Tyndall Centre for Climate Change Research

Governing Climate Change Post-2012: The Role of Global Cities Case-Study: Los Angeles

Heike Schroeder and Harriet Bulkeley

September 2008

Governing Climate Change Post-2012: The Role of Global Cities

Case-Study: Los Angeles

Heike Schroeder and Harriet Bulkeley

Tyndall Working Paper No. 122, September 2008

"This mayor said if you stake out a goal what you do is you
then rally the city's agency and the public behind that goal that you can accomplish this."
(Interview excerpt)

Abstract

In May 2007 Los Angeles adopted an ***Action Plan to Lead the Nation In Fighting Global Warming.*** The plan includes a CO2 emissions reduction target of 35 percent by 2030 of 1990 levels. The approach Los Angeles is taking is one of simultaneously addressing future energy and water security by investing in decentralised renewable energy and decreasing per-capita water use. Additional areas include waste management, greening of buildings and open space and addressing emissions from the transport sector. The emphasis has so far been on the supply, rather than the demand, side. While political leadership has been very important in pushing through this action plan, a mature local environmental community and membership in transnational city networks such as C40 have been instrumental in working out the details of this plan. The impact on LA's actions on climate change will likely reach beyond city limits given the United States' continued obstruction of international efforts to address climate change and given Los Angeles ability to act as a significant role model both domestically and internationally. This could be crucial at a time when the international community is faced with the need to translate scienitific recommendations into political action and forge a post-Kyoto deal.

1. Introduction

While negotiations towards an international framework for climate change action continue, there is increasing recognition that a range of activities to reduce greenhouse gas emissions are taking place 'beyond' the formal arena of international negotiations. The purpose of Tyndall Research Programme 1 – Informing International Climate Policy – is to examine the significance of the activities of 'non (nation) state' actors in addressing climate change, and to assess how they are affecting and will be affected by the post-2012 international policy framework.[1]

International climate change policy has developed significantly over the past twenty years. In 1992, the United Nations Framework Convention on Climate Change was adopted at the Rio Summit with countries pledging to prevent 'dangerous interference with the climate system'. In 1997, the Kyoto Protocol gave industrialised countries mandatory targets to reduce emissions of greenhouse gases by 2008-2012, together with a range of economic instruments designed to assist with this goal. Over the past decade, negotiations have continued as the finer details of the Kyoto Protocol, the economic instruments – the Clean Development Mechanism, Emissions Trading and Joint Implementation – and issues of enforcement were hammered out. Although not all countries are on track to meeting their targets under the Kyoto Protocol, and the USA remains outside it, negotiations are now under way to develop a 'post-2012' agreement. To date, most analysis has focused on the role of nation-states in the design, promotion and implementation of various 'post-2012' policy architectures and instruments. This Tyndall Centre Programme suggests that there are other, non (nation) state actors who may be critical in both shaping the post-2012 climate agreement and in its implementation.

This research project focuses on one such group of actors: global cities. Cities across the world have been responding to the challenge of climate change for over a decade (Betsill and Bulkeley 2007). Recent years have witnessed an increasing importance of urban responses to climate change, with the gradual involvement of urban political leaders (e.g. the US Mayors Climate Change Agreement and the Bali World Mayors and Local Governments Climate

[1] For further information see http://www.tyndall.ac.uk/research/programme1/.

Protection Agreement) and major, global and mega-cities in climate change policy (e.g. through the networks Metropolis and C40). This shift has been accompanied by the growing recognition of cities as the predominant source of anthropogenic carbon dioxide emissions – perhaps as much as 78% by some accounts (Stern 2006) – and as places where vulnerability to climate change may be acute. For the world's major cities, climate change is therefore becoming an issue of increasing political and environmental significance. Critical questions remain, however, about how far such concerns are being translated into action and how the international policy framework facilitates or impedes action at this level of governance. As the international negotiations unfold, we have identified four areas which may be significant for urban level climate policy, and where global cities may have an impact on the implementation of future climate policy:

