expanding sub-regional service centre functions, improved rail links with London, good road communications (the M11 and A14) and recognition that Cambridge offers a good quality of life - have turned the City into a focus for successful growth. It is against this background that Cambridge looks towards smarter growth.

The Growth Context

Planning History

Cambridge* is a largely unplanned city – the idyllic, iconic green corridor that runs through it from Stourbridge Common along the Backs and on to Grantchester Meadows is an accident of history. Over the centuries the town was shaped not by for-

Figure 1 | King's College Chapel and the Backs, a classic view of the historic university city. *Brian Human*

mal planning, but largely by ad hoc events. From the mid 19th century, building on its historic role as a market town and trading centre, Cambridge's prominence as a regional centre started to emerge. Large new areas of largely terraced housing were built through the latter part of the nineteenth century; and large suburbs were built to accommodate the town's growth from 40,000 to 90,000 inhabitants in the first 50 years of the twentieth century.

Figure 1

In the late 1940s Cambridge was the subject of a major town planning study by William Holford and Myles Wright. Holford concluded that 'one cannot make a good expanding plan for Cambridge' but recognised that a town of 100,000 – 125,000 could be 'very fine'. Following its publication in 1950, the Holford Report formed the basis for Cambridgeshire's 1952 County Development Plan. In 1957 a Green Belt was defined around Cambridge to protect its setting by limiting development outside the existing urban edge to primarily open space uses.

As the development pressures on the city-region grew the debates continued. Holford's policy of containment was proving not just unviable but also positively damaging: diverting growth away from Cambridge had resulted in village expansion ('detached suburbs') increasingly dependent on car based commuting into the City. By the 1990s it had become clear that Holford's assertion that '… one cannot make a good expanding plan for Cambridge …' had to be challenged.

Issues and New Plans

Developing a new approach has been a slow process: the serious shift away from a policy of containing Cambridge to one of expansion dates back to 1990 when work started on the 1996 Cambridge Local Plan. The 1980s had been a period of frustration. The Cambridge Phenomenon of high tech-driven expansion had proceeded apace, but the City had no overall plan to guide its development. The consequences included over-rapid job growth, an imbalance between the locations of homes and jobs and consequent traffic congestion. The response of the 1996 Plan to these issues was comparatively cautious in proposing only modest further expansion of the City.

Publication of the 1996 Plan coincided with a period in which national priorities were shifting. The ideas around sustainability were emerging in significant national policy statements such as *A Better Quality of Life: A Strategy for Sustainable Development in the United Kingdom (1999).*

Regional Planning Guidance for East Anglia to 2016 (RPG6), published in 2000, reflected this shift. Its vision and strategic aims acknowledged the importance of the environment, the economy and resources. RPG6 planned for a 3.8% annual growth in the regional economy and the construction of 2,800 houses a year in the Cambridge Sub-region. This new approach set an agenda of major growth for the Cambridge Sub-region and a regional policy proposed a review of the Cambridge Green Belt to establish what land might be released for development. Figure 2

The local authorities carried out studies of the Cambridge Green Belt between 1998 and 2002. These studies provided critical inputs to the Cambridgeshire and Peterborough Structure Plan (2003) by evaluating alternative scenarios and assessing where land might be released for development. The Structure Plan proposed that land to the west and south-east of the City should be protected, while land to the east, south and north-west could be developed as urban extensions and a new settlement es-

Figure 2 | Cambridge from the south showing the importance of the green corridors penetrating into the built urban area *Brian Human*

Figure 3 | Map of Sub Region. *Cambridgeshire Horizons*

tablished away from Cambridge. It forecast that the population of the City would rise by 21,100 between 1999 and 2016 and that of surrounding district of South Cambridgeshire by 42,700; projected housing growth was 12,500 and 20,000 units respectively; and estimated the combined growth in jobs to be 38,180 over the same period. The Plan sets out a number of policies to guide the development of the Cambridge Sub-region, see Text Box 1

Between 2006 and 2008, the City and South Cambridgeshire Councils translated the Structure Plan policies into local planning documents. These identify the extent of the development for each urban extension and urban extension and the new settlement of Northstowe, including the land take and the number of dwellings, see Table 1. The growth agenda allocates 1008 hectares of land for development in major urban extensions and a new settlement, intended to deliver 31,880 housing units, spread over the period 2008/09 through to 2016 and beyond. The strategy retains the historic structure of Cambridge with urban development inter-penetrated by strategic open space (green corridors).

The Partners

Recognising the imperatives for growth is one thing; planning and delivering it are something else. Key partners are National Government, the East of England Regional Assembly, Cambridgeshire County Council and five District Councils. Cambridgeshire Horizons was established by the Cambridgeshire Local Authorities, the East of England Development Agency and English Partnerships in 2004 as the Local Delivery Vehicle for the major growth in the County. It works in partnership with all stakeholders and aims to facilitate delivery by influence and persuasion, cutting across organisational boundaries. It has no statutory planning powers, is steered by a Board under an independent chair and core funding is provided by the local authorities and central government.

Carbon Assessment

The Cambridge Sub-region needs to deliver thousands of new homes over the next two decades while responding to the challenge of climate change and the imperative of reducing carbon dioxide emissions. In 2007 Cambridgeshire Horizons prepared a Long Term Delivery Plan (LTDP) for the growth strategy and an appraisal of this evaluates the carbon impacts.

The current carbon footprint of Cambridgeshire is 6.5 million tonnes of CO_2 annually and this could grow to eight million tonnes by 2031 if energy consumption in existing communities is not controlled and if the Sub-region's growth follows a business as usual model. However, the IPCC recommended carbon reduction target of 60% by 2031 for Cambridgeshire means reducing CO_2 emissions to 3 million tonnes. The study highlights that to achieve long term carbon targets for 2031 and beyond, the new housing would need to be built to zero carbon standards. In addition, the growth process will need to drive low carbon infrastructure that can facilitate carbon reductions deriving from the existing building stock.

Total carbon emissions from a business-as-usual approach to growth in the Sub-region would be half a million tonnes of CO_2 by 2031. This could be reduced to 200,000 tonnes if the buildings are constructed to zero carbon standard from 2010 and substantial local renewable energy comes on stream. It could be reduced still further by more challenging transport policies and a carbon offsetting scheme that enables additional carbon reductions from the existing communities. Figure 4

Currently, the main component of the LTDP that contributes to carbon reductions, or to reducing the growth in carbon emissions, is the transport related infrastructure, which is outlined below. Conversely, some transport infrastructure projects within the LTDP will lead to an increase in carbon emissions, such as the upgrade to the A14, which increases road capacity and enables greater traffic flows both through and within the Sub-region. Overall the transport infrastruc-

> Provision of 8,900 dwellings within the built-up area of Cambridge and 8,000 on the edge of Cambridge subject to a review of the Green Belt (12,500 in the City and 4,400 in South Cambs); 6,000 in a new settlement (Northstowe); and 9,600 in market towns and elsewhere
> A Green Belt to be retained, but land for development to be released in Cambridge East, the Cambridge Southern Fringe and North West Cambridge. This will provide for 8,000 houses by 2016. (Some land at Cambridge Airport will not come forward before 2016)
> Master plans to be prepared and Cambridge East and the Southern Fringe to include protected green corridors running into the City.
> High quality public transport to be provided along key corridors (one being the Cambridgeshire Guided Bus, see below)
> Orbital movements around the city to be accommodated
> Demand management measures for car use to be introduced in Cambridge
> Improvements for walking and cycling
> Highway improvements to serve new development, e.g. the Addenbrooke's Access Road within the Southern Fringe.

Text Box 1 | Cambridgeshire Structure Plan proposals 1999-2016

Development	**Total Area (ha)**	**Estimated planned residential units**	**Phasing**
Cambridge East	250	11,000	2009/10–2015/16 & post 2016
Cambridge Southern Fringe & Addenbrooke's	177	3,950	2009/10–2015/16 & post 2016
North & West Cambridge	154	4930 & 2000 student units	2006 – 2015/16 & post 2016
Northstowe	427	10,000	Post 2009 & post 2016 to 2025

Table 1 | Development Summary to 2016 and beyond

Figure 4 | Science park development epitomises the growth of high-tec activity in Cambridge. *Brian Human*

ture changes are expected to reduce carbon emissions across Cambridgeshire by approximately 80,000 tonnes relative to a do-minimum. However, this is compared with a 237,000 tonnes potential increase in carbon emissions from transport growth associated with the new housing and population. Hence, the increase in transport emissions from growth is potentially three times greater than the emission reductions from infrastructure improvements. The measures within the proposed Transport Innovation Fund package go a long way towards stimulating & facilitating low carbon travel. However, the LTDP would need to introduce further robust measures if it is to ensure low to zero carbon growth from transport.

Approximate costs of achieving low carbon scenarios range from £1.5 to £2.5 billion. Up to 50% of this investment could be covered through the involvement of (energy service companies) ESCos within the developments and through innovative financing mechanisms which manage financial risk. The lower cost is based on a major contribution from larger scale off-site renewable energy, in particular from wind power, which depends upon the ability to both link wind turbine capacity to new developments and to install wind turbines within the Sub-region.

Key Responses to achieving the Low Carbon Smarter Growth

In an ideal world planning would be a single process from visioning through to delivery. However, it is not. There are multiple agencies involved working to different timescales, unpredictable exogenous influences and priorities changing over time. Hence, it is not possible to say that there has been a single approach to delivering low carbon growth: rather it is an evolving and responsive mix involving three themes: spatial planning, transport planning and energy use and generation. Overall the aim has been to address both growth and existing problems and at the same time maintain economic prosperity.

Spatial Planning

The Regional Planning Guidance objectives included tackling energy use/emissions, enhancing the economy and competitiveness and promoting a close relationship between homes and jobs. In a statement that mirrors the Cambridge experience, it says:

'Much development in East Anglia in recent years has been in smaller settlements, [and] has been poorly located relative to the location of employment and services…. If East Anglia is to accommodate its development needs in an environmentally acceptable and sustainable way existing trends will need to be modified. Development for housing, jobs and services will need to be much more closely integrated with each other and much more closely related to sustainable transport provision'

Figure 5

The Regional Planning Guidance policy for reducing the need to travel set out in Text Box 2 was particularly important in shaping the current growth strategy and required that this policy be followed in Local Development Plans.

Text Box 2

The Structure Plan policies are based around a Sustainable Development Strategy embracing the scale and location of built development, economic development, the provision of infrastructure and environmental performance. It specifically aims to provide 'for the Cambridge Sub-region to accommodate continued expansion whilst restoring the balance of jobs and housing', i.e. reducing the need to travel.

Local Development Frameworks further build on this by setting out the need for the major development areas to include a mix of land uses and activities essential for sustainable communities, including employment land, open space, retailing (usually in a local/district centre), education, community facilities and transport infrastructure, again aimed at reducing the needs for unnecessary travel by less sustainable modes.

The adoption of this spatial strategy embodies some fundamental re-thinking about planning priorities. It suggests that the

Figure 5 | The pedestrianised city centre provides a good environment for cycling and walking. *Brian Human*

Policy 22, Location of housing and related development, set out a sequential test for major housing development to be, in order of preference

> Within the built up area of Cambridge
> On the periphery of the built up area of Cambridge
> In a new settlement close to Cambridge
> Within the built up area of market towns, larger villages and previously established new settlements with good public transport access
> Extensions to market towns, larger villages and previously established new settlements with good public transport access

Text Box 2 | Regional Planning Guidance Policy 22

benefits of meeting housing need, supporting economic prosperity, providing transport infrastructure and achieving a more sustainable pattern of development (better co-location of homes and jobs) outweigh the importance of retaining a sacrosanct Green Belt. In a notable break with the planning tradition of Cambridge, releases of Green Belt land for development envisage continuous urban extensions across the boundary between the City and the neighbouring District of South Cambridgeshire.

Transport Infrastructure

The planned growth of Cambridge presents acute transport challenges. As the planning history of the City recognises, the central problem is that the unrestricted use of the private car: causes gridlock in the narrow streets; results in an unacceptable reduction in air quality; contributes to global warming; and makes conditions for pedestrians and cyclists increasingly unpleasant. It is widely accepted, though by no means universally, that Cambridge is not large enough to justify a conventional underground network or a comprehensive tram system. As a consequence, Cambridgeshire County Council, the highway authority, working with the District Councils, has pursued a carrot and stick approach designed to shift trips from private cars to more sustainable modes.
Figure 6

The carrots have been improved bus services, including an extensive Park and Ride network and investment in cycling and walking routes. In 2008, Cambridge was awarded National Cycling Town status, which will see £7.2 million spent on cycling improvements in Cambridge and its surrounding villages until March 2011. The sticks have included the use of rising bollards to ban private cars from the city centre, the allocation of road space to buses and cyclists and the use of an aggressive tariff for public car parks in and around the City Centre. Indicators of the impact of these polices in 2008 include: 4.38 million park and ride passenger journeys, a growth of 234% since 1998; and a modal share for pedestrians and cyclist crossing the River Cam of 28%. As a result congestion has been kept to reasonable levels within the inner ring road and Cambridge has become one of the few places in the country to show growth in bus use. However, the suburbs and the main radial routes into the City continue to show high level of traffic and congestion and the transport strategy continues to evolve.
Figure 7, 8, 9

A key component of the transport strategy for the Sub-region is the Cambridgeshire Guided Busway linking Huntingdon, St Ives and Cambridge - the longest guided busway in the world at 40km long, with guided sections of just over 25km. It will include two new Park & Ride sites (potential 1700 spaces) and connect to a new Parkway rail station planned for the north eastern edge of the City. The guided sections are being built along the route of the old railway lines from St Ives to Cambridge and from Cambridge railway station to Addenbrooke's Hospital and the Trumpington Park & Ride. There will also be a new bridleway for pedestrians, cyclists and horse riders built alongside the busway from St Ives to Cambridge Science Park.

The busway is for dedicated buses and can be used by any bus that has two small extra wheels (guide wheels) attached in front of its regular wheels to connect with the track. Guided buses will travel on both the newly built guideways and also on ordinary roads. Where guided buses travel on normal roads they will use bus priority measures, including new bus lanes and bus priority traffic signals. Two bus companies (Stagecoach and Whippet Coaches) will run services on the busway. Stagecoach's new guided buses will run on 100% bio diesel made from sustainable sources – they will account for 75% of peak services and 86 % off peak. Bio diesel buses produce up to 80% less carbon emissions than conventional buses.

The Busway scheme will cost a total of £116.2 million to build and the Government is supporting it with a grant of £92.5 million.

Figure 6 | Park and Ride. *Brian Human*

Figure 7, 8, 9
The Cambridgeshire Guided Busway is a critical part of the sustainable transport infrastructure.
Credit: Cambridgeshire County Council

The rest of the funding will come from developers, who are building in the area, e.g. at Northstowe. When it opens in late 2009 the Guided Busway is expected to provide a reliable, fast and frequent service, a genuine public transport alternative to driving into Cambridge on the busy, accident prone, A14.

To cope with the existing problems and the impact of further growth, the County Council has studied future transport scenarios in detail and with central Government aid has investigated the introduction of fiscal demand management in the form of a congestion charge. The model tested envisages the introduction of a charge for vehicles within a defined citywide zone between 7.30 am and 9.30 am Monday to Friday. It is argued that this charging structure would discourage car-born commuters, who are the main cause of peak hour congestion, while having a minimal adverse impact on other trips. The modelling target has been to achieve a shift from the current 60/40 modal split in favour of cars to a 60/40 split in favour of sustainable modes (walk, cycle, public transport). This new modal split is used in planning major urban extensions like Cambridge East. In a continuation of the carrot and stick approach, the introduction of a charge would be accompanied by massive investment in public transport and cycling facilities, supported through a 'smarter choices' behavioural campaign, which has been included in a £400m bid to the Government's Transport Innovation Fund (TIF). The proposals were the subject of public consultation in 2008 when, unsurprisingly, they stimulated mixed reactions. The County Council has appointed an independent transport commission to review issues and options and make recommendations.

Energy

Domestic and business energy requirements in the growth area are already high, reflecting the size of the population and the long term buoyancy of the local economy. Further growth will undoubtedly increase demands, as shown above. However, efforts are being made to address energy use within developments through three main routes.

First, local planning polices will require 20% of a development's predicted energy requirements to be provided from on-site renewable energy sources together with the provision of Combined Heat and Power (CHP), preferably fuelled by renewable energy sources, to meet a further 20% of needs. In taking forward 'zero carbon' developments it is often very challenging to generate a high proportion of energy needs within the boundaries of the development. This can be particularly problematical for some commercial users and University-related research activities, which impose very high start-up power loads.

Second, strategic low carbon generation. Delivering zero carbon developments through on-site renewable energy for all new housing and non-domestic buildings is likely be at best inefficient and at worst undeliverable - an unreasonably large biomass fuel supply for biomass CHP systems in the higher density developments and huge numbers of micro-renewable energy installations at lower densities. A balanced approach to energy supply with contributions from both on-site, near-site and off-site low carbon energy could help achieve the right balance. In this context wind power will have a part to play if planning and environmental concerns can be overcome. Fenland in the North of Cambridgeshire has seven schemes comprising 34 turbines, but there are still only demonstration projects in the south of the County.

Third, by requiring new development to be designed and built to low carbon/low energy standards. The local authorities will work with developers to achieve the significant improvements sought by the Code of

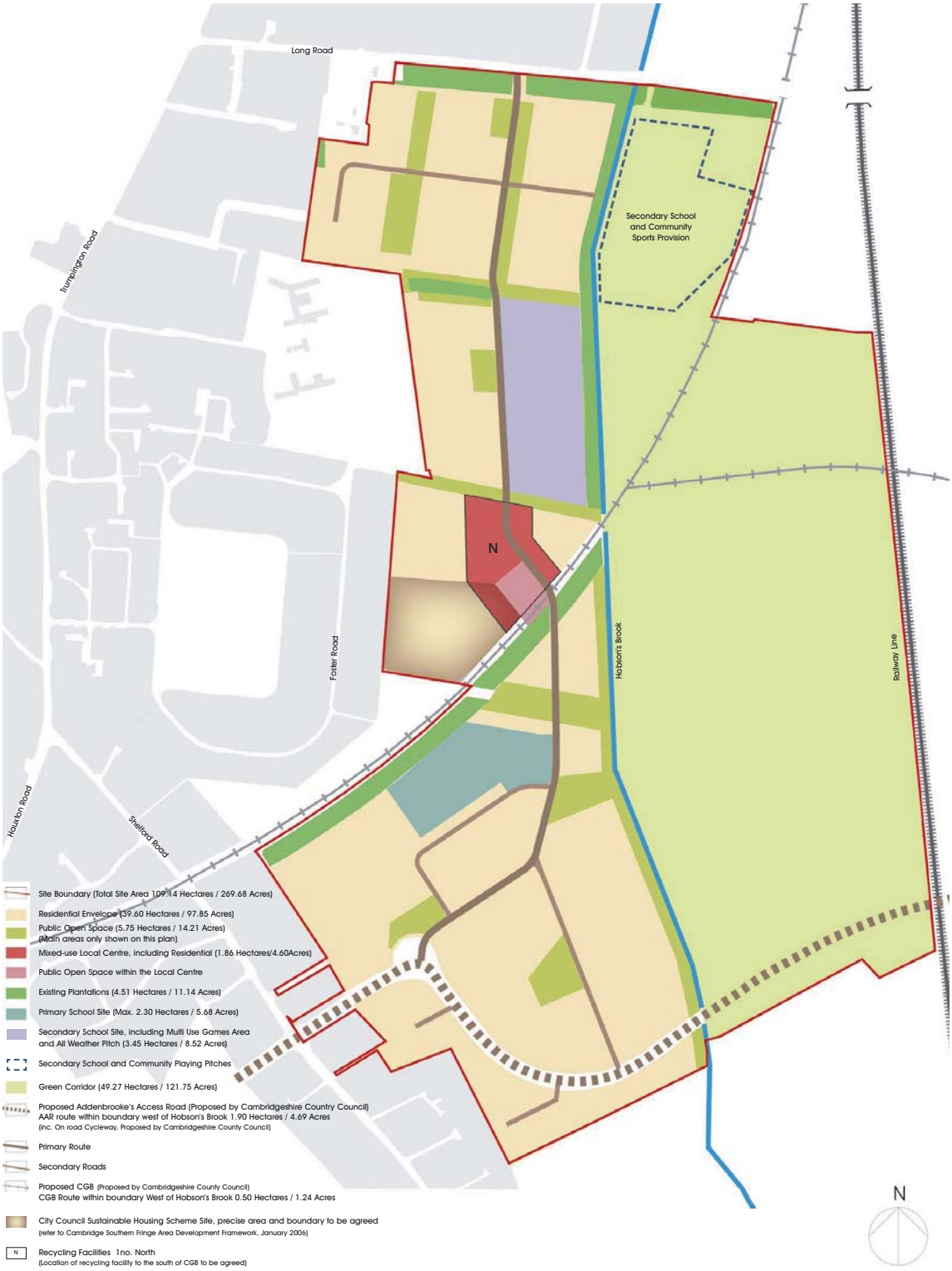

Figure 10 | Clay farm plan. *Credit: Countryside Properties*

Figure 11 | The Addenbrooke's Medipark plan. *Credit: Addenbrooke's NHS Trust*

Sustainable Homes and significantly exceed national standards set by building regulations, including through the City Council's Supplementary Planning Document Sustainable Design and Construction. The aspiration is for ultimately all new residential development to be built to the Code 6 standard, which will anyway be required by legislation by 2016.

Case Studies

The way in which the preceding principles will play out in practice and be implemented is illustrated by a sample of case studies showing a number of consistent themes.

Southern Fringe
Clay Farm & Trumpington Meadows

Figure 10

Clay Farm (in Cambridge City) and Trumpington Meadows (mainly in South Cambridgeshire District) together account for nearly 90 per cent of the housing development planned for the Southern Fringe of Cambridge. Clay Farm is the centre piece of the Southern Fringe housing developments, running due south from the City. Proposals include around 2,150 dwellings, a neighbourhood centre and community facilities on a site of some 61 ha. The vision is to create a distinctive new urban extension. The City Council wishes to build an exemplar, low carbon development on land it owns within the area. On the south-west-

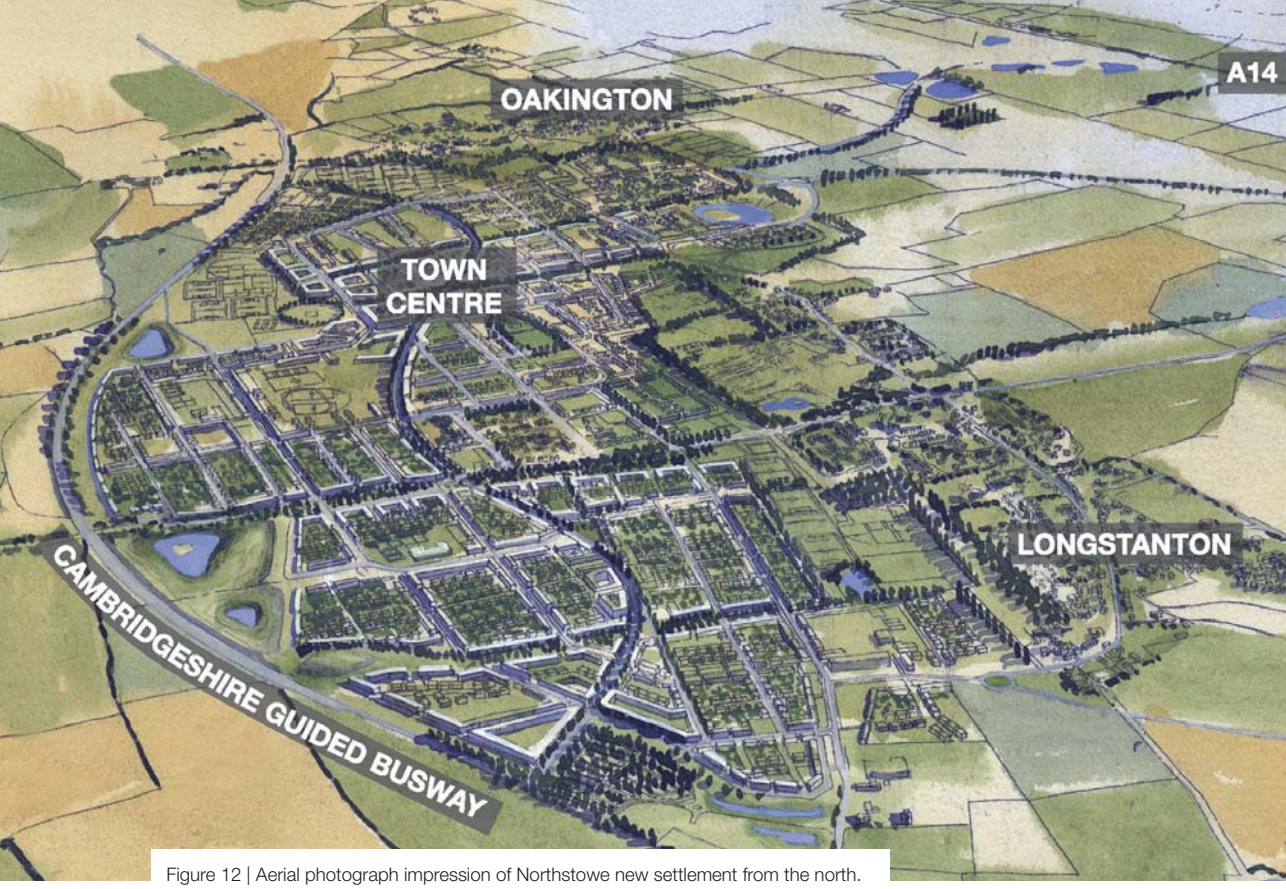

Figure 12 | Aerial photograph impression of Northstowe new settlement from the north.
Credit: Gallagher/Cambridge Association of Architects

ern edge of the City, Trumpington Meadows will provide around 1,180 homes and community facilities on a site of 31 ha. The vision is for the development to be highly sustainable, including energy efficiency measures and exemplar projects employing cutting edge construction technology. Both areas will include up to 40% affordable housing.

Features that will help to lead to a low carbon development include:

- Housing density averaging 50 dwellings per hectare with an emphasis on higher densities in the most accessible locations
- Local services, community facilities and employment in accessible locations within a convenient 10 minute or 800m walking and cycling distance
- High quality safe walking cycling routes, including
  - o those internal to the sites
  - o strategic routes to Addenbrooke's (see below) and to the rest of the City
  - o connections via the Right of Way and National Cycle Route networks to Cambridge and nearby villages
- Encouragement of car pooling
- Proactive travel planning with residents and employees
- Served by the Cambridgeshire Guided Busway with a direct link to Addenbrooke's and Cambridge railway station
- Stops on high quality public transport routes within 400m of all developments.

Addenbrooke's Medipark Figure 11

The Addenbrooke's Hospital site is hugely important to Cambridge, not only as a national centre of medical excellence but also for co-located activities like the Medical Research Council's Laboratory of Molecular Biology and the national research centre for Cancer UK. The Cambridge growth agenda includes proposals to extend the Addenbrooke's Hospital site to create the Cambridge Biomedical Campus. The ex-

tension covers 28ha and will accommodate 215,000 sq m of clinical and biomedical research space, plus supporting services and staff housing. The development will create 7,500 jobs. Addenbrooke's has appointed a full time Sustainability Manager, created both a Sustainability and Environment Strategy Group and a Sustainability and Environment Implementation Group, is in Phase 3 of the Carbon Trust's Carbon Management Programme and is using the Good Corporate Citizenship Toolkit to assess improvements on wider sustainability issues. Detailed proposals for dealing with low energy are still emerging, but key smarter growth features include:

- A new access road will link the Campus to the new Southern Fringe housing and the M11, thus avoiding taking traffic through existing residential areas - control measures will eliminate its use as a cut-through
- The Guided Bus connects to the new development via a separate bridge
- Addenbrooke's will continue with its innovative travel planning, which promotes sustainable travel including:
  - o A service of 60 buses per hour in the peak hour – bus use is now 22% of trips compared with 12% in 1999
  - o Over 1500 on site cycle parking spaces – cycling accounts for 28% of trips compared with 21% in1999
- Addenbrooke's already has: a CHP generator on-site; a small wind turbine on top of the new multi-storey car park; solar thermal panels on new ward blocks; and produces about a third of its hot water demand through an energy from waste plant

Northstowe | Figure 12

Situated, approximately five miles north-west of Cambridge, Northstowe is to be a complete new town with ultimately 10,000 homes, including up to 40 per cent affordable dwellings subject to negotiation. It will occupy a site of around 427 ha, much of which is a redundant airfield and barracks. The vision is to create a sustainable and vibrant new community embracing projects that are exemplars in sustainability. Northstowe will include a town centre, with shops, services and cultural facilities, and 20ha of land for mixed employment uses. Features addressing energy and the carbon agenda include:

- Housing built to the highest contemporary standard of the Code for Sustainable homes and pushing at the boundaries of the proven technology available at the time of the development
- Mixed development aimed at reducing the need to travel to other service and employment centres;
- Local centres with collocated uses easily accessible by walking 400-600m;
- High quality dedicated and segregated walking and cycling routes, including:
  - o Internal routes
  - o Right of way links to other villages
  - o Connection to the National Cycle network
- Encouragement of car pooling and car sharing
- The Cambridgeshire Guided Busway bounds the site to the east with a local loop through the town, providing a focus for each of its three districts with stops within 600m of all development
- Other high quality public transport stops within 400m of all development
- Subsidised public transport travel for early occupants of the town
- Northstowe offers considerable technical potential for:
  - o incorporating renewable energy sources, including photovoltaic energy (PV), solar, thermal, biomass and wind; and
  - o planned development of infrastructure, such as heat grids and private wire electrical networks needed to provide energy independently of the National Grid.

Conclusions

Cambridge and its immediate Sub-region have changed enormously over the past 50 years. The further growth and change that they face over the next 20-30 years is probably unprecedented. Indeed, the East of England Plan for the period to 2021 (the Regional Spatial Strategy (RSS)) published in May 2008 allocates growth in addition to that described in this paper to the Cambridge area; and the current early RSS Review for the period to 2031 is canvassing the potential for yet further increases. Despite its comparatively modest size the City is important nationally and internationally for its heritage and as a centre for learning and innovation. It is also a place much loved by the people who live there. The challenge that decision makers have been wrestling with in recent years is how to plan and manage change in a away that optimises the benefits of growth, does not kill the goose that has laid a clutch of golden eggs and addresses 21st century climate change concerns raised by both new and existing development.

While a great deal is being done to promote smarter growth, it is sad but true that the Cambridge Sub-region is not on-track to meet the long term carbon reduction targets up to 2050; and the current LTDP will only contribute to a small reduction within the increase of emissions associated with the planned development. Among the many steps that must be considered to achieve smarter low carbon growth are the following.

A low carbon transport strategy, which: reviews current and proposed policy measures; sets more challenging transport policies to reduce the need for travel; and restricts car use and provides alternatives.

Establishment of a ring-fenced carbon investment fund to provide upfront investment in low carbon infrastructure.

Increased support for renewable energy development in the Subregion with mechanisms to link offsite renewable energy infrastructure to new developments contractually and physically.

Develop proposals for a 'sub-regional carbon offset mechanism' that can enable residual carbon emissions associated with new development to be offset through energy efficiency activity in the existing community.

Ensure that the master plans for the strategic growth sites contain comprehensive zero carbon methodologies addressing buildings, low carbon infrastructure and transport; and develop further planning guidance, policies and wider support package to deliver zero carbon growth.

Planning & delivery of low carbon infrastructure should be carried out by an entity with long term interest in assets, such as an Energy Services Company (ESCo) and developers encouraged to engage early with ESCos to facilitate a more effective approach to rolling out low carbon infrastructure.

Concerted efforts to effect both institutional and individual behavioural change towards more sustainable ways of life.

We cannot be certain that the current growth strategy will be successful in achieving this – even less so with the further growth sought through the RSS - but by using evidence based spatial and transport planning, promoting compact development and increasingly integrating carbon assessments into the overall planning it has been given a sound foundation. The aim is to deliver climate sensitive quality development and this is embodied in the *Cambridgeshire Quality Charter for Growth*, which promotes sustainable and vibrant new communities through an integrated approach to community, connectivity, climate and character. Historic towns like Cambridge are frequently exemplars of sustainability and maintaining this through the opportunities offered by smarter growth is a huge challenge. And the learning curve is steep. But as Peter Studdert, Joint Director of Planning has said about expanding this precious historic city, 'The 21st century is but another layer of history – let's ensure that it adds value and richness.'

Acknowledgements

My thanks to the many colleagues who have supported me in writing this article; and special thanks to Peter Carolin and the Cambridge Association of Architects for help with this article and permission to draw on the Cambridge Architecture Gazette *CAg 57*. •

* This paper concentrates on Cambridge and its immediate hinterland, which are the focus for much of the growth within the current development strategy. However, planning is taking place across the Sub-region and County and it is frequently necessary to draw on policy and analysis that is carried out at these levels.

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Increasing CO_2 Emissions in the Douro Valley – the role of land use changes and fires

Introduction

Portugal experienced significant urban development during the 1990s in the coastal urban regions located along the axis connecting the metropolitan areas of Lisbon and Porto, following a 400-year old migration trend of population from the rural interior areas of the country. Consequently, the duality between coastal versus interior urban growth is clearly identifiable in and furthered by the lack of urban homogeneity across the country. While the entire territory is covered by plans and programmes for territorial development, these have yet failed to effectively secure a critical population mass that enables the interior to sustain more desirable levels of urban growth and economic development.

In northern Portugal, the Douro Valley is a rather apt example of such phenomena. Despite being the object of a number of urban development plans, specific territorial programmes and diverse projects, the region cannot yet compete with the more affluent coastal regions. Exemplary in nature and content – focusing on the mobilisation of local growth potential and resources for social and economic development, job creation and quality of life improvements – these development instruments managed to bring several millions of Euro in investment funds, National and European, along with tools and models of intervention that addressed specific development objectives and strategies. As these were tailored to the region's diversity of resources, an inter-sectoral approach progressively emerged from strategies centred on increasing agricultural production and productivity and in the improvement of the conditions of life of the rural population, supplemented by considerable investments

in infrastructure. Simultaneously, private agents and investors were able to access a number of incentive systems carrying special benefits for sectors like vineyard farming and wine-making, tourism, the food industry, services and local commerce. These actions were aimed at streamlining the undertaking of initiative capacity and management, and ultimately, at attracting and sustaining qualified human resources, complemented by the promotion of historic, cultural and natural heritage, as well as tourism.

The relative improvement in the quality of life of the population, the reinforcement and the expansion of water and sanitation infrastructure, the social equipment network and the partial modernization of the economic and social tissue are visible results and evidence of the positive impact of the overall development strategies and actions for Douro. In fact, the region managed to become second only to Porto in terms of agriculture and tourism dominance (Lourenço, 2004). Notwithstanding, the overall contribution to the development of this region is declining or at the very least, fails to meet expectations fostered by the magnitude of policy incentives.

Given the unique importance of the region – besides being one of UNESCO's World Heritage Sites, the Douro Valley includes the world's oldest wine demarcated region and is home to Port and other top quality wines and agricultural products – the region has been the object of several studies focused on how urban growth development is taking place and particularly, how land use changes are affecting the local social and economic development dynamics.

More recently, the focus has been on raising environmental concerns associated with urban expansion, namely those related to greenhouse gas emissions and sequestration. Of the many possible sources for increased levels of atmospheric carbon dioxide (CO_2), land use changes – namely those associated with urbanisation and often urban sprawl as a consequence of urban population growth – are significant contributors to the intensification of carbon emissions and the reduction of the carbon sequestration capacity. When these changes are associated with deforestation for economic development, the carbon balance can be severely altered and more so, in areas that are naturally prone to wildfires. Consequently, while carbon budgets are or should be of concern to any country and any region, areas that have traditionally reported low emission and high sequestration rates should be particularly aware of how the evolution of land uses is affecting the local carbon balance. Since the carbon sequestration capacity of land systems comprised predominantly of forests and woody vegetation is two to three times lower than the output from the burning of fossil fuels, it is of paramount importance that these areas are carefully managed.

These concerns are clearly illustrated in a study covering the evolution of land use changes in the Douro Valley over a period of 16 years. Shifts to the carbon balance are observed and correlate to land use changes driven by the replacement of forested areas by rural and urban uses. Despite the dominance of vineyards and woodland, significant, albeit proportionally small, increases in urban occupation are capable of negatively tipping the local carbon balance. This effect is compounded by the region's natural tendency for the occurrence of forest fires leading to further deforestation and land abandonment.

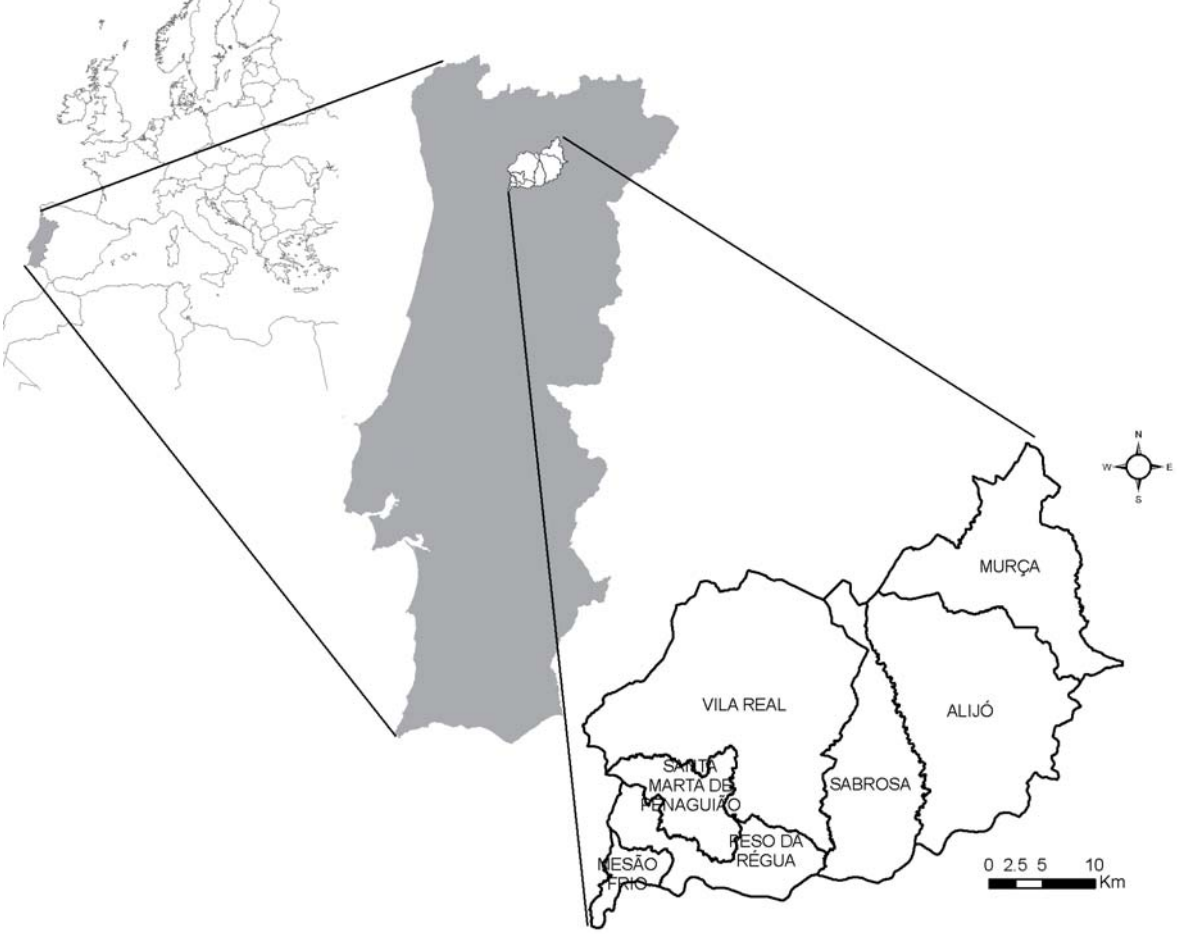


Figure 1 | Case study municipalities *(Adapted from Danko and Lourenço, 2008)*

Land Uses in the Douro Valley

Given the transitional geographical location between the coastal and interior regions, the municipalities of Alijó, Mesão Frio, Murça, Peso da Régua, Sabrosa, Santa Marta de Penaguião and Vila Real were selected (see Figure 1) as suitable case studies capable of representing the land use changes and consequent carbon balance shifts in the Douro Valley region.

Not unlike other regions in Europe, namely Holland (Priemus, 2004), urban development in the Douro Valley appears to follow the improvements in accessibility and not necessarily what has been put forward in the land development policies. For instance, Vila Real has certainly benefited from the overhaul to its transportation infrastructure systems, namely the construction of the IP4 (Itinerário Principal, main road itinerary) that promoted the consolidation of the urban front and the creation of new urban areas through the swift conversion of rural land uses into urban ones. Neighbouring municipalities, such as Sabrosa (Danko and Santos, 2009), have also benefited from these infrastructure improvements. Figure 2 presents the major road network in the case study region.

In 2008, Lourenço et al., published the results of a study devoted to the identification of land use change processes and the quantification of affected areas for the period of 1990-2000. The work was supported by the definition and analysis of a series of parameters based on the analytical methodology described by Pontius (2002) and Pontius Jr. et al. (2004). Satellite and cartographic images were used to gather data

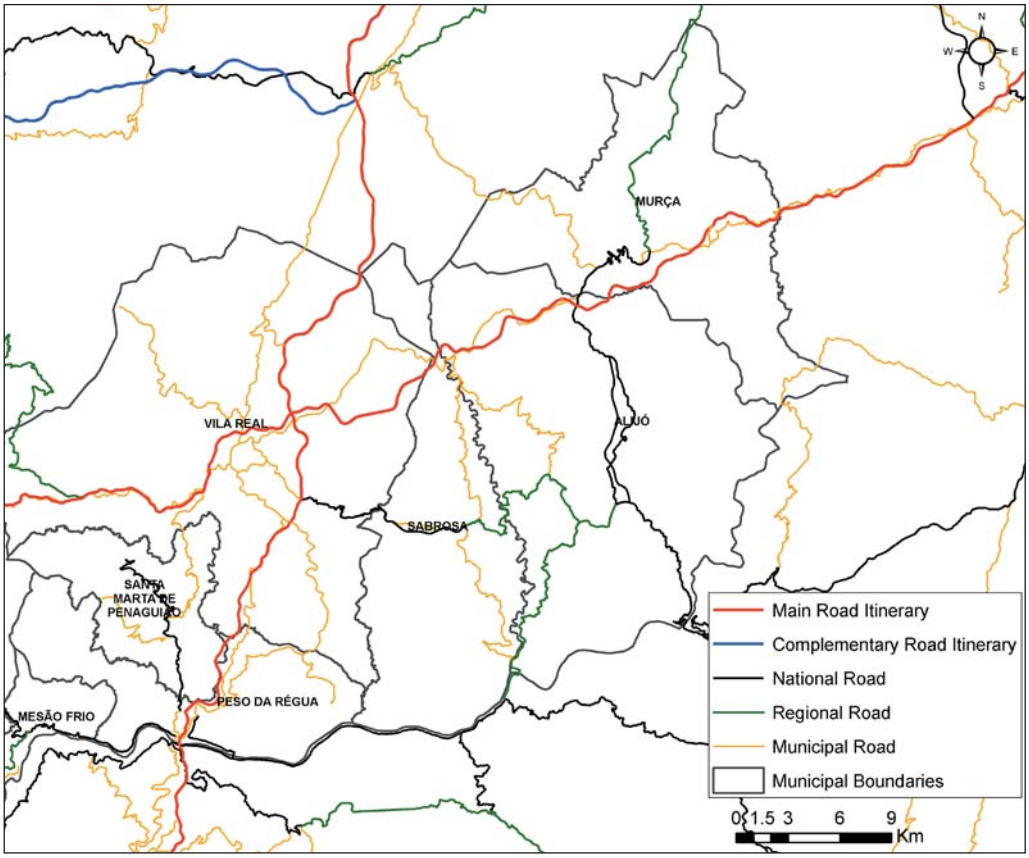
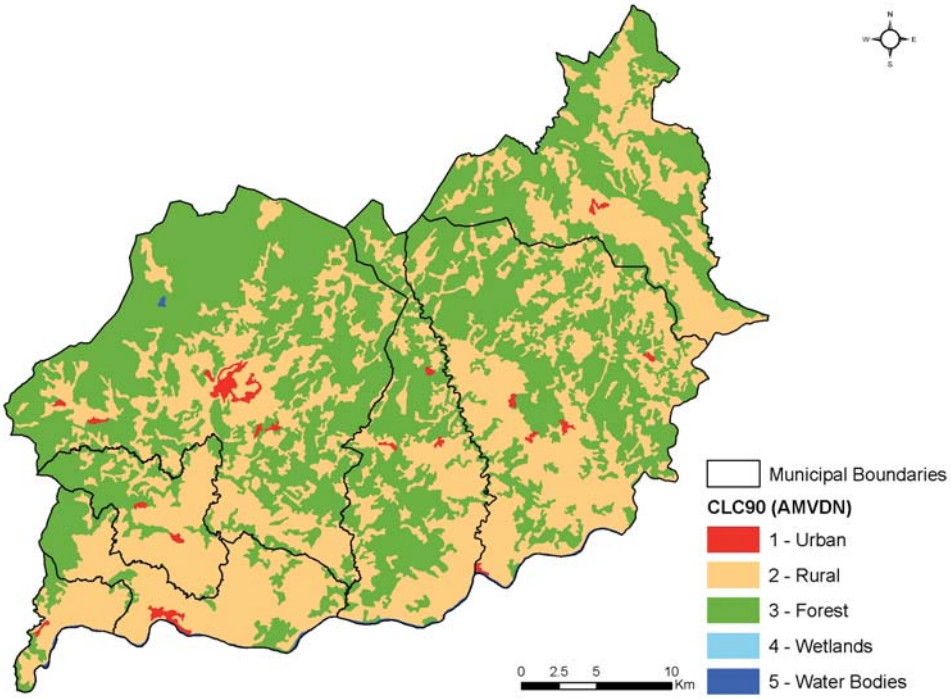


Figure 2 | Road network in the case study region

for two discrete moments in time (1990 and 2000) and build a digital database. As these data were treated and validated, thematic maps were generated according to desired and pre-defined analytical parameters. Through these, land uses were identified and quantified for both moments in time. Data regarding the differences between them were collected and registered in transitional matrixes that allowed the immediate identification of the most significant shifts in land occupation. This study was complemented by the analysis of additional data obtained in the meantime for the period of 2000-2006. Figure 3 presents the CORINE Land Cover (CLC) uses identified in the selected municipalities.

As displayed in Figure 3, forestry and rural uses prevail over occupation by urban uses, wetlands and water bodies. As expected, urban uses have little expression since the Douro region is dominated by agricultural uses, particularly those associated with vineyard farming. While some regions show some development that has been largely associated with rural uses, agricultural or not, other regions have been affected by processes derived from stagnant socio-economic conditions. These are associated with homogeneous land-uses (extensive areas set aside for one single use) and eventually with the abandonment and/or changes to the original land, such that multifunctional capabilities and biodiversity are reduced, potentially causing land and population desertification and aging. Figure 4 illustrates the quantification of land use changes observed for the 1990-2000 and 2000-2006 periods.


Municipal Boundaries
CLC90 (AMVDN)
1 - Urban
2 - Rural
3 - Forest
4 - Wetlands
5 - Water Bodies
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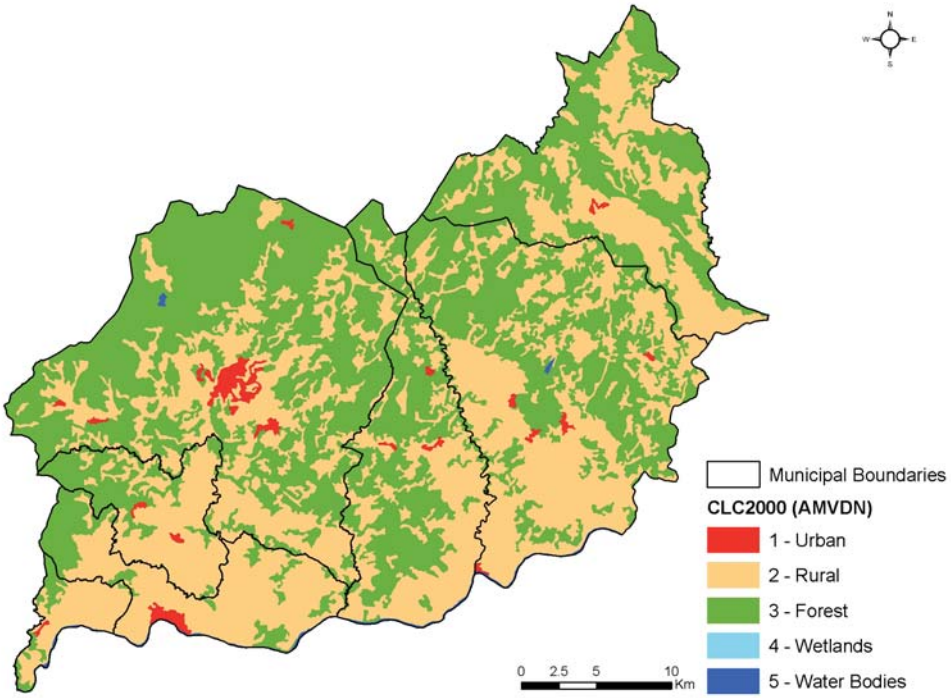
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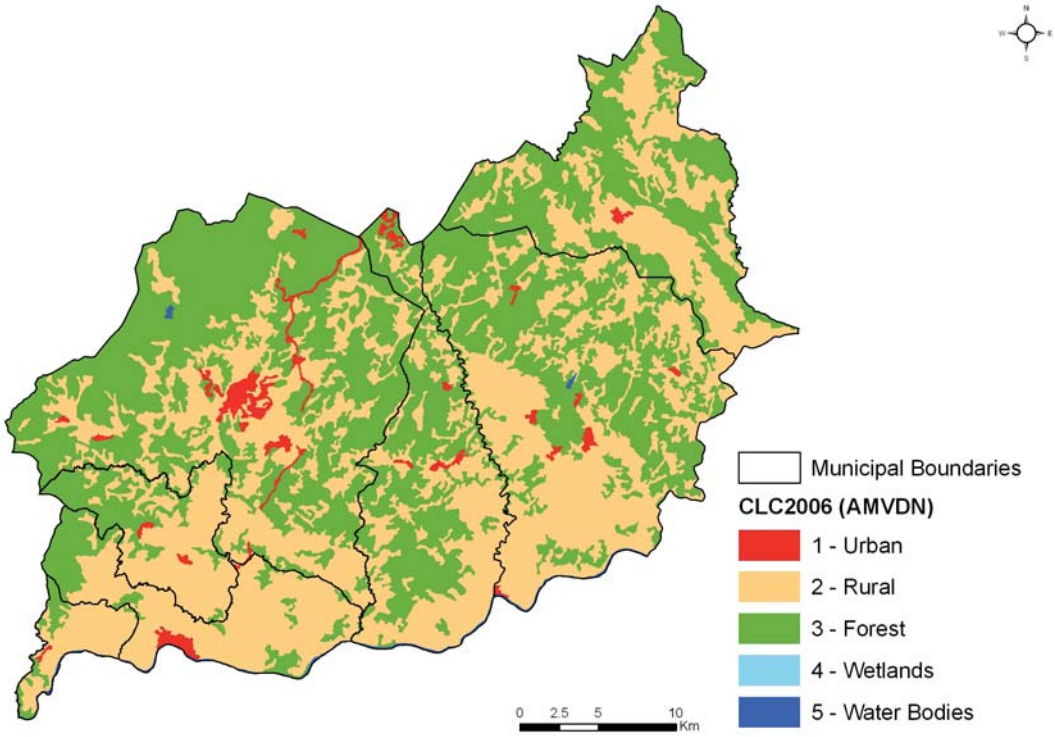


Figure 3 | Land uses identified in 1990 (a), 2000 (b) and 2006 (c)

As observed, the most significant changes occur when forested areas are taken over by rural land, and conversely, when these are converted to urban land. Table 1 provides a better understanding of the relative magnitude of these changes.

Overall, deforestation has reached a net loss of over 13% between 1990 and 2006. Forest uses were converted mainly into urban and rural uses, which continue to dominate the landscape, with a tendency to increase in certain municipalities. This conversion of uses is thought to be one of the driving forces behind deforestation, an observation corroborated by the data obtained for Mesão Frio, Alijó and Peso da Régua, which have seen the most significant increases in rural land use and decreases in forested areas.

As for urban uses, they are most significant for Vila Real. Not surprisingly, given that this municipality consistently displays increasing annual population growth rates of 2-3% (Lourenço et al., 2008), it has also undergone the greatest change in urban land, with an increase of approximately 822 ha. Sabrosa also reveals a significant increase in urban occupation of 221 ha. Except for Mesão Frio, the remaining municipalities also exhibit increases in urban uses, albeit more modest ones. Improvements to the main road connections are thought to have been the major driving force behind the urban expansion in Vila Real and Sabrosa (Danko and Santos, 2009) rather than the application of urban and other land-planning policies. These shifts are particularly visible in Figure 4b.

Most changes associated with shifts within agricultural uses relate to an increase in vineyard-occupied areas, accompanied by a decrease in forests and natural vegetation as well as in the percentage of land devoted to annual-permanent crops. Fur-

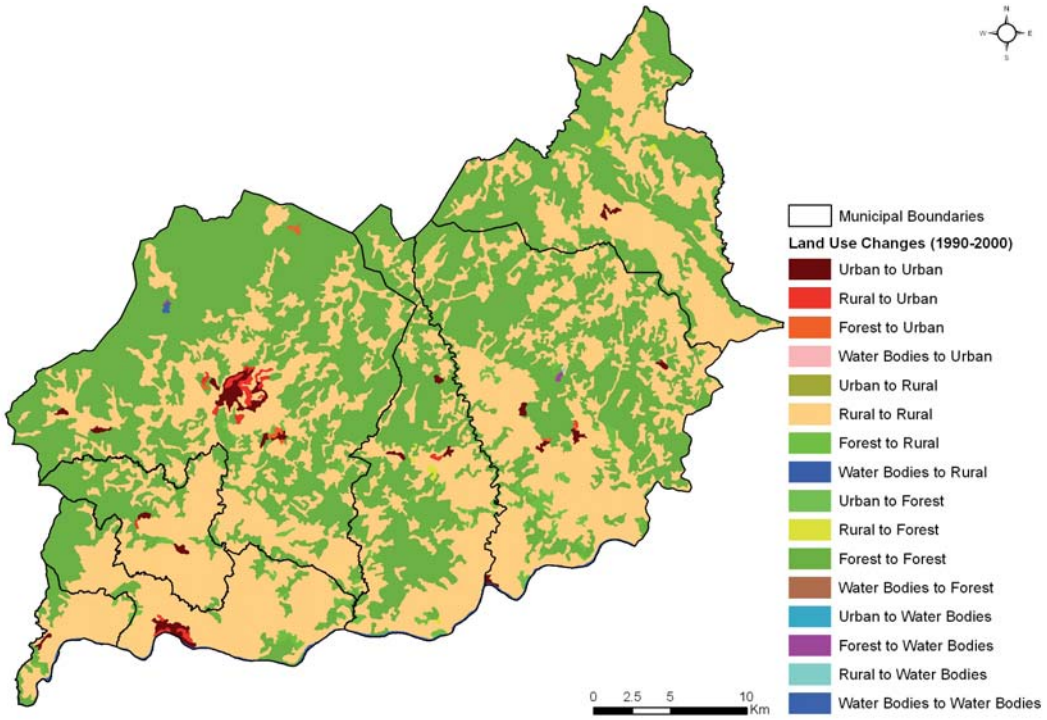
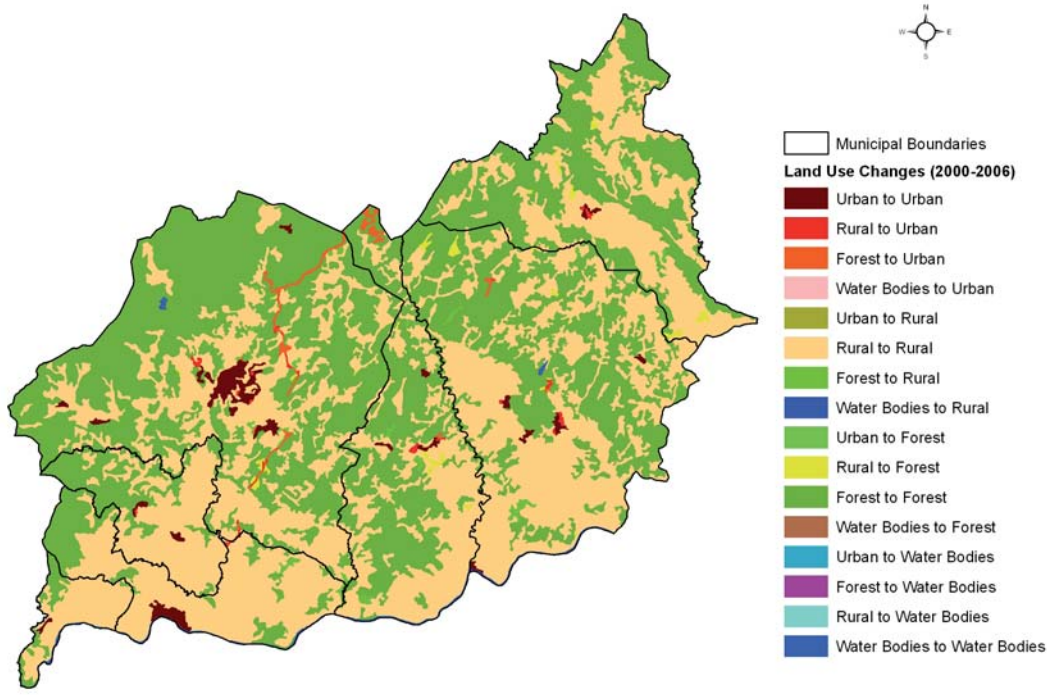


Figure 4 | Land use changes identified and quantified for 1990-2000 (a) and 2000-2006 (b)



Land Cover		Municipality						
		Alijó	Mesão Frio	Murça	Peso da Régua	Sabrosa	Santa Marta de Penaguião	Vila Real
Total Area	(ha)	29762	2666	18939	9487	15694	6931	37882
Urban (%)	1990	0.55	1.07	0.26	1.69	0.50	0.98	1.28
	2000	0.63	1.07	0.26	2.42	0.64	1.12	2.22
	2006	0.96	1.07	0.39	2.57	1.91	1.21	3.45
	change (1990-2006)	0.41	0.00	0.13	0.88	1.41	0.23	2.17
Rural (%)	1990	50.71	72.62	45.97	70.74	46.08	64.12	34.67
	2000	53.17	75.14	46.15	72.38	47.01	64.73	34.45
	2006	53.04	75.23	45.38	73.19	46.97	64.61	34.39
	change (1990-2006)	2.33	2.61	-0.59	2.45	0.89	0.49	-0.28
Forest (%)	1990	48.32	23.37	53.77	26.03	52.63	34.90	63.98
	2000	45.70	20.85	53.59	23.66	51.56	34.15	63.24
	2006	45.48	20.70	54.23	22.67	50.31	34.17	62.06
	change (1990-2006)	-2.84	-2.67	0.46	-3.36	-2.32	-0.73	-1.92
Wetland (%)	1990	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	2000	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	2006	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	change (1990-2006)	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Water Bodies (%)	1990	0.42	2.94	0.00	1.54	0.79	0.00	0.07
	2000	0.50	2.94	0.00	1.54	0.79	0.00	0.09
	2006	0.50	2.99	0.00	1.56	0.80	0.00	0.09
	change (1990-2006)	0.08	0.05	0.00	0.02	0.01	0.00	0.02

Table 1 | Land use and land use changes in the selected municipalities

thermore, a combination of wildfires, complex topography and scant reforestation efforts do not favour the swift and lasting regeneration of the woodland. On the other hand, these and other non-cultivated areas are promoters of biodiversity, offering several habitat possibilities to flora and fauna species.

How Land Use Changes Can Affect the Local Carbon Balance

Changes in agricultural policies, demographic trends and global trade are drivers of land use changes in Europe. Since CO_2 sources and sinks over land masses are intimately related to soil and vegetation types, changes in land cover and related uses bring more or less significant shifts in carbon stock change (Schulp et al., 2008; Shao et al., 2008, Houghton, 2007). Under the Kyoto Protocol and despite the uncertainty related to the estimates of carbon storage shifts due to land use changes, countries are required to report these and are given the possibility of partially offsetting their carbon emissions by implementing beneficial measures regarding land cover and uses.

Urban sprawl is a consequence of urban population growth into rural areas, thus replacing agricultural and forestry with other

Figure 5 | Guiding axes and scenarios
(Adapted from IPCC, 2000; Schulp et al., 2008)

uses more susceptible to affecting carbon cycling processes. Urban land transformation studies conducted in mainland USA point to a reduction in the capacity for carbon fixation by as much as 1.6 % of pre-urban conditions (Imhoff et al., 2004). The rate of urban sprawl in north-central Indiana in a study (Shao et al., 2008) for the Midwestern USA between 1940 and 1998 showed that the overall effects of land-use changes have led to the region becoming an increasing source of CO_2 in the past half-century. It was concluded that forestation of marginal agricultural land, improved soil/crop management practices, and use of renewable energy could lead to a 67% reduction of the gap between CO_2 emissions and carbon sequestration.

Using emission factor (EF) data reported for each EU State, Schulp et al. (2008) devised a methodology capable of assessing the effects of agricultural, forest and natural land use changes on carbon sequestration. The work was carried under different scenarios defined according to the level of globalisation and government intervention (Figure 5), for a period of 30 years into the future (2000-2030).

Thus defined, the scenarios for EU States cover the wide range of possibilities regarding macro-economic policies and their potential consequences in terms of land uses.

Overall, the results show that, depending on scenario, there are clear differences in terms of spatial distribution of carbon sources and sinks, as well as in their size. Nevertheless and except for scenario A2, the results indicate a net increase of carbon sequestration due to a de-

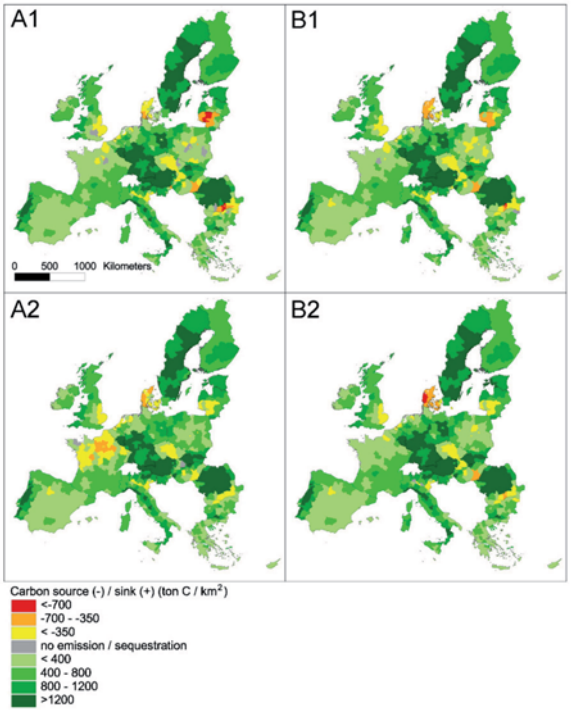


Figure 6 | Projected carbon emissions and sequestration for 2030 *(Adapted from Schulp et al., 2008)*

crease in cropland area, ranging from 90 to 111 TgC.year-1 by 2030 (Schulp et al., 2008)

In north-eastern Portugal (Figure 6), the region consistently meets the 400 to 800 tonC.km^{-2} sink class. The differences between scenarios are not discernible because land use changes in the region are not significantly visible and quantifiable at the selected resolution. However, as Shao et al. (2008) and others emphasize, changes in atmospheric carbon are global in scope and effect despite, as these and other studies have demonstrated, their local and spatially confined origins. Though there are no universal solutions, there are strategic approaches that can be derived from commonalities such as urban land growth and deforestation processes.

Carbon Balance Shifts in the Douro Valley

In view of the concerns and issues described, efforts have been conducted to characterise the carbon budget in the Douro Valley, using existing data on land use changes and the recommendations of Shao et al. (2008) and Schulp et al. (2008) set forth in their carbon balance calculation methodologies. As such, it is possible to quantify carbon emissions and sequestration based on the magnitude of the observed land use changes for 1990-2006 and a series of emissions factors defined in similar studies. As such, a series of emissions factors (EF) for non-urban uses (Table 2) were obtained from Schulp et al. (2008).

According to these parameters, increases in cropland and wetlands and decreases in forested areas mean an increase in carbon emissions. Conversely, carbon sequestration is promoted by reducing cropland and wetland uses and increasing forestry uses. Carbon emission and sequestration rates for water bodies have not been considered at this point. Therefore, the corresponding EF was taken as zero.

Urban uses EF were calculated using per capita emissions data published elsewhere (Table 3).

Accordingly, two types of urban EF were defined and used for determining municipality-specific EF. Two sets of data were generated and used to determine the extent of the effect of land use changes in the local carbon budget.

Carbon emissions from wildfires were estimated using standard methods, namely by assuming 45% as the biomass carbon fraction (Seiler and Crutzen, 1980) and an emission factor of 1569 g CO_2/kg dry matter (Andreae and Merlet, 2001). Available biomass for combustion was estimated separately for forest and shrub land areas, and

Cropland	Wetlands	Forest
-28.1	-2.0	92.0

Table 2 | Non-urban EF per land use type (tC/km^2/year) for Portugal *(Source: Schulp et al., 2008; EF<0: carbon emission; EF>0: carbon sequestration)*

Table 3 – Per capita carbon emissions (tC/inhab), for Portugal *(Source: EEA, 2009; LULUCF: Land Use, Land Use Change and Forestry)*

Method	1990	2000	2006
1. IPCC Sector 1.A, Fuel Combustion - Sectoral Approach	3.917	5.641	5.426
2. IPCC Sector, Total Emissions 1-7, excluding 5 LULUCF*	4.360	6.253	6.171

Figure 7 | Young cypress plantation after wildfire, Murça, 2003

Figure 8 | Pinus nigra settlement in Marão mountains, Gontães, 2006

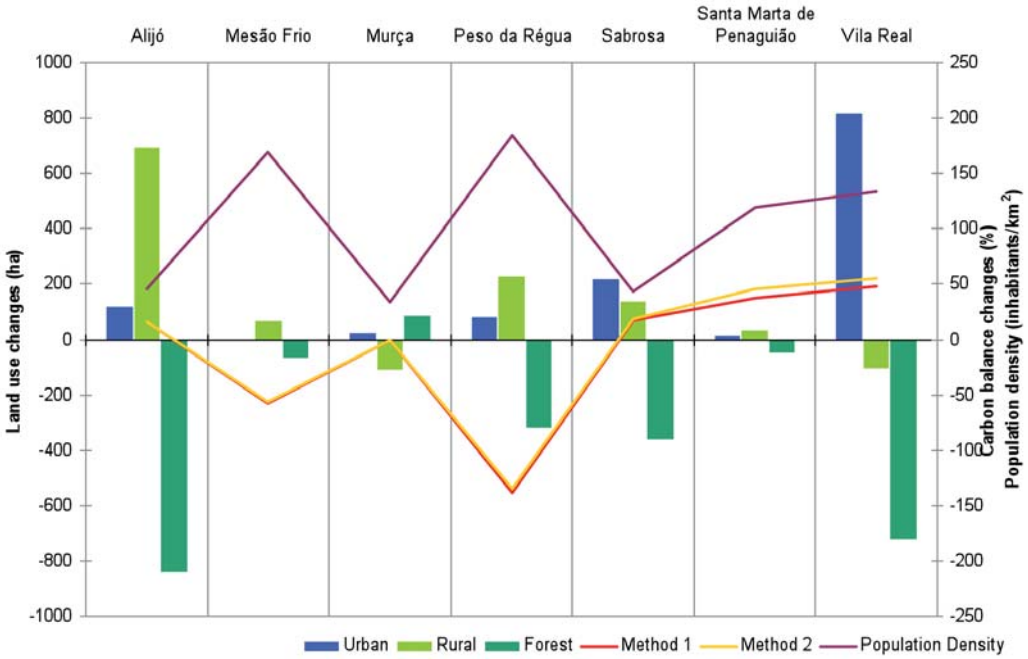


Figure 9 | Land use and carbon balance changes in target areas for 1990-2006

the results generated within the frame of a nation-wide forest fuel modelling project (Fernandes et al., 2009) based on data from the National Forest Inventory (195 sampling points in the study area). The results are presented in the Appendix.

There is a general change in the balance between carbon sequestration and emissions, away from sequestration. Given the decrease in forested and increase in rural and urban areas, these results are not unexpected. However, population density appears to play an important role in terms of how the carbon balance is estimated and the intensity of its variations. For the period of 1990-2006, Mesão Frio, Murça and Peso da Régua yield negative carbon balances, meaning emissions surpass sequestration in values that range from 1% (Murça) to and as much as 138% (Peso da Régua). The highest deforestation rates for Peso da Régua help explain the dramatic difference between carbon emission and sequestration rates in this municipality. Additionally, the high population densities and the increase in the average per capita emissions in the nineties from which the overall EF were derived (Figure 9) explain the results for the Mesão Frio and Murça, since there are no significant increases in urban or rural nor decreases in forested uses.

Conversely, Alijó, Sabrosa and Vila Real, which exhibit the highest increases in rural and urban uses, respectively, combined with the highest level of deforestation, produced global net results significantly favourable to carbon sequestration. A quick glance at the data shown above suggests that population density weighs more heavily in the balance than do land use changes. This is particularly apparent for Alijó, where the loss of forested areas ranked the highest (approximately 850 ha, followed by Vila Real with a loss of approximately 726 ha) but where population density is the third lowest of the group of municipalities. Santa Marta de Penaguião's modest land use changes and relatively high population den-

sity indicate a trend of decreasing sequestration capacity between 1990 and 2006.

In general (Table 4), both urban EF calculation approaches yielded similar results.

Carbon Per land use	Method 1	Method 2
Urban	190% increase	196% increase
Rural	1.66% increase	
Forest	3.66% decrease	
Water bodies	0.00% increase.	
Total Sequestration	3.66% decrease	
Total Emissions	46 % increase	51% increase
Carbon Balance	32% decrease	36% decrease

Table 4 | Overall carbon balance for 1990-2006

Both methods resulted in an approximate 50% increase in emissions that, given the dominance of rural and other non-urban uses, was still insufficient to overwhelm the carbon sequestration capacity of the target region – a total sequestration of 55461 tC/yr in 2006 versus a maximum emission of -32542 tC/yr estimated by method 2. In fact, despite the global 3.66% decrease in sequestration, the region was still able enough to completely offset the emissions despite their increase. However, this offsetting capacity has diminished by approximately a third in the 16 years under analysis at a rate of about 2% per year. If the observed trends continue and remain unaltered, it is possible that the region might loose its positive carbon balance by 2020, at which point carbon emissions are likely to surpass the region's sequestration capacity.

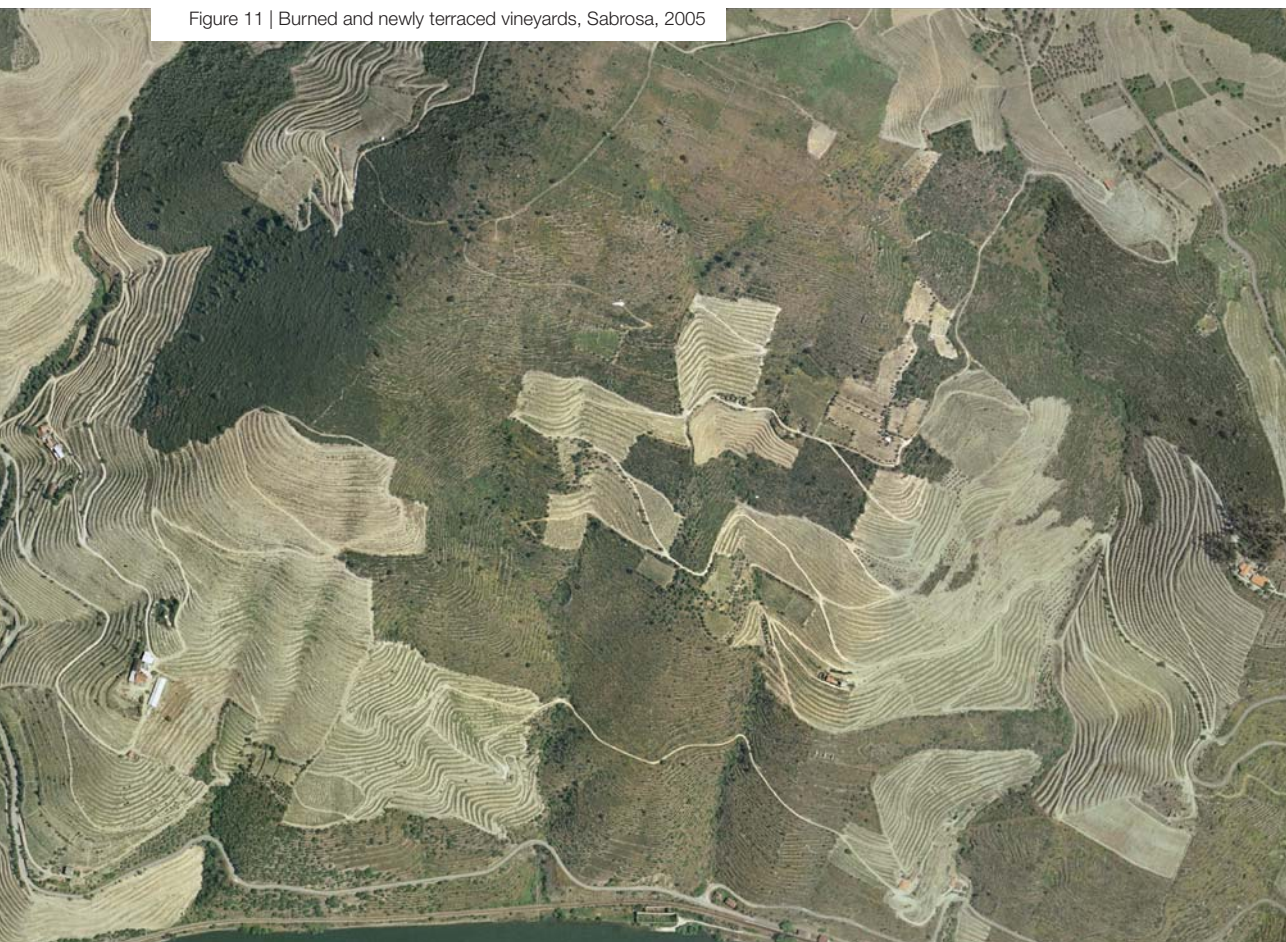
Nonetheless, it should be noted that the data do not take into account urban sequestration effects – brought by urban forests and vegetation – nor did the study consider carbon sequestration processes over water bodies. It is known that in lakes considered in a long term equilibrium with the nutrients they receive, carbon accumulation will be sedimentary which is small relative to in situ primary production, implying most of it is respired either in the water column or in the sediment. It is already well established (Prairie et al., 2009) that for the water column compartment, respiration generally exceeds the gross primary production surface. But while the area of aquatic systems is small, they can affect the regional carbon balance, representing an active component, especially the fresh water ones, of the global carbon cycle (Cole et al., 2007). For these reasons, forecasting exercises, though informative, are not precise and should only be considered in the context of the existing limitations.

Likewise, other non-urban carbon emissions, such as those resulting from biomass burning in wildfires have seen an increase across the target area from 1990 to 2006, (Figure 9).

Alijó, Murça and Vila Real display the highest levels of biomass loss to wildfires. In absolute terms, biomass losses translate into a total of 781 tons of CO_2 in the analysed period, or approximately 49 tC/yr. Given the magnitude of the carbon emissions derived from urban land uses, biomass burning contributions are still small. However, wildfires can negatively affect the local carbon balance from two points of view: not only are they sources of carbon emissions

Figure 10 | Burned and newly terraced vineyards, Mesão Frio, 2002

Figure 11 | Burned and newly terraced vineyards, Sabrosa, 2005



but they can also be devastating to forestry uses and have the potential to cause major local deforestation and therefore, significant loss of carbon sequestration capacity. As the analysis shows, while the absolute increase in carbon emissions is not alarming, a combination of increased frequency and severity of incidences of fire combined with the observed urban expansion and deforestation trends might become a reason for apprehension and justified concern (Figure 13 and Figure 14). Recent prescribed burning techniques for mitigating carbon dioxin emissions from forest fires can be seen as a valid measure and current analyses have shown that the potential reduction attained in the European region is almost 50% (Narayan et al., 2007).

Conclusions

The analysis herein presented indicates that in the Douro Valley, the dominance of vineyards and forestry uses over urban occupation accounts for a much higher sequestration than emissions of carbon. Despite general stagnant socio-economic developments in the area, some parts of it show relevant shifts in land-use, be it urban sprawl, deforestation or abandonment. Forest fires and a complex topography are major causes for the growth of abandoned areas which make these areas more prone to erosion and desertification.

Some occurrence of urban sprawl and the replacement of forested areas by urban uses, has determined an overall decrease in the carbon sequestration capacity for the area under study. Furthermore, the estimated carbon emissions have increased partly due to land-use shifts and in larger proportion to per capita emissions. As the estimated per capita average for Portugal has increased from 1990 to 2006, the estimated

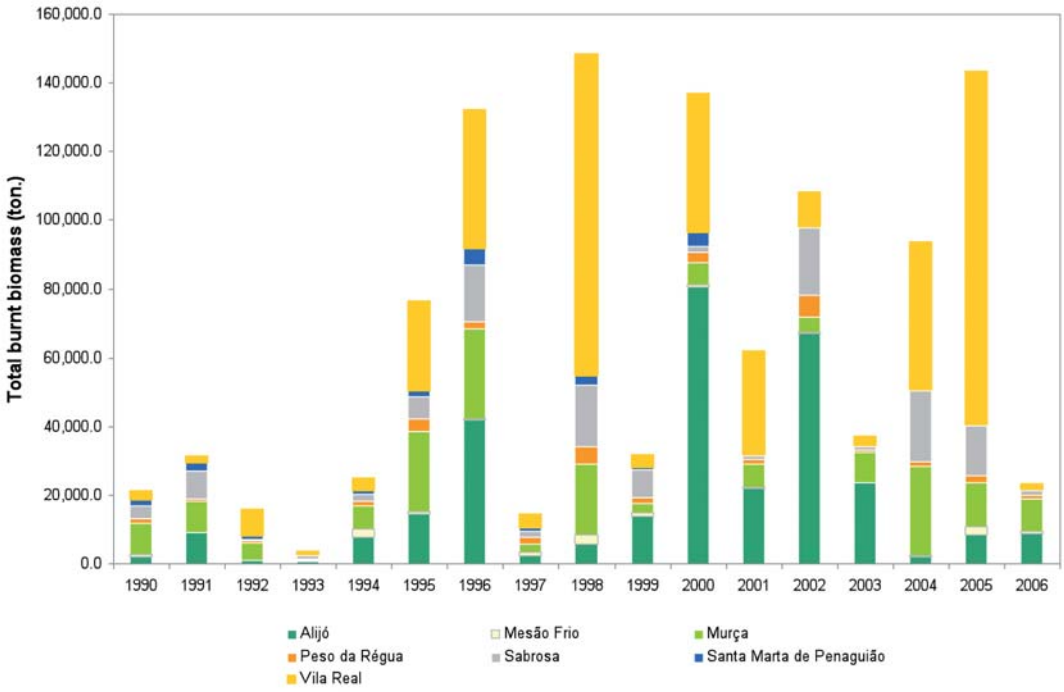


Figure 12 | Land use and carbon balance changes in target areas for 1990-2006

Figure 13 | Spring wildfire in the Marão mountains, 2005

Figure 14 | Experimental fire to study the effectiveness of fire hazard mitigation practices, Padrela mountains, 2003

emissions in the area have risen by a third in 16 years, despite the population loss observed for the same period.

This is a preliminary approach at local/sub-regional scale for estimating the carbon balance that has yet to address urban sequestration and the effects of aquatic systems and wetlands and adjusted sub-regional per capita emissions that are required in order for the definition of an encompassing approach to a more accurate, detailed and area-specific carbon budget to be achieved.

Future studies will also likely include the effects of increasing tourism activity, particularly in the areas where social and economic development is most closely related to the offer of tourism resources, such as Sabrosa and Vila Real. An increase in the number of tourists translates into an increase in per capita contributions to the total carbon emission balance, through the larger energy consumption by facilities such as hotels and similar structures versus residential uses. Other aspects lend themselves to further study. For instance, and given the growing trend in mechanisation of agricultural activities including wine-farming, emission factors for croplands should be re-evaluated for their validity, as these carbon emitting trends become more visible over time.

Likewise, policy measures such as forestation of marginal agricultural land and reforestation, among others, may be adopted in order to increase carbon sequestration in the area. The enlarged use of renewable energies (Figure 15) in the sub-region and policies towards urban sustainability and energy efficiency, especially in the housing sector and in the built environment, may help lower carbon emissions.