- Targets and timetables: the inclusion, level and nature of targets for reducing emissions of greenhouse gases
- Membership: which nation-states do or do not sign up to a new international agreement
- Carbon finance and markets: access to the CDM and/or emissions trading schemes for municipalities and/or carbon financing for urban projects
- Adaptation: access to finance for adaptation for cities in the Global South

In this context, the research project seeks to address three central questions:

1. What action is taking place in global cities on climate change and why?
2. What barriers and opportunities have been encountered?
3. How relevant is post-2012 climate policy for global cities, and how in turn might developments at the urban level affect international climate policy?

In order to address these questions, the project focuses on four case-studies: London, Los Angeles, Mexico City and Melbourne. These cities were chosen to represent cases from an early Kyoto-ratified, a recently Kyoto-ratified and a non-ratified country as well as a case from a non-Annex I country. This report documents the experience of Los Angeles. It is based on the analysis of policy documents, media reports and interviews with 14 representatives of the public and private sectors in Los Angeles conducted from September to October 2007.[2]

The next section outlines the research context for Los Angeles, including the federal and state policy contexts and the history of climate policy in the city. It provides an overview of the actions taking place and the drivers behind policy development. Section 3 provides details on some specific initiatives and of the opportunities and challenges which they have encountered. Section 4 considers the opportunities and challenges arising from working with other public and private sector actors. Section 5 focuses on the question of the role and importance of the relation between post-2012 international climate policy and Los Angeles. Section 6 provides a short conclusion.

2. Research Context

2.1 Climate change policy in the United States

The United States is the single most important contributor to the problem of climate change. While having the highest real GDP growth worldwide and being the third most populous country, it is the only country to rank among the highest in both, total and per capita emissions of greenhouse gases (GHGs). Between 1990 and 2004, emissions have risen by 15.8 percent (CAR 2006). Given its political, economic, geographic and cultural circumstances, particularly its hegemonic position internationally, the United States is especially challenged with significantly reducing carbon dioxide emissions. The politics of climate change are shaped by well-organised interest groups as well as the separation of powers between the legislative and executive arms of government, for example in that signing and ratification of international treaties are conducted by the President and the Senate, respectively. In addition, high levels of energy consumption, large share of fossil fuels in the energy mix and abundance of cheap coal as well as vast distances and personal mobility further compound this situation. (Depledge 2005)

After ratifying the UNFCCC in 1994 and signing the Kyoto Protocol in 1998, the Bush Administration withdrew from the Kyoto process in 2001 on the grounds that it is too costly and unfair given developing countries are not included in the commitments. The most significant policy measure taken by the federal government to date is the creation of an 18 percent reduction of GHG intensity by 2012, which is assessed to be close to a business-as-usual scenario (Bang, Tjernshaugen and Andresen 2005; Harrison 2007). The most recent attempt to introduce a federal-level cap-and-trade system – the Lieberman-Warner Climate Security Act – failed to receive the required majority in the Senate in June 2008. It was designed to reduce GHG emissions by 63 percent below 2005 levels by 2050. It is likely that with either a

[2] We are grateful to all those who gave their valuable time and insights to the study. We thank the rest of the Tyndall Programme 1 team – Chuks Okereke, Alex Haxeltine, Duncan Russell, Diana Liverman and Heather Lovell – as well as Juan Arredondo and Elizabeth Anderson for their comments on a draft of the report. The views expressed in this report are those of the authors alone.

Democratic or Republican president from 2009 the United States will adopt an amended version of this scheme in the coming years. (Pew Center 2008)

As of the April 2007 US Supreme Court ruling (Massachusetts vs. EPA case), carbon dioxide is considered a pollutant under the Clean Air Act, enabling the US Environmental Protection Agency (US EPA) to regulate it. Given California has the authority to enact environmental regulations that are stricter than federal standards under the Clean Air Act, tailpipe emissions of carbon dioxide can now be regulated by the State of California under AB 1493 (see below). Under the Clean Air Act, other states are empowered to adopt California's tougher environmental standards if they so choose, and so far about a dozen are planning to do so, once the EPA waiver situation is resolved. California filed a lawsuit in early 2008 after its waiver application was denied in late 2007 on the grounds that climate change is defined as a global issue and therefore does not pose compelling and extraordinary effects on the state compared to the rest of the country (EPA 2008).