Acknowledgements

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Figure 15 | Pinus nigra settlement in Marão mountains, *Campeã 2006*

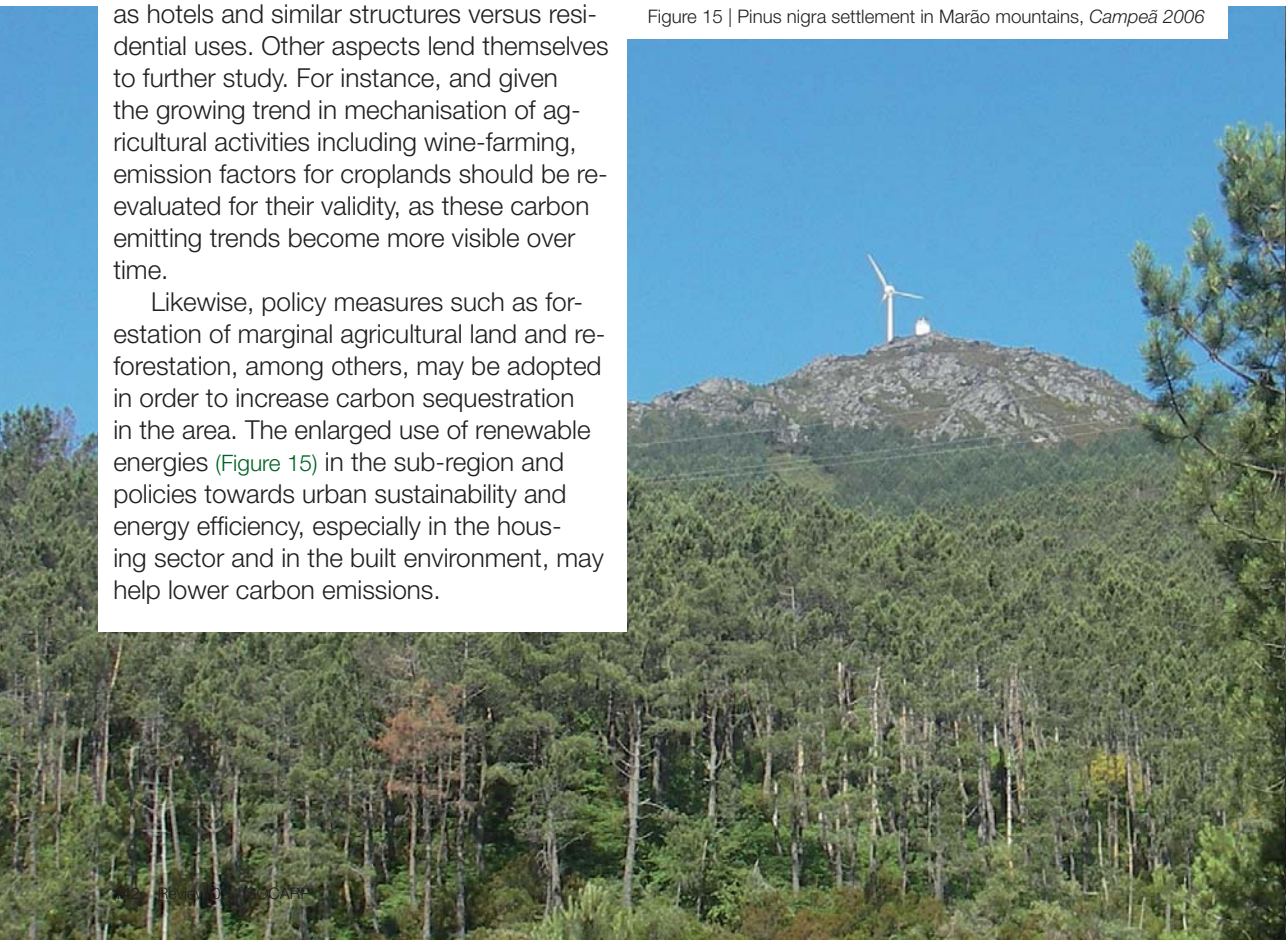

Figure 16 | Pinus nigra settlement in Marão mountains, Campeã 2006

Figure 17 | Betula celtiberica Settlements in Marão mountains, 2006

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Robert Shaw

Energy Planning at the Community Level in England

An Emerging Agenda

Any lingering doubts that climate change is a reality have been systematically discredited over the past few years, the apparent cooling of the lower troposphere being once example. This leaves us with the stark reality of needing to make swift and dramatic cuts in carbon dioxide (CO_2) and other greenhouse gas emissions globally. The world climate talks in Copenhagen in December 2009 will be a critical determinant of whether we have any hope of achieving such reductions.

Each year now tends to be another record breaker. In 2009 greenhouse gas emissions are likely to be the highest ever and their growth shows no sign of slowing, despite the economic downturn. It is also likely to be a year where the effects are felt more than ever before. The recently published UK Climate Projections (UKCP09) are the most sophisticated and robust yet produced, anywhere in the world. They offer, therefore, the best available guide to understanding risks and taking effective action in the UK. The projections reiterate the sort of impacts we can expect: warmer, wetter winters; hotter, dryer summers; and a great deal more uncertainty and extreme weather. The extensive wet weather and floods experienced in the UK in 2008, for example, were mirrored by droughts and extreme temperatures in other parts of Europe and the world.

In the UK the Government has been slowly waking up to the scale of the challenge and the responses needed. It has expressed this in the form of three drivers: climate change; the need for low carbon secure energy; and concerns about fuel poverty. The responses at national level have been set out in a range of strategies and Acts of parliament, brought together in the Government's July *UK Low Carbon Transition Plan.* They include:

- A legally binding commitment to reducing CO_2 emissions by 80% against 1990 levels by 2050 delivered through the Climate Change Act, 2008, with an interim target of 34% by 2020.
- A binding commitment to generating 15% of the UK's *total* energy from renewables by 2020. This covers not only electricity but energy used for heat and transport also. The government believes that this will see the share of renewable electricity rising to over 30% from a current base of just 5% (Figure 1).

Building regulations in England to require zero carbon new homes by 2016 and zero carbon non-domestic buildings by 2019. Interim targets are expected to require a 25% reduction on 2006 dwelling emission rates in the 2010 revision to the regulations and a 44% reduction by 2013. These targets are guided by the emission rates in the energy element of the national voluntary Code for Sustainable Homes.

This is arguably the most challenging 'to do' list imaginable and requires action to be taken by Government, industry, communities and the organisations that represent them, including local authorities, and of course individuals. It is at the local level that some of the biggest and most exciting opportunities present themselves.

Planning for Energy

Many of the necessary responses to the cli-

mate change and energy challenges require a spatial approach. The UK is fortunate to have a well established spatial planning system that provides us with a framework for guiding the activities of key delivery bodies from the national down to local levels. The difficulty comes with ensuring that it is fit for purpose, since until recently planners have had little to do with energy and little need to understand the complexities of the subject.

This has now changed dramatically. In December 2007 the Government published PPS1: Planning and Climate Change[1] (PPS1 Supplement), applicable to England. This requires planners to identify decentralised renewable and low carbon energy opportunities across regions and local authority areas and to design policies and targets to deliver these.

AECOM worked with the Department of Communities and Local Government (CLG) to develop the energy methodology for accompanying Practice Guide that is now used by planners to prepare regional and local policies and targets. We have subsequently worked with planners and masterplanners across England to develop energy opportunities plans, policies, targets and strategies. In this paper we explore what we have learned.

Figure 2 describes three types of energy opportunity of interest to planners in setting policies and targets and their deliver partners.

- The first, stand alone generation, includes wind turbines or biomass power stations. Planning has a key role to play here in identifying opportunities spatially and developing policies, criteria and targets to support their delivery. Typically, delivery will be via proposals from specialist energy developers or community owned co-operatives.
- The second type of energy opportunity refers to what the PPS1 Supplement calls decentralised energy, such as district heating and combined heat and power (CHP). Essentially we are talking not just about renewable and low carbon generation, but also infrastructure. Planning again has a key role in identifying appropriate locations. For example, planning policies could require new developments to connect to existing district heating networks or to contribute (financially or physically) to expansion of a network.
- The third energy opportunity relates to on-site renewable and low carbon energy generation. In England these have become known as the 'Merton Rule' after the London Borough that pioneered them. However, the proposed changes to the building regulations described earlier means that planning will have only a limited role in terms of the building or development integrated generation element. This role will diminish over time as the requirements for CO_2 reduction through the regulations increases. Planning should seek to support developers in meeting their regulatory obligations by using viability assessments to test whether or not there is any opportunity to set energy performance standards ahead of building regulations through planning. The remaining role for planning at the building scale post 2016 (when all new homes will need to be zero carbon) and 2019 for buildings would be to require developments, subject to tests of viability, to achieve elements of the Code not included as part of the building regulations, such as ecology or adaptation to climate change.

Evidence Based Planning

Understanding what types of policies are appropriate for a particular local authority area or site and what targets are technically feasible or financially viable requires us to develop a robust evidence base. Government dictates that planning policy in England be evidence based and AECOM has gained valuable experience of what this entails.

There are a number of broad elements to an evidence base:

Setting the baseline

We need to start by developing an under-

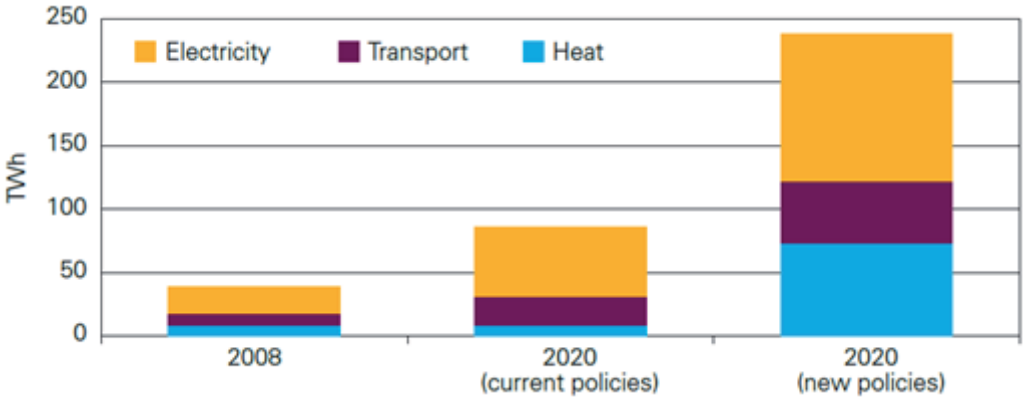
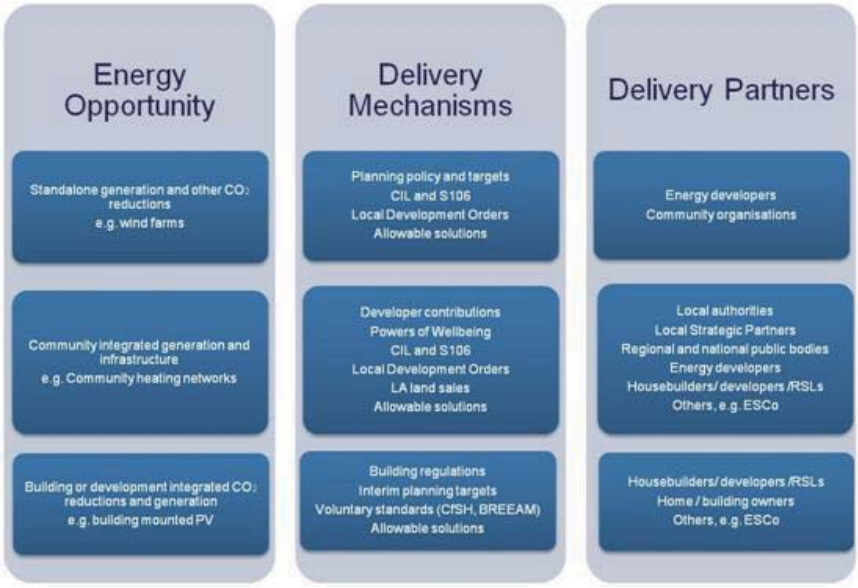


Figure 1 | potential scenario for reaching 15% renewable energy by 2020

Figure 2 | types of energy opportunity



standing of the energy use and corresponding CO_2 emissions of existing buildings and proposed future development within a given area:

- Using publicly available national data we can produce a dataset of existing development and corresponding energy demands and CO_2 emissions. Data sets include the English House Condition Survey, the Building Research Establishment Domestic Energy Factfile, Home Energy Conservation Act (HECA) reports and data from local initiatives. This allows us to understand any progress that has been made towards reducing energy demand and likely efficiency trends. At this stage we should identify existing energy generation facilities and infrastructure, such as power stations, gas and electricity networks, district heating, wastewater and municipal waste treatment plants and major industrial users or producers of heat.
- Future energy demands from proposed residential and non-residential development can also be predicted. This is based on dwelling numbers and floor areas taken from growth scenarios – PPS3 requires local authorities to assess strategic housing land availability. When making predictions for future energy use and CO_2 emissions it is important that we consider national and regional reduction targets alongside the potential effect of climate change, particularly the impact of increasing temperatures on energy demands for cooling.
- Energy demand and likely CO_2 reductions can then be mapped using GIS to reveal existing and future areas of high heat and power demand. This will allow us to identify opportunities for supplying renewable and low carbon energy to new sites, for example by linking them to heat networks which serve existing buildings with high year-round heat demands that act as "anchor loads".

Opportunities for reducing energy demand
We then need to identify a local strategy for CO_2 reduction which considers the potential for increased energy efficiency in the existing stock as well as in new development. We will need to explore the extent to which energy demands could be reduced through design, for example, through orientation, passive façade design, improvements in wall, floor, roof and glazing fabric performance and more efficient heating systems and fuel types. At the same time, we can look to identify opportunities for adaptation to the impacts of climate change, particularly looking at measures with mutual benefits such as shading or planting to reduce the urban heat island effect or passive cooling strategies such as night time ventilation which will act to reduce future energy demands for mechanical cooling (figure 3).

Potential for decentralised renewable and low carbon energy generation
Once we have an understanding of baseline energy demands for existing and proposed new development, we can look at scenarios for generating renewable and low carbon energy. This entails assessing energy resources, taking into account the constraints and opportunities presented by the local environment, development characteristics and infrastructure. The principal options (figures 4 and 5) are likely to be:

- District heating and combined heat and power (CHP) in locations identified using a heat map as having sufficient heat density (above 3MW per km2 is considered necessary in viability terms).
- Biomass heating.
- Energy from waste.
- Wind power.
- Hydro power.
- Emerging technologies, such as fuel cells.
- Small scale, decentralised and renewable or low carbon technologies. These could be photovoltaic cells, solar thermal, small scale wind, and heat pumps (air and ground sourced).

Character areas and energy opportunities plans

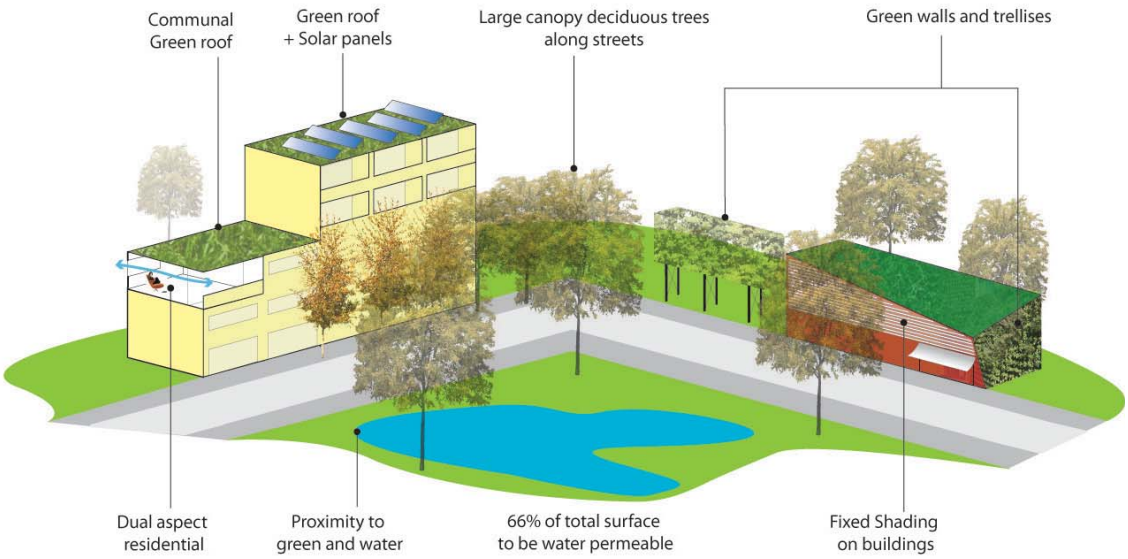


Figure 3 | Options for adapting spaces to be comfortable under higher temperatures scenarios also help to reduce energy demand.

A further question is how best to co-ordinate the evidence so as to develop meaningful conclusions that fully reflect the range of opportunities which exist at different spatial scales and locations. Two approaches can be helpful and can work well in combination:

- Energy opportunities can be mapped using GIS and together with the understanding of energy demands and CO_2 emissions this forms an 'energy opportunities plan' (figure 6). The plan can be used as a visual guide to advise on policy making, target setting and delivery strategies.
- The approach developed in Community Energy: Urban Planning for a Low Carbon Future uses a series of 'character areas' based on distinctive locational characteristics including land use mix, density, age of stock and tenure. For larger studies (regions, sub-regions or local authorities particularly) character areas can support an energy opportunities plan by helping to define the likely technology mix. For example, a mixed use town centre will have different opportunities to those in a largely residential suburb or rural village. Policy approaches and targets can be tailored to each if necessary.

Information on design issues, cost, viability and deliverability, and potential land take can be undertaken for each technology. An assessment of the potential contribution from renewable and low carbon technologies should also take into account current and projected assumptions relating to future grid CO_2 intensity (i.e. the average carbon content of grid supplied energy), which will influence the potential for total CO_2 savings as well as renewable resource availability. The long term availability of fuel and air quality concerns relating to the use of biomass is a particularly important consideration for these studies.

Assessing feasibility and viability

In developing policies and setting targets it is important to understand the impact on and of the technical feasibility and financial viability of achieving targets for a range of development types. In other words, do the constraints of a site make it physically impossible to meet the proposed targets and what will the affect of the target be on the site's financial viability? Indicative energy strategies for different development types can be a helpful way of assessing this. These should be based on likely dwelling numbers and floor areas and assumptions about other proposed development characteristics, such as massing and street layouts.

Assessing technical feasibility of a range of energy efficiency, generation, and energy supply measures involves identifying site-specific opportunities. A constrained site is unlikely to be able to deliver very high energy standards within the development itself. Therefore, there may be potential to link up with energy infrastructure proposed as part of other major regeneration projects in neighbouring areas. The UK Green Building Council suggests that meeting the proposed building regulations zero carbon requirement in 2016 through on-site measures alone will not be possible on up to 80% of developments. This has led to the Government's new proposed definition of zero carbon whereby only a 70% reduction in CO_2 emissions regulated by building regulations needs to be achieved on-site. The remaining 30% along with the unregulated emissions (from appliances and some cooking) can be achieved through 'allowable solutions'. Allowable solutions are likely to include, amongst other things, connection to a district heating or CHP system: local planning is ideally placed to identify these.

The financial viability of development is sensitive to a number of variables, including land value, construction costs, market conditions, affordable housing provision and other planning obligations. Modelling the marginal cost implications of achieving energy or CO_2 reduction targets (cost per m^2) on a district-wide basis (including community infrastructure) and for the outline energy strategies enables us to compare the viability of options.

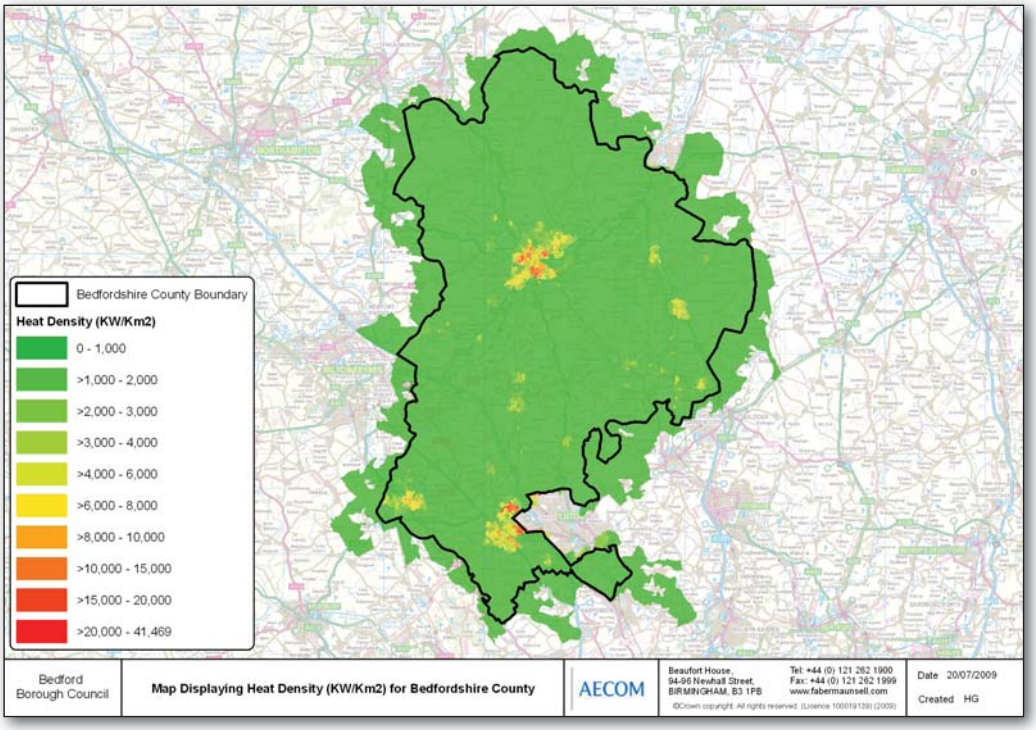


Figure 4 | Heat density map for Bedfordshire

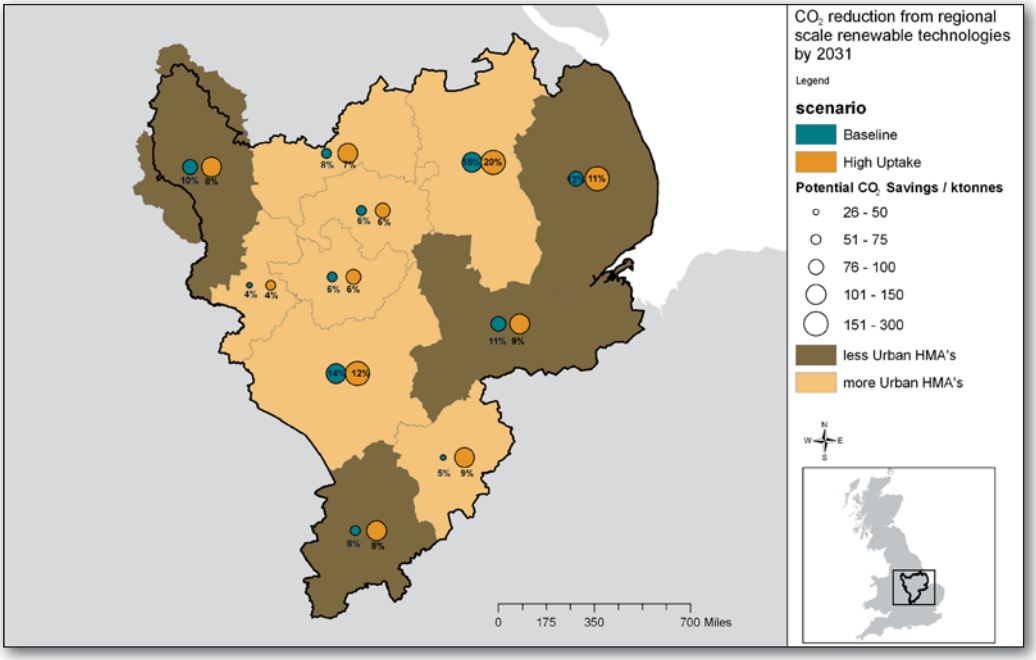


Figure 5 | Mapped CO_2 reductions from regional scale renewable energy technologies for the East Midlands region.

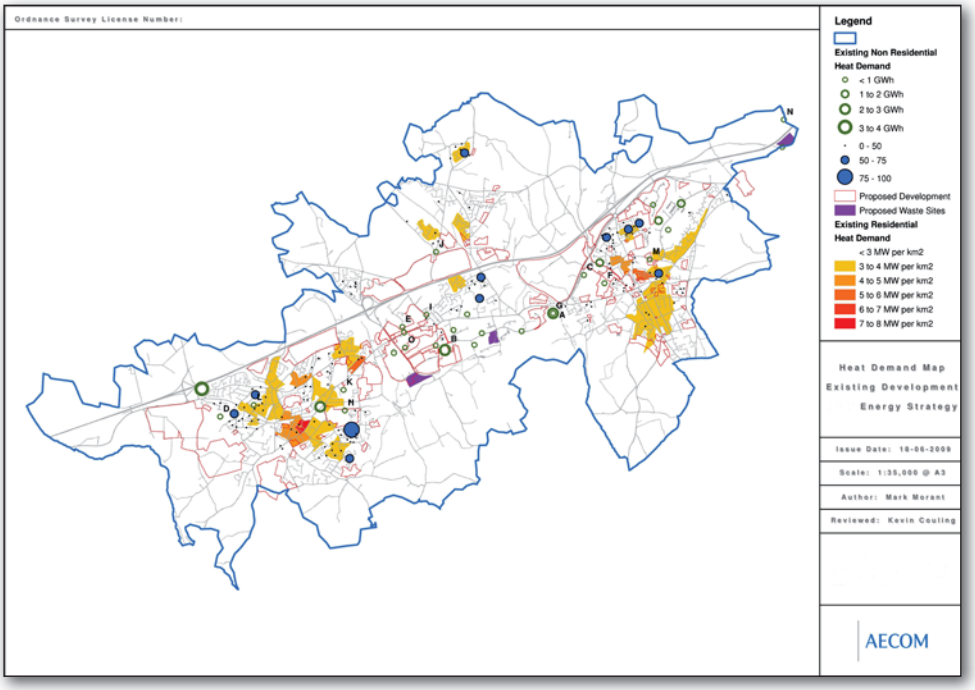


Figure 6 | an 'energy opportunities plan' maps development sites against energy opportunities and can form the basis of energy policies, targets and delivery plans

It is important that policies and targets are flexible enough to accommodate differences in viability across a given area. We might want to allow targets for some sites to be relaxed or increased where justified on feasibility or viability grounds.

Delivering the Vision

What is clear is that planning cannot deliver the energy generation and infrastructure capacity alone. Planning operates within a wider system, which at the local level involves politicians, Local Strategic Partnerships (LSP) and other local authority departments. A good and co-ordinated relationship between these parties is key to effective delivery.

The two central documents for co-ordinating delivery of renewable and low carbon energy projects at the local level are the Sustainable Community Strategy, prepared by the LSP and supplemented by a specific energy strategy if need be, and Local Development Frameworks (LDF) prepared by planners. The strategies should not be prepared in isolation and ideally planners should be seconded to the LSP during the Sustainable Community Strategy preparation process and vice versa to ensure compatibility. Both need to set out a clear delivery plan for policies and targets.

The use of character areas and an energy opportunities plan can help us to define suitable delivery mechanisms across LDF Development Plan Documents and the Sustainable Community Strategy. A town centre district heating scheme, for example, could well be funded, delivered and managed by a public private partnership energy service company (ESCo) supported by financial contributions from developers. Energy efficiency improvements or microgeneration technologies in a suburban district on the other hand might be better funded through local authority loans or grants to householders. The Salix fund can be accessed by local authorities to provide a revolving fund for such purposes. Further opportunities

are discussed in the Government's recently launched Heat and Energy Saving Strategy consultation.

Key to delivering effective area-based renewable and low carbon energy strategies is successfully drawing on the opportunities presented by the Comprehensive Area Assessment (CAA) process. CAA provide a snapshot of how effectively local partnerships are working together to deliver local priorities and improve quality of life. This is in recognition of the fact that no single organisation can be responsible for meeting local needs. The framework analyses performance against up to 35 targets chosen from the National Indicator Set and agreed as part of a Local Area Agreement (LAA) between central and local government. The LAA acts as a short term delivery mechanism for the Sustainable Community Strategy. Currently there is no specific National Indicator for renewable energy, although the recent Renewable Energy Strategy[3] proposes to introduce one shortly. Until this time, several can currently be used to deliver energy projects:

- NI 185 – Percentage CO_2 reduction from local authority operations.
- NI 186 – Per capita CO_2 emissions in the local authority area – Some two thirds of local authorities have adopted this indicator.
- NI 187 – Tackling fuel poverty – percentage of people receiving income based benefits living in homes with a low and high energy efficiency rating.
- NI 188 – Planning to adapt to climate change.

The local authority is the statutory body responsible for the LAA which is overseen by the LSP. A multi-area agreement is effectively a cross-boundary LAA, which can be set up to address issues such as energy, which cross administrational boundaries and may be better addressed in partnership, at a regional and sub-regional scale.

But local authorities have a wide range of other powers and tools that they can draw on. These include:

- The Community Infrastructure Levy (CIL) – CIL is expected to be introduced in 2010 and will empower local authorities in England and Wales to levy a charge on new development. It will be a useful tool for pooling developer contributions to fund community energy infrastructure. This could be supported by a Regional Infrastructure Fund, such as that set up by the RDA in the South West, to enable forward funding of infrastructure. Money could be recouped through the CIL or Section 106 once development comes forward.
- Local Development Orders (LDO) – LDOs remove the need for a planning application to be made for a specific technology or site. Interestingly, they could be used to designate areas where particular opportunities have been identified for energy technologies or infrastructure or to promote green industries in particular locations. A pilot LDO has recently been designated for the Barking district heating network in East London.
- Powers of Wellbeing, introduced by the Local Government Act 2000 – allow public sector participation in special purpose vehicles. The powers could be used by local authorities to establish public private partnership ESCo to deliver renewable and low carbon energy services and co-ordinate investment and property investment. Despite their potential, Wellbeing powers have not yet be extensively used.
- Local authorities can agree lower land receipts from developers in return for improved energy standards. The local authority in Wolverhampton used this right to require energy performance standards in the Showell Park development.
- Procurement decisions. Local authorities have significant influence through their own spending.
- Local authority initiatives such as affordable warmth programmes and those aimed at influencing behaviour.
- Corporate strategies for development and investment by local strategic partners, including in health and education.

Figure 7 | Ancoats Mills, Manchester (source: Manchester Public Library)

Can Local Government Rise to the Challenge?

There is no doubt that planning and delivering renewable and low carbon energy presents a huge challenge to us all. The discussion above makes it clear that local authorities are or will be at the front line of co-ordinating this delivery and many people question whether they have the capacity to do so. However, history tells a different story. As part of a study carried out for the ten Greater Manchester Authorities, AECOM and URBED looked into the development of Manchester's first gas and electricity networks. The study tells us that local authorities have been here before and have proved themselves more than capable.

The world's first gas networks were developed by mill operators at the turn of the 19th century to supply the cotton mills with gas for lighting from the new gas factories. The small networks expanded as private undertakings, supplying the emerging market in Greater Manchester's expanding town centres for street, retail and office lighting, but, seeing an opportunity to expand supply and to make money, Manchester City Council established a precedent as first area to set up its own municipal gas company. Manchester established a precedent as the first area to establish its own municipal gas company. Upon being granted its Charter it invested to expand the network by buying up the private gas undertakings from industrialists so that they too could generate revenue to fund public works.

Figure 7

As the 19th century progressed, electricity became more widespread. Early Acts of Parliament created the necessary licensing regime and a range of private enterprise began supplying buildings and factories. Buoyed by its success with gas networks, the local authorities again took an interest. The 1882 Electricity Lighting Act enabled them to establish their own undertakings, in-

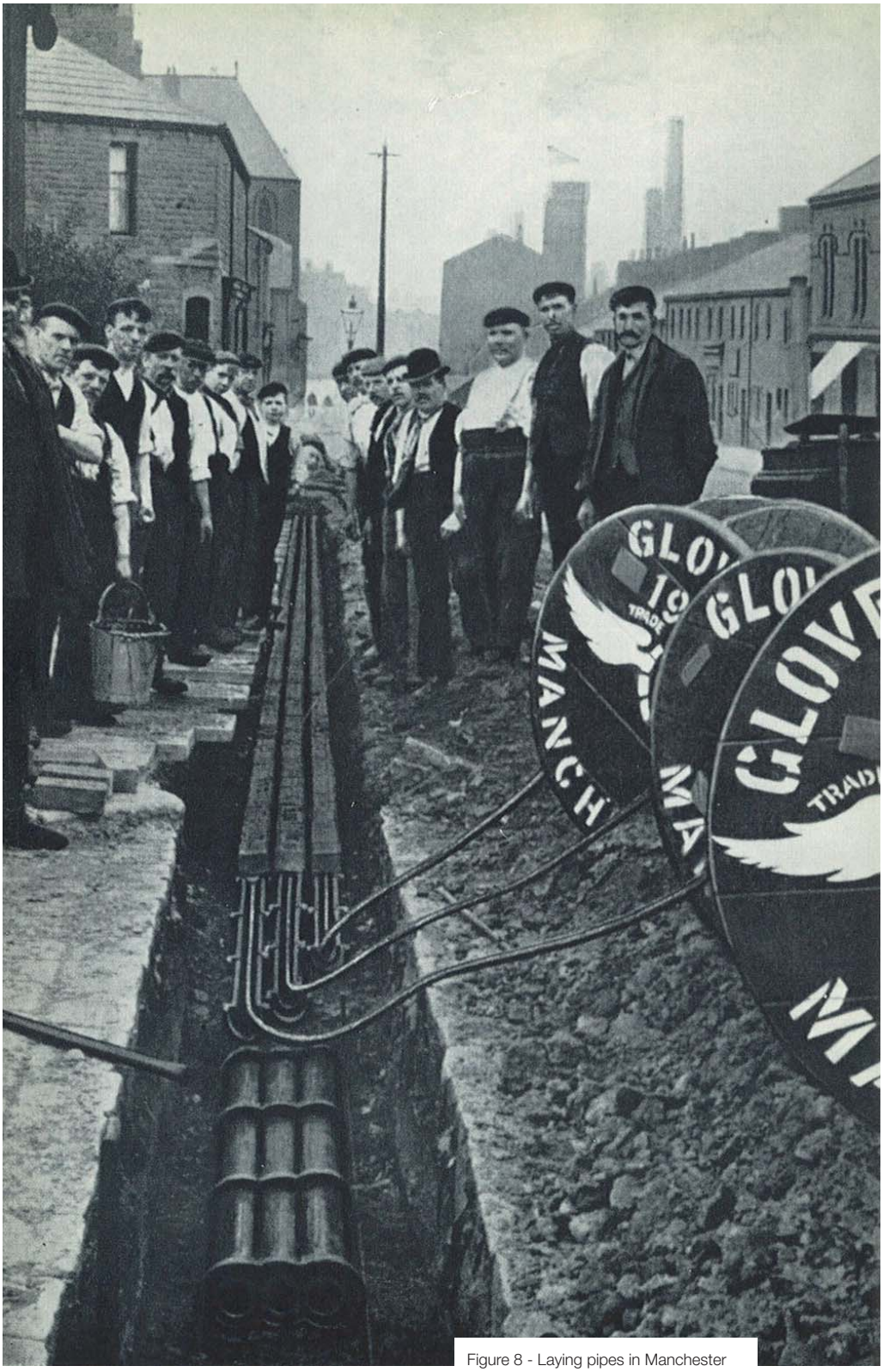


Figure 8 - Laying pipes in Manchester

cluding the right to break open highways. Partly again to ensure that the growth in electricity supported the huge population growth that Manchester was experiencing but also out of self interest, authorities were even known to oppose private sector network applications.

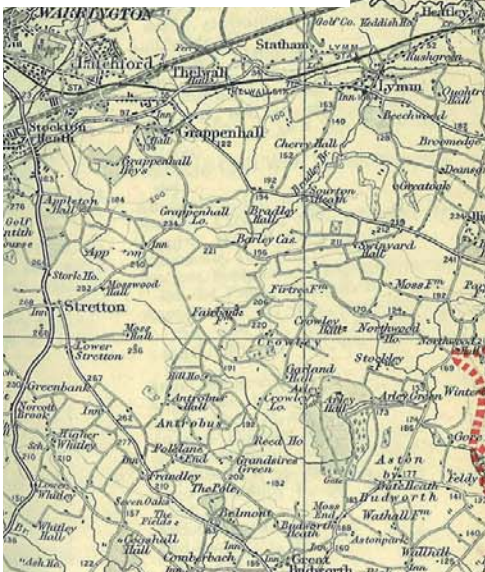
1880 to 1890 saw massive growth in scale and capacity, based on state-of-the-art technology. Bloom Street became the world's first CHP plant. The public and private undertakings that invested in infrastructure were critical to Manchester's growth. Figure 8

Manchester saw further exponential growth between 1900 and 1920, driven by expansion of the electric tram network, demand for new electrical supply and the conversion of mills to electricity. Supply therefore became a critical issue with many plant running flat out. Around this time longer distance transmission was becoming possible which enabled a regional grid to develop between larger power stations, such as Barton, Chadderton and Agecroft. Figure 9

In today's world of very large centralised power stations we would call these decentralised networks. With the current drivers of climate change and the need for low carbon secure energy we are coming full circle. We will no longer be able to rely on centralised fossil fuelled power generation. As fossil fuel use becomes more constrained we will have to burn it more efficiently by making use of the heat that we currently release into the atmosphere by piping it through district heating pipes. This necessitates locating power stations close to their end users.

Similarly, the nature of renewable energy is that it is often small scale, usually intermittent and is generally restricted in where it can be generated. Solar panels will need to be put on our roofs, wind turbines where it is windy and biomass grown where it does not conflict with space for growing food crops. The energy generation and distribution network is having to adapt to a new reality where it must be smart and whereby consumers are also producers.

The range of actors involved is huge but for the small and community scale technologies and infrastructure, which will make a up large part of our future energy generation and distribution, local authorities must once again step up to the mark. •



1 Communities and Local Government (2007) 'Planning Policy Statement: Planning and Climate Change: Supplement to Planning Policy Statement 1'. TSO: London.