2.2 Climate change policy in California

In response to inaction at the federal level, and specifically the government's withdrawal from the international process, California, along with several other states, has pledged to implement the Kyoto Protocol's provisions at the state level and has introduced a variety of policy measures. (Pew Center 2008) The 2001 California Climate Action Registry was the first of its kind to be established, and has led to the creation of the Climate Registry which, as of January 2008, serves large parts of North America in supporting voluntary, market-based and regulatory GHG emissions reporting schemes.

In addition to already existing building and appliance codes, the state has recently passed several important pieces of legislation: In 2006, it passed the California Global Warming Solutions Act (AB 32), which, through an economy-wide regulatory programme, mandates reductions in GHG emissions to 1990 levels by 2020 (equalling a 25-30 percent reduction from current emission levels). The act includes a package of policies to be put in place by state agencies. In Governor Schwarzenegger's Executive Order S-3-05 of 2005 he establishes a reduction of GHG emissions to 2000 levels by 2010, a reduction to 1990 levels by 2020 and a reduction to 80 percent below 1990 levels by 2050. AB 1493, passed in 2002, has made California the first US state to regulate carbon dioxide emissions from motor vehicles. It mandates that the California Air Resources Board (CARB) develop and implement emission caps for vehicles beginning in model year 2009. California enacted a Renewable Energies Act in 2005, which requires that 20 percent of the electricity sold by investor-owned electric utilities in the state come from renewable sources by 2010 (SB 107 – the target year was initially 2017 and accelerated by the CA Public Utilities Commission (CPUC)). It is currently under consideration to be strengthened further – possibly to 33 percent by 2020 (CPUC 2005). SB 1368 of 2006, the Greenhouse Gas (GHG) Emissions Performance Standard, requires the California Energy Commission (CEC) and the CPUC to set a GHG emissions standard for electricity used in California, regardless of whether it is generated in state or purchased from plants out of state. These laws taken together constitute the most ambitious and comprehensive effort to mitigate climate change presently in the United States. (Hanemann 2008)

2.3. Los Angeles' profile

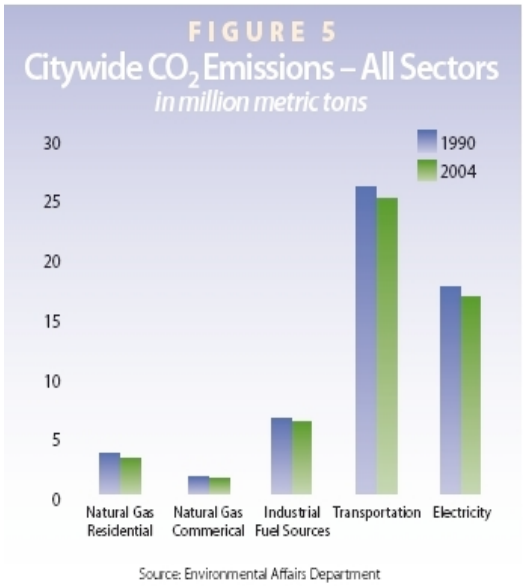
Los Angeles is the largest city in California and the second largest in the country (after New York City) with a population of 3.9 million. It spans over 465 square miles (1,204 square km) and has a relatively low population density of 2,980 inhabitants per km² (New York City's is 10,452 and London's is 4,387). The LA Metropolitan Area houses a population of 17.8 million. Because of the city's sea and airports, which are among the largest in the world, and LA's size and continuing urban sprawl, air pollution from transport has been a major environmental problem for the city during the last decades. Los Angeles is the most car-populated metropolis in the world with 1 registered automobile for every 1.8 people. The scarcity of rainfall – LA gets only 15 inches (381 mm) of rain each year – further exacerbates the problem as rain can clear smog to some extent.