2 TCPA and CHPA (2008) 'Community Energy: Urban Planning for a Low Carbon Future'. TCPA and CHPA: London

3 HM Government (2009) 'The UK Renewable Energy Strategy'. The Stationary Office: Norwich.

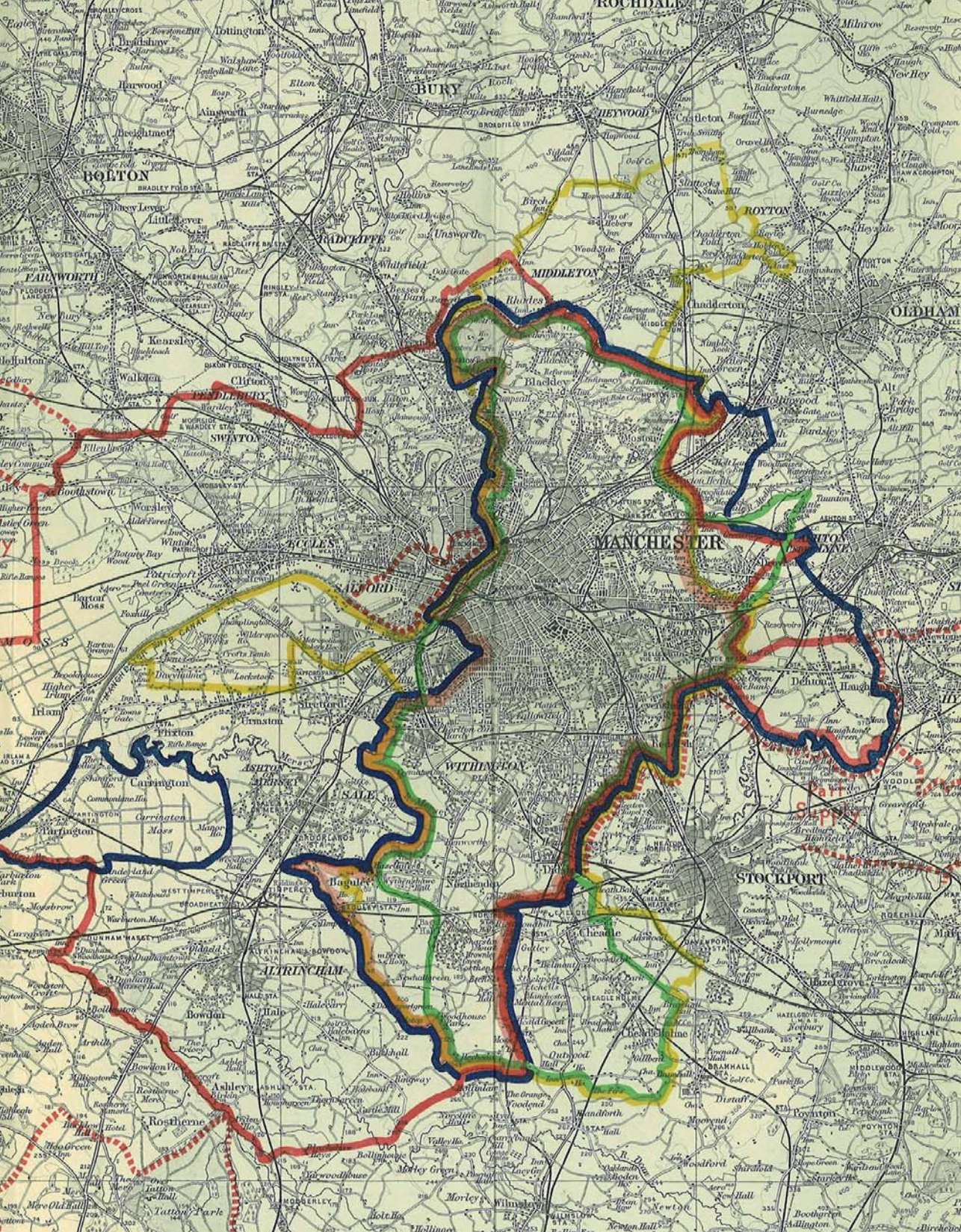
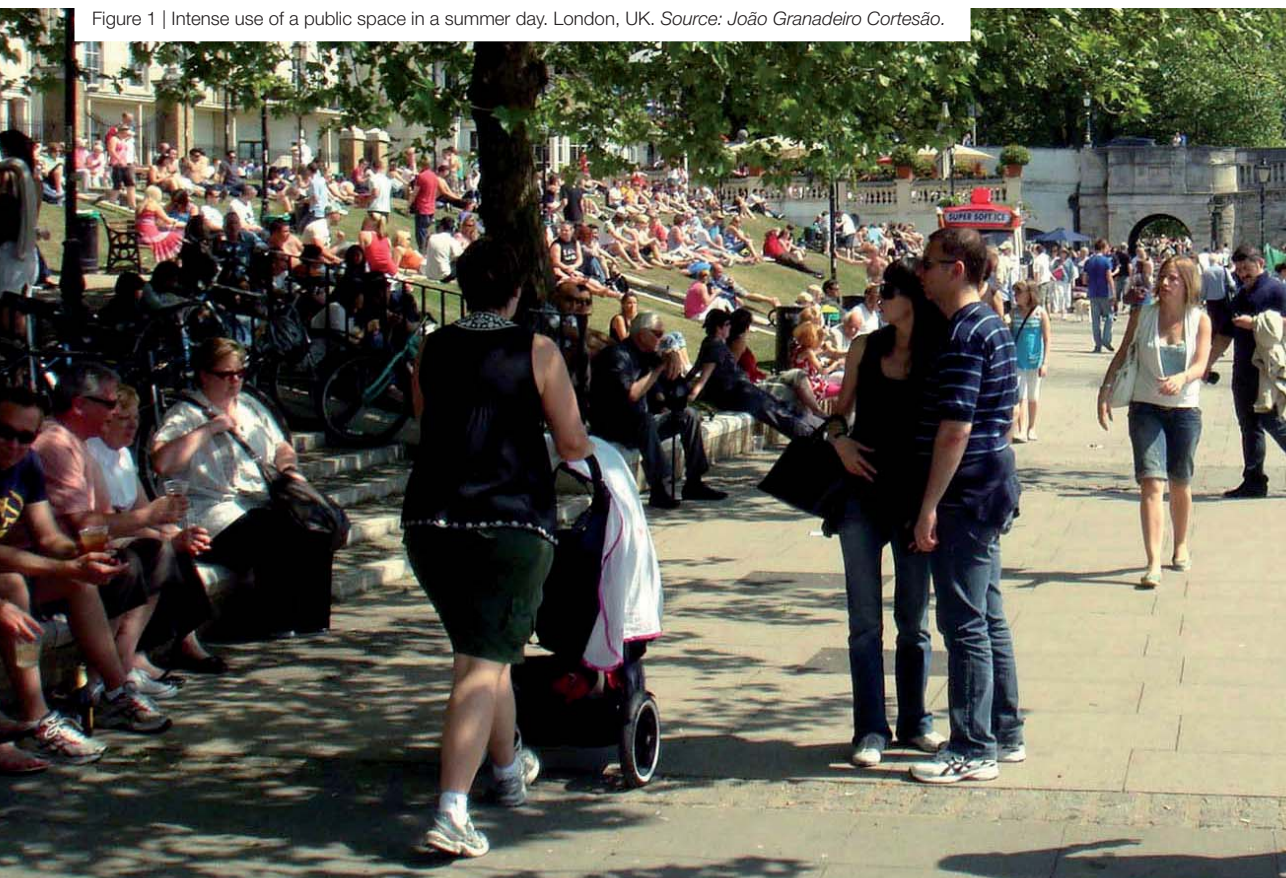


Figure 9 – the early 20th century saw the first regional energy networks emerging across Manchester.

F. Brandão Alves
João Granadeiro Cortesão
Joanne Patterson
Joaquim Góis

Investigation of potential bioclimatic Interventions for a Portuguese City

Figure 1 | Intense use of a public space in a summer day. London, UK. *Source: João Granadeiro Cortesão.*



Introduction

Contemporary urban renewal is particularly aimed at pedestrianising the cities' public spaces. But encouraging people to use a public space is also about ensuring that the impact of climate change and the additional effects of the urban heat island are controlled in summer. Considering a global strategy for the improvement of the urban environment with regard to thermal comfort outdoors and the reduction of CO_2 emissions, is therefore crucial. The correlation between morphologic and climatic parameters can play an important role in this issue especially in solid urban structures. This article demonstrates how this correlation occurs in two spaces in Porto while exploring a potential methodology for bioclimatic urban interventions.

Urban Renewal, thermal Comfort Outdoors and Microclimate

The importance of environmental issues with respect to a city is particularly evident when we consider that 'people's use of open space is changing in response to climatic change' (Handley and Carter, 2006b, p.58). With the increase in air temperature, an increase in outdoor living during the warmer months is expected (Handley and Carter, 2006a, p.12). As such, urban environments must be improved.

Figure 1

The main reasons underlying urban environmental problems have been pointed out already and potential solutions have been widely explored; thus to put into practice forward-looking urban design solutions either to counter climate change or progressively reduce our dependency on fossil fuels (2006d, p.3) is crucial for urban quality of life. In fact, it has been acknowledged that the quality of public spaces 'can contribute to the quality of life within cities' (Katzschner, 2006, p.1).

In this context, contemporary urban renewal policies in Europe are particularly aimed at turning public spaces into pedestrian areas (amongst many other aims), having urban centres as the main intervention field and the ideal of the 'compact European city' and the highlighting of the urban open spaces' ecological role (1996, p.167) as motivation.

But with the increasing use of public spaces comes the need to ensure not only functional, technical or infrastructural requisites. Thermal comfort and the urban environmental conditions have to be considered and improved as well as they affect people using public spaces (Katzschner, 2006, p.1). Bearing in mind global warming, it is not very effective to conceive a functionally attractive pedestrian public space if its thermal conditions are not favourable for people to walk, use a bicycle or public transport.

Figure 2 | A thermally comfortable public space. Basel, Switzerland. *Source: João Granadeiro Cortesão.*

As Nikolopoulou, Baker et al. (2001, p.235) argue, we should firstly focus on how to make people to come out of the buildings or to stop when they are passing through a space. In order to do so, thermal comfort outdoors has to be ensured for it 'significantly influences the human activities in outdoor areas' and as such, 'the degree and intensity of such activities depend on the level of satisfaction or dissatisfaction under the prevailing climatic conditions' (Gaitani et al., 2007, p.319).

Figure 2

Bearing this in mind urban planning and urban design should be more related to site, climate and nature (Goulding and Lewis, 1997, p.9), especially when considering summer thermal conditions, for during this season higher temperatures are expected, in the context of global warming. Additionally, the urban heat island phenomenon accentuates the thermal conditions of urban centres for it has the potential 'to compound and accelerate temperature rises' (Handley and Carter, 2006a, p.9) in those areas. We therefore consider the urban heat as a mainly negative phenomenon in temperate Mediterranean climates, especially during the day as people mostly use public spaces in daytime.

As the urban heat island is not a linear phenomenon even in the same city, the microclimatic scale in bioclimatic studies is fundamental. Indeed, the microclimatic conditions are crucial for a space's activities and therefore 'to a great extent determine their use' (Nikolopoulou, 2004, p.2). It is necessary to determine which microclimatic parameters can be manipulated in order to promote more pleasant open spaces and to enhance a more sustainable urban environment (Ochoa et al., 2006, p.1). This might involve 'the best use of structural and landscape design elements to maximize or moderate sunlight, shade and air movement' (Meerow and Black, 1991, p.1). Consequently, urban designers should be aware of the climatic conse-

quences of their proposals (Ochoa et al., 2006, p.1).

The parameters influencing microclimate can be basically divided into atmospheric (commonly ascribed to be air temperature, relative humidity, wind velocity and global radiation) and morphologic (e.g. urban facing materials, vegetation, orientation, horizontal/vertical proportion or water elements). In addition to many non-physical factors (Jones, 2001, p.120), these are the main parameters affecting thermal comfort outdoors. Bioclimatic urban interventions (all the urban design projects concerned in creating more thermally comfortable public spaces for people) come into this category as one of the most important answers to the environmental challenges presented to cities.

A microclimate improvement also affects thermal comfort indoors for it resists 'the effect of heat island and temperature increase and the corresponding increase of the cooling demand in buildings' (Santamouris, 2006, p.2). Therefore, if an outdoor space is thermally improved so will an indoor one be improved as well, reducing CO_2 emissions related to mechanical devices to control air temperature. As such, microclimate improvement outdoors constitutes a strategy to promote a low carbon urban environment.

Portuguese Practice in Planning and Designing to Counter the Urban Heat Island

In Portugal although some work has been already developed on thermal comfort outdoors and on heat island issues, there is still a lack of experience in dealing with the environmental problems of inner cities; there is still a need for studies highlighting the importance of thermal comfort in urban design; there is still an overall lack of its application in contemporary urban planning and design practice (Andrade, 2005, pp.75, 76).

Nevertheless some governmental documents, although not having the mitigation of the urban heat island as a basis or a target, do have an impact on the reduction of its intensity. We are referring for instance to the promotion of new green and blue areas (and the restoration of former ones), the increased in number of pedestrian areas within the urban fabric and the reduction of CO_2 emissions.

Conspicuous amongst these documents we would mention the PNPOT - National Plan for Land Management Policy – that places the passive solar energy and the urban bioclimatology as one of its strategic objectives (2007b); the PNAC - National Plan for Climate Change - aiming to reduce the greenhouse gases emissions for the first period of accomplishment of the Kyoto Protocol (2008-2012) for the reduction of CO_2 emissions (2006c); the ENDS - National Strategy for Sustainable Development 2005-2015 - concerned with ensuring a rapid and vigorous economical growth, social cohesion and high and ever-growing level of environmental protection and restoration in Portugal (2007a); the Local Agenda 21, in the process of implementation in

several municipalities (from among the 308 municipalities, around 100 have implemented Actions); the PENT - National Strategic Plan for Tourism 2006-2015 – that enhances urban, environmental and landscape quality as a crucial component of the tourist product and as such the preservation of the architectonic authenticity of the historical cores and the creation of conditions for bike or pedestrian circulation as well as of green areas (2006a); the ENE - National Strategy for Energy - aiming to reduce the dependence of Portugal on fossil fuels, CO_2 emissions on enterprises in the energy sector, to reinforce the renewable energies in the context of the Portuguese agreements on the Kyoto Protocol and to increase the energy efficiency as a way of finding a balance between supply and demand for energy (2005); the RCCTE - Regulation on Characteristics of Thermal Performance in Buildings - which transposes the European Union's Directive EPBD (Energy Performance Building Directive) into Portuguese law; and finally, the PNALE - National Plan for the Attribution of CO_2 Emissions Licenses 2008-2012 – envisioning the reduction of the greenhouse gases in the industrial sector (2006b).

It is especially at an academic level that one may find specific approaches to the urban environment, urban heat island and thermal comfort areas, mainly undertaken by geographers (Góis, 2002, p.2.10). From this set it is worth particularly noting the research undertaken (for the first time in Portugal) by Maria João Alcoforado in Lisbon; in Coimbra, 1992, by Nuno Ganho; in Porto, 1993, by Ana Monteiro; and in Lisbon again, 1994, by Henrique Andrade and Lopes de Andrade, widening the initial studies of Maria João Alcoforado (Góis, 2002, p.2.10).

Besides these studies, other investigations have been undertaken over the last few years, such as on urban climatology and its relations with urban pollution, by Ana Monteiro in 1990 and Andrade in 1994 and 1996; on the correlation between urban climate and health, by Ana Monteiro and Maria João Alcoforado throughout the 90´s; or the urban heat island of Bragança, by Katzschner in 1995, and Évora, by Maria João Alcoforado and Taborda in 1997 (Góis, 2002, p.2.11).

To sum up, while at a legislative level there are instruments eventually and indirectly contributing to the mitigation of the urban heat island, the direct consideration of this phenomenon is taken forward by well structured academic research. Despite this there are still no specific and direct mitigation measures to counter the heat island phenomenon in Portugal.

Correlating Morphology and Climate in Urban Centres With a Simplified Language

The creation of more climatically improved urban environments is potentially more easily taken forward in a new expansion area than in a consolidated (historical) central area as here 'the hard structure cannot be changed, so it has to be used to obtain the greatest benefit' (1996, p.178). Consequently, changes in orientation, density or other structural morphologic parameters are not so easily expected to take place in these areas (e.g. the demolition of a building or a block to improve indoors and outdoors wind flows or solar access).

This is mainly due to the fact that these areas are predominantly protected by strict regulations ensuring its historicall integrity, which generally does not allow many interventions to take place as the intact historical centres of cities represent a link between people and local culture and heritage. Furthermore, the indirect effects of tourism on historical central areas, for instance, such as an increase in road traffic, more people circulating in the streets or more demand for leisure space in addition to the day-to-day activity of its inhabitants, make questions of thermal comfort outdoors here more important than in any other part of a city.

Thus, from amongst all the morphologic parameters influencing microclimate, facing materials and vegetation are potentially the most suitable to work with in urban centres

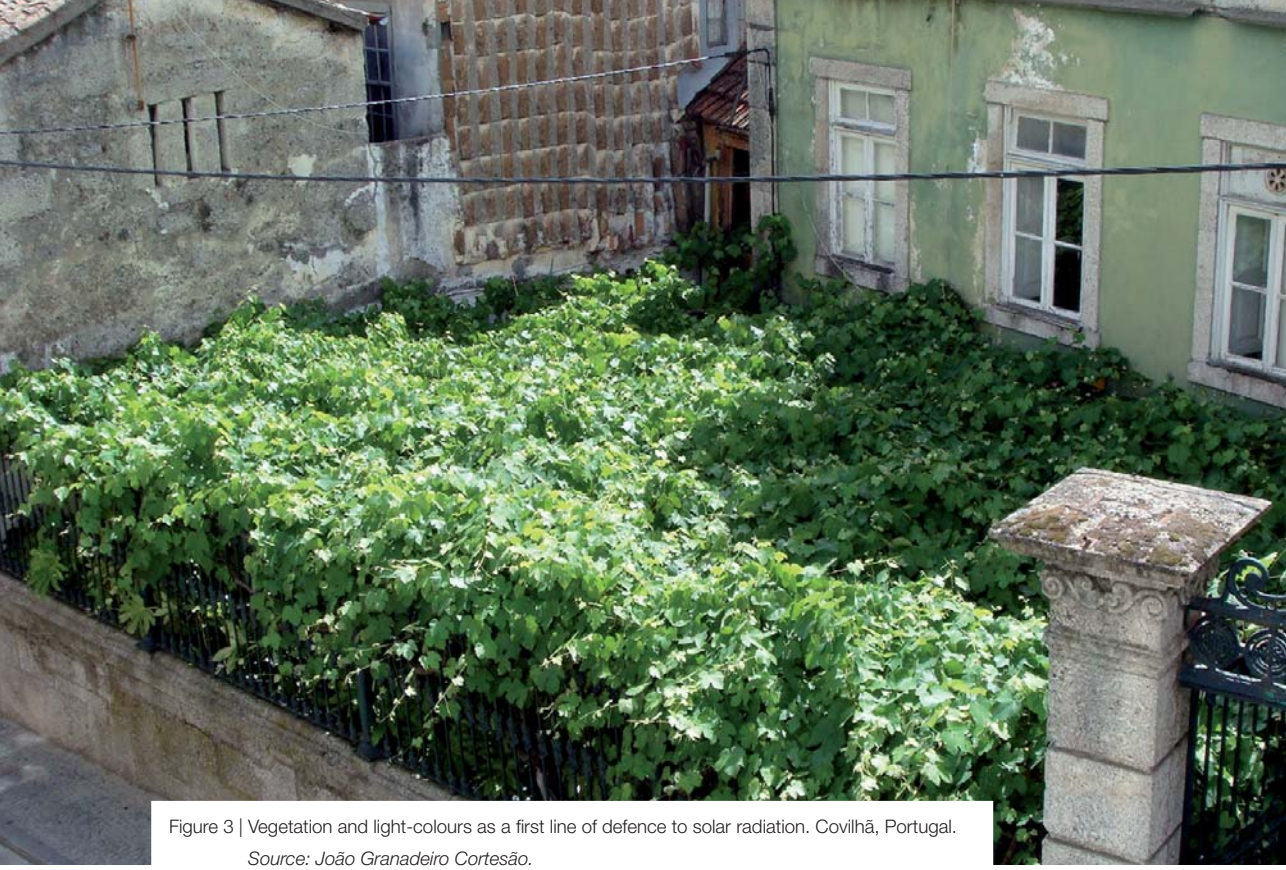


Figure 3 | Vegetation and light-colours as a first line of defence to solar radiation. Covilhã, Portugal. *Source: João Granadeiro Cortesão.*

for in often subtle ways they can improve the ambience of these places.

Focusing on Mediterranean climates where higher temperatures do mean an increase in people's discomfort, increased demand of buildings for energy and risks to health, the use of suitable vegetation and high albedo materials makes sense as the best option to improve a microclimate. Indeed, shade trees 'reduce the insolation on a surface' and cool surfaces (i.e. high albedo surfaces) 'absorb little of the incident insolation' (Rosenfeld et al., 1995, p.256). A thermally comfortable, low carbon built environment can thus be enhanced when these two parameters are correctly brought together.

As such, 'raising the albedo of urban surfaces and increasing urban vegetation are easy ways to conserve energy, save money and probably to reduce air pollution', particularly with regard to CO_2 emissions (Rosenfeld et al., 1995, p.264), mitigating or perhaps reversing the heat island effects in summer (Rosenfeld et al., 1995, p.260).

As Santamouris (2001, p.12) argues, 'if the temperature of an entire community drops by a degree thanks to lighter roofs and pavements and to the evapotranspiration from trees, then outdoors thermal comfort is enhanced and the 'air-conditioning load of all buildings may be reduced' keeping their surfaces cooler. The basic principle underlying this argument is that to use high-albedo materials 'reduces the amount of solar radiation absorbed through building envelopes and urban structures' keeping their surfaces cooler (Santamouris, 2001, p.43). Figure 3

Finally we would like to highlight the importance of correlating morphology and climate in urban centres through a simplified language.

The question is that although the fields of urban climatology and thermal comfort outdoors are extensively developed, their highly relevant outcomes are at the time either 'too complex, or not available to common design

practice' (Nikolopoulou, 2004, p.12). Moreover, many of them are based on steady-state conditions that do not correspond to any real outdoors situation or are 'measures of specific case studies or simulations done with complex programmes' (Nikolopoulou, 2004, p.12).

In their turn, both architecture and urban design areas deal with more human based languages, methodologies and approaches rather than with mathematical ones and assume a more pragmatic/operational aim rather than a theoretical/hypothetical one.

Field surveys undertaken by the RUROS Project have revealed 'the need for empirical data' on the (subjective) human parameter in outdoor spaces as this would provide 'a broader perspective from which to view comfort in urban spaces' (Nikolopoulou and Lykoudis, 2006, pp.1455, 1456). Furthermore, the 'communication of comfort' should adopt a familiar language to the envisioned audience according to their 'tangible experience' (Taylor and Guthrie, 2008, p.23), in this case with regard to the urban design field.

Thus, it is necessary to find new ways of developing these areas without necessarily and unavoidably using complex mathematically-based models. More operational approaches relating to the practical needs of urban design need to be introduced, putting into practice the outcomes of previous studies.

An Illustrative Case in Porto

In order to illustrate how the correlation between morphologic and climatic parameters might effectively take place, two spaces in Porto were analysed: Praça dos Poveiros (Poveiros Square) and Jardim de São Lázaro (São Lázaro Garden).

According to Köppen's main climate classification, Porto has a Mediterranean temperate climate with an Atlantic influence. In terms of temperature Oliveira Ramos and Monteiro (Oliveira Ramos, 2000, Monteiro, 2001 apud Góis, 2002, p.3.22) refer to the fact that July has the highest average temperatures (around 19.7ºC), while January has the average lower ones (around 8.7ºC). Therefore it can be said that July has the highest temperatures in Porto so that the summer season might be said to extend from late June until late August. Considering the maximum temperatures, summer can be said to extend definitely and with some constancy from between the end of July to late August.

Despite this, according to Monteiro (1997, p.175) there is clear evidence of climatic changes in Porto in the last decades namely a gradual rise in air temperatures and higher levels of rain during the wet season as well as lower levels during the dry season. The author points out that the main reason for this is the worsening of the 'local greenhouse effect'. Additionally, at the national scale, the SIAM II Project has verified a considerable increase, and in the same magnitude, in the average maximum and minimum temperatures in Continental Portugal in the last twenty-five years of the 20th century (Santos and Miranda, 2006, p.51).

With respect to Porto's urban heat island, field surveys undertaken by Góis (2002) have shown that the city's central core and central core's periphery systematically exhibited the highest temperatures, independently of the season when the measurements were made. This is mainly due to the high urban and populational density of the central core of Porto, to the proximity to the river and to the near absence of green areas (Góis, 2002, p.7.5). Faced with this evidence, thermal conditions can be expected to be problematic in the summer.

The case studies are focused on the city's historical core and therefore relate to its heat island. This is quite clear when the site plan is overlapped with the *'cartographic representation of temperatures spatial distribution in a typical summer day'* proposed by Góis (2002, p.6.11), as shown in the figure 4.

Poveiros square (Figure 5) is a compact 10.700m2 space with a slightly trapezoidal shape orientated towards the south and bordered by a consolidated urban fabric of high density. This built-up surrounding is

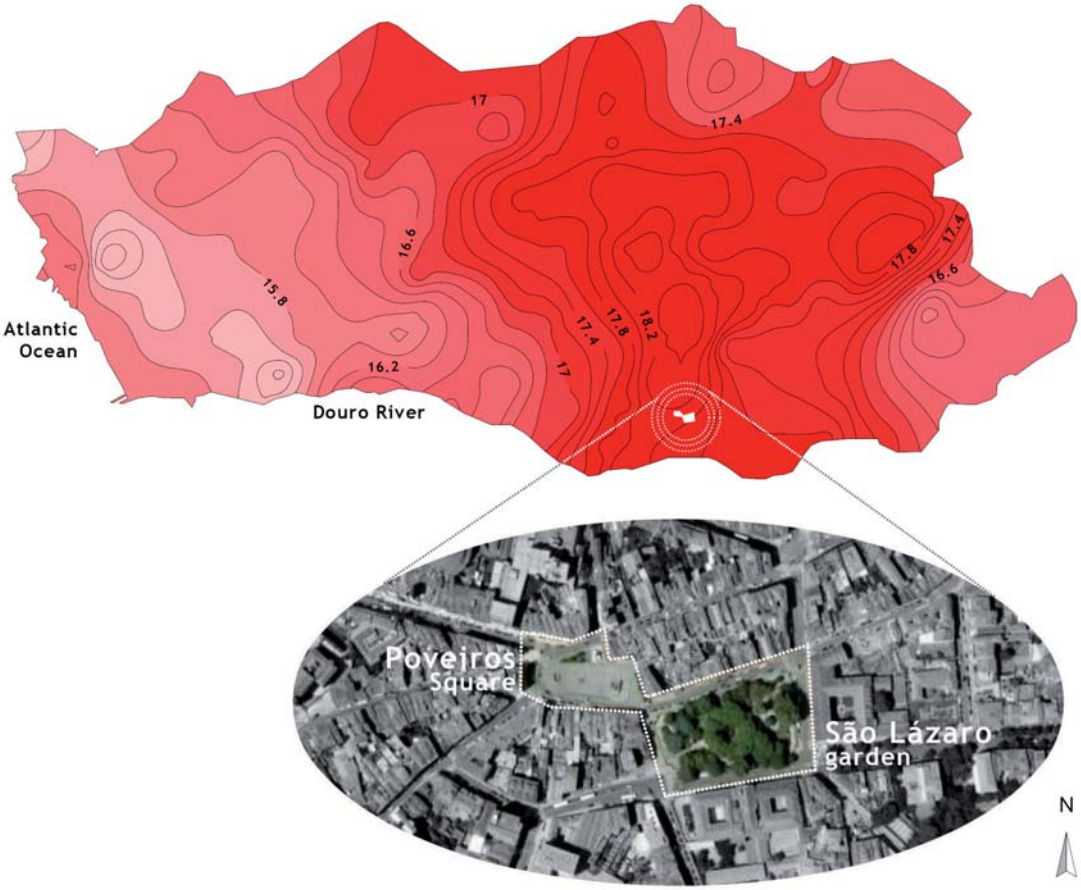


Figure 4 | Case studies position in Porto's heat island; case studies urban framing.
Source: adapted from Góis (2002); GoogleEarth and João Granadeiro Cortesão.

mainly composed of a sequence of buildings defining a regular urban front around the square; the upper floors fulfil housing functions whereas commercial activities are held on the ground floors, in a total average of three to five floors; the main facing materials are soft-coloured ceramic tiles, mixed-coloured plasters and granite applications. The square's present form dates back some 10 years , to the time that the underground public car park was built. This came to replace the former surface car parking, releasing that area to pedestrians. Its main effective use is as a passage. Its main horizontal facing materials are granite stone cubes and vegetation, and water surfaces are concentrated on its eastern and northern edges.

São Lázaro garden (Figure 6) is a typical Romantic garden and the city's first public garden, opening to the public in 1834. Its main characteristics are that it is enclosed and densely vegetated. Like Poveiros square, this 22.300m2 space has a slightly trapezoidal shape towards the south and is surrounded by a consolidated urban fabric with the same characteristics as Poveiros square. The only exception to this is that its southern and eastern edges are bordered by a single public building, namely Porto's

municipal library (east) and a college (south). Its main function is as a place for meeting/ leisure activities. The main horizontal facing materials of this garden are bare soil, grass and seasonal flowers and there is a water feature at its geometric centre.

The field surveys were held in both spaces from the 18th to the 22nd June 2009 under the weather conditions of cloudless sky, no precipitation, a slight breeze and an average air temperature of between 25ºC and 30ºC. The methodology for this analysis was based on the correlation of three main elements: physical characterization, a questionnaire on both spaces' thermal conditions to the users of Poveiros square (a total number of 110, divided in groups from 09a.m. to 11a.m., noon to 2 o'clock and from 5p.m. to 7p.m.) and main bioclimatic urban design principles gathered from several sources such as the research undertaken by Nikolopoulou (2004), Santamouris (2001) or Rosenfeld (1995).

Figure 5 | General perspective of Poveiros square. *Source: João Granadeiro Cortesão*

The morphologic analysis has shown that the main morphologic differences between both spaces are the facing materials of the horizontal surfaces and vegetation cover. While Poveiros Square has hard impermeable facing materials and the near total absence of vegetation, São Lázaro garden presents soft permeable natural facing materials and intense vegetation. Therefore, it was observed that the sky view factor is total in Poveiros square and almost nil in most of São Lázaro garden.It was also necessary to use shade devices to block excessive solar radiation in Poveiros square whereas in São Lázaro garden none were used. Moreover there is a total exposure of the buildings facing south to solar radiation in Poveiros square while in São Lázaro garden the facades facing south are partially in shadow at least for some time of the day as a result of the garden's vegetation.

The questionnaires revealed mainly that independently of the period of analysis 49% of the interviewees use Poveiros square

Figure 6 | General perspective of São Lázaro garden. *Source: João Granadeiro Cortesão*

Figure 7 | Aerial photo of Poveiros square and São Lázaro garden site. *Source: Google Earth*

only as a passage to somewhere else or simply for a walk. 43% of interviewees who were resting were mainly concentrated in the cafés' terraces that had sunshades (visible in Figure 7).

41% of people referred to the fact that the most unpleasant climatic feature at the time of the interview was solar radiation and 41% referred to none of the climatic factors. Even when directly exposed to sun, 78% of the interviewees said they were thermally comfortable while only 22% were uncomfortable. Despite this, 85% of them considered Poveiros square as usually an uncomfortable place during summer, as it is too exposed to solar radiation. We attribute this to the fact that 76% of the interviewees were passing through the square, so probably their answers were conditioned by their spending only a short time there. Also, during the second day of surveys there was some cloud cover that partially blocked the the sunlight, therefore potentially influencing people's answers. In its turn, São Lázaro garden was described by 100% of the interviewees as a comfortable space during summer, so people felt motivated to use it during that season whereas in Poveiros square they did not.

As expected, due to the exposure to the open sky and the main facing materials used, 57% of the users considered Poveiros square as a bright space whereas São Lázaro garden was very much considered (98%) to have a pleasant shadowed ambience (Chart 1 and 2). Consequently, 75% of the interviewees referred to the glare of the hard surfaces in the former space while, unsurprisingly, there was no mention of glare at all in the latter.

With respect to vegetation, 97% of people considered Poveiros square to have little vegetation (Chart 3) and 95% that the few trees existing do not represent an effective contribution to thermal comfort, namely through shading. In its turn São Lázaro gar-

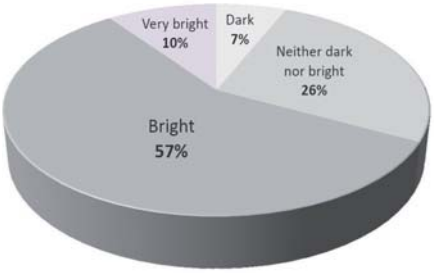


Chart 1: Poveiros square brightness/darkness.

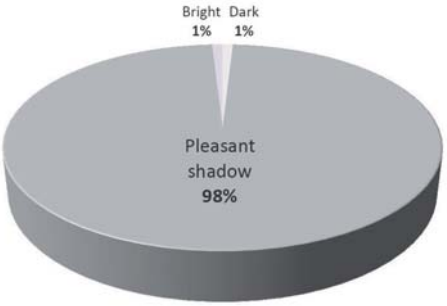


Chart 2: São Lázaro garden brightness/darkness.

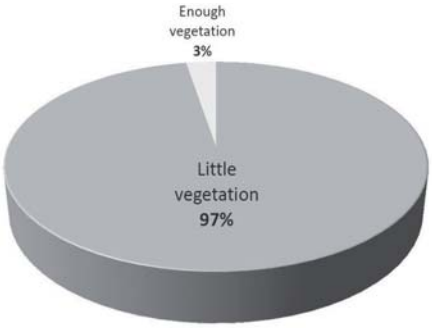


Chart 3: Presence of vegetation in Poveiros square.

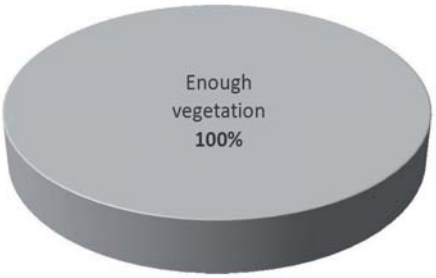


Chart 4: Presence of vegetation in São Lázaro garden.

den was considered by allthe interviewees to have enough vegetation (Chart 4) and by 90% to provide effective protection against the sun and 10% against sun and wind.

Additionally it is relevant to mention that Poveiros square was mostly used during the 5p.m. to 7p.m. period as at this time solar radiation is weaker and people come out to the terraces of the square's cafés after work. São Lázaro garden showed the same level of use all day long but especially after lunch.

By correlating these results of both morphologic analysis and questionnaires to the main bioclimatic urban design principles, one can draw more consistent conclusions about the negative bioclimatic aspects of Poveiros square.

In an overall perspective, the final outcome of this correlation are that São Lázaro garden is a much more comfortable space than Poveiros square during summer, and that this is mainly due to the presence of vegetation and to the nature of its pavement facing materials. Therefore, the main problems revealed by Poveiros square are at the morphological level -facing materials and vegetation- and, at the climatic level, air temperature and solar radiation. The remedies that we now propose should be based upon bioclimatic urban design principles with a direct relation to a space's thermal conditions.

To use light colours and reflective surfaces to prevent surface overheating. The type of horizontal facing materials used in the square is not the major problem, but rather the extent of its use. The solution for this could be achieved by adding to the 0.40 albedo granite stone other high-albedo facing materials such as gravel (0.72), light coloured sand (0.60) or whitewashed stone (0.80).

To use a mix of impervious and porous materials or lighter coloured pavements. Mixing different facing materials has a ma-

jor impact on the reflection of solar radiation and on the water cycle. It is clear that Poveiros square presents an excessively uniform paving solution, in this case totally impermeable and monochromatic.

To use shade trees or horizontal devices to provide shade. The few existing trees on Poveiros square provide neither shade nor evapotranspiration as these are positioned on the eastern and northern edges rather than randomly throughout the space or in its southern and western edges, where they would be more effective.

To provide people with the potential to use the space all year round. Currently, Poveiros square does not present such opportunities, either in terms of providing shade or shelter from the rain and wind.. The almost total absence of vegetation or other shade devices reduces dramatically the square's capacity for offering people any micro¬climatic amenity in summer or winter.

To choose carefully the plantl species most compatible with each place. In Poveiros square, for example, tree planting might be constrained by the underground car park. Thus alternative solutions to counter this challenge might be needed, such as potted trees.

To use water features Although Poveiros square possesses such features (a fountain and pond), they are of limited value in influencing the microclimate because of their position at the edge of the space), their small size and their inccessibility.

Conclusion

In a time when there is already quite developed and tested theoretical work on urban climatology, microclimate improvement and thermal comfort, it is now the moment to seek straightforward tools to adapt cities for the future. This article has put forward a potential way to achieve such a goal, using the city of Porto as a stage and the relationship between morphological and climatic parameters as the central argument. The two case studies allowed testing to what extent this relationship really takes place in a specific site and to understand how people feel about it.

The final outcome of the analysis is that the correlation between morphological and climatic parameters does affect a microclimate, a space's thermal comfort conditions and therefore people's motivation to use that space. In the case studies presented here it is clear that the absence of vegetation and the nature of the pavement's facing materials is producing quite dramatic differences in people's thermal comfort conditions and therefore in the degree to which these spaces are used.

Bearing this in mind and addressing the low carbon built environment area, these case studies clearly illustrate how the urban form affects CO_2 emissions. Thus, the negative bioclimatic aspects of Poveiros square directly influence the 'local greenhouse effect, namely at the level of sensible heat storage in the urban fabric: storage of solar energy within building mass during the day and its subsequent release at night; concentration of anthropogenic heat, in this particular space related to the cooling down of the surrounding indoor spaces; and low evaporation rate by the soil and vegetation. This heat storage definitely increases the demand for cooling in buildings and consequently the emissions of CO_2 related to mechanical devices to control indoor air temperature.

In its turn, São Lázaro garden possessing a consistent and effective degree of microclimatic amenities in summer (mainly as a result of its vegetation) enhances not only

thermal comfort outdoors but indoors as well. Although this was not part of the questionnaire undertaken, many of the interviewees living in buildings around this garden spontaneously mentioned that its vegetation cools the air entering their houses or at least at a visual/psychological level, these trees do cool temperatures.

This is why these spaces seemed to provide the ideal scenario to illustrate the correlation between a space's morphology and climate: we are looking at two contiguous spaces of similar dimension, same placement, density of building, morphologic characteristics, centrality with regard to pedestrian circulation, public services and facilities but still with a completely different pattern of use. The surveys undertaken confirmed that such a situation occurs due to differences in vegetation and facing materials.

In contemporary urban renewal, bioclimatic thermal comfort and a low carbon built environment in Mediterranean urban cores can therefore be achieved through a simple but carefully balanced relation between these two morphological parameters.

In this context urban design plays the major role: the role of giving people the opportunity to move the notion of home from the boundaries of their houses into the liveability of urban spaces. •

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Ecocity Sarriguren

Case Study

Abstract
The Ecocity of Sarriguren, located in Navarra on the periphery of Pamplona, is the first initiative of its kind to be built in Spain. The project was designed in 1998 by the Studio Taller de Ideas with the Fundación Metrópoli acting as a Knowledge Partner. The Ecocity includes Social Housing for 5000 bioclimatic dwellings, specialized sustainability features, mixed-used urban programs, the Innovation Park of Navarra and proposals for new typologies such us the Cubes of Innovation (i-cubes). Sarriguren has been fully realized since 2007.

The Ecocity of Sarriguren was awarded the 7th European Urban and Regional Planning Award in the category of Environmental/Sustainability for 2008. This is a biannual award that recognizes the best completed projects within the 27 countries of the European Union. Sarriguren was also given the distinction of “Good Practice” by the United Nations, Centre for Human Settlements in 2000. Figure 01

Figure 1 | Cover of the book, Sarriguren Ecociudad.

Ecocities Defined

Cities only occupy about 2% of the globe, however, they present a serious challenge to climate change. The exact amount of environmental degradation caused by cities is rarely examined, as we can assume that their share of non renewable resources can at this point be considered environmentally unsustainable. Conversely, cities account for the largest share of global economic growth and productivity. They are the privileged places of production, talent and creativity, and they are the epicenters of global economy. In particular, they foster research and development and ensure technological innovation, key factors in securing the viability of the knowledge society.

Cities have become integral to the creative economy. They are shaped by the needs of their inhabitants on the one hand and adapt to a broader, continuously changing global environment on the other. With increasing global interdependence, cities must compete and cooperate with one another in order to survive. It is their identity, and in particular their urban quality, which enables them to attract and maintain talent, a basic ingredient of the knowledge society, thereby giving them their competitive advantage.

As city-leaders world-wide acknowledge the importance of environmental quality, the potential positive impact of sustainability efforts becomes increasingly apparent. Ecocities have proven to be an effective measure for achieving sustainability goals, notwithstanding the many unknown aspects of urban complexity. Regardless, the key to sustainability is innovation and readiness for change. Transforming cities according to the ecosystems paradigm enables urban communities to remain dynamic in their approach to development in an ever changing world.

What is an Ecocity?

Figure 2

"Ecocities are urban communities conceived on the basis of eco-planning and design criteria. They incorporate integrated public transport systems, sustainable mobility, bioclimatic architecture and planning, diversity of architectural typologies for housing and economic activities, diversity of urban spaces and spatial relations, renewable energies, healthy construction, state of the art digital infrastructure, electronic management of domestic appliances, use of clean technologies, complete water cycle management, sustainable waste management and treatment, as well as reliance on incentives in support of eco-communities." [i]

Where Does the Notion of 'Ecocity' come From?

Ecocities are not new. Early settlements can be conceived as the precursors of ecocities (ecovillages, ecotowns, ecopolis, sustainable city, etc). They served the collective needs of the communities by protecting them from the elements and accommodating their activities. They were built with local natural and renewable materials, using climatic 'design', for example in ancient Mesopotamia. They were the natural setting for the division of labor, specialization, adaptation, and innovation. The physical form of such ecocities is often termed vernacular architecture. [ii]

When Richard Register coined the term ecocity in 1987 in the developed world, he defined an ecocity as "a sustainable city which is entirely dedicated to minimizing required inputs (energy, water, food) and its waste output (heat, air and water pollution). It also relies minimally on the surrounding countryside, creating the smallest possible

Figure 2 | Central Park landscape, Ecocity Sarriguren.

ecological footprint. It resorts to renewable energy sources, ecologically designed buildings and appliances, natural ventilation and public transport, with an environment conducive for cycling and walking". Later, Register's Ecocity Builders borrowed the definition of Urban Ecology Australia: "an ecocity is a human settlement that enables its residents to live a good quality of life while using minimal natural resources", but Register proposes his own design criteria for ecocities to build or rebuild the ecological carrying capacity of bio-regions.[iii] For others, Ecocities are about healing or ethical programs for ecological restoration. In the developing world, Akhtar Chauhan for instance, conceives a sustainable living environment as being "based on climate responsiveness, appropriate use of technologies, and innovation of sustainable environmental design".[iv] Alternatively, the European Union ecocity project on "urban development towards appropriate structures for sustainable transport" did not seek a single definition and incorporated the key sustainability visions of the participant cities instead.

At a more abstract level, the idea of ecocities draws on analogies with biology and the notion that successful ecosystems are driven by innovation and shaped by human intervention. Ecocities constitute a context to which human beings adapt, with their integrated design facilitates continuous and complex interactions and information flows, the key ingredients of innovation brought about by intellectual exchanges and synergies which assist cities in their transition to a knowledge society.

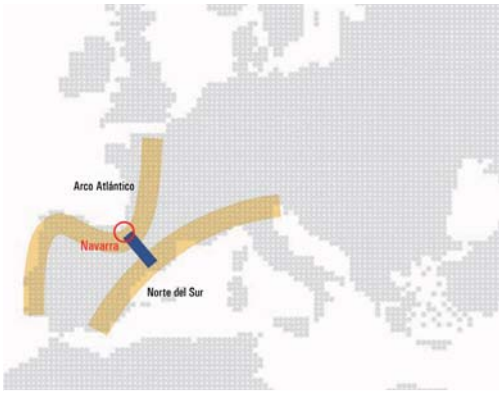

Figure 3 | Strategic location of Narvarra

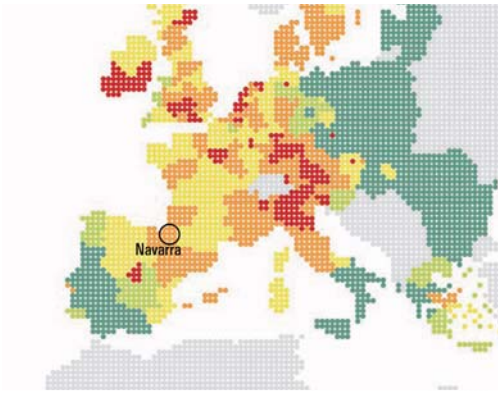

Figure 4 | Strategic location of Narvarra within European context

Ecocity Design

When cities are preparing pre-emptive or retroactive instruments to curb the adverse effects of climate change they encounter difficulties in coping realistically with the full complexity of energy consumption, pollution, the relationship between them and the relationship with other urban activities. Many city leaders who are committed to the principles of sustainability tend to isolate specific groups of assumed effects on climate change, accepting that they may have to subsidize interventions to reduce energy consumption and curb environmental pollution. Discrete interventions can apply at various scales: at the level of individual buildings and their uses; in urban areas to accommodate specific single or mixed urban activities and groups of people; more ambitiously at the level of the city as a whole; or at the city region including its hinterland which has to absorb the city's environmental footprint.

The practical application of ecocity principles provides the empirical setting for experimenting with various ecological components, monitoring them and learning from experience to advance sustainable design and management. Sustainable planning enables cities to identify potential areas of intervention, produce strategies for the reduction of green house gas emissions at the city level, and target sectoral interventions. In Sarriguren for example, the decision makers selected a particular part of the Pamplona conurbation and applied known eco-principles and eco-technologies to it, including raising awareness and providing incentives to change consumer behavior. By implementing such concrete actions, Sarriguren has been able to make positive contributions to climate change and sustainable development.

Regional Navarra and Metropolitan Pamplona

Ideal Setting for an Ecocity

Figure 3, figure 4

The Spanish autonomous region of Navarra, located between the Atlantic Arc and the Ebro basin near the French border, is among the most dynamic economies of Spain. With an average annual income exceeding the European Union average, Navarra has grown into one of Spain's wealthiest regions. Part of this fortune is due to Navarra's investment in the innovative sectors of the economy, as many of Navarra's new industries and technologies focus on renewable energies and environmental sustainability. As a result, Navarra has become an international player in knowledge economies such as renewable energy production. While already well set on a trajectory of innovative economic investment, planned high speed train

Figure 5 | Urban Design Master Plan for Ecocity Sarriguren

connections will allow Navarra to integrate even more closely with Madrid and Barcelona, the leaders of the Spanish economy.

Navarra has adopted a planning strategy which enables it to adjust its existing settlement structure to an integrated city region. The concept of city region presents an alternative to urban sprawl, spiraling land costs and congestion. Based on key components of excellence, which are considered as drivers of the sustainable development process, the spatial strategy for the Pamplona agglomeration builds on innovative communication technologies, new values attributed to the natural environment, and the preservation of existing physical and cultural identity.

The Metropolitan area of Pamplona defines the settlement structure of Navarra, where economic and productive activities, infrastructure, services, and housing are concentrated. Nevertheless, future development potential is not anticipated to occur in the dense center of Pamplona, but rather, in the wider metropolitan region, including the Ebro Valley and the strategic spaces connected to the Atlantic. On the outskirts of Pamplona, Sarriguren is one of the areas of expansion planned to retain and attract talent, especially young people who need housing to start up families when taking on creative sector jobs. Conceived as an ecocity, the development concept proposed by Navarra and its capital Pamplona, responds to the challenges of climate change and environmental sustainability.

The Ecocity of Sarriguren, an initiative of the Department of Housing and Planning of the Government of Navarra, provided an opportunity to apply all these principles in a single urban project, managed by the public company Navarra de Suelo Residencial S.A. (NASURSA). The design of the Ecocity Sarriguren was selected from eight competition submissions in which the most prestigious architectural firms in Spain were invited to participate. The government of Navarra sought a design that provided the most

innovative, accessible, high-quality social housing, with the most advanced bioclimatic architecture and planning criteria. The project selection board prioritized the quality of the public realm and the harmonious integration of the city and landscape into the metropolitan area.

Figure 5

In pursuit of the project, the Government of Navarra sponsored a series of financial incentives for various developers to carry out the project according to its environmental aspirations. More specifically, incentives for bioclimatic architecture and urban design reached approximately 2,500 Euro per housing unit, encouraging the participation of numerous design and construction firms, and ultimately, creating an architecturally diverse Ecocity.

Fundación Metrópoli: Methodology for Urban Innovation

The Fundación Metrópoli has developed an analytical method for understanding a city and its unique potential by exploring its *components of excellence*. This process involves highlighting the synergetic value of a city´s competitive advantages, which include not only physical, but organizational, socio-economic, and cultural aspects. The components of excellence can be existing or potential, and are subject to the state of development of the city. Comprehensive urban profiles that are exclusive to each city are then created from the components of excellence. This body of knowledge indicates opportunities for greater competitiveness in terms of spatial and economic strategies. Identified and exploited components of excellence reach beyond the local conditions and prepare the city for global competition. Some components of excellence emerge spontaneously, while others require development as part of a proactive spatial development strategy. Successful cities of the future will be those that are best equipped to take advantage of their unique components of excellence.

Metropolitan Pamplona: Components of Excellence

Figure 6

The profiles derived from the components of excellence and their synergetic interaction as clusters of excellence provide the key to urban design strategies for the Pamplona Metro-region. They can inform new strategies for the entire city region or selected parts, such as the ecocity of Sarriguren. Seven key components of excellence were identified for the Pamplona Metropolitan area. Together they constitute a cluster of excellence for the Pamplona conurbation.

1. The Historic Center
2. The Universities
3. Biotechnology, Teaching Hospitals and CIMA
4. The Green Areas
5. The Rural Settlement System of the Hinterland
6. Infrastructures Connecting the City to the Region and Beyond
7. Industrial Profile and Technological Development

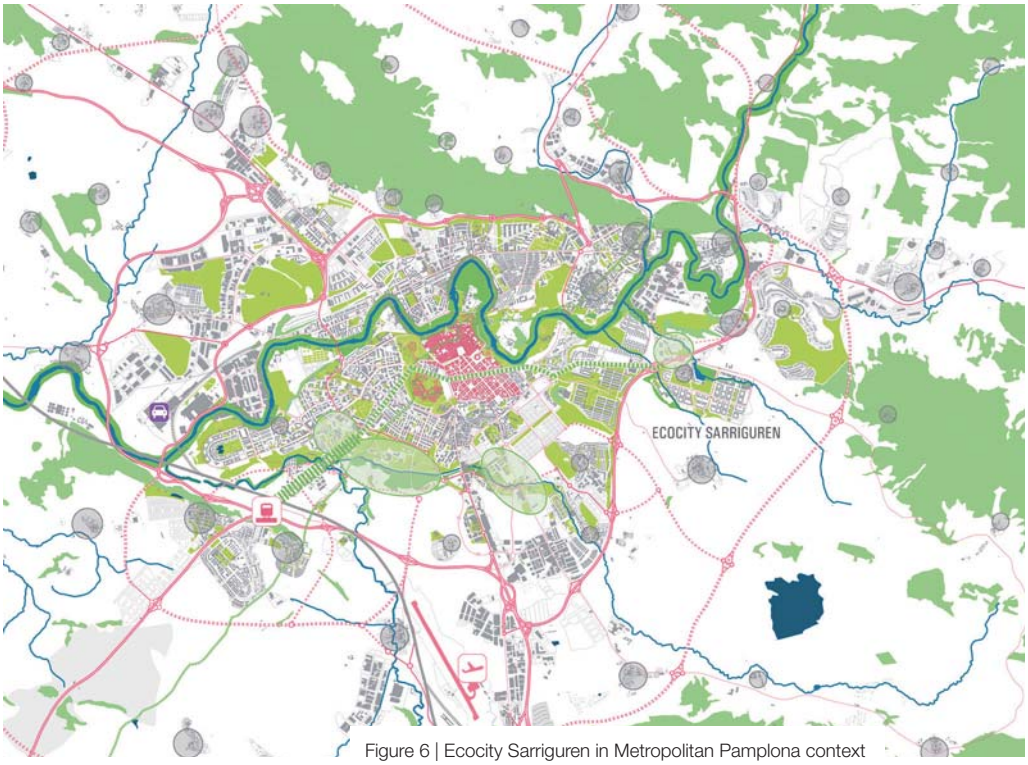

Figure 6 | Ecocity Sarriguren in Metropolitan Pamplona context

Figure 7 | Metropolitan Pamplona aerial photograph.

The components of excellence of the Pamplona city region have a specific connection with two strategic places: the “innovation corridor” and the “green corridor” along the main Arga River. The former links the planned high speed train station with the innovation park and presents opportunities for high skill employment connected to the knowledge economy. The latter informs further developments in the metropolitan region from an ecological/recreational standpoint. The main components of excellence of Pamplona are located in the innovation corridor; the high speed rail station, the university campuses, the hospitals and the applied medical research institute, the citadel, the historic centre together with the 19th and 20th century extensions and the Innovation Park. The ecocity of Sarriguren forms a logical extension of this corridor and has the capacity to become a place of creativity and innovation. It is located at the north east end of the corridor in a privileged position. Good accessibility and connections are secured by the existing infrastructure networks. The ecocity can evolve into one of the main development areas capable of transforming Navarra. Figure 7

Ecocity Design Criteria

A consistent development goal of the ecocity has been to remain affordable and socially accessible. This initiative was strongly supported by the Government of Navarra and the project team for the Ecocity of Sarriguren. More than 90% of the currently completed 5,217 housing units are affordable, 3056 of which are officially protected, and 2041 of which are fixed price.

In spite of the challenges presented by prioritizing the affordability goal, the development proceeded with an ambitious list of design criteria. These criteria, summarized in the following, were intended to contribute to the realization of the development not simply as urbanization, but as an ecocity:

Figure 08

> Sustainability and compactness
> Shared mobility, public transport
> Responsive dialogue with surroundings
> Diversity of public realm, interconnected places of encounter
> Combining living, working and leisure
> Architectural diversity
> Social cohesion, communal infrastructure
> Bio-climatic architecture and urban design
> Use of renewable energy source
> Complete water cycle management
> Sustainable waste management and treatment
> Integration of new and clean technologies
> Identity of place

In addition to the unique advantages that are revealed in the components of excellence research, Fundación Metrópoli applies these criteria to eco-city design at a variety of scales. At the level of eco-buildings and eco-neighborhoods, ecocity design provides residents with the opportunity to choose more sustainable lifestyles. However, the impact of individual sustainable action is often perceived as negligible or requiring sacrifice of comfort and convenience. As a result, civic leadership is also necessary to realize the goal of environmen-

Figure 8 | Indigenous landscape along the lake in Sarriguren

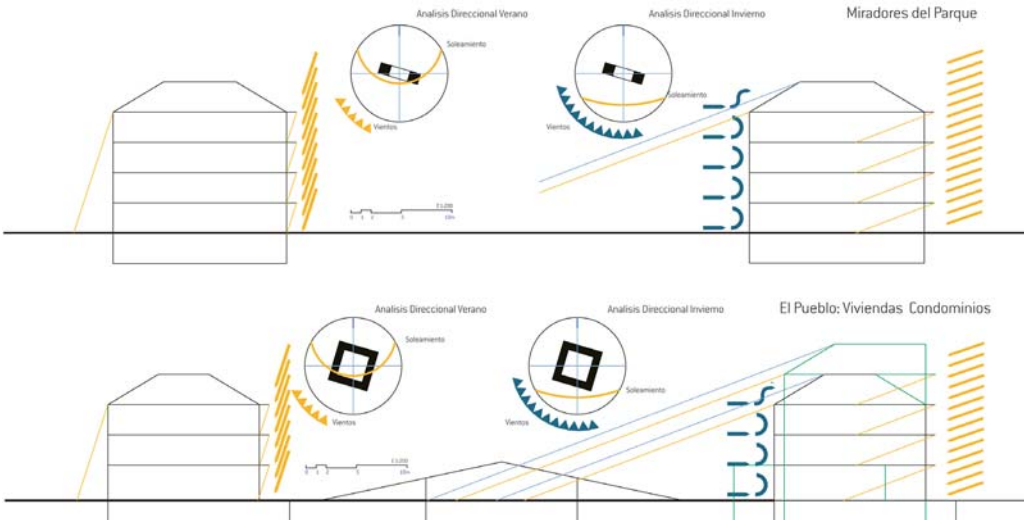

Figure 09 | Bioclimatic diagrams for sun and wind conditions

tal sustainability on a macro-scale. Indeed, design and planning agencies have begun to include sustainability principles more generally in their urban development and management initiatives.

Building an Ecocity: Case Study Sarriguren

Sustainable Features of Sarriguren

At the most local scale, the practice of bioclimatic architecture has been the guiding light for realizing the above stated principles in the Ecocity of Sarriguren. Buildings were situated, designed, and built to take advantage of the day-to-day environmental conditions. Among other sustainability principles in the project, Sarriguren incorporates *passive and active solar systems, natural ventilation, low-impact construction, insulation and thermal inertia, centralized systems, and photovoltaic technology* in its buildings.

Passive solar systems in Sarriguren reduce energy consumption, protect against winter winds, and mitigate direct solar gain in the summer. Active solar panels are another preponderant feature of Ecocity Sarriguren architecture. These were designed and oriented to catch as much sunlight as possible in the winter and to protect the inside of the buildings against direct heat gain in the summer. Trees around the buildings form a natural filter of sunlight and shield the buildings from the winter wind, while letting through daylight. Rooftop solar panels were installed for hot water generation. Additionally, photovoltaic solar panels capture and convert energy into electricity, which is channeled into the national electricity grid, and sold back to the ecocity at a reduced price.

All Ecocity Sarriguren dwellings are oriented in two directions, in order to cool the buildings during hot periods and to provide natural cross ventilation and rapid air exchange, (also to avoid creating spaces that are less vibrant than others). Furthermore,

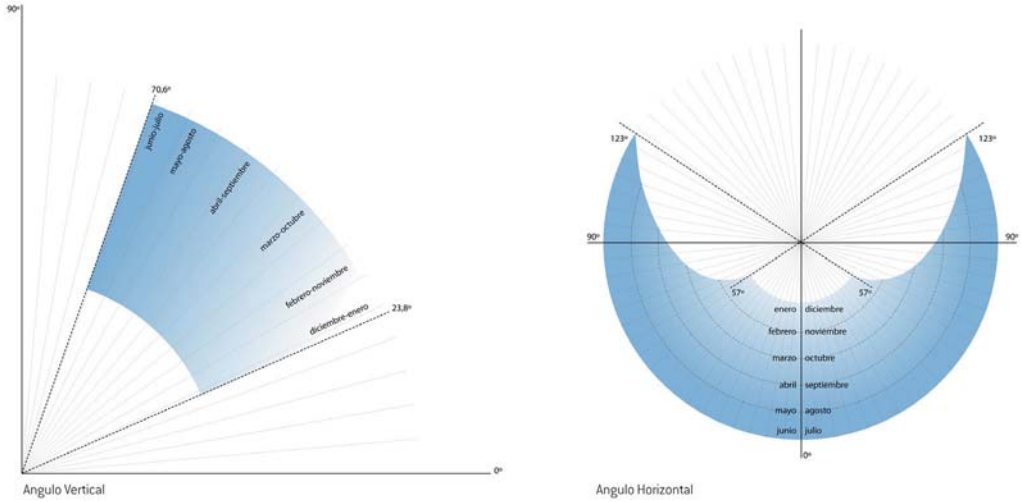

Figure 10 | Angle of solar influence diagram

buildings are generally situated in a north-east-to-southwest fashion, to best utilize local winds and sunlight. Figure 09, 10

The bioclimatic norms of Sarriguren aim to prevent thermal loss through external walls. They are more stringent than the minimal values prescribed by the general local building codes, and they facilitate increased thermal insulation. The coefficient of thermal transmission for these buildings proves an increased thermal efficiency measure that is 25% above baseline norms. Also, buildings employ thermal inertia by using dark colored materials to absorb and accumulate heat in roofing tiles.

Ecocity Sarriguren employs sustainability strategies at the regional scale with a preponderant focus on transit, capitalizing on the immense potential to reduce energy consumption and pollution. Though the ecocity gives a higher priority to pedestrian oriented networks, the incorporation of an exemplary public transit system is an integral part of the ecocity. A coordinated sustainable transportation strategy has been planned for the entire Pamplona-Valle de Egues region (an initiative partly catalyzed by the development of Ecocity Sarriguren). The development companies of Ecocity Sarriguren, NASURSA and CRANA, have been actively involved in EU Pro.motion, a project that combines sustainable transportation solutions with strategies for land use and environmental protection. This exploratory knowledge partnership identified the current and future mobility needs of Sarriguren, and has informed a plan to effectively accommodate new residents and visitors into the regional transportation network.

At the regional scale, the Ecocity of Sarriguren includes comprehensive water management in its design priorities. This consists of captured and gray water irrigation, on site biological sewage treatment, and water turbidity remediation via natural separation systems. Similarly, new sustainable technologies are applied to solid, fluid and gaseous waste collection, recycling

Figure 11 | Ecocity Sarriguren: System of green networks plan

Figure 12 | Ecocity Sarriguren: Ecological Corridors

Figure 13 | Ecocity Sarriguren: Inter-urban Parks and Gardens

Figure 14 | Sustainable energy collection features

and disposal, with special attention to radioactive, electromagnetic, toxic and volatile materials.

The blue & green Network

Figure 11, figure 12

Blue-green networks are the base of the ecocity design of Sarriguren. The intimate juxtaposition of built and natural elements gives the ecocity its unique ecological character. Interplay between architectural elements, landscape and public open spaces weaves through the ecocity while the historic village is preserved as the identity center of the development. In response to this design scheme, over 4,000 indigenous or adapted trees and shrubs were planted in the first phase of the project.

Green Corridor of the Arga River

The Arga valley is an essential aspect of the Pamplona regional landscape, which first and foremost, dictates the urban structure of Pamplona. A renewed focus on the improvement of the quality of water systems in Navarra has most certainly enlivened the urban landscape of Pamplona, and it provides a tremendous opportunity to connect Ecocity Sarriguren with the landscape and urban fabric of the existing city. Currently, the Arga River as it passes through Pamplona is a continuous blue-green parkland of 33 km, dedicated to recreation, fishing, cycling and walking. In addition to Ecocity Sarriguren, other municipalities in the Pamplona region have shown an interest in participating in this large scale watershed regeneration suggesting the continued expansion of the park.

Ecocity Sarriguren Ecological Corridors

Continuations of the Arga River corridor buffer Ecocity Sarriguren on both sides. These corridors, left in their natural state, and expanded by complementary landscape buffers, protect, define, and enliven

Figure 15 | Ecocity Sarriguren: Residential building and shared garden spaces

Figure 16 | Ecocity Sarriguren: Residential building with louvered façade for solar protection

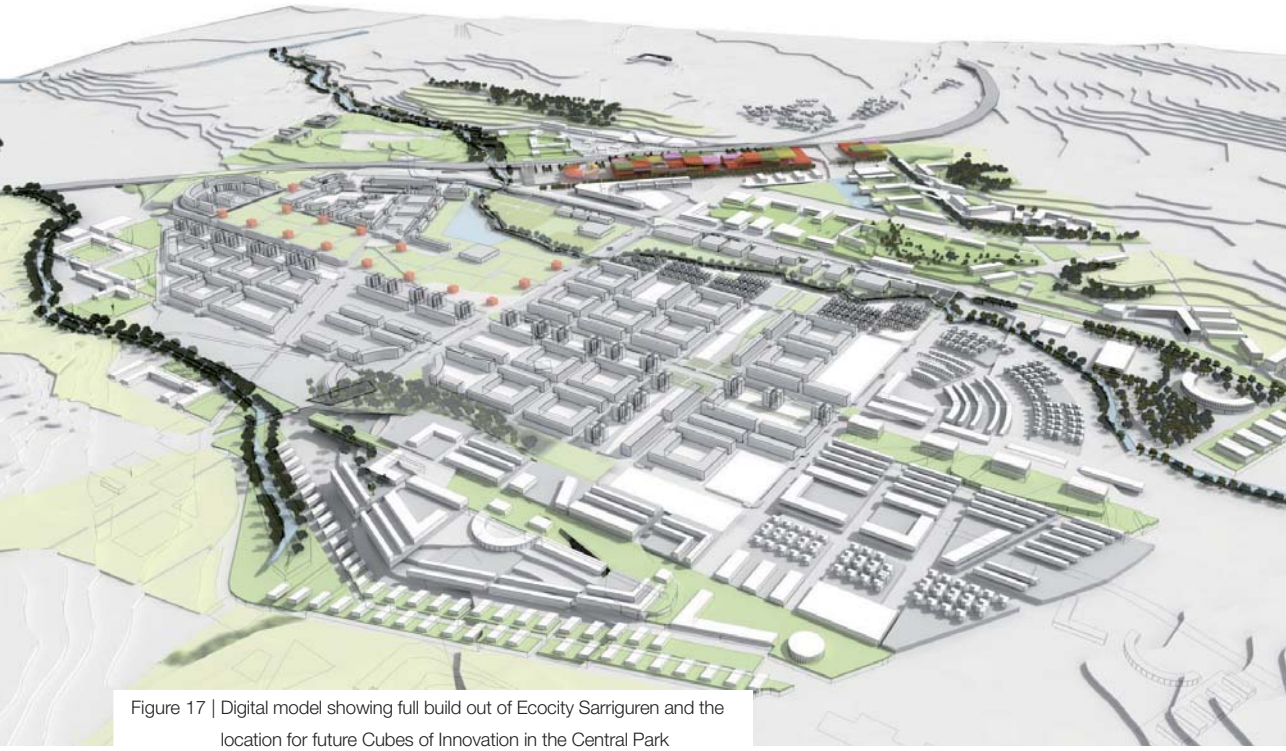

Figure 17 | Digital model showing full build out of Ecocity Sarriguren and the location for future Cubes of Innovation in the Central Park

the ecocity. They are the anchors of green pedestrian networks that weave through the city.

The Lake

Adjacent to Barranco Grande (the northernmost ecological corridor in Ecocity Sarriguren) is the lake. This feature is the strongest statement in the man-made landscape of Ecocity Sarriguren. With structures bordering nearly half of its shores, the lake is a true dialogue between the built and natural environments of Sarriguren. Further, the lake has proven to be an improvement to the existing natural ecosystems, as it regulates water flows and sedimentation in the Arga River tributaries.

Inter-urban Parks and Gardens Network

The final piece of the blue-green network of Sarriguren is the system of pedestrian and landscaped spaces that weaves throughout the city. These features are characterized by a comprehensive integration with streets and boulevards, and a mixing of use and transport modes into green zones. These areas are intended to be heavily used, and are built to accommodate pleasant and inviting movement through the ecocity. Figure 13

Residential Areas

Though by no means separate from the other major uses of Ecocity Sarriguren, residential areas have a number of unique features that are vital to the explanation of Ecocity Sarriguren design and functionality. All residential designs in ecocity respond to the aforementioned design concepts, focusing particularly on diverse, affordable, high-quality housing, bio-climatic architecture, and communal infrastructure and urban design.

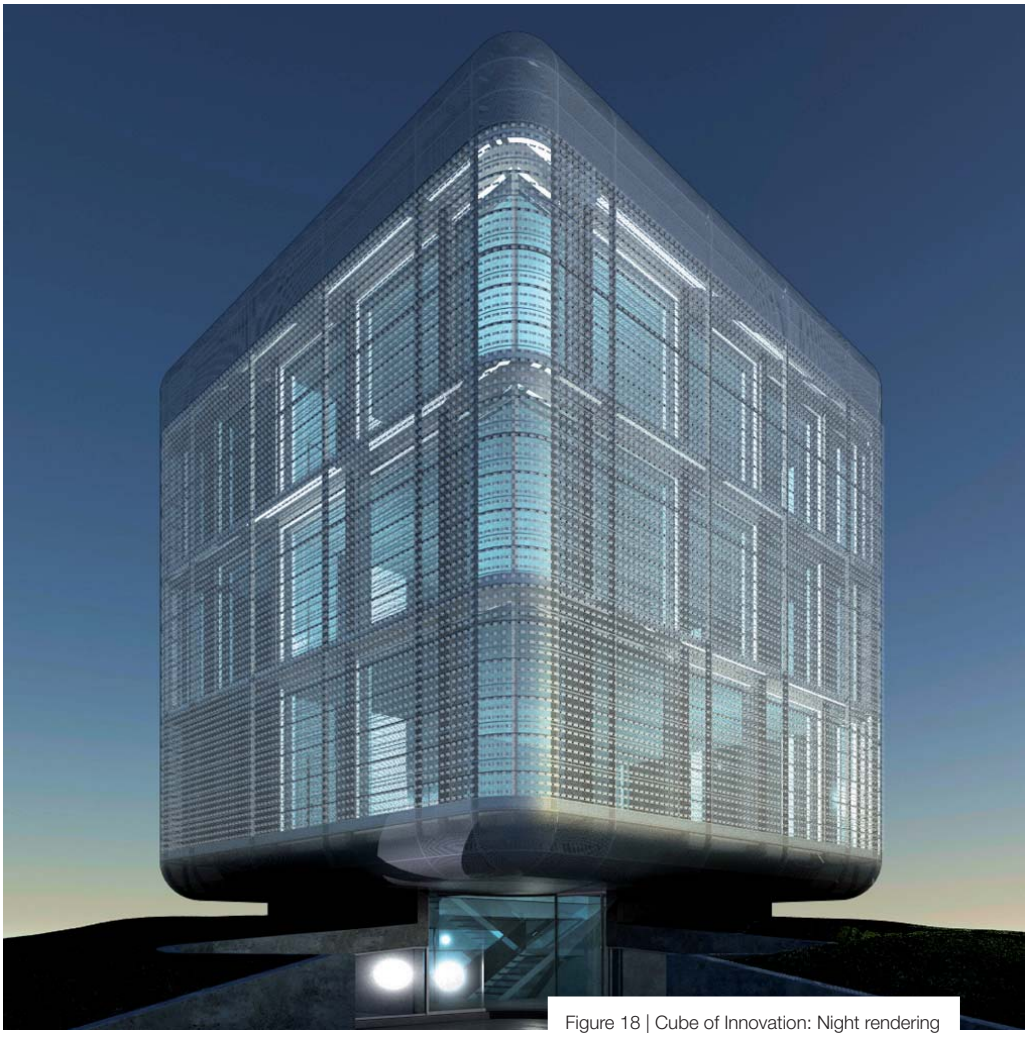

Figure 18 | Cube of Innovation: Night rendering

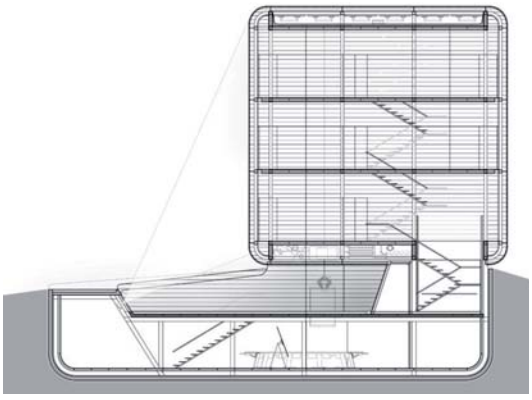

Figure 19 | Cube of Innovation: Typical Section

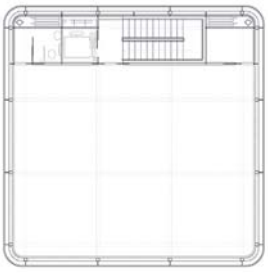

Figure 20 | Cube of Innovation: Typical Plan

Figure 21 | Innovation Park of Navarra: Corporate office of Acciona

Sustainable Energy Assessment

One of the major instruments to reduce energy consumption in the ecocity of Sarriguren, and fulfill design intentions, was implementation of a Sustainable Energy Assessment. This was a pilot program to check the relative merits of building energy efficiency. Assessment certificates measure the energy consumption of residential buildings objectively providing potential ecocity buyers and investors with the opportunity to consider this information as a part of their purchasing decision. This also allows project developers to evaluate the economic results arrived at by various building efficiencies and standards. Energy efficiency norms applied to Sarriguren initially required a 25% improvement over the existing norms. Upon completion however, the average energy savings per building in Sarriguren amounted to a 51.85% improvement over existing standards.
Figure 14

Housing Typologies In pursuing the goal of architectural diversity, the plans for Ecocity Sarriguren included the following offerings: Figure 15, figure 16

>El Pueblo: the historic village
>The EcoCity Gates: medium sized flats
>Ecocity Condominiums: Low rise, courtyard-surrounded flats with private gardens
>Parkview: Medium-High rise apartments
>Ecocity Single Family Dwellings

Areas of Production and Innovation

Ecocity Sarriguren focuses on the creative economy and knowledge sector development. A crucial part of the city design has been the placement and articulation of the types of spaces that are ideal for innovation. Project designers imagined architecturally unique “Cubes of Innovation”, as well as an innovation and production park within the city.

Cubes of Innovation Cubes of Innovation are distinct architectural structures with 13 x 13 x 13 meters of flexible space to ac-

Figure 22 | June 2008 photograph showing realized Ecocity Sarriguren project

commodate innovative activities. They are placed in a way that gives visual order to the areas between communal housing and the Central Park. The Cubes can be used as offices for young entrepreneurs and researchers in Navarra, for urban services, such as tourist offices or libraries, as well as for commercial activities such as cafes. Figure 17,18,19, 20

Innovation Park The Innovation Park of Navarra, situated at the north-west edge of the ecocity, is an incubator for alternative energy development and environmentally friendly technologies. Ground floor spaces are allocated to retail and services that foster social interaction in the critical spaces of the development. In addition to enterprise areas, the innovation park hosts mixed spaces for living accommodations, learning facilities, and leisure. Landscape and design choices follow the criteria of other developments in the Ecocity of Sarriguren, while naturalized spaces feature a wider range of topographic change and interest. Enterprises currently housed in the park include world leaders in the fields of renewable energy research and development, like Acciona Energy and Acciona Solar (figure 21), CENER, Gamesa and Ingeteam Energy. The park also hosts the National Renewable Energy Center (CENER), which is a technology center specializing in applied research, and the development and promotion of renewable energies. CENER researches six areas in the field of renewable energies: wind, solar thermal, solar photovoltaic, biomass, bioclimatic architecture and integration of decentralized energy generation into the national grid.

The CENER building is exemplary of the architecture found in the Ecocity Sarriguren Technology Park. In addition to its compliance with the general guidelines of Ecocity Sarriguren architecture, it incorporates passive design principles, photovoltaic façade paneling, a glazed gallery and solar

flue, thermal inertia, cross ventilation, solar blinds, and a green roof. The building won an award at the International Conference GBC/Sustainable Building 2005 in Tokyo and also received the CONSTRUMAT Prize in 2005.

Community Services

The ecocity of Sarriguren provides a comprehensive range of accessible collective facilities for the community. These include a sports center, a health care center, and social services. These facilities are generally positioned near a main road that links Sarriguren to Pamplona- strategically located to encourage the creation of a vital multimodal boulevard, lined with buildings and landscaping, connecting the two centers.
Conclusion and Reflections.
Figure 22

What distinguishes ecocities from traditional cities is their emphasis on the close relationship between those who live, work, learn and play in a city, and the environment in which these activities take place. Man-made artifacts are intimately intertwined with nature in every part of an ecocity, extending seamlessly into the surrounding natural environment. Most importantly, the bond between the built and natural environment fosters a mutually beneficial relationship between man and nature.

The design of Sarriguren is based on ecological principles that allow nature to be omnipresent in the everyday life of its citizens. The eco-design of buildings encourages this notion by cooperating with nature and incorporating renewable energy, natural lighting and shading, heat storage and preservation, photovoltaic electricity production, native landscape regeneration and water resource management. These features promote the awareness and appreciation of nature with regard to healthy lifestyles and preservation for future generations. Life in ecocities is thus a balanced and enjoyable experience, taking advantage of the continual exploration of nature, innovation, mobility, and recreation. •

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i. Alfonso Vegara (2009) “Sarriguren Ecociudad”. *Gobierno de Navarra*. Pamplona, Spain

ii. Amos Rapoport (1969) “House Form and Culture”. Prentice-Hall/ Ed. Española: 1972. “Vivienda y Culturea”.Gustavo Fili.

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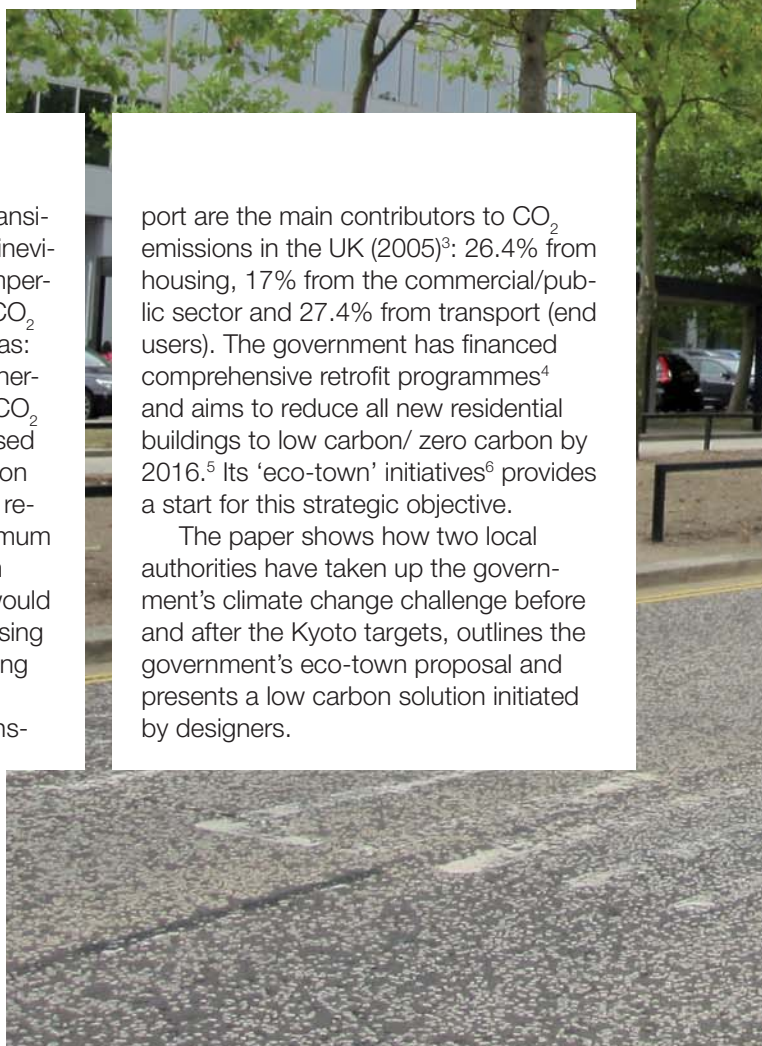
Judith Ryser

Low Carbon Cities: Examples from The United Kingdom



Background: UK Actions to Reduce CO_2 Emissions[1]

The UK government considers the transition to a "Low Carbon Britain" as an inevitable environmental and economic imperative. It has set stringent targets for CO_2 emission reductions[2] in three key areas: buildings, transport and renewable energy. Its current goals (2009) are 80% CO_2 reduction by 2050 over 1990 (increased from 60% in 2008), with 20% reduction by 2010; 15% of energy supply from renewable sources by 2020; and maximum 100g/km CO_2 vehicle emissions from 10% of new cars by 2012. The UK would have to achieve an annual decarbonising rate in excess of 4-5% over the coming decades to achieve these goals.

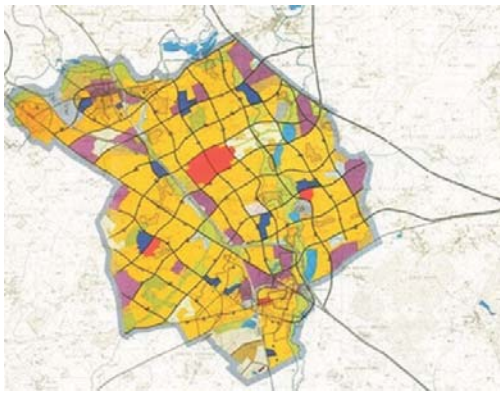
Emissions from buildings and transport are the main contributors to CO_2 emissions in the UK (2005)[3]: 26.4% from housing, 17% from the commercial/public sector and 27.4% from transport (end users). The government has financed comprehensive retrofit programmes[4] and aims to reduce all new residential buildings to low carbon/ zero carbon by 2016.[5] Its 'eco-town' initiatives[6] provides a start for this strategic objective.

The paper shows how two local authorities have taken up the government's climate change challenge before and after the Kyoto targets, outlines the government's eco-town proposal and presents a low carbon solution initiated by designers.

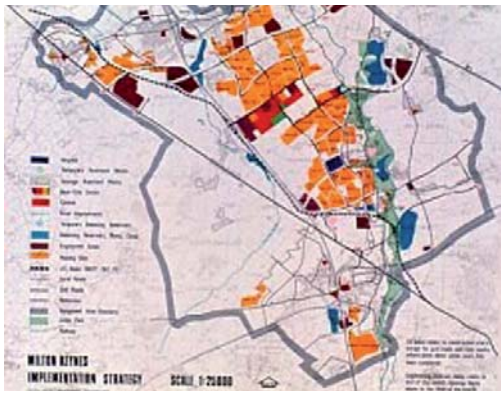

Silicon Court

Milton Keynes, a Pioneer of Energy Efficient Design

Milton Keynes reflects environmental consciousness of the nineteen seventies and how it continues to be addressed to this day. Low density and car based Milton Keynes was the last 'mark' of UK New Towns. Unsustainable in today's terms, it was nevertheless among the first to experiment with energy efficient buildings in response to the 1970s energy shock. It encouraged innovative ecological design, imposed higher than average insulation standards and set up monitoring devices.



Dia 1a Milton Keynes master plan: grid iron structure based on car for New Town designated in 1967



Dia 1b Early development plan

National Energy Centre in Milton Keynes

Low Carbon House Design

Early experiments focused on gaining 'free' energy from the sun and wind. They include the Bradville Solar House, Solar Court consisting of nine terrace houses, the Rainbow Housing Cooperative Conservatory and Summerhayes, the latter to demonstrate that such houses could be sold to the private sector.

According to the 'Thimkagain' Campaign,[7] the aim of the Home World Exhibition, staged on Bradwell Common in 1981, was to showcase innovative energy efficient housing design. Twenty developers built 36 houses, including the Ideal Home, the Autarkic House and Futurehome 2000 which were considered ground-breaking. This led to more energy efficient housing, including timber frame houses into timber frame houses and 36 flats with 60% space heating reduction, incurring only £500 extra construction costs.

Designated in 1985, the Energy Park was planned as a demonstration project of energy efficiency on 300 acres. On Shenley Lodge it comprised housing, workplaces, parks and community facilities and the adjacent Knowlhill high tech business park. The development had to meet energy performance standards using the Milton Keynes Energy Cost Index elaborated by the Open University (located in Milton Keynes) in partnership with Milton Keynes Development Corporation. This increased the minimum National Home Energy Rating (NHER) from 7.5 to 9.0 for housing. The houses were designed to be at least 30% more energy efficient than the Building Regulations then in force, later amended accordingly. The Energy Park was launched by Energy World, a show village of 50 dwellings built by local and volume house builders, together with a wind turbine, later removed. A wide range of house design and sizes comprised the highly insulated Round House with under-floor heating, the triple glazed Solaire House with low emissivity coating, as well

Dias 2 a-f | Milton Keynes Energy Park/ Home World Exhibition: Energy efficient houses:
Autarkic House; Ideal Home; Round House; superinsulated; Bastide; office in Knowlhill[8]

as more conventional designs including a Victorian home retrofitted with an active solar element. 1200 dwellings were built with increasingly demanding energy efficiency designs, together with an experiment of a glazed street to extend energy efficiency to the public realm.