LA's emissions of carbon dioxide amounted to some 51.6 million metric tons in 2004, a third of which were municipal (including electricity use and generation, sea and air ports). Despite high emissions from transport due to Los Angeles' urban sprawl, the city's emissions are about two-thirds of the US average. This is mainly due to below-average emissions in the housing sector (heating/cooling) thanks to the region's moderate climate, but also California's comparatively stringent building and appliance codes (e.g. Title 24). While the population of LA grew by about 10 percent during the last 15 years, per capita emissions decreased by around 13 percent during this period.

The City of LA is governed by a mayor-council system with 15 city council districts. It owns and operates its electric utility, the LA Department of Water and Power (LADWP), which is the largest publicly owned municipal utility in the US. LADWP provides water and electricity to the entire population of LA. It is a proprietary department, which means that it does not rely on tax payer money. The city also owns its sea and air ports and manages their on-the-ground operations. The Boards of Directors of the LADWP and LA's sea and air ports are selected by the mayor and confirmed

by the 15-member City Council for a four-year term. Some major sources of GHG emissions are therefore largely controlled by the mayor.

Figure 1: LA's carbon dioxide emissions (City of Los Angeles 2007, p. 14)



2.4 The evolution of Los Angeles' climate change policy

The city has issued several climate change plans since 1995, but they were narrowly focused on corporate emissions, on electricity use of the city to light its buildings or on the fuel the city used in its own fleets. During Mayor Antonio Villaraigosa's campaign in 2005 he issued a Green Plan as the first mayoral candidate in Los Angeles to do so. While addressing comprehensively the main environmental issues Los Angeles is faced with, including air pollution, water quality, industrial waste and lack of green space, it did not explicitly address climate change. Recognising this gap, the mayor and his staff identified climate change specifically as a problem for Los Angeles upon taking office.

Four aspects turned climate change into a priority issue for the city. First, the mayor and his staff recognised that "everything was kind of related and that the kinds of strategies that we would consider to reduce the city's greenhouse gas emissions were also things that would benefit us on all of the other environmental problems that Los Angeles faces". A Resource Management Blueprint and a Renewable Portfolio Standard (see Table 1 below) were already in place. Second, it was realised that climate change will likely have significant adverse effects on Los Angeles and that climate change is not just a global and future problem, but a local and high-risk one for Los Angeles. Third, interviewees reported that the mayor has ambitions to run for the office of Governor of California. Given California's leadership position on climate change, it is suggested that developing a profile as a leader on climate change would put him at an advantage during a possible run for the governor's office. Fourth, early on is his tenure, the mayor was contacted by the City of London to become part of their C-20 network, providing opportunities to further raise his profile as a leader on climate change. While measures to mitigate climate change on the whole do not seem to have direct impacts within or across levels of governance, the mayor's motivation seems to have been at least strengthened by action in other global cities and at the state level, thereby being indirectly affected by them.

In May 2007, the mayor's office published an action plan, titled "Green LA: An Action Plan to Lead the Nation In Fighting Global Warming". The plan also incorporated several already established measures targeting air pollution, water conservation and energy decentralisation, as they are also reducing GHG emissions. It was put together with the help of the coalition Green LA (different from the city's action plan, also called Green LA), consisting of over 60 environmental and community-based organisations focusing largely on climate change issues. Green LA was formed in 2006 in response to the then new mayor's commitment to addressing environmental issues in the city, expressed in several speeches over the course of his first year in office. Green LA provides "environmental guidance and expertise to the City of Los Angeles in an exciting model of collaboration between decision-makers and advocates, helping to inform City policies and programs". (Green LA 2006, p. 3)

Table 1: Los Angeles' climate policy milestones

Milestone	Goal	Approach
May 1999 – LADWP Green Power for a Green LA Program	▪ Reach 10% of power from renewables	▪ DWP customers have the option to directly purchase energy produced from renewable resources
June 2005 – RENEW LA, A Resource Management Blueprint (short for Recovering Energy, Natural resources and Economic benefit from Waste for LA)	▪ Shift the city's waste disposal system to one of resource recovery ▪ Help meet the city's goal of recovering 90% or more of waste by 2025	▪ 20-year waste management strategy (2005-25) ▪ Build seven conversion technology plants to draw valuable materials (e.g. plastics) from trash to use in manufacturing, and at the same time produce renewable energy
December 2005 – LADWP Renewable Portfolio Standard / Renewable Energy Goal	▪ Increase share of renewables to 10% by 2010 and 35% by 2030	▪ LADWP is developing several energy projects to generate energy from wind, solar and landfills
July 2006 – Million Trees LA	▪ Plant one million new trees within the city limits, but without giving a set deadline	▪ The City of LA, community groups, businesses, and individuals are collaborating in efforts to plant and provide long-term stewardship of one million trees
May 2007 – Green LA: An Action Plan to Lead the Nation In Fighting Global Warming	▪ ***Reduce city's emissions by 35% by 2030***	▪ ***See Table 3 below***
April 2008 – Los Angeles Green Building Ordinance	▪ Require that all new projects greater than 50 units or 50,000 square feet show compliance with the US Green Building Council's LEED certified level	▪ Provide incentives (expedite processing through all departments if LEED Silver designation is met) ▪ Improve interdepartmental coordination (through a cross-departmental Sustainability Team that meets weekly to review and revise green building policies and specific projects) ▪ Improve green building expertise (through training of staff in green building methods and policies and/or as LEED Accredited Professionals)
In preparation – Water and Wastewater Integrated Resources Plan	▪ Decrease per capita water use by 20% to eliminate the electricity required for pumping and treating drinking water and for processing wastewater discharge	▪ Adopt tiered water pricing, building code changes and other financial incentives ▪ Adopt technical assistance programs for business and industry, large landscape irrigation efficiency programs, system infrastructure maintenance, and continue ongoing programs to educate communities, build involvement in conservation initiatives, and develop water-use awareness
In discussion – Expansion of transit system	▪ Reduce emissions from transport sector	▪ Introduce a coutywide half percent sales tax to fund transportation infrastructure improvements

The city's Green LA action plan commits the city to reduce greenhouse gas (GHG) emissions by 35 percent by 2030 of 1990 levels. It is, however, viewed as mainly a marketing tool by members of the environmental community and officials outside government offices. Its deadlines are seen as too weak and adequate staffing to implement the actions laid out in it is lacking. As mentioned above, the action plan is to some extent also a repackaging and synthesis of already existing measures. For example, it includes a Renewable Energy Goal of 20 percent by 2010 and 35 percent by 2030, adopted in December 2005, which should translate into a 17.5 percent reduction of emissions by 2030. The target goes beyond the requirements under the California Renewable Energy Act. To coordinate the various actions promulgated under this plan, the mayor initially created a sustainable practices cabinet and later a climate action team, which includes members of each department.

The transport sector, which is responsible for around half of Los Angeles' emissions, was left largely untouched by the Green LA action plan. A major barrier was the cost of building a transit system comparable to other major cities around the world and the perception that the support base was not yet strong enough. The investment required was estimated by

interviewees to be around USD 25 billion. Funding for transit in California "goes to the CA Transport Commission, and their mission, along with that of CALTRANS, is to build more roads" (Interviewee, September 2007). While it is possible for cities in other states, such as Portland, Seattle, Denver or Chicago, to share the financial burden of expanding public transit systems with the state, in California 90 percent of the funds have to be generated locally. A new countywide sales tax may be put on the ballot in November 2008 of half a percent to fund transportation infrastructure improvements. Counties in California are able to place local option sales taxes before its voters, requiring a two-thirds majority. The revenue, estimated at around USD 40 billion over 30 years, would currently include both transit and road improvements. Debate is ongoing as to which projects would get funded. Surveys currently show overwhelming public support for this measure (METRO 2008), despite being in a recession. There is no indication, however, how voters differentiate their support for new rail lines versus new freeway lanes. Talks are also underway regarding public-private partnerships on public transit.