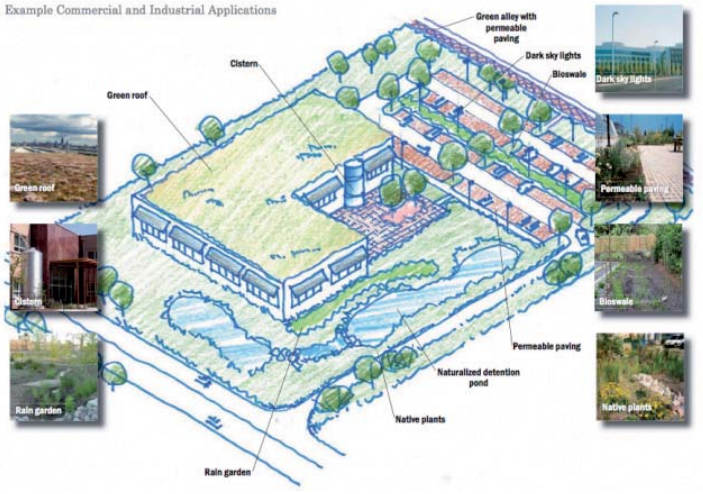
This ambitious programme could not be achieved without the private sector. Co-opting the National House Building Council to Milton Keynes' energy efficiency programmes secured successful implementation. The private builders adopted diverse new technologies and innovative architectural designs which yielded 3% above average house prices. These experiments were a significant landmark in the design and construction of low-energy housing and the development of energy efficiency evaluation tools. Low energy projects were built and monitored over 16 years in the Milton Keynes Energy Park by the Building Research Establishment in cooperation with the National Energy Foundation. Subsequently, their standards were applied city-wide.[9]

Low Carbon Layouts

Energy efficient design was extended to commercial buildings and whole layouts. Urban design focused on grouped buildings to minimise the extent and exposure of external wall surfaces. Landscape design and planting aimed to optimise screening and thus to increase the thermal performance of individual buildings. Within an individual grid of the grid iron structure of Milton Keynes the Pennyland low energy layout was designed to create a favourable micro-climate.

The current programme of collective renewable energy generation includes external solar collectors, wind turbines and photovoltaic devices. Sustainable urban drainage systems, encompassing rainwater and wastewater collection and recycling, significant use of building materials which

Dia 3a-c | Eco-microclimate design: Pennyland; monorail (not realised); other eco-features



are renewable or recycled, and general waste reduction through recycling form an integral part of Milton Keynes' measures to curb CO_2 emissions.

Institutional Low Carbon Measures

Milton Keynes set up a Carbon Offset Fund (COF)[10] and introduced fiscal measures to reduce fuel bills. It aims to cut emissions in industry, commerce and the public sector by using the Carbon Trust programmes. The monitoring programme undertaken by the National Energy Foundation insures the wider dissemination of experimental low carbon technologies.

Milton Keynes is keen to strengthen its position as a centre of excellence of energy efficiency. When it was managed by the Milton Keynes Development Corporation, it created the National Energy Foundation and attracted the National Energy Centre. They provide citizen advise for global warming and specialised training on solar thermal, photovoltaics and wind, wood fuel heating and combined heat and power (CHP), and attribute grants to companies to develop a lower carbon future. They draw on the Sustainable Energy Academy set up by Milton Keynes Council and work, inter alia, with the London Mayor on Green500 Awards. They founded the 'ThimkAgain Campaign' as part of the Milton Keynes Carbon Reduction Programme. They mobilised bottom up initiatives such as a micro-wind turbine to charge electric cars, wood pellet fired biomass boilers and retrofitted solar heating panels. The Milton Keynes Council's Climate Change Liaison Group coordinates these efforts in cooperation with the United Sustainable Energy Agency and Greymatter, a local company marketing integrated design.

Milton Keynes' unique 'lived-in' database of energy efficient designs has been evaluated academically.[11] The findings are that Milton Keynes' efficient and economic use of energy was lowering CO_2 emissions, albeit not an initial prime objective but a welcome additional effect. The Open University makes active contributions to educating the UK population on climate change and more sustainable lifestyles. Its Energy and Environment Research Unit has established a partnership with the Nationwide Building Society to develop environmentally sound approaches to the generation and use of energy. The nearby Cranfield Energy Technology Centre is contributing to power generation technology, including offshore sub-sea engineering and risk management.

The government has earmarked the Milton Keynes area to accommodate a substantial part of its new housing programme of 3 million dwellings.[12] Milton Keynes' 40 year expertise of sustainable development should enable it to turn the planned urban expansion in Marston Vale, Bedfordshire,[13] situated between Milton Keynes and Bedford into a genuine low carbon 'eco-town'.

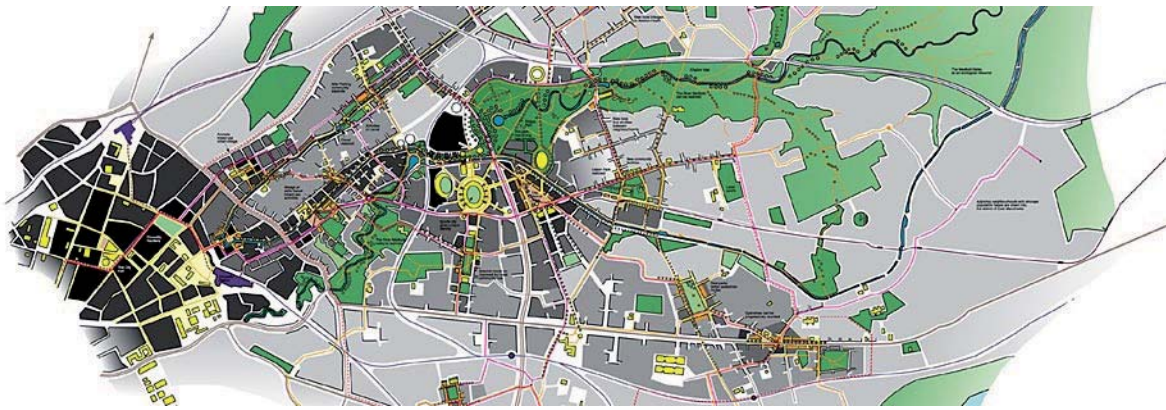
Manchester: An Aspiring Low Carbon City

Manchester announced its ambition to lead the world in tackling climate change.[14] To that effect it earmarked a multi-million £ strategy to cut the city's CO_2 emissions from vehicles, buildings and businesses by a third by 2020 (from base date 2009). Together with some 340 councils it has subscribed to the Nottingham Declaration on Climate Change.[15]

Carbon Anatomy of Manchester

Manchester's sustainability approach is based on a business rationale rather than green principles. It commissioned the consultants Deloitte[16] to carry out an audit, inspired by the Stern Review which the government had commissioned to assess the 'Economics of Climate Change".[17] Deloitte concentrated on transport, energy intensive manufacturing and textiles, the latter a key industry which generated Manchester's wealth during the industrial revolution. Their audit is more limited than Stern's who incorporated all sources of CO_2 emissions, including energy emissions from power generation and distribution. Deloitte started from the international and national regulations and targets of CO_2 emission reduc-

tions to which Manchester was to respond, instead of taking pre-emptive actions. They recommend that the public sector should lead by example through policies and actions, such as procurement. They proposed a regional Climate Change Agency to mobilise the private sector in conjunction with the public sector to deliver the necessary interventions.



Dia 4 | Manchester green master plan

Deloitte found that the Manchester region was able to produce economic growth without significant increases in direct CO_2 emissions because its economy had shifted from manufacturing to financial, business, professional and public services. Taking into account Manchester's industrial expertise and science-oriented universities, Deloitte considered that the development of environmental technology and services, together with eco-innovation presented great opportunities for Manchester's economy. Moreover, climate change measures and revised energy planning could lead to cost cutting. Planning adapted to CO_2 reductions was expected to bring improvements to function, infrastructure, design, location and density of major developments, as well as fostering cluster formation of new technologies. All these initiatives would foment Manchester as a location of choice for environmental innovation.

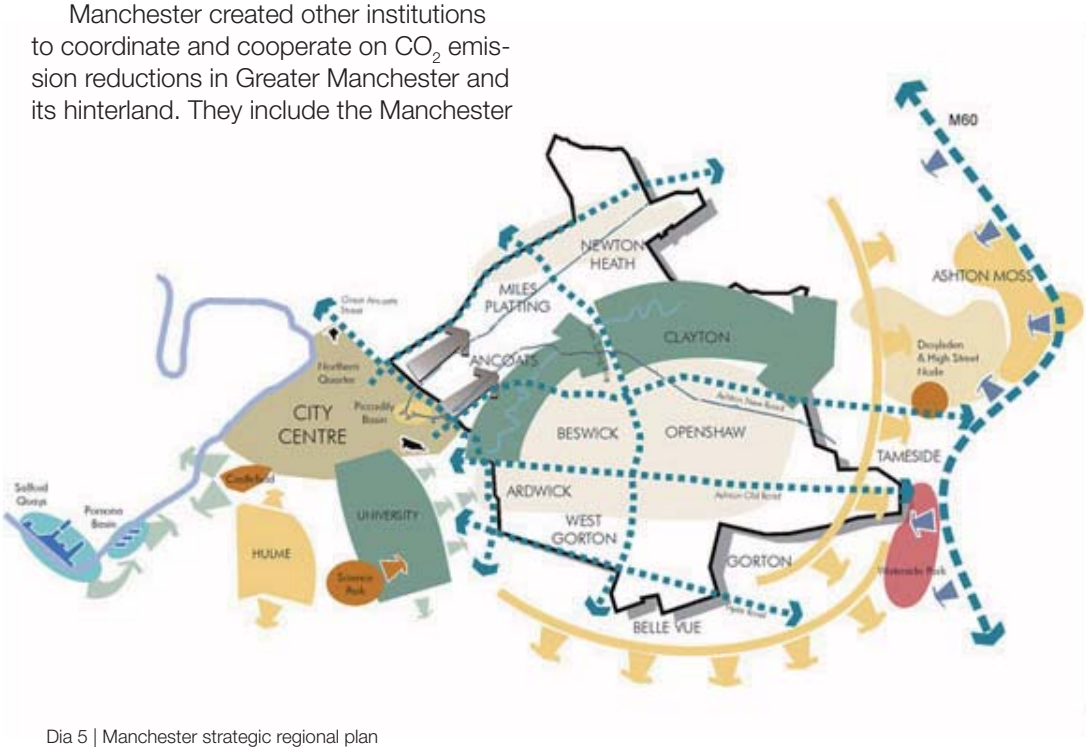
In operational terms, Manchester was advised to position itself at the forefront of the global environmental industry by changing its energy mix in order to reduce economic costs; by adjusting its procurement strategies toward greener products; and by developing specific mitigation strategies for highly polluting sectors such as industry and transport. Other recommendations urge Manchester to align its spatial with its economic policies across the metropolitan region and to create specialised bodies and networks to improve regional cooperation and capacity building.

Institutional Low Carbon Measures

One such body is Envirolink Northwest[18] which fosters the development and growth of the 'energy and environmental technologies and services sector' in the northwest of England. A not-for-profit organisation, Envirolink was founded by the northwest Regional Development Agency to increase technology transfer in the fields of energy

efficiency, land remediation, renewable energy, recycling, waste, water and wastewater treatment, besides improving knowledge and skills regarding low carbon solutions. A concrete step toward the latter was to set up a database to identify environmental research expertise among northwest universities.

Manchester created other institutions to coordinate and cooperate on CO_2 emission reductions in Greater Manchester and its hinterland. They include the Manchester



Dia 5 | Manchester strategic regional plan

Partnership which elaborated a Community Strategy for 2006-2015. Manchester commissioned the Beyond Green consultancy to write a 'Call to Action'[19] published in January 2009. 'Call to Action' set aside £1million expecting the private sector to match this sum to achieve the stated goals. A group of 'concerned citizens' responded to this initiative with their 'Call to Real Action'.[20] Interesting ideas figure among their realistic, as well as idealistic proposals for bottom-up community initiatives.[21] A further pressure group is 'Manchestergreencity'[22] which expects Manchester to become Britain's greenest city. A number of other bodies were created and existing bodies were adjusted to incorporate climate change issues into their action programmes.[23]

Manchester City Council produced its own principles of how to tackle climate change in its area.[24] It outlines its initiatives to turn Manchester into a low carbon city and how it conceives Manchester to reduce CO_2 emissions by almost 1 million tonnes per annum.

Manchester proposes to create 'bit-size' targets in the commercial, transport and domestic sectors.[25] The report proposes 17 principles to implement its CO_2 emission reduction targets or, alternatively, to persuade

others in charge to follow suit. Overall, Manchester introduced more stringent environmental standards into its planning framework. As a practical implementation tool it created a Transport Innovation Fund. In its efforts to co-opt support from third parties, it set up the Green City Programme and obtained community contributions from the Environmental Business Pledge. Other initiatives include eco-schools and Action for Sustainable Living.[26] The 'Manchester is My Planet' initiative comes under the Manches-

Manchester CO_2 emissions*

Data Local Area Agreement (LAA) year	**Baseline**	**2008/09**	**2009/10**	**2010/11**
Data LAA year	**2005**	**2006**	**2007**	**2008**
CO_2/capita	6.7	6.5	6.2	6.0
% reduction target	-	3.7%	7.4%	11.1%
CO_2/capita actual	6.7	6.9	-	-
% reduction actual	0	-3.0%	-	-

Source: Manchester City Council. Note that CO_2 emissions have actually increased in 2006.

According to the Energy Saving Trust, during its first year of action 2008, 440,000 tonnes CO_2 (lifetime) have been saved across the conurbation through retrofitting housing and switching to fuel efficient cars.

ter Knowledge Capital programme[27] which was created in 2005 for Greater Manchester. It has managed to obtain 2055 pledges, amounting to a potential saving of 46.343 tonnes of CO_2 per year.

Manchester's projects to curb CO_2 emissions include institutional initiatives, such as the creation of a Climate Change/Sustainable Energy Agency, and 'Community Renewables'. The latter established cooperative ownership schemes for local communities to set up renewable energy schemes which generate clean energy and an income stream to the benefit of the community. Other practical undertakings include 'greening the town halls' which aims to reduce the city's own CO_2 emissions by 50% and to encourage local procurement. 'Greening households' informs and assists households to take energy efficiency measures and set up micro-generation with companies like Ecotricity (wind) and Solartwin (solar thermal).

It may be early days yet, but besides target setting and campaigning, information remains scarce on concrete results derived from these policies and proposed measures. Moreover, Manchester has the sec-

ond international airport after London and its actions to reduce CO_2 emissions from air travel are rather non committal, a stance which has been challenged by local pressure groups.

Low Carbon New Islington, Manchester East

A concrete example of implementing Manchester's CO_2 emission reduction targets is being realised under the Millennium Communities Programme, in cooperation with English Partnerships (now part of Housing and Community Agency: HCA).[28] New Islington[29] is being built in East Manchester where half the buildings were left standing empty. From 100,000 inhabitants this neighbourhood, Ancoats, had shrunk to 17,000. A public private partnership was set up to regenerate this 'brown field' site. Its main partners are: English Partnerships, lead developer Urban Splash, the Urban Regeneration Company New East Manchester Ltd, Manchester City Council, Manchester Methodist Housing Association, (part of Great Places Housing Group) and the New Islington Millennium Community which represents the local community interests.

Forming part of the Millennium Community Programme New Islington has to meet its objectives and its environmental performance standards: reducing energy used in constructing homes by 50%, reducing energy consumption in use by 20%, and waste disposal by 50%. The way innovative and energy efficient construction methods and materials are applied is expected to become a model for volume house builders. A combined heat and power plant will be installed for the whole site. New inhabitants have been moving in since 2006 and the scheme is being developed further, in-

Dia 6 a-c | New Islington Manchester, previous situation, ecological regeneration, and urban design plan. Islington Square. Chips by Urban Splash. Photos: Joel Chester Fildes ©. Webb Aviation ©

cluding communal facilities such as a hospital and a school, all built according to energy efficiency principles. 1700 new homes are planned for rent and sale on 12.5ha of mixed development at a cost of £250m including government subsidy. Besides energy efficiency and low carbon emissions the aim of this regeneration project is to be financially self supporting.

Part of the East Manchester framework for sustainable mixed development comprising 15,000 new homes on 2000ha, New Islington fulfils many preconditions of the eco-towns discussed below. Moreover, it takes up the challenge to regenerate the dilapidated first British industrial suburb. What both Milton Keynes and Manchester demonstrate is that the acceptance and implementation of low carbon development necessitate a long time frame and innovative institutional structures, besides cooperation between the public and the private sector, as well as with civil society.

Low Carbon, Zero Carbon Cities: The UK Eco-Town Experiment

The UK government initiated eco-towns as a key instrument to reduce CO_2 emissions, akin to the 'eco-city' concept which I discussed elsewhere.[30] After inviting bids from local authorities and developers, [31] the government selected the first four proposals from 75 initial submissions and ten short listed schemes and it intends to nominate six more for completion by 2020.[32]

The four selected proposals which share the special £60m Growth Fund for local infrastructure support are:

- 5000 dwellings in Clay Country, St Austell Cornwall (best change of implementation)
- 4000 dwellings in Rackheath, on a disused airfield near Norwich in East Anglia
- 10,000 dwellings near Bicester, Oxfordshire, on 345ha farmland bisected by rail track
- 5500 dwellings in Whitehill-Bordon Hampshire, on Ministry of Defence land.

All the schemes, mainly on government owned discounted land, are supported by their respective local authorities. Despite public consultation, they have encountered strong opposition and need to obtain planning permission before they can be built. None of them are self-contained but can be linked to existing developments.

Government Definition of Eco-Towns

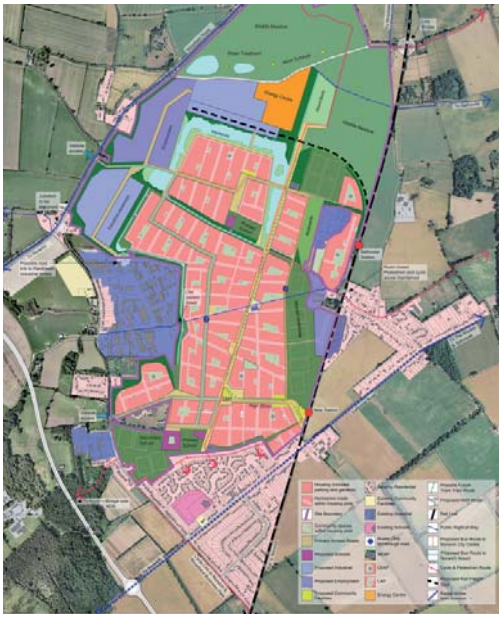
In its Eco-towns Prospectus,[33] the government defined eco-towns as follows:

"Eco-towns will be small new towns of at least 5-20,000 homes. They are intended to exploit the potential to create a complete new settlement to achieve zero carbon development and more sustainable living using the best new design and architecture."
The key features of eco-towns were proposed as:

Dia 7 | map of eco-town location

Dia 8 | Community objection to eco-town

Dias 9-10 | St Austell site and masterplan



Dias 11-12 | Rackheath site and masterplan

- places with a separate and distinct identity but good links to surrounding towns and cities in terms of jobs, transport and services;
- the development as a whole to achieve zero carbon and to be an exemplar in at least one area of environment technology;
- a good range of facilities within the town including a secondary school, shopping, business space and leisure;
- between 30 and 50 per cent affordable housing with a good mix of tenures and size of homes in mixed communities; and
- a delivery organisation to manage the town and its development and provide support for people, businesses and community services.

The government laid down main standards for eco-towns in the Planning Policy Statement (PPS1 Planning and Climate Change, Supplement Practice Guidance) and updated the code for sustainable homes (Planning Policy Guidance PPG Part L) . Specific 'eco-criteria' are:

- Community-scale heat sources, possibly using combined heat and power plants
- Charging points for electric cars
- All homes within 10 minutes walk of frequent public transport and everyday services
- Parks, playgrounds and gardens to make up 40% of towns, at least half open to the public
- Individual homes must achieve 70% carbon savings above current building regulations in terms of heating, hot water and lighting
- Zero-carbon buildings to include shops, restaurants and schools
- Ensuring a minimum of one job per house which can be reached by walking, cycling or public transport to reduce car dependence
- Car journeys to make up less than half of all journeys
- Efficient, 30% affordable homes, fitted with smart meters for individual control of heat and ventilation, taking their energy from the sun, wind and earth and able to sell surplus to the grid.

Building design of eco-towns was to follow ecological principles to help curb CO_2 emissions at significantly tougher thresholds than any existing or agreed targets, including water efficiency (rain water collection, protection against flooding, improved local water quality, grey-water recycling, etc). Similarly, reduced waste and waste recycling is expected to be high. Zero carbon will be achieved by harnessing solar energy combined with other clean renewable energies, such as wind turbines, together with renewable energy generation, energy efficiency, low energy appliances, high insulation levels and innovative technologies. Inbuilt real time energy monitoring will check these objectives which should lower energy bills for the inhabitants.

The bidders had to produce action plans, local spending reports and fulfil the prescribed ecological conditions, as well as demonstrate that public participation had influenced the design and will continue during the implementation and running of the eco-town. The government expects eco-towns to be finalised and built expediently, although the Millennium Communities Initiative predicts that eco-towns require a long time to come to fruition. [34]

Alternatives to Eco-Towns

Campaigns opposing the proposed eco-towns[35] have been joined by previous protagonists.[36] Experts, even among the bidders, claim that zero carbon towns are impossible to produce without very costly carbon offsets which defy the purpose of fossil fuel dependency. The size of eco-towns does not provide the critical mass for self-contained entities. Requiring inordinate infrastructures, their location on green fields cannot deliver overall CO_2 neutrality, nor a car-less existence. They contradict the notion of 'compact city' and should be planned in contiguity with existing urban areas.

The Empty Homes Agency demonstrated that building new houses emits 4.5 times more carbon than rehabilitating old ones.

They are joined by those who advocate 're-tooling' existing cities which have the potential to become better eco-towns, owing to their higher densities, existing public transport, lower car ownership, mixed uses, adequate service provision and settled communities. Their ecological regeneration may also include their capability of absorbing immigrants, instead of trying to impose social mix on new eco-towns, an undertaking with little historic success in suburban and rural Britain, or in new towns. The Housing and Community Agency (HCA)[37] may become instrumental in turning existing cities into eco-towns, or at least in parts, by realising eco-developments on their brown fields or infill sites, like the 'eco-estate' BedZED in London.

BedZED, a Low Carbon Test Case

BedZED stands for Beddington Zero Energy Design. This socially inclusive 'green live-work-leisure' ensemble, comprising 99 homes and 100 workplaces, was completed in Sutton, South London in 2002 on reclaimed, local authority owned land. It was instantly acknowledged by the Energy Global Award, the Building Services Sustainability Award and the Evening Standard Lifestyle Award in 2002, and its design has earned the Housing Design Award 2000 for Sustainability and Most Promising Scheme. It manifestly appealed to the zeitgeist and remains an exemplar 'eco-quarter'.

The multidisciplinary team which managed to bring this eco-development to fruition consisted of BioRegionalDevelopment Group (co-developer, sustainability solutions), Bill Dunster Architects (masterplan and design), Ove Arup & Partners (building physics, energy, water, ventilation, services), Ellis & Moore (structural and civil engineers), Gardiner & Theobald (quantity surveyors, project managers and main contractors), BP Solar (photovoltaic installation), and a progressive client and co-developer, The Peabody Trust which has a long history of philanthropic housing provision.

Dia 13 | BedZED (photo © Bill Dunster) aerial

Dia 14-16 BedZED housing and CHP plant, bridges between housing and work, eco-façade (photos Judith Ryser ©)

This ‘eco-community’, the first and largest in the UK, has been designed with carbon neutrality in mind before the government had proposed eco-towns or the newly created Greater London Authority[38] had pushed sustainability principles in the Strategic London Plan. From an ‘eco-design’ point of view, the five south facing terraces were built with renewable or recycled, locally produced materials, specially designed to store heat when warm and release heat when colder, together with super-insulated walls and roofs and triple glazed windows to minimise central heating needs. All houses have three storey conservatories to maximise light and sun warmth, photovoltaic panels as a further source of renewable energy which supply 11% of electricity needs, wind powered ventilation to supply fresh air, as well as energy and water efficient appliances. These houses save some 90% space heating and 30% water use.

The innovative heating system is storing and reusing excess heat from cooking, lighting and everyday activities. It is fuelled by a local, small scale combined heat and power plant fired with off cuts from tree surgery waste. Unfortunately the plant met technical problems and is being redesigned. One handicap is the unfavourable prices of locally generated energy sold back to the grid.

The largest CO_2 reductions of BedZED emanate from its green transport plan and green lifestyles. The transport plan includes public transport (over-ground rail and tram) within 10 minutes walk, incentives for bicycle use and storage inside dwellings, London’s first car club, home zones, reduced car parking and road space, charging for car parking spaces and a car parking permit system achieving 11% CO_2 emission reductions.[39] Local food links and waste recycling reduce carbon impacts by an additional 7% while architectural design features, such as conservatories, solar panels, etc. reduce emissions by another 2%. An on site visitor centre provides information on progress.

The ecological footprint of an average BedZED inhabitant is 4.67gha (2.6 planets equivalent), or 9.9 tonnes.[40] With a biomass CHP and a carbon restrained lifestyle 6 tonnes could be achieved. The London Borough of Sutton is committed to reduce the ecological footprint Borough-wide by 2025 in cooperation with BioRegional by environmentally upgrading existing homes and building more ‘eco-quarters’ on both brown and green field sites. The Local Development Framework[41] is indicating options for sustainable solutions. The Hackbridge North eco-quarter is planned adjacent to BedZED for 1100 new environment friendly homes and facilities.

London is considered ideal for a large scale exemplar sustainable community of around 2000 homes, a mix of new and refurbished properties including all amenities, as well as employment opportunities for 1000 workers, a school, health care facilities and retail. Such a development would provide synergies between mixed uses, economies of scale for green technologies and sustainable lifestyle initiatives. While the One Planet Living, One Gallions scheme in Newham is large but mainly residential, Z-squared in the Thames Gateway is a more integrated proposal, still at an initial stage.

Conclusion

Although potentially far more devastating than the current economic recession, climate change does not entice public imagination. Individuals fail to see the link between the climate challenge and their everyday lives.[42] Despite public awareness-raising campaigns few are persuaded to adjust their behaviour, especially if it entails curtailing their quality of life. Confronted by too many unknowns, decision makers have a hard task steering between coercion and voluntary cooperation. This context may explain the slow progress of achieving effective CO_2 emission reductions.

Despite these difficulties, the UK government has pledged a plethora of ad hoc targets and measures to curb CO_2 emissions. It has devised policies, set up agencies, made budget streams available, provided incentives, and stimulated public awareness. Many cities have followed suit

Dia 17 | Hackbridge draft eco- master plan

Proposals for potential development sites:

1 mixed use district centre (retail, catering, community and health facilities, housing, employment)
2 lower rise development to ensure prominence of adjacent planned centre
3 new road layout on redundant industrial site to improve connections with the district centre and the railway station
4 improve pedestrian and cycle connections to the regional park
5 + 6 compact developments north of BedZED with new green links
7 development of Wandle Valley Trading Estate to create improved gateway to Wandle Trail
8 traffic management, new cycles lanes, improved footways and signal controlled junction to make main through road more user friendly for local population BedZED is below 5

source ©: http://www.sutton.gov.uk/index.aspx?articleid=3990

by integrating climate change policies into their own development strategies and introducing measures to reduce CO_2 emissions appropriate to local circumstances. Yet little change has taken place in the real world so far. Most funds have been spent on institution building and R&D into mitigation and adaptation, less on subsidies for real life experiments. Only a few new technologies and design principles have been transformed into concrete projects with real CO_2 emission reductions, thus providing as yet few opportunities for monitoring and adjustment.

The many commissioned expert findings show that the sheer scale and complexity of the tasks in hand require knowledge accumulation and preparation time for well pondered interventions, many of them facing inertia and long term consequences, such as nuclear power futures.

Nevertheless, in the UK political will persists at all levels of governance to pursue CO_2 emission reductions, despite the economic downturn which, in the opinion of forward looking activists, presents a unique opportunity to prepare for a future with more sustainable economic growth. •

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1 Judith Ryser (2009) 'Comparative Study of National Responses to the Challenge Posed by Climate Change and Energy Resource Constraints'. United Kingdom Response. This paper provides details on UK legislation, planning guidance and targets at national and local levels.

2 Climate Change Act 2008. http://www.opsi.gov.uk/acts/acts2008/ukpga_20080027_en_1

3 http://www.cfit.gov.uk/docs/2007/climatechange/02.htm

4 HMG (2008) Home Energy Saving Programme. £1billion government subsidies, £910 million expected from energy suppliers and electricity generators. In total: £6.5billion over three years mainly aimed at fuel poor areas and households. 1.6 million households have received help with home insulation and central heating. A Community Energy Savings Programme (CERT) is imposed on energy suppliers. Target is 100 new Community Energy Savings schemes benefiting 90,000 homes (2008-11). Extra £2.2billion on Decent Homes programme (2008-11) to improve energy efficiency in rented accommodation.

5 Government definition of Zero Carbon Home: "A zero carbon home is one whose net carbon dioxide emissions, taking account of emissions associated with all energy use in the home, is equal to zero or negative across the year" www.communities.gov.uk

6 Sustainable Communities Act 2007 (promoting sustainable local communities and providing the framework for bidding for eco-towns). http://www.opsi.gov.uk/acts/acts2007/ukpga_20070023_en_1

7 created by the Milton Keynes Strategic Partnership with initial funding form Milton Keynes Council and support from a number of partners, including the National Energy Foundation.

8 images from: http://www.solarenergyltd.net/Solar%20and%20Low%20Energy%20Architecture%20and%20Design.htm www.newhomes-milton-keynes.co.uk/ http://www.novaloca.com/images/property/sm_24245_633512186942020000.jpg

www.inhabitat.com/wp-content/uploads/rogers2.jpg
www.kwosh.co.uk/images/energy_efficient_house.jpg
http://www.solarenergyltd.net/IDEAL%20HOME%20SOLAR%20HOUSE%20%20Milton%20Keynes.gif

9 http://www.thimkagain.co.uk/mk/energy-world.htm

10 The aim of COF is to tax carbon emissions of new developments above carbon neutrality to upgrade the energy efficiency of existing homes. The benefit of lower fuel bills accrues to the users/ occupiers.

11 AJ Summerfield, HR Bruhns, JA Caeiro, RJ Lowe,JP Steadman, T Oreszxzyn (2006) Milton Keynes Energy Park Revisited: changes in internal temperatures. UCL

12 Government target is to build 2 million housing units by 2016 and another million of carbon neutral housing by 2020, a target disputed by the National Housing Federation because of market downturn.

13 www.marstonvale.com

14 http://www.manchester.gov.uk/site/scripts/documents_info.php?documentID=2476

15 http://www.energysavingtrust.org.uk/nottingham

16 Deloitte (2008) Mini-Stern for Manchester. Assessing the economic impact of EU and UK climate change legislation on Manchester City Region and the North West.

17 Stern Review on the Economics of Climate Change (2006). HM Treasury, Cabinet Office.

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19 images from: http://www.solarenergyltd.net/Solar%20and%20Low%20Energy%20Architecture%20and%20Design.htm
www.newhomes-milton-keynes.co.uk/
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http://www.manchester.gov.uk/site/scripts/documents_info.php?categoryID=500117&documentID=3833&pageNumber=3

20 http://calltorealaction.wordpress.com/ch-1-introduction/

21 Generally initiating actions from the bottom up. Examples: meat free Monday. Energy Descent Programme to decrease energy consumption.

22 http://www.manchester.gov.uk/manchestergreencity

23 This includes a multi-agency Environmental Strategy Programme Board overseeing the19 projects of the Environmental Strategy Portfolio 2009/10 which includes the implementation of the Climate Change to Action Plan 2009 developed by the Green City Team and the Sustainable Neighbourhood Partnership. During the 100 Days campaign, environmental campaigns staff delivered climate change clinics.

24 Manchester City Council. 5 February 2008. Report on introducing the issue of climate change and to outline the principles behind tackling climate change in Manchester. For its Local Area Agreements it uses baseline year 2005 for its incremental targets of CO_2 emission reductions.

25 Ibid. p 6 details the proposed emission reductions of 970,000 tonnes.

26 Manchester's State of the City Report 2008/2009. Manchester City Council

27 http://www.manchesterismyplanet.com/

28 http://www.englishpartnerships.co.uk/communitiespublications.htm#newislington

29 New Islington Millennium Community, local community

30 See: Article on Sarriguren in this ISOCARP Review 5; 'Sarriguren Eco-ciudad Ecocity' (2009). Government of Navarra; Judith Ryser & Gabriel Escobar. forthcoming. Climate Change and the Cities of the Future, Art, Technology and Economics against Climate Change. ECF (European Climate Forum).

31 http://www.communities.gov.uk/housing/housingsupply/ecotowns/

32 Planning Policy Statement (PPS)L, 16 July 2009, "a statement about potential" according to the Minister John Healey.

33 Department for Communities and Local Government (2007). Eco-towns Prospectus.

34 http://www.englishpartnerships.co.uk/millcomms.htm

35 See, for example, articles by Damian Arnold. 'Who killed the eco-town', Architect's Journal 25 June 2009; Simon Jenkins, 'Eco-towns are the greatest try-on in the history of property speculation', The Guardian 4 April 2008; Jonathan Leake and Brendan Montague, 'Eco-towns will break Gordon Brown's carbon pledge', The Times 30 March 2008.

36 e.g. Town and Country Planning Association.

37 a quasi government organisation which has absorbed the agency holding government-owned land for decontamination and sale

38 For a discussion about London's CO_2 emission reduction policies, see paper presented at the 45th ISOCARP congress. Judith Ryser & Teresa Franchini (2009). 'Toward Low Carbon Cities: Madrid and London'.

39 Three sets of monitoring data over six years of occupation indicate a 50-65% reduction in private car fossil fuel miles travelled compared to the local average. Just 17% of residents travel to work by car, against the local average of 42%. Residents' air travel however does add to their environmental impact (BRE 2002. tinyutl.com/5sgg2 - BioRegional www.bioregional.com.

40 as opposed to 1 tonne per capital per annum, corresponding to sustainable living. UK CO_2 emissions (average) were 9.4t/cap in 2006 (source UN Statistics Division calculated by US Department of Energy).

41 Part of the statutory development plan of the local authority.

42 See case study on environmentalism in Manuel Castells' Communication Power (2009). Oxford University Press.

Trevor Graham

Malmö, Sweden: Towards the Sustainable City

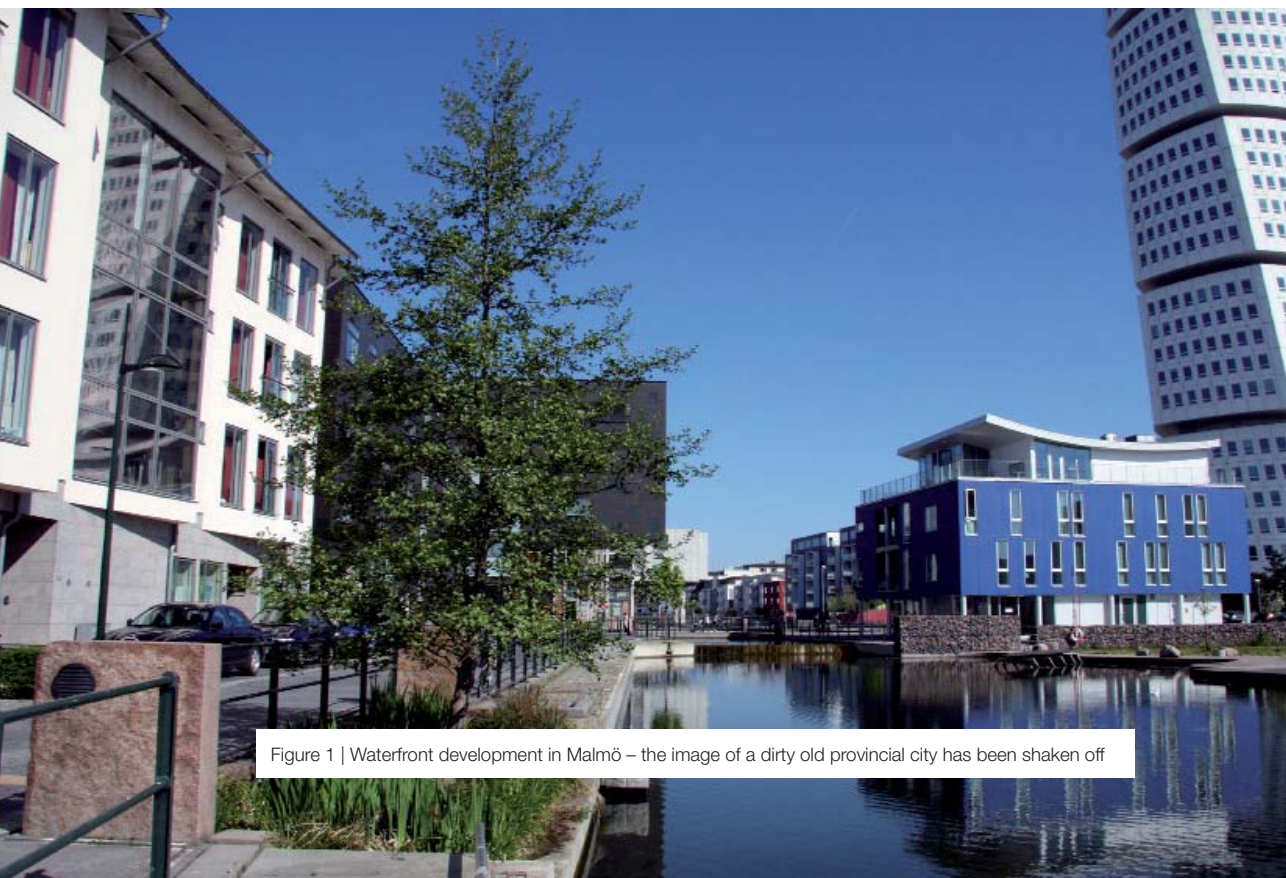

Figure 1 | Waterfront development in Malmö – the image of a dirty old provincial city has been shaken off

The story of Malmö is in many ways similar to the rise and fall and rise again of many industrial cities in Europe whose economies flourished in the booms of the 20th century only to go bust as industry moved out wholesale to South East Asia. The rebirth of Malmö has certainly been among the more dramatic, but perhaps the defining feature of Malmö's renaissance has been its early work to incorporate a holistic sustainability approach to its redevelopment.

Twenty years ago a Swedish joke was that the best thing about Malmö was its proximity to Copenhagen. But a lot has happened since the late 1980s when the shipyards and textiles industries closed and 25,000 jobs were lost almost overnight. Sweden joined the EU in the early 1990s, Malmö established its university in the late 1990s as the first step towards embracing the knowledge economy, and the bridge to Copenhagen opened in 2000. With a huge influx of refugees from Eastern Europe, the Balkans and Somalia also joining the already large immigrant groups from the Middle East, the city was suddenly transformed into a cultural melting pot in the middle of a dynamic cross-border region enjoying some of the most rapid growth in Europe and one of the few healthy demographic pyramids in Scandinavia.

The roots of the sustainability commitment are hard to trace in full, but are linked closely to Swedish politics, and also to a large extent to the timing of Malmö's decline at the end of the 1980s. This had coincided with Sweden being badly hit by acid rain laden winds from the Ruhr and Yorkshire, mass seal death in the Baltic Sea, and a huge rekindling of environmental interest. The Rio Summit in 1992 also highlighted for the first time the importance of local government in tackling the sustainability challenge, not least in view of the strong links between environmental and social issues. As Malmö went through visioning exercises to rebrand and recreate itself, shaking off the image of a dirty old provincial town, there was a clear role for environmental improvements at a very immediate level, and also with an eye on addressing global environmental issues.

A huge programme to regenerate the city centre got under way, with a focus on creating space for people and reducing space for cars. This has led to the emergence of a vibrant city centre with cobbled streets, large pedestrianised areas, and, as soon as the sun appears, hundreds of people sitting outside the cafés and bars.

The bus fleet moved from running on diesel to natural gas, and a shift is now under way from natural gas to biogas – sourced from the organic waste of the city. Public transport use increased by 12 per cent last year. A huge programme of cycleway development has led to 40 per cent of all journeys in Malmö taking place by bike, and one of the latest challenges is finding more efficient large-scale cycle-parking facilities. The municipal vehicle fleet operates almost entirely on biofuels, and many business fleets in the city have followed suit. The result is a massive improvement in air quality, a reduction in emissions and, it is hoped, over time an improvement in public health.

Sustainable urban Development Benchmarks

When Malmö bid to host a national Swedish Housing Expo, its initial submission was for Malmö as a 'Sustainable City of Tomorrow'. At the same time planning was under way for the regeneration of the post-war Augustenborg housing estate, which had fallen on hard times, and where environmental and social measures were to go hand in hand. Together, these two projects have become international benchmarks for sustainable urban development.

The Augustenborg neighbourhood was the pride of Swedish urban planning in the 1950s when the first residents moved from inner city slums into affordable homes with hot water, toilets, fridges and bedrooms. A brochure from 1952 boasts that the boiler for the local district heating system burned 5tonnes of coal an hour. The neighbourhood was initially renowned for its well planned homes and streets with abundant commu-

nity facilities, small shops and work places. But it soon became known for street fights with rockers from other neighbourhoods, and eventually slipped off the radar in the usual downward spiral of poor reputation, empty apartments and social problems.

In the 1990s the city-owned MKB housing company turned its business around by focusing on socio-economic development in its neighbourhoods, and, together with the manager of the industrial estate in Augustenborg, it started drawing up plans for sustainable regeneration of the whole of Augustenborg, with its school, industrial estate, classic 1950s square and tired shops, and 1,800 homes. As the city mobilised, the Government launched a funding programme for sustainable development, and in 1997 Malmö won a bid for about £1.8million for Augustenborg, and the ball started rolling.

The initial focus was very much on process – on getting local people on board, listening to their ideas, worries and hopes, finding the local movers for change, and then starting to make the first changes. A couple of local people had started an Agenda 21 group that worked with the employment agency to get local unemployed people working on short-term contracts to develop ideas for the neighbourhood. They set up the pilot recycling programme, listened to the concerns of other residents, and worked with them to write the design brief for the recycling houses with recycling and composting facilities and develop a community information programme that could reach every household.

It was discovered that one local man who was playing around with water in his spare time in a cellar in Augustenborg was actually doing some quite radical practical research into how the movement of water could be used in different ways. He set up his own business and started working as a design consultant with the City Council and built the forms to cast the first sections of one of the world's most groundbreaking stormwater systems.

The residents' association from one part of the neighbourhood was keen to get started with renewing their common outdoor area; visioning exercises with local people and businesses started throwing out ideas about community car pools, co-operative businesses and renewable energy; and suddenly one of the most ambitious sustainable regeneration programmes was taking place.

The result was a massive turn-around in the first five years. The flooding problems of the 1990s were solved by green roofs and open stormwater systems that filled the neighbourhood with channels and ponds and wildlife. This kick-started the Swedish green roof industry and put climate adaptation on the map. The recycling system collected 70 per cent of the neighbourhood's waste for recycling and composting in the local recycling houses, one of which, located in the school, had been built by the kids out of clay and straw. Façade renewal reinstated the original appearance of a number of buildings while also reducing energy use by 35 per cent, and improvements to the district heating system cut a further 20 per cent from energy bills. The electric street trains had rolled in public service for a number of years but had not found a commercial future and were sold off, but the community car pool, designed by local people, was going strong. Green space, school grounds and park renewal had created a much more attractive outdoor environment.

About 50 people had come through the project directly into other jobs, and unemployment was on its way down. A newly established youth organisation was going from strength to strength, getting local youngsters involved in the community and healing some of the wounds from the Balkans conflict that were then still open, and lots of other community activity was under way – not least through 'Augustenborg's Day', which saw the local community putting on (almost) annual festivals, initially for the local community, but increasingly to show off the neighbourhood to people from outside. Voter turn-out increased from 53 per cent in the elections of 1998 to 79 per cent in 2002

Figure 2 | Augustenborg – environmental and social regeneration have gone hand in hand

– an unprecedented rise in the city. And the media was full of positive images of the neighbourhood, and local people were still excited to see groups of English-speaking strangers being taken around to study the neighbourhood.

Meanwhile, in the Western Harbour area another sustainable renewal process had been started. The first phase of the redevelopment of the industrial wastelands around the old shipyards had got under way in 1999, with a consensus quality programme agreed by developers, utility providers and the City Council underpinning the concept of creating the 'Sustainable City of Tomorrow'. Phase one was due to be ready in time for the Housing Expo Bo01 in 2001, and the race was on. The quality programme demanded the use of named architects, approved by the city but then given few restrictions in an attempt to create a diversity of design. Development plots were unusually small, again to break the monotony of many newly built areas, and a radical urban plan, inspired by organic medieval cities, created the base for a diverse urban environment.

A maximum energy allowance for heat, hot water and electricity was put at 105kilowatts per square metre in order to enable the energy utility Eon to build a 100 per cent locally renewable energy system which 'breathes' with the other energy infrastructure in the city – exporting energy at times, and importing at other times, in order to match supply with demand over the course of the year. Heat comes from the sun (12 per cent) and from heat pumps extracting energy from the sea and from the aquifer, essentially a large underground water store. In the winter the waste product of the system is cold water, which is stored in the cold aquifer for district cooling in offices in the summer – the waste product of which is warm water, which can then be stored for heating in the winter. All the electricity is provided by wind power.

The green space implemented in the

Figure 2 | Housing in Augustenborg

neighbourhood helped to create a new benchmark and a new urban aesthetic, with open water, green roofs and reedbeds becoming commonplace – inspired in part by Augustenborg. Narrow winding streets, varied building heights and designs and a high-quality public realm, leading through to a dramatic seafront promenade with views to Copenhagen, make this an area of contrasts that have proved appealing to professionals from across the globe, as well as to the residents of the city. On summer afternoons you can hardly find a spot to lay out a towel among the bathers and sunworshippers on the waterfront. The 190metre Turning Torso skyscraper, designed by Santiago Calatrava and towering over the neighbourhood, has replaced the shipyard crane as the symbol of the new Malmö.

In many ways this may all sound too good to be true, and in some ways the city has been struggling to take the next step in the big shoes that it suddenly finds itself in. It has been working to move from pilot to mainstream, taking lessons learnt and finding ways to establish them as the norm. From a process that was very much pushed by the public sector ten years ago, the city is now in a dramatically new situation.

In the latest phase of the Western Harbour, the developers worked together in a shared planning process with a lesser number of quality targets, and less ambitious targets, but still some developers have gone on to construct multi-family passive houses, far outstripping the energy performance of the first phase. In another new development south of the city at Hyllie, developers are demanding lower parking requirements, owing to the proximity to a new rail link to Malmö and Copenhagen city centres, and insisting that car pools are more interesting in the sustainable neighbourhood of tomorrow. Cutting energy use by 30 per cent or more is no longer seen as an insurmountable challenge, and Malmö's new

sustainable building programme has been warmly welcomed by the private sector. The next phase of the Western Harbour is going to be more ambitious than ever.

The Challenges of Mainstreaming

The challenges of much of the old city, however, have still not reached the mainstreaming stage, although the next major steps towards sustainable renewal are now being developed for a swathe of the south and east of the city that is dominated by tower block estates with pockets of severe socio-economic hardship. Hard-nosed property development thinking and community initiatives are starting to link up in new ways. However, it remains to be seen whether social exclusion, ethnic divides and the sort of discontent that sees bricks hurled at fire engines can be consigned to the history books.

There are certainly huge challenges ahead. But the work in the Western Harbour and Augustenborg have kick-started a new way of thinking in the city, in which environment, economy and social inclusion are being seen as intricately interlinked in a way that few could have imagined 15 years ago. The City Council's budget is all about sustainable development; the economic development strategy is focusing on clean technologies; and environmental thinking is making good business sense.

Solar City Malmö – a non-profit partnership to increase the use of solar energy in Malmö – has taken up the solar energy challenge, and Malmö is now the leading city in Scandinavia in solar energy production, and revolutionary new technologies are being developed and tested in the city. Malmö is moving ahead with wind power too. Already a commercial off-shore windfarm is generating the equivalent of 40 per cent of domestic electricity demand, and the City Council is in the process of erecting the first 6megawatt turbine, and is preparing to become 100 per cent renewable in energy use in all council buildings by slashing consumption by 50 per cent and building its own generation capacity by 2020.

Increasingly, 100 per cent isn't enough. We need to look at doing more, creating duel functions and multiple benefits to meet the sustainability challenge. 'Plus energy' buildings, generating more power then they use, are what we need. Similarly, our target of 100 per cent organic school meals by 2012 isn't good enough; we need the kids to get their parents to convert to organic food at home too. And we must start looking at the multi-functional role of the urban fringes in terms of the services they can provide to the city (in terms of high-quality food, recreation, stormwater management, biodiversity, energy crops etc.). The new public rail transport system and planned tram system should speed up the modal shift in the city, but will not solve all the problems in themselves, and the focus on creating a more compact city is starting to raise questions about prime development space that is currently dedicated to cars but which could be used to help to create multi-functional communities.

In other words, the sustainability challenge has only just started, and for every solution, a new question arises. But the exciting reality is that those questions are now being considered and addressed in completely new ways. •

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Planning and Design for Low Carbon Development in a Sensitive Landscape

A Douro Valley setting for the YPP Workshop

Preamble

Selecting the Douro Valley as the location of the Young Planning Professionals (YPP) workshop posed a challenge. Given the remoteness of this area, its low population densities and its corresponding low carbon emissions, and also its outstanding landscape, this was perhaps not the most obvious place as the location for a discussion about low carbon cities. But in other respects, this is a good location for such a brainstorm. The potential advantage is the innovative planning approach provided by the YPP Workshop, with its branding potential for the region. For ISOCARP the exercise provides an input to the Society's growing knowledge about energy resources issues and sustainable spatial planning.

by courtesy of C.M. Alijó

Figure 1 | Population map of Portugal and Douro Region.
Source: Danko and Lourenço, 2008a

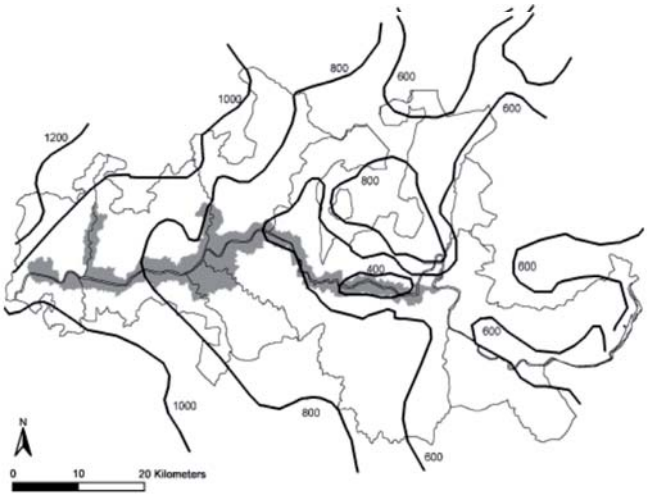

Figure 2 | Douro Valley: Precipitation Map, municipal boundaries and World Heritage area.
Source: Andresen et al., 2004

The Douro Region – Morphology and Territory Development

The complicated topography of the Douro Valley is at the heart of the considerable variations in climate conditions across the region and throughout the year. Those variations can be quite extreme (severe droughts and frequent flooding) and microclimate areas can be identified, pertaining to the differences in sun exposure and wind direction associate with the distinct morphological features of the terrain (Danko and Lourenço, 2008b).

The climate in Douro Demarcated Region is chiefly Mediterranean. Rainfall ranges from 1000 mm per annum in the more Atlantic regions of the west to 400 mm, or less, as one travels eastwards. At first sight this may not appear as little rainfall overall, but rain is scarce for long periods of time, particularly in the summer, from May to September.

The relief in the Douro Demarcated Region is formed by steep hills and steeply enclosed valleys that flatten out into plateaus above 400 m. The valley of the River Douro forms the back-bone of this landscape. The reservoirs behind its dams act as immense mirrors that continuously reflect the hills and the ever-changing sky, displaying a natural grandiose panorama. The tributaries of the Douro flow through even narrower valleys whose steeply rising riverbanks make one feel as if one were perched on the brink of an abyss.

The Douro River has been an important means of communication and transport for the region´s products, especially wine later designated as Port wine, and until the beginning of the 20th century it was the region´s only means of access. To maintain the navigability of the Douro River, the five dams which were built within the Portuguese section of the river since the 1970s had each a lock that can take large vessels (length: 83 m, beam: 11.40 m, and draft: 3,8 m, and carrying capacity up to 2500 tons). This decision to allow naviga-

by courtesy of Estrutura de Missão do Douro

tion in the river had been taken in the forties, at the time of the first dams being built in Douro. The Carrapatelo dam, a hydroelectric development built in 1971, has one of the highest locks in the world, with a rise of 35 m. It was the first of its type to be built in Portugal and in its grandeur also represents a landmark in the history of navigation on the Douro (edp, 2008). It was followed by Régua (1973), Valeira (1976), Pocinho (1983) and Crestuma / Lever (1985), which have locks with rises of 28 m, 32.5 m, 22 m, and 14.10 m, respectively. Each of the locks represents a critical step in the ´stairway of water´ that makes navigation possible between Porto and Barca de Alva, near the border with Spain, covering a total length of 210 km. Once the whole course of Douro river within Portuguese territory became navigable, in the 1980s, it was opened up for the use of leisure craft. Since then their number has been rapidly increasing, which is a sign both of the development of tourism and leisure services and the transformation of the Douro River. It is now a highway for leisure trips and also a reliable gateway, as compared to past times, for the export of various products from the Douro´s region, particularly granite, thus making a positive contribution to the national economy and to the environment. This latter contribution derives from the promotion of a greener mode of transportation – water as opposed to roads - and also from hydro power - a highly productive source of renewable energy.

In the Douro Valley, the landscape is the main tourist attraction and it was the reason for the UNESCO World Heritage nomination (CED, 2008). The unique character of the landscape, stemming from a combination of natural and human influences, already internationally recognized in the late eighties, fostered in 1998 the studies that led to its listing in the UNESCO Word Heritage Sites as an ‘evolved continuing cultural

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landscape' in 2001. These studies determined the selection of the most representative area within the Douro Demarcated Region; about 10% of the total area and later entitled Alto Douro Wine Region. This selected area can also be considered as a greenway, both for its content in terms of its natural and cultural values. The greenway concept when applied to the whole Douro Demarcated Region becomes a strong and very effective landscape planning tool. (Andresen et al., 2004). Furthermore, it is the landscape together with the edapho-climatic conditions and the particular soil constitution that are responsible for the Douro Valley´s competitive advantage in wine production.

In reality, the region's unique natural and cultural heritage is intimately linked to the agro-forestry uses of the land. Three main trends have been observed for rural development in Douro:

(1) The complementarities between agricultural, forestry and tourism uses;
(2) The overall decline of the agro-forestry uses, except for vineyards;
(3) The expansion of disused land, arising from losses due to forest fires (Lourenço et al, 2008).

For their part, the areas taken up by urban uses are expanding, albeit from a relatively small base. This has been most pronounced in existing urban areas, especially in Vila Real town. One of the possible reasons, apart from the upgrading of infrastructure and social facilities of this capital city of the northern interior area, stems from the strategic planning approach that has been applied to urban settlements in Portugal.

The map below shows the nodes of the Portuguese urban system and the links to gateway cities. This approach was de-

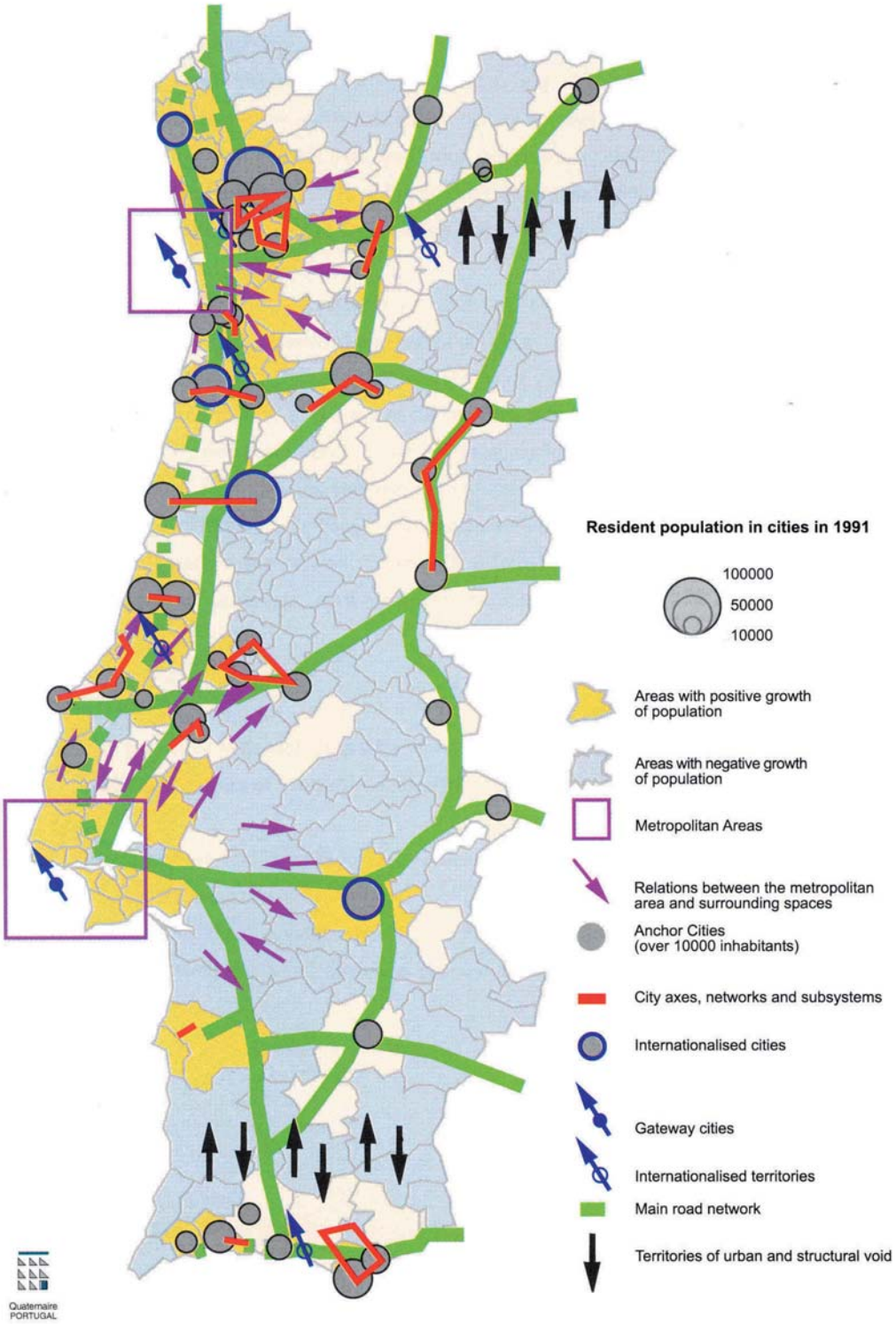

Figure 3 | The Portuguese Urban System – a strategic approach in 1991.
Source: DGOTDU, 2002

Figure 4 | Douro and Alto Trás-os-Montes subregions.
Source: Danko and Lourenço, 2008b

signed at a time of underdeveloped infrastructure and poor access to specialized networking which hindered the desired interconnectivity among the nodes. In fact, for decades, infrastructure development had been lagging behind in the axis Vila Real / Régua / Lamego due to the high costs of building a motor way in a topographically constrained territory and in costly land, bearing in mind that this is a Port wine production area. The idea behind the approach was to discuss how medium-sized cities can network effectively in order to attract population and activities, in a globalizing society where the metropolitan urban regions keep growing, often within a pattern of urban sprawl, and where national governments maintain the dominance of sector planning over comprehensive regional planning.

This approach was first introduced at the end of the 1980s. It found expression in in the Regional Plan for Douro Valley Land (PROZED) approved in 1991 that for the first time assumed the need to develop three key towns as a major anchor in the interior of northern Portugal. Afterwards, through funding programmes such as PROSIURB and POLIS, the axis Vila Real / Régua / Lamego began to take shape. These three towns and corresponding municipalities joined with other neighbour municipalities giving rise to a new urban community (DOURO).

The present Portuguese territorial model was achieved through a process in which the municipalities decided where to fit in, after discussing among themselves where to belong and how to relate to the municipalities with which they were once associated. Despite the bottom up approach, there were clear splits that emerged in the process.The decision to launch the axis was heavily criticised and, as can be well imagined, contested by the other three municipalities which had political-administrative power in the same region (Trás-os-Montes and Alto Douro) or the major neighbour

towns but all of them located 60 Km further away. They could perceive and consequently fear the threat of concentration of resources (Lourenço, 2004). For about fifteen years, this idea remained essentially a planning concept and it was only, in 2003, that the axis Vila Real / Régua / Lamego took political administrative shape.

For the first time, in 2008, it adopted the brand name "Douro Alliance". Naturally, the situation took time to evolve, as fostering the attractiveness of medium-sized towns can be a time lengthy process. The eventual change was quite a distinctive one , from a former concentration of facilities in Vila Real to the spreading of technical support facilities among the three cities. The same reasoning applies to the Douro Mission technical office recently located in Régua.

Socio-Economic Trends in the Douro Valley

According to the latest census update (INE, 2008), the region accounted for approximately 4.1% of the total population of the Country. This is considered a sparsely populated area, with a mere 43 inhabitants per km^2, well below the national average of 115 inhabitants per km^2. Historically, population numbers have been gradually declining for the entire Northeastern region (INE, 2008). This population decline is related to several local factors, particularly migration in search of better employment opportunities, towards the more developed coastal areas (the Portuguese Northwest has actually recorded an increase in total population numbers) or even abroad. Local employment and unemployment trends are directly related to the effects of globalisation (CCDRN, 2007). Unemployment rates in 2006 for the region were fairly high, at 4.49% on average, when the national average was approximately 4.03% (IEFP, 2008; INE, 2008).

Nevertheless, the region remains amongst the poorest in the Country. Its contribution to the national gross domestic product (GDP) has consistently been approximately 3% (INE, 2008). Exports from the Northern region of Portugal concern mainly those of industrial origin, corresponding to the strong presence of the secondary sector in the region (CCDRN, 2007). The coastal/interior imbalance could not be plainer. Interestingly enough, these apparently low figures do not seem to agree with the Douro's reputation as being s strong player in global trading and exports. Actually, many of the multinational companies devoted to producing and trading Douro's exports (e.g., Port wine) have their headquarters in the coastal cities of Vila Nova de Gaia and Porto. Ultimately, any financial transactions concerning these trades are reported based on these locations and not on the production sites. Therefore, transactions and trading in Douro, for these particular products, are no more than a few local sales at the farms where they are produced and thus, have very little or no expression in terms of global results.

Primary activities contribute significantly to the national agricultural sector in the form of high quality products, including wine, olive oil, dried fruits and fresh fruits. This is an essentially rural area, where agricultural activities contribute much more than just meeting local food demands; they also affect the dynamics of other sectoral activities such as tourism, handcrafts, gastronomy and agro-related industry. Landscape, agro-ecosystems and environmental features are also significantly impacted by agriculture (Melo and Lima, 2000). However and since the 1990s, agriculture has steadily decreased (despite an increase in land productivity), accompanied by an overall reduction of arable land and increase in forestry and non-cultivated uses. The simultaneous increase in animal-farming and dairy productivity has not been able to offset the decline of the primary sector. Population decline and the aging of farmers may underlie this trend. They may also deter further investment, potentially jeopardising productive systems (Melo and Lima, 2000). By contrast, vineyard farming has seen an increase in Douro (Lourenço et al., 2008).

CO_2 Emissions in the Douro Valley

Studies on carbon emissions are the latest addition to the range of research topics undertaken on Douro Valley. This environmental awakening in respect of greenhouse gas emissions has been further enhanced by the close association with ISOCARP's 2009 Congress on Low Carbon Cities.

As is described in an earlier essay, since 1990 there has been evidence pointing to the increase in the areas devoted to urban uses, and vineyards but also regarding deforestation and the area lost to forest fires (CCDRN, 2007; Lourenço et al., 2008). Regional development has also taken into account the need to protect and promote the natural heritage. Over 40% of the northern areas of Portugal are covered by natural protection programmes such as the National Ecological Reserve (REN, Reserva Ecológica Nacional, 2000) and the Natura 2000 Network (CCDRN, 2007). As a consequence of these land shifts, intensified motor traffic, increased tourism flows and major forest fires, the carbon balance in the Douro Valley is showing a trend towards the increase of carbon emissions.

Considering that in 2008 , the World Centre of Excellence for Destinations (CED) awarded an excellence rating to the environment and landscape characteristics of the Douro Valley, these unique attributes have to be looked after. These tourism experts further suggested a Green Plan for the Region in order to improve further its environmental conditions. They found that there is no information available to the tourism industry concerning measures to offset the carbon footprint generated by tourism, the means of getting to the destination, as well as energy used once there (CED, 2008).

In this context, therefore, the Young Planning Professionals Workshop that is to take place in the village of Pinhão - in the municipality of Alijó - offers the setting for a very relevant contact with the region in terms of energy efficiency, low carbon footprint, renewable energies and sustainable urban development.

Planning Energy in a Sustainable Spatial Environment - What Do You Need to Create the Sustainable Energy Landscape of the 21st Century?

ISOCARP's Young Planning Professionals (YPP) Programme was set up in 1991 with the aim of bringing together young professional urban planners from all parts of the world to work in closely knit teams on real-life planning and design exercises. These Workshops that are associated with ISOCARP's annual congress have proved immensely popular. The 2009 Workshop focuses on the Douro. It addresses the role and potential benefits of using sustainable energy in the built up areas in Douro Region, the world´s oldest controlled wine production region, nowadays listed as world heritage area.

The YPP Workshop is structured on three specific themes:

(1) Strategies for reducing CO_2 emissions and combining sustainable energy use (mainly wind, but also photovoltaic, biomass, hydro and other renewable sources);

(2) Spatial planning and urban design towards the energy sustainable city, within pre-set scenarios applying the principles of concentration, diversity and association;

(3) Protection of landscape and environmental considerations within pre-set scenarios of more or less intensive wind energy use.

The questions addressed in the Workshops arose from the urgent need to understand how renewable forms of energy installation, which are generally prominent to varying degrees, would fit in the landscapes of our times. This leads to the discussion about how to position energy plants, photovoltaic and solar power, electricity pylons and wind turbines.

Energy is the theme that connects a more efficient use of sustainable resources and spatial strategies. It also connects the existence of the low carbon city and its surrounding space: a landscape with multiple

uses of space where wind turbines and other energy installations can be highly visible.

The goal to create a energy landscape in this world heritage area, is a befitting challenge. Hydroelectric power, is an existing important energy source which shows one way forward. Of the newer alternatives, wind will provide the main vector but, for a variety of reasons, it is not suitable throughout the whole region, due to the landform, agricultural interests and the need to protect classic landscapes.

The main aims and the expected outcomes of the exercise pointed at defining criteria and principles for a good (urban) design for each of the three macro scenarios for wind and other forms of renewable energy in the context of the specific interests and qualities of the Douro region.

The following six scenarios were designed, to be pursued by twenty four young professionals whose age ranged between 26 and 33 years.

Three micro scenarios are next described as they set the macro examples from wind and urban design attributes that will then be specified accordingly into Douro and Pinhão characteristics.

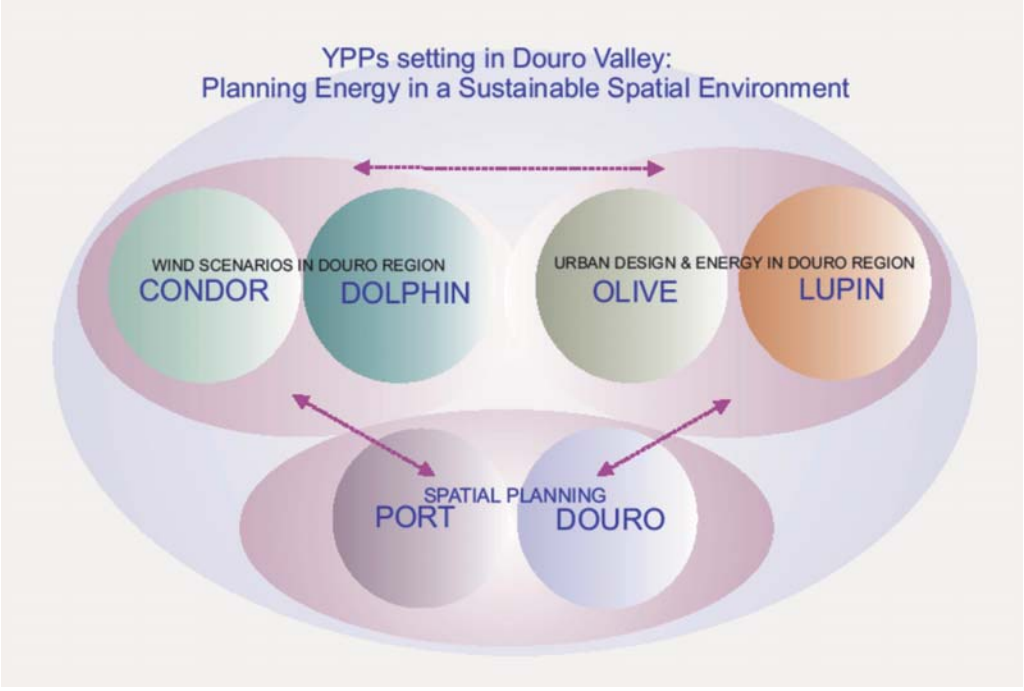

Figure 5 | Scenarios diagram for YPP Workshop.

• CONDOR (endangered species)
Large concentrations of wind energy in open landscapes.

This scenario aimed at achieving the goals of sustainability for energy resources while preserving t the quality of the existing landscape. That might require the designation of large areas where wind turbines would be excluded coupled with concentrations of them in one or more wind parks. Such a scenario opens the question: which other renewable sources are possible and which smart combinations and solutions can co-exist with wind energy as local power sources. For low carbon cities, the generation of sustainable energy has to take place close to its users. For wind energy this means great concentrations in the open transitional spaces between cities and open land. Important to these open landscapes is the protection of their values, particularly their scale, openness, uniqueness and cultural history.

• DOLPHIN (social, intelligent animal)
Complete intertwining of wind energy in and next to the built- up areas and cities.

This scenario aimed at achieving the goals of sustainability for energy resources, under the condition of a decentralised allocation of wind energy and other forms of renewable energy. The consequences for the urban design of an area, taking into account its local qualities and interests was a major factor. Any large scale application of wind energy could be expected to involve considerable design innovation. .

• LUPIN (the organic solution)
Combining spatial functions with wind energy.

The challenge in this scenario was to explore the suitability of wind and photovoltaic energy in the context of more energy intensive forms of land use and spatial functions. Examples are industrial and harbour areas, and areas with large-scale infrastructure or agricultural use. The aim was to achieve the goals of sustainability for energy resources by making optimal use of a combination of large wind turbines, other forms of renewable energy and suitable functions and land use. It was considered especially relevant to explore the combination in the context of the major urban axis Villa Real / Régua / Lamego having regard to the World Heritage designation.

• OLIVE (the fruit coming from centennial trees)
This scenario was to consider the detailed implications of the pursuit of more sustainable energy consumption for detailed urban design. How might this fruit from the designers and city planners bring such ideas and thoughts into reality? And in the urban setting, how might this approach embrace solar energy, on the one hand and wind on the other?

• PORT (for brand) and DOURO (the local context)
This scenario was a combination of two different flavours. It also means that sharing knowledge and experience of one city could be very much important to develop another region too. This is also a comprehensive approach for a sustainable planning in the cities. The cutting edge technologies will be helpful for the society to adopt the comprehensive planning approaches to get the best benefit of it. It is a better functional description of what goes on within the spatial economy, by capturing the production processes that must be planned for in near future in each and every city of the world.

by courtesy of Estrutura de Missão do Douro

Concluding Remarks

The fact that Douro Valley is a designated part of the World Heritage List justly acknowledges the value of a collective work of art that was tailored by successive generations, while simultaneously reinforcing the need to conserve and enhance this cultural landscape. The area is also very important for the Portuguese economy and cultural heritage as shown in this paper. The importance of this area in nature conservation terms is becoming increasingly well known as is the fact that it is the producer of one of Portugal´s main exports – Port wine.

Considering all these aspects, as well as the increasing emissions of CO_2 faced by the region, it was intended that the YPP Workshop should help foster an increasing awareness of the issues involved, leading to carbon footprint studies of the region. The YPP's outcomes, and in particular those for Pinhão, at the "heart" of the demarcated wine region where the workshop took place, should provide an input to sustainable city development guidelines for energy planning. This is a cutting edge issue to be considered for applied research and study in many other regions and cities worldwide. In practical terms, the outcomes of such research could assist many countries with their management and conservation of energy resources and in terms of the large scale initiatives that they and their cities will need to pursue to accommodate renewable energy. Such plans will need to be pursued sensitively to avoid damaging important landscape, natural and cultural interests.

Acknowledgements

The 2009 YPP event was a jointly organized Workshop, the main partners being: ISOCARP, Centre for Territory, Environment and Construction / University of Minho, Faculty of Engineering of Porto University, Trás-os-Montes University, Douro Mission Structure / CCDR-N, Municipality of Alijó and the Dutch Ministry of Housing, Spatial Planning and the Environment (VROM).

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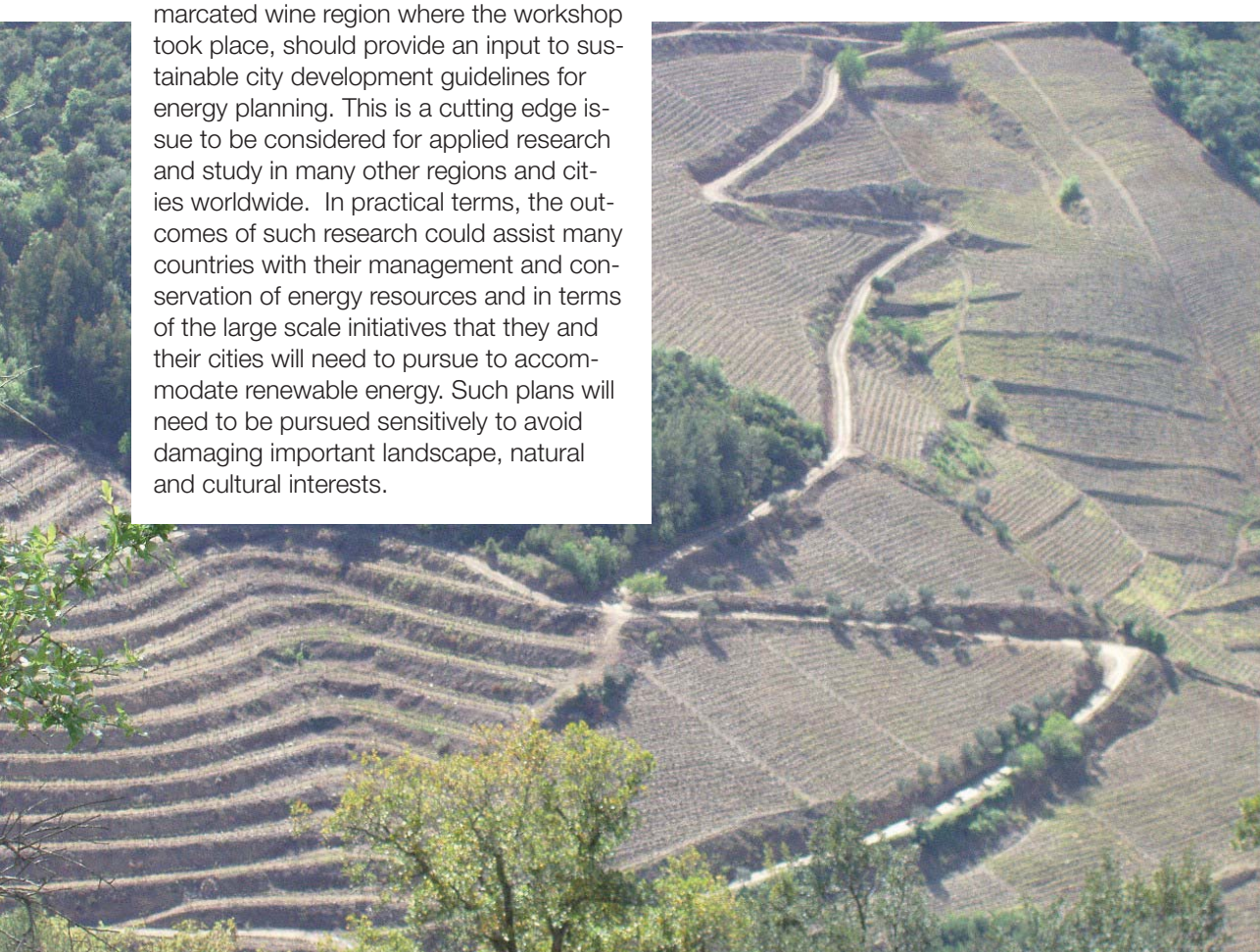

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Comparative Study of National Responses to Climate Change

Introduction

One of the main strengths of ISOCARP is that it is a truly global association of planners with some 80 countries now represented. This provides a powerful knowledge base regarding the theory and practice of planning world wide, knowledge that is disseminated and shared at Annual Congresses and other events and through the Society's publications. ISOCARP's international network has also facilitated the assembly of comparative material about the world's planning systems. Thus, in 1989 the Society published its first edition of the International Manual of Planning Practice (IMPP) and this has since been updated and expanded several times. The most recent and most ambitious version was published in 2008.

Over the last two years, ISOCARP has turned its attention to what is seemingly the most difficult environmental issue that we face, that of climate change, and this has led to the choice of low carbon cities as the theme for its 2009 Porto Congress. In parallel with that decision, the Society resolved to carry out a further comparative study, this time asking its members to chart the policy course being followed by their own countries in response to climate change. The aim was to have the findings of the comparative study ready for publication in time for the Porto Congress.

This exercise took the form of a questionnaire which was sent to the heads of ISOCARP's national delegations (ND). Its purpose was to obtain information about the role of spatial planning in the shaping or maintenance of low carbon cities. However, it was also thought important to understand the overall national position regarding climate change and energy resources, as this should provide the context for spatial planning at any particular level.

Thus the questionnaire was in two sections, the first of which (Section 1) sought information on the strategic and policy context for any action programs being run, especially any involving spatial planning. The questions tackle five areas, including the nation-

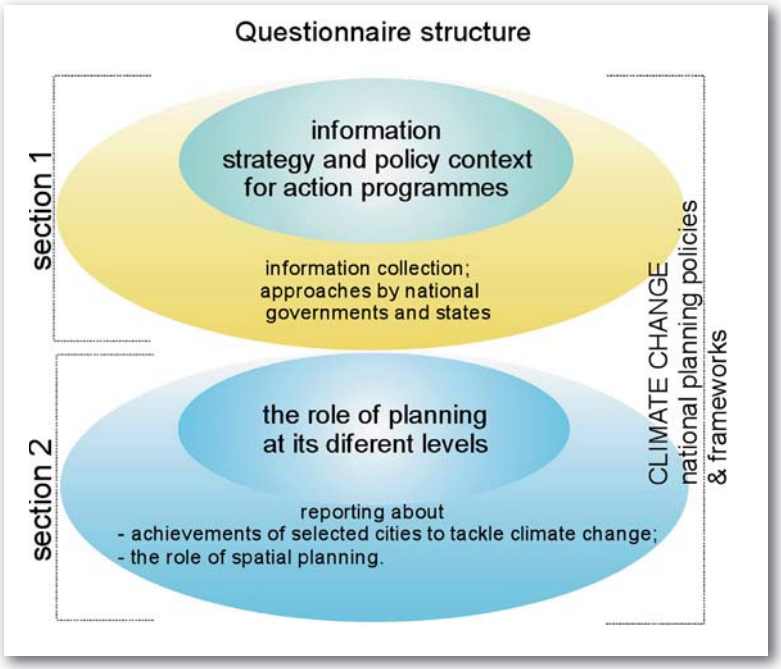
al stance taken on the need for action, the possible role of targets at national and more local levels, and special challenges faced by the country, for example, acute dependence on fossil fuels or rises in sea level. The other two topics address the range of policies adopted by the country and the question of definitions.

The two Section 2 questions focus on the role of planning at its various levels. The first of these requests information on the setting of national planning policies or frameworks aimed at tackling climate change, for example in terms of housing density or the pursuit of mixed use development. The second question invites respondents to provide information about the practical achievements of specific cities in tackling climate change, and about the role of spatial planning in this. Spatial planning is taken as anything that has a bearing on land use and the density, layout and essential functioning of our cities, for example transport, energy, and waste/recycling infrastructure.

This final question on the cities is an especially important one which relates most directly to the Porto Congress. There is a general acceptance that solutions at the level of the world's cities will play an essential role in global strategies to reduce greenhouse gas emissions, the primary underlying factor in climate change. So, a particular aim of the comparative study has been to seek practical examples of what is being done at the city and neighbourhood levels.

In the end, responses were received from a total of 26 countries, about one third of the total represented in ISOCARP. Given the complexity and, for many members, the unfamiliarity of the issues, this was a good result which was in line with our expectations. We present the responses in two forms. First, in what follows next we analyse each of the individual questions, across the range of countries that responded. Secondly, summaries of the individual national responses are presented in CD form (see inside the back cover).