The most important drivers and motivations behind this policy shift in Los Angeles include the commitment of critical individuals (mayor and his staff, a green-minded City Council, leaders in LA's environmental community), past/interim policy success (addressing, above all, air pollution), a diverse but positive climate of public opinion (reflected, for example, in the tone of articles in the *LA Times*), a lack of overt opposition from key interest groups (evident through business culture in California), the emergence of new market opportunities in the carbon economy (renewable energy, water, waste management) and environmental advocacy (Green LA, a network of environmental organisations) (Table 2 below).

Table 2: Drivers and Motivations for LA's Climate Change Policy

Driver/motivation	Examples
Critical individuals / competitiveness	"Let's dare to imagine Los Angeles as the cleanest and greenest big city in America…The great cities of the 21st Century will…be places where residents are at home in vibrant, clean, and sustainable communities." (Mayor Villaraigosa, "City of Dreams" Remarks, 9 November 2005)
Past/interim successes	"Air quality is a big concern in Southern California; we've always had the worst air quality in the United States. Our combination of our climate plus all of the sources of pollution has made air quality probably the highest priority pollution problem to deal with in Southern California for pretty much the last 40 years." (Interviewee, October 2007) -- For example, cap-and-trade schemes for local nitrogen oxide and sulfur dioxide emissions
Public opinion	"California and Los Angeles are different to the rest of the United States and have always been different when it comes to environmental issues - there's always been very strong support within California for addressing environmental problems and a lot of support in the public for increasingly stringent environmental regulation." (Interviewee, October 2007)
Business consensus	"The business community does fight but those businesses that are California based or have a large presence in California have come to accept that they would always be asked to do more in California." (Interviewee, October 2007) "The people who fight hardest in California when California decides to go out there are big national or international companies like auto companies in particular. To some extent the oil companies as well, although they have learnt long ago that you don't fight it but shape it the best way you can because they cannot pick up and move from California." (Interviewee, October 2007)
Market opportunity	"To grow green technology, to be a centre for renewable energy, to be an economic engine." (Interviewee, October 2007)
Environmental advocacy	"We have a fairly sophisticated and well-organized community with a long history of environmental advocacy amongst non-governmental organizations." (Interviewee, October 2007)

On the basis of these drivers and motivations, Los Angeles has begun to develop a comprehensive approach to climate change. It is based on "what the city has under its control" (Interviewee, October 2007), leaving out for now the transport sector, which accounts for around half of GHG emissions.

3. Climate change policy and action

On the basis of motivations and drivers discussed above, Los Angeles has in the course of the last two years established the basis for a comprehensive approach to addressing climate change within its city. While some of the measures adopted address both the need to mitigate and to adapt to climate change (energy and water conservation and security), this research project focussed primarily on policy and action in the area of mitigation. A number of goals, measures and initiatives have been put into place to reduce emissions of greenhouse gases (Research Question 1). These focus on

many, but not all, areas of emissions. For example, cities cannot themselves regulate vehicle tailpipe emissions (see above). Energy supply in the US is mostly regulated by state governments, except in the case of cities which own their utilities, such as Los Angeles.

The actions in response to climate change in Los Angeles can be divided into three categories: an emphasis on leadership; attempts to reconfigure energy infrastructures within the city; and a focus on changing the practices of individuals and corporations. Below we consider the initiatives in more detail in order to examine the opportunities and barriers they have encountered (Table 3; Research Question 2).

Table 3: Los Angeles' climate change policy measures and initiatives under Green LA

Focus area and policy initiatives	Collaborating organisations	Goals and opportunities	Challenges