On behalf of ISOCARP, we express our gratitude to all those who took part in this valuable exercise which has provided much useful information.



Countries Overview

Most of the questionnaire responses refer to the Kyoto Protocol which continues to be regarded as the most serious international effort to deal with climate change. As at February 2009, 183 states have signed and ratified this international agreement linked to the United Nations Framework Convention on Climate Change and aiming at combating global warming. It was initially adopted for use on 11 December 1997 and entered into force on 16 February 2005. Under the Kyoto Protocol, industrialized countries agreed to reduce their collective greenhouse gas (GHG) emissions by 5.2% from the level in 1990, in the period 2008-2012, while the reduction in GHG in Europe was set at an overall level of 8%.

Green = signed and ratified;
Red = signed, ratification declined;
Grey = no position.

The Kyoto mechanisms are emissions trading – known as “the carbon market”, the Clean Development Mechanism (CDM) and the Joint Implementation (JI).

There is practically unanimity among the 26 National Delegations (NDs) of ISOCARP that answered the survey on stating that their countries recognize the need to tackle climate change. In respect of Libya it is reasoned that a low population density and lack of relevant sources of carbon pollution make this a more relevant issue for other countries.

Nevertheless, this widespread recognition can vary from a vague or more committed awareness, to different levels of policy making through the negotiation and signing of agreements and, in just a few countries, promoting actions that have already contributed to the reduction of GHG emissions. A clear distinction between countries should be introduced at this point: at one extreme, the net emitters, corresponding mostly to developed countries, and the receivers of the effects which belong to the other extreme of the development ladder.

In the first case, the European countries stand out with their early signing of international protocols such as the United Nations Framework on Climate Change and the Kyoto Protocol, and there is a clear trend for most European Union (EU) delegations to mention the European Energy and Climate Package in their answers. There are some exceptions. Thus France concentrates on national legislation and technical studies. For its part, Poland, a relatively new Member State, responds that the public debate on climate change issues has been focused on emissions trade negotiations within the EU.

In the second case, proactive receivers of the effects like Bangladesh have already established Designated National Authorities and some interim sustainable development criteria for the evaluation of Clean Development Mechanisms.

The NDs for Brazil and Nigeria describe their countries as being both emitters and receivers, the matters needing to be tackled being deforestation and oil extraction practices, respectively. But they also refer to their sub-standard national development indexes as supporting lesser responsibilities compared to those of the more developed countries. The Uruguay delegation reports upon some NGO initiatives, but these have no funding support, while the country's construction sector proposes some eco developments.

While twenty of the NDs indicated that their countries had targets aimed at reductions of carbon emissions by 2025, in most cases these were quite unspecific. In the main, those that are set tend to address mainly the different sectors of the economy. For their part, several European countries (for example The Netherlands and the United Kingdom) have set specific targets in respect of renewable energy.

Special Challenges

More than 3000 cities have been identified by the UN HABITAT report State of the World's Cities 2008/09 as facing the prospect of sea level rise and surge-induced flooding. In order to avoid this and other risks of dangerous climate change, global GHG emissions should peak within the next fifteen years but should be halved relative to 1990 by 2050, and then decline to less than 10 Gigatonnes (GT) of emissions (1 tonne per capita).

This challenge requires global action to sustain growth against the risks of climate change. Among the countries that face acute risks due to sea level rise are The Netherlands, Nigeria and Bangladesh. They are all densely populated, low-lying coastal countries with large river deltas. Furthermore, the Randstad, the heart of the Dutch economy, is largely situated below sea level.

In the Niger Delta, it is estimated that with a sea level rise of 30cm, about 1 to 2 million people will be directly affected. Other adverse effects of sea level rise are increased salinity of both surface and underground water, affecting aquatic plants and animals and coastal agriculture, as well as shortages of fresh water and the emergence of health-related hazards.

The vulnerability of Nigeria and Bangladesh is exacerbated by widespread poverty, recurrent droughts, inequitable land distribution, environmental degradation, natural resource mismanagement and dependence on rain-fed agriculture. A range of practical adaptation options have been identified, but underdeveloped human and institutional capacity, as well as the absence of adequate infrastructure, renders

many traditional coping strategies (rooted in political and economic stability) ineffective or insufficient. Much of the present action on existing climate change in Asian and African countries has been driven mostly by civil society, with support from donors. This has created a significant knowledge base and engagement with the public. In Nigeria, access to climate change information has been limited due to the worsening conditions of human development.

Besides rises in sea level, important challenges in the areas of demographic growth, acute dependence on fossil fuel, drought and social conflict are also already being faced in many other countries.

The adaptation of landscapes and settlements to the effects of climate change is closely related to the history of The Netherlands: the Eastern Scheldt Storm Surge Barrier (top); the river Waal and the Ooypolder near Nijmegen (middle); the historical city of Deventer is occasionally flooded by the river IJssel (bottom) .
Photos by Hans Dijkstra, BvB

In Portugal, the dependence on fossil fuels for primary energy supply and a domestic energy production based on renewable energy and dominated by hydropower generation as the main source, highly vulnerable in drying weather conditions, led to a major societal goal of widening the scope of renewable energies and enlarging the supplied capacity.

There is a commitment to a leading role for the use of renewable energies, especially solar, wind, biomass, bioenergy, and ocean energy. The governmental drive to achieve the climate change objectives seems to be supported by the population as in an international survey in 2008, the Portuguese were among the most worried about climate change, and private adherence to renewable energies (solar and wind) is a fact.

Arga wind farm, Caminha (top), owned by "Empreendimentos Eólicos do Vale do Minho", operational since 2006; Pelamis unit (middle), owned by Enersis and Ocean Power Delivery, operational since 2008; Moura photovoltaic power station (bottom), owned by BP Solar, operational since 2009

Renewable technologies and services are developing fast and the Portugese Government is supporting a wide range of measures to achieve progress in energy efficiency. This approach is followed by regional and sub-regional institutions, sectoral agencies and by the municipalities. Some major projects have already been implemented. These include the largest wind farm in Europe (Alto Minho I), which has a 240 MW capacity; this was initiated by four municipalities that launched together the field work and hired experts.

This trend towards increasing amounts of renewable energy is by no means a universal one in Europe. Thus France and Poland, as well as the Russian Federation to the east continue to rely very largely on nuclear and fossil fuel generation.

Dolna Odra Power Station – one of the biggest in Poland, located South of Szczecin, Poland.
Photo: Krystyna Mieszkowska, 2009

Policies and Definitions

In addition to its efforts to hold back the sea, The Netherlands is placing considerable emphasis on mitigation policies to tackle climate change. These are both short term (up to 2020) and long term (up to 2050). Dutch policies are described in much more detail in the article 'The Netherlands 2020'.

In Portugal several plans, programs and measures concerned with energy efficiency, such as the National Energy Strategy published in 2005, the enactment of liberalization and legislative reforms in the electricity and gas sectors, and the second National Allocation Plan (NAP II) have been prepared. These plans and programs are being monitored by the National Agency for Energy (ADENE) and the General Directorate of Energy and the Climate Change Commission (CECAC). There are also a range of financial incentives aimed both at the general population and business. Portugal has also introduced the "Vehicle Renewal Programme" for increasing energy efficiency in private transport and "Green taxes" for private vehicles. In terms of policies for adaptation to combat climate change, the Portuguese Strategy for Climate Change Adaptation is still under public discussion.

The UK has introduced legislation covering both mitigation and adaptation. This includes, principally, the Climate Change Act 2008. This has enabled the establishment of a Climate Change Committee which has the remit to set binding carbon targets. Policies are in place that seek progressively to improve the energy efficiency of new buildings; carbon neutral housing will be required by 2016, for example.

UK policy has been heavily influenced by several ground breaking reports. Amongst these, is the Royal Commission on Environmental Pollution' report on The Urban Environment, which recommended UK priorities for sustainable urban transport, sustainable urban management, construction and design, and resource and energy efficiency. Also, the Stern Review of 2007 addressed the Economics of Climate Change, concluding that action pursued in the short term would be much less costly than leaving it to the long term.

In Brazil, the policies related to the energy sector determine special incentives for investment in renewable energy sources such as wind power and small hydroelectric plants. There is also a requirement that 1% of the budget of major energy producers be reinvested in energy efficiency projects, thus mitigating the cost of energy use. In the transportation sector, three core policies have a beneficial impact on climate change: 1) the biofuel policy, whereby all the diesel sold should include at least 3% biodiesel; 2) a policy on transport guiding a shift on the transport of goods from road to rail or water transport; and 3) public transport policies, geared towards motivating more people to rely on this mode.

To control deforestation, the federal government has established a plan under three axes: 1) legalising land use in the Amazonian area, giving titles of property, when appropriate; 2) monitoring and controlling environmental standards; and 3) enabling the sustainable use of the forest.

A national adaptation strategy for Belgium is under construction and the Flemish government is working on an adaptation plan. Flanders has adopted a regional climate action plan for 2006-2012. Among the range of measures is a commitment to reduce GHG emissions from buildings by 30% by 2020. The Brussels Region has developed an Air and Climate Plan for the period of 2002-2010. This brought together the issues of air quality and climate change and identified 5 action domains: transportation, buildings, fostering of renewable energy, industry and decreasing citizen exposure to pollutants.

SwissEnergy is a specific and directly effective instrument for Swiss federal government and cantons to implement their energy and climate objectives. In accordance with the CO_2 Act, measures are primarily based on the principle of voluntary

action. The CO_2 fee and “climate cent” are intended to complement the SwissEnergy programme. The cantons are searching for joint measures for a sustainable energy supply, energy planning and energy-efficient mobility. The legal and financial (budget) prerequisites for a cantonal promotion programme currently exist in 22 cantons.

Most of the countries that participated in the study still do not have clear definitions on what is meant by a zero carbon development, for example. . However, a few countries such as Belgium, France, Netherlands, Portugal, United Kingdom and Switzerland have made progress in this regard and are setting their own definitions. Belgium seems to have a well defined understanding of “Climate neutral”, “CO_2-neutral”, “CO_2-free” & “Zero Emission neighbourhoods” whereas France recognises a definition of “Eco-District” and “Green City”. In the Netherlands, the following three expressions, CO_2 neutral, climate neutral and energy neutral are often used interchangeably although they have different meanings. These terms concern the energy consumption of (existing) buildings or areas. For its part, Switzerland has defined its own label of excellence on energy performance and this had been awarded to about 175 Swiss municipalities by early 2009. In Portugal, the Certificate for Energy Efficiency for Buildings was introduced in January 2009. Most of these definitions used by the participating countries place their main emphasis on primary energy use giving less priority to the energy used for transport, construction, etc.

Spatial Planning

In the main, the developing countries do not have specific planning legislation at the national level directly related to tackling climate change, although at the local level they have master plans or other spatial planning tools that guide sustainable development. India and Kosovo have environmental protection legislation to minimize/mitigate the environmental impacts of development activities. In Israel, municipalities are required to carry out surveys of air pollution, GHG emissions and their sources, to define a guiding vision and policy for their areas, together with quantitative reduction goals and to prepare an urban master plan accordingly.

Some European and Latin American countries have attempted to integrate spatial planning with national and regional strategies to tackle climate change. They have also taken some specific planning initiatives at local level which are mentioned below:

Belgium’s 2009 Spatial Planning Decree contains new prescriptions concerning energy saving and the development of collective energy systems. l.

In Brazil, national policy requires that all cities of over 20000 inhabitants and all those comprised within an official Metropolitan Region must have a Participatory Master Plan. At the state level, there is São Paulo’s example of integrating the climate variable throughout all environmental regulation. The State’s Plan on Climate Change determines that land use regulation shall take into account the possibility of climate disasters and be used as a tool to facilitate sustainable transportation and to decentralize public services and economic activity.

The biggest challenge of France is to guide urban growth through densification of urban areas, and the recovery and reuse of wasteland. Similarly Dutch spatial planning is characterized by the objective to achieve compact and lively towns.

Some mandatory regulations have been issued in Portugal concerning the inclusion of energy efficiency in Regional Plans. Ur-

ban Mobility Plans are mandatory for district capitals and the same regulation applies to business or industrial parks with over 500 employees. These parks should have a mobility plan, including: shuttle/minibus service with modal connection points; banking services; restaurant services; newsagent and/or post-office services. The General Directorate for Land Use Planning and Urban Development (DGOTDU) has issued some energy guidelines for cities.

In 2008, the County Councils of Sweden were given the task to develop regional climate and energy strategies in order to reduce the discharge of greenhouse gases, increase the amount of renewable energy and foster energy conversion for a more cost effective use.

Local government in Switzerland has formulated a joint strategy for energy-related activities in the buildings sector. These prioritise energy-efficiency and the utilisation of waste-generated heat. At the municipal level, the SwissEnergy programme offers financial support and provides advisory services related to energy and mobility.

In United Kingdom, local authorities at municipal and county council levels have set their own targets for CO_2 emission reduction. For example, the Mayor of London has set the target of reducing CO_2 emissions in London by 60% by 2025.

Case Studies

In this section several projects aiming at reducing greenhouse gas emissions are described. Most of the projects deal with energy and a smaller number with transportation. Other projects are neighbourhood oriented and integrate several domains in the drive to achieve sustainable developments.

These projects are not representative of all the countries that participated in the survey. Projects in The Netherlands and in the United Kingdom are described in earlier essays in this Review

City-wide Projects

In Belgium, five cities are involved in the Climate Alliance (Ghent, Torhout, Zemst, Zoersel and Zwijndrecht) and six cities in the project Energie-Cités (Anderlecht, Brussels, Brussels Capital Region, Genappe, Liege and Namur). Two cities have received the Climate Star Award, an initiative of the Climate Alliance to reward best practices that could serve as an example: Eupen (2004) and Ghent (2007). The 2004 Award focused on renewable energy and the 2007 Award was centered on environmental-friendly traffic schemes. The city of Ghent developed a Barometer of Sustainability used for all urban projects based upon the LEED (Leadership in Energy and Environmental Design) and BREEAM (BRE Environmental Assessment Method) standards. A further scheme will be introduced for business areas.

In India, the city of Delhi is implementing the following measures in order to achieve low carbon city status: building specifications for rainwater collection compulsory in all buildings larger than 100 m2, designing mixed use and high density projects, developing multi-modal transport systems, keeping 20% of city area as green, increasing forest cover from 23% to 33%, recycling domestic waste, using a minimum of 25% fly-ash in all road construction works, introducing clean fuels and replacing fossil fuel power plants by combined heat and power plants.

Despite the shortcomings of the Lithuanian territorial planning system, some municipalities are currently implementing integrated urban sustainability plans. The master plan of Vilnius promotes energy efficiency by renovating the existing Soviet-era housing stock (approximately 4000 buildings) and aims at modernizing and renewing public infrastructure networks, creating public spaces, and implementing park and ride systems.

In Portugal, since the early 90s, the reduction of energy consumption at city level has been undertaken by several municipalities. Relevant cases include the historical centre of Évora and the former Expo 98 site, at present a neighborhood in which

Nations' Park on former Expo 98 site in Lisbon /an energy efficient CBD. *Photo: Paulo Pinho*

Lisbon's average energy consumption per capita has been halved while service levels are at the peak, representing a new CBD.

Other energy saving initiatives worth mentioning are related to the public transportation system in the city of Porto and its metropolitan area: the longest subway network launched in the nineties in Europe and the bus fleet in the city, 50% of which runs on natural gas.

Several municipalities on the northern bank of Douro Valley, namely Vila Real, Régua, Santa Marta de Penaguião, among others, have restructured the heating systems for public schools and converted them into forest biomass energy systems under a global plan. Public facilities such as swimming pools have also been reconverted to micro-generation. Lighting on bus shelters is being generated by associated photovoltaic panels.

Energy saving Metro Rail in Porto. *Photo: Cecília Silva*

Ecological Neighbourhoods

In France, the project of Maine-et-Loire eco-neighbourhood covers 17 ha and encompasses 500 houses. Among other things, the project seeks to reduce the amount of road surface and, instead, to provide an attractive pedestrian environment.

In Slovenia, the spa Snovik integrates energy efficient technologies; in Komenda, a low-energy housing project is being built and the municipalities of Bovec, Kranjska Gora, Bohinj and Idrija are investing in sustainable transport models.

In Sweden, municipalities are expected to plan for good living environments. Hammarby Sjöstad is one of the newest districts in central Stockholm. The project is based on an eco-cycle model that handles energy, sewage, and water for homes, offices and other activities within the district. The goal is to create a residential environment based on sustainable resource usage. Combustion of waste is used for heating up the water in the district heating system.

Enköping is a small town near Stockholm with about 20000 inhabitants. The municipality has developed a similar energy project through the collaboration with several partners. A bio-cycle solution was designed that uses the nutrients from sewage products and ashes from energy production, thus reducing the discharge of nitrogen and phosphorus to Lake Malaren and the Baltic Sea. Waste from crops, logging and recycled wooden material is used as bio-fuel in the municipal heating plant, producing heat to 95% of the consumers and generating 50% of the local electricity needs. Residual ash is used to make fertilizer used by local farmers.

In Switzerland, the Basel Pilot Region is a cooperative project (public private partnership) between Novatlantis and the city of Basel. The project functions as a practice-oriented laboratory of sustainability research, fostering the vision of a 2000 watt-society for sustainable energy use, i.e. a reduction in energy consumption from the current 6000 watt per person. Involving 170000 people, the project aims at showing that the quality of life will not decline with the implemen-

Bristol – Temple Quay, Bristol, United Kingdom – a new energy efficient employment quarter.

tation of actions such as improving building materials and increasing energy efficiency, replacing fossil fuels with renewable energy sources and reducing CO_2 emissions.

Erlenmmat, a city district located at the northern edge of Basel city centre - to be developed under mix-use typologies in the coming years.

In Portugal as elsewhere in Europe, innovatory buildings aiming at high levels of energy efficiency are already being built. Among other things they are demonstrating the potential for using solar energy and they also prove that, even in hot weather it is possible to work in an air conditioning free environment. Moreover, in addition to providing electricity, photovoltaic panels have been found to be very useful as shading devices for the parking of hybrid cars or other uses.

Other Specific Projects

In Russia is home to several projects aimed at mitigating climate change. They include the forestation of unused agricultural land in the Volga river region (2007), a municipal gas distribution system in Kaliningrad that reduced CO_2 equivalent emissions by 40000 tons (2005), and the use of forest biomass instead of fossil fuels in the in Nyzhny Novgorod region (Volga River basin) – the results show that fossil fuel costs can be reduced by 3-4 times, implying a reduction in GHG (Green House Gas) emission of 367000 ton per year. Also, the Moscow public transportation system can be seen as a particularly interesting example, its underground metro system transporting more

Solar XXI Building in Lisbon generates 80% of its energy consumption. Innovative energy concepts also take place in the surroundings. *Source: "INEGI 2009" – Portugal*

than 9 million passengers per day.

In Portugal, the efforts of Almada municipality in public transportation and green areas are worth mentioning. Many Portuguese municipalities are also improving riverbanks or coastal areas for pedestrian use along considerable extensions of land. This effort can be seen as an indirect way of fostering ecological lifestyles since longer trips for recreation purposes are replaced by short-distance trips and walking. The Metropolitan Area of Porto stands out as a large part of its coastal area has pedestrian corridors.

The Kyoto Protocol has stimulated the implementation of greenhouse gas reduction commitments in developing countries as an alternative to more expensive emission reductions in the industrialized countries financing these projects. In Bangladesh, for instance, Dhaka City is home to a population of 10 million that generates substantial amounts of municipal waste. However, the energy content of this waste is comparatively low (777-1444 kcal/kg) because of its high moisture content. The Matuail landfill is the first clean development mechanism project in Bangladesh (and the first sanitary landfill as well). It uses composting technologies and addresses issues of water pollution, spread of disease vectors, GHG emissions and odor pollution. Expected benefits reaped from the project include the reduction of 1 million tons CO_2 equivalent in a six-year period, the processing of 50000 tons/year of compost and the generation of 3-6 MW electricity from landfill gas extracted.

Conclusion

These survey findings provide a useful snapshot of the 'state of play' in a range of countries around the world. They indicate that there is a general awareness of the need for action and they provide evidence that, at one level, national strategies are being formulated and, at the other, that some local areas are beginning to take action in terms of both spatial planning policies and otherwise.

So, the first steps are being taken towards combating change. But, collectively, the action taken so far is tiny and swamped by still rising emissions. If we are to avoid the worst effects, such action will have to be stepped up from the scale of the pilot project to mainstream action to achieve a lower carbon society globally.We will need to act at all levels, top down as well as bottom up, but particularly at the level of the city. In tandem with that, we must pursue the necessary international agreements and share our knowledge and understanding to achieve rapid progress along the low carbon path. •

Annex: List of Participant Countries

Argentina	Namibia
Bangladesh	Netherlands
Belgium	Nigeria
Brazil	Poland
Colombia	Portugal
France	Russia
India	Slovenia
Israel	South Africa
Kazakhstan	Sweden
Kosovo	Switzerland
Lebanon	Tunisia
Libya	United Kingdom
Lithuania	Uruguay

About the Editors

CHRIS GOSSOP
BSc MA PhD MRTPI is a chartered town planner with a broad range of experience that has embraced both local and central government, as well as a non governmental organisation, the Town and Country Planning Association (TCPA). He served in three local authorities, including Leicester City Council where he managed substantial environmental programs. Later, as Deputy Director with the TCPA, he became involved in numerous campaigning issues, at many levels, from the local to that of the European Union. In 1995, he joined the former Department of the Environment to coordinate United Kingdom preparations for Habitat II, the United Nations conference on human settlements. He currently serves as a planning inspector with responsibility for the scrutiny and determination of planning and environmental appeals, combining this with his work for ISOCARP where he is a Vice President and also General Rapporteur for the 45th World Congress on Low Carbon Cities to which this book relates.

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Fernando Brandão Alves, Ph. D / Doctor and M. Sc. - Urban and Regional Planning - Technical University of Lisbon, 1997 (C.R.); Graduated in Architecture - Faculty of Architecture, Technical University of Lisbon, 1988. He is an Assoc. Professor at the Faculty of Engineering of Porto University (FEUP); Member of the Scientific Board - "Rehabilitation of Building Patrimony", Master Course, since 2002, FEUP; and Director of Planning Laboratory at FEUP – University of Porto (since 2007). In terms of researching experience he is a member of Directory Board of the Portuguese Architects Society (since 2008); Vice-President of the International Society of City and Regional Planners (ISOCARP) 2001-2007; Senior Researcher of CITTA - Research Centre of Territory, Transports and Environment – FEUP, University of Porto, since 2002; member of the Scientific Committee of "*Cadernos ESAP"* (Architecture Review), Ed. CESAP, Porto (1997-2000); and Coordinator and Chairman of Scientific Meetings, Conferences, Seminars and Juries in several countries. He is author/co-author of several Books, Book Chapters and other Scientific Publications in national and international books, reviews, and proceedings of Congresses and other *Fora,* as well as Coordinator of several professional Projects under Public Competitions, in several countries, in the Architecture, Urban Design and Urban Planning field.

About the Authors

KEY TO A LOW CARBON SOCIETY: REFLECTIONS FROM A EUROPEAN PERSPECTIVE

RONAN UHEL
Head of Programme natural Systems and Vulnerability, European Environment Agency (Denmark)
In charge of the Spatial Analysis Department at the European Environment Agency, Ronan Uhel has more than 20 years of experience in European sustainable development issues from an analytical and political standpoint. As such, he has participated in relevant UN-based activities (UN-CSD, UNEP-GEO, UN-Habitat) and OECD assessments and paid early attention to the global dimension of environmental problems. Integrated urban matters struck him as a weak link in the related policy discussions and therefore his interest in contributing to the first EU Green Paper on Urban environment issued in 1990, an important milestone in putting cities and urban areas on the EU policy agenda. The EEA report "Urban sprawl in Europe - The ignored challenge" (2006), which he coordinated, shows that unfortunately little progress have been made since in terms of integrated urban spatial planning.

BIRGIT GEORGI
Project manager urban issues, European Environment Agency (Denmark)
In charge for urban assessments at the EEA for nearly 3 years, Birgit Georgi can build on a 17 year professional career in the German and East-German environmental agencies. From the beginning, her focus was on integrated themes like regional planning, environmental management, biodiversity, and sustainable transport gaining thus a broad experience on a variety of interlinked themes – nationally and internationally. Coming back to her professional roots as a landscape architect she explores now the European dimension of urban development, its impacts on the environment and the effectiveness of European policy on the local level. As such she coordinated and wrote together with partners the EEA report "Ensuring quality of life in Europe's cities and towns" (2009) which focuses on the potential of urban development for sustainability and quality of life across Europe.

CITIES AND CLIMATE CHANGE: THE PERSPECTIVE OF UN-HABITAT

HABITAT AUTHORS

The United Nations Human Settlements Programme, UN-HABITAT was created in 1978 and is the United Nations agency for human settlements, mandated by the UN General Assembly to promote socially and environmentally sustainable towns and cities with the goal of providing adequate shelter for all. UN-HABITAT works at global, regional, country and city level, and focuses on:

1. Advocacy, monitoring and partnerships in promoting sustainable urbanisation
2. Participatory urban planning, management and governance
3. Pro-poor land and housing:
4. Environmentally sound basic infrastructure and services
5. Strengthened human settlements finance systems

Through advocacy, policy development, capacity building and support to urban investment, UN-HABITAT supports local and national governments faced with environmental challenges, poverty and urban growth. The UN-HABITAT's Draft Strategy on Cities and Climate Change guides the agency's efforts towards support to local governments facing climate change. The 2009 Global Report on Human Settlement 'Planning Sustainable Cities' is a Flagship product of UN-HABITAT prepared by the Policy Analysis Branch of the Monitoring and Research Division. The article in this Review has been prepared by staff involved with urban planning and environmental issues, in particular LAURA PETRELLA, Urban Environment Planning Branch, RAF TUTS, Chief, Urban Environment Planning Branch and PAUL TAYLOR, Chief, Office of the Executive Director. For further information on UN-HABITAT work on planning and climate change, contact: raf.tuts@unhabitat.org or visit http://www.unhabitat.org

THE NETHERLANDS 2020, BOUNDLESS POLICIES TOWARDS LOW CARBON REGIONS AND CITIES

MARTIN DUBBELING

Martin Dubbeling is a senior consultant, urban planner and urban designer at SAB, a multi-disciplinary office active in the fields of spatial planning, urban planning, landscape architecture and the environment in Arnhem, The Netherlands. He is bureau member of ISOCARP and co-chair of the committee on sustainable urban design and planning of the Dutch professional organisations of landscape architecture and urban planning and design. Martin Dubbeling is one of the authors of the publication *Sustainable Urban Design, Perspectives and Examples*, for which he was awarded the Gerd Albers Award at the 42nd ISOCARP Congress in Istanbul.
Martin Dubbeling has a strong professional record in the consultancy, design and process of regeneration of historic town and village centres, sustainable urban planning and design and the redevelopment of urban networks and retail districts. He has made several master plans for sus-

tainable residential areas and sustainable residential urban renewal in The Nether¬lands. Many of these projects have been realised or are under construction. In his projects, publications and presentations, Martin Dubbeling states that sustainable urban design is urban design that focuses on people and the environment and can be used for a very long time and that continues to meet the requirements that occur throughout time.

MICHAËL MEIJER
Michaël Meijer (1980) is a spatial planner and landscape designer at SAB, a multi-disciplinary office active in the fields of spatial planning, urban planning, landscape architecture and the environment in Arnhem, The Netherlands. He was a Young Planning Professional at the 44th ISOCARP congress in Dalian and is (co-)author of three ISOCARP workshop papers from 2007 until now. Michaël is the secretary of the committee on sustainable urban design and planning of the Dutch professional organisations of landscape architecture and urban planning and design and one of the authors of the second edition of the book 'Sustainable Urban Design, Perspectives and Examples'.

PORTLAND METROPOLITAN REGION TURNS A CLIMATE CHANGE CORNER

RICHARD BENNER
Richard Benner serves in the Office of Metro Attorney and advises Metro on urban growth management and transportation. Between 1991 and 2001 he served as Director of the Oregon Department of Land Conservation and Development, the state agency that oversees the Oregon statewide land use planning program. Before that, he was the Executive Director of the Columbia River Gorge Commission during the time (1987-1991) the commission developed a management plan for the Columbia River Gorge National Scenic Area. Prior to that, he spent 12 years as Senior Staff Attorney with 1000 Friends of Oregon. He is a graduate of Princeton University and the University of Oregon Law School.

FROM WESTERNISED TO LOW CARBON CITY: CLIMATE CHANGE ADAPTATION

GARRY SMITH
Professor Garry Smith is Principal, Risk Assessment, at AECOM and has over 20 years experience in Environmental Risk Assessment, Brownfields and Contaminated Land Management, and sustainability-based planning. Formerly Director of the Institute of Environmental Studies, University of NSW, and Principal Environmental Scientist Sutherland Municipality in Sydney, he is Professorial Visiting Fellow in the School of Risk and Safety Sciences, University of New South Wales. Garry is a dual Fulbright Fellow and studied with the USEPA in health and environment protection

and brownfields. He has specialized in sustainability policy, brownfields assessment and risk communication programmes in Australia for government and industry. Garry was project leader on work awarded the inaugural NSW Local Government Excellence in the Environment Award in 1999 and was the invited Australian Member at the international workshop developing the ICLEI Global Water Campaign 1999. Key professional practice areas include development of methodologies for local risk assessment application to land use decision-making, community communication frameworks, and organisational sustainability planning training. Garry's consulting work has included advice to the UNDP South Pacific Regional Environment Programme; Australian Government; and State government Olympics 2000 brownfields development project.

CAMBRIDGE: DELIVERING SMARTER GROWTH

BRIAN HUMAN

Brian Human has worked in urban land use, transport and environmental planning in Britain for over 30 years. At Cambridge City Council he was Head of Policy and Projects leading a multidisciplinary team dealing with planning, conservation, arboriculture, transport, research, urban design, environmental improvements and sustainability issues. A key focus for the work was supporting the growth agenda.

Brian has built up a strong interest in tourism planning and destination management within historic towns. This involved the preparation of tourism strategies for Cambridge, leading the preparation of best practice guides for the English Historic Towns Forum and contributing to academic papers/research.

Brian left Cambridge City Council in 2008 is now an independent consultant taking an interdisciplinary approach to urban planning, especially in the context of historic towns and cities.

He was Chair of the English Historic Towns Forum (now the Historic Towns Forum) in 2006-2008 and is currently Vice Chair – the Forum promotes best practice in conserving historic towns and cities.

Brian is a Member of the Royal Town Planning Institute and Fellow of the Tourism Society. He has a Degree in Economics and a Post Graduate Diploma in Social and Environmental Planning.

INCREASING CO2 EMISSIONS IN THE DOURO VALLEY – THE ROLE OF LAND USE CHANGES AND FIRES

JÚLIA M. LOURENÇO

Júlia M. Lourenço is an Assistant Professor in the Civil Engineering Department of the University of Minho in Portugal. Since mid eighties she has been working in the fields of spatial, urban and environmental planning for the Douro. She was president of several Advisory Boards that supervised the local plans in the region and coordinated the final stages of the land-

use regional plan approved for the Douro Valley. She is bureau member of ISOCARP and national delegate for Cost C-27 Action for Minor Urban Deprived Communities. Júlia M. Lourenço is the author of the book Expansão Urbana: Gestão de Planos-Processo, for which she was awarded the Gerd Albers Award 2003. She coordinates research projects on Douro region which involve Invited Assistants CRISTINA DANKO from the Civil Engineering Department, University of Minho and RICARDO BENTO from the Engineering Department, University of Trás-os-Montes and Alto Douro as well as a Research Assistant NUNO PEREIRA from the later institution.

LUÍS RAMOS and ISABEL BENTES
Luís Ramos and Isabel Bentes are both Associate Professors of the Engineering Department, University of Trás-os-Montes and Alto Douro, while they also have a strong professional record in the consultancy and design of sustainable development, the former on regional and land-use issues, the later on water and sustainability.

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Paulo A. M. Fernandes is an Assistant Researcher from the Forestry Department & CITAB, University of Trás-os-Montes and Alto Douro. He is an expert on forest fires and has commissioned research on experimental techniques to study the effectiveness of fire hazard mitigation practices.

ENERGY PLANNING AT THE COMMUNITY LEVEL IN ENGLAND

ROBERT SHAW
Robert Shaw, Associate Director, AECOM (formerly Faber Maunsell) is a qualified town planner with 10 years experience. He joined AECOM's Sustainable Development Group in November 2007 having been Director of Policy & Projects at the Town and Country Planning Association. He has been responsible for promoting effective action on climate change mitigation and adaptation. Rob has significant experience of promoting sustainable communities through planning, ranging from urban infill and regeneration to large urban extensions and new settlements.
He has worked extensively on energy planning policy relating to large- and small-scale technologies and approaches. He has played a key role in the wide-spread implementation of decentralised renewable and low-carbon energy planning policies across England. He led the campaign that resulted in the Government's preparation of the PPS on planning and climate change and was a member of CLG's PPS Sounding Board. Rob was part of the team that recently completed the accompanying Practice Guide. Following on from this he is delivering training to planners in England on behalf of DCLG, DECC and Defra and is carrying out renewable and low carbon energy planning studies for a range of local and regional planning bodies, including: Cornwall, the Association of Greater Manchester Authorities, East Midlands Regional Assembly, Eastbourne and Bedford. Rob worked with RegenSW and Yorkshire and the Humber Assembly to

prepare local authority energy and planning toolkits. He was a member of CLG's eco-towns expert panel and is developing Government guidance to support the implementation of the Government's eco-towns proposals. He is currently engaged in preparing the Legacy Masterplanning Framework for the London 2012 Olympics Park and leading the sustainable development masterplan for the proposed Whitehill Bordon eco-town.

INVESTIGATION OF POTENTIAL BIOCLIMATIC INTERVENTIONS FOR A PORTUGUESE CITY

FERNANDO BRANDÃO ALVES
See "About the Editors"

JOÃO GRANADEIRO CORTESÃO
João Granadeiro Cortesão graduated in Architecture – Porto Superior Artistic School (ESAP/CESAP). Presently he is undertaking Ph.D research at the Faculty of Engineering of Porto University (FEUP) in the bioclimatic urban design area. This investigation is integrated in the Research Centre for Territory, Transports and Environment of FEUP's Civil Engineering Department and with support from the Welsh School of Architecture at Cardiff University (where the co-orientation is held).

JOANNE PATTERSON
Joanne Patterson is a Research Fellow at the Welsh School of Architecture at Cardiff University in the UK. Research has encompassed the fields of energy, general sustainability and the built environment and has crossed the disciplines of physical and social sciences at different scales of the built environment. She is particularly interested in improving the existing built environment to enhance environmental, social and economic sustainability at an urban scale and modelling and monitoring of changes to ensure real improvements are being made.
Joanne is currently collaborating on research projects and proposals associated with a low carbon built environment as part of the Low Carbon Research Institute, established to unite and promote the diverse range of energy research in Wales in order to deliver a low carbon future. This links to an ongoing COST Action investigating Low Carbon Urban Built Environments in partnership with 19 countries across the EU which Joanne is coordinating. Other key work involves the development of a matrix for sustainability in the built environment entitled 'Practical Evaluation Tools for Urban Sustainability (PETUS)' and a range of projects that have involved extensive modelling of the built environment to predict change, at all scales, using GIS (EEP model).

JOAQUIM GÓIS
Joaquim Góis, Ph. D in Engineering Sciences with the theme "Stochastic models in the study of urban climatology". Since 1991 he has been Professor in the Faculty of Engineering of Porto University in the areas of Statistics and Geostatistics of Environmental Engineering and Mining En-

gineering. In the last 10 years he has been undertaking research in the urban climatology area. He is author and co-author of twenty scientific articles on this scientific area, amongst which can be highlighted: “Geostatistics Applied to the City of Porto Urban Climatology”, 7th International Conference on Geostatistics for Environmental Applications, 2009 (J.Góis, H. Garcia-Pereira, A.R. Salgueiro); “Urban geometry parameters as indicators for urbanization effects: A case study in Paranhos, Portugal”, The Third International Council for European Urbanism Congress - Climate Change and Urban Design: Science, Policy, Education and Best Practice, 2008 (J. Góis, L. Balkeståhl, A.Monteiro, R.Taesler); “The influence of weather types on the Urban Heat Island’s magnitude and patterns at Paranhos, Oporto – a case study from November 2003 to January 2005”, 6th International Conference on Urban Climate, June 12 – 16, 2006, Göteborg, Sweden, (J. Góis, L. Balkeståhl, A. Monteiro, R. Taesler, H. Quenol).

ECOCITY SARRIGUREN

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Aaron Kelley is currently pursuing a Masters Degree in City and Regional planning from the University of Pennsylvania, School of Design. Prior to enrolling at the University of Pennsylvania, he obtained a bachelor’s degree in geography, and a career in landscape design and contracting. Aaron is collaborator with the Fundacion Metropoli on a range of ongoing projects and publications.

ALFONSO VEGARA
Alfonso Vegara is an Architect, Economist and Sociologist and earned a PhD in City and Regional Planning. He is the founder and President of the Fundación Metrópoli, fellow and Trustee of the Eisenhower Foundation. He has taught architecture and planning at the Universities of Madrid, Navarra and Pennsylvania School of Design. He has also worked as an advisor to the Government of Singapore for the One North Project, as well as Cities as Curitiba, Dublin, Bilbao, Casablanca, Sydney, etc. From 2002-2005 he was President of ISOCARP, The International Society of City and Regional Planners. In 2006 he received the European City and Regional Planning Award and in 2007 the Jaime I Award on Planning, Landscape and Sustainability delivered by the King of Spain. His research on Urban Planning has been presented in the book “Territorios Inteligentes”.

JUDITH RYSER
See “Low Carbon Cities: Examples from the United Kingdom”

MARK DWYER
Mark Dwyer is an Architect and Urban Designer in the United States and holds a Masters of Architecture in Urban Design from the Graduate School of Design at Harvard University. He has taught Urban Design and Architecture and Harvard GSD, University of Pennsylvania School of Design and the Boston Architectural Center. Prior to joining the Fundacion Metropoli in January of 2009, Mark was an Associate in the New York office of Enrique Norten (TEN Arquitectos), managing large scale architectural and urban design projects for the firm.

FUNDACIÓN METRÓPOLI
Fundación Metrópoli is an international organization, at the forefront of a new generation of “intellectual capital institutions” that aspires to contribute to the innovation and development of cities and regions through the research, sharing and implementation of knowledge, and with the objective of building a sustainable future. The aim of the Fundación is to be a catalyst for the positive transformation of cities and landscapes in the 21st century.

LOW CARBON CITIES: EXAMPLES FROM THE UNITED KINGDOM

JUDITH RYSER
Educated as an architect and urbanist with an MSc in Social Sciences, Judith Ryser is dedicating her cosmopolitan profession life to the built environment and its sustainability at university, in the public sector, private practice and with community groups. Her research in London, Paris, Stockholm, Geneva [United Nations] and Madrid focuses on the future of cities in the knowledge society, with emphasis on Europe. As Vice President of the International Society of City and Regional Planners she edited several publications, including four decades of knowledge creation and sharing and is joint editor of the International Manual of Planning Practice. A member of the UK Chartered Institute of Journalists, she writes and edits books, articles and reports for international organizations.

MALMÖ, SWEDEN - TOWARDS THE SUSTAINABLE CITY

TREVOR GRAHAM
Trevor Graham is Head of the Sustainable Unit in the City of Malmö working with sustainable urban development through a wide range of projects and strategic initiatives. He has previously worked with urban sustainability and sustainable building in the UK and came to Malmö in 1998 to head the Eco-City Augustenborg initiative, Europe’s most ambitious sustainable urban regeneration programme. The Augustenborg initiative has been heralded as a pioneer in new approaches to sustainable urban drainage. Current work includes developing plans for large scale regeneration programmes in Malmö incorporating innovation and sustainable economic development as key parameters to speed up the process towards the sustainable city. Trevor Graham is also CEO of the Scandinavian Green Roof Institute and a board member of both the European Green Roof Federation and the European Sustainable Cities and Towns Campaign. Trevor has also led a bilateral programme for knowledge and technology transfer on sustainable construction between the UK and Sweden.

PLANNING AND DESIGN FOR LOW CARBON DEVELOPMENT IN A SENSITIVE LANDSCAPE

JÚLIA M. LOURENÇO
See "Increasing CO2 Emissions in the Douro Valley – The role of land use changes and fires"

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COMPARATIVE STUDY OF NATIONAL RESPONSES TO CLIMATE CHANGE

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CHRIS GOSSOP
See "About the Editors"

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ISOCARP International Society of City and Regional Planners
AIU Association Internationale des Urbanistes
IGSRP Internationale Gesellschaft der Stadt- und Regionalplaner
AIU Asociación Internacional de Urbanistas

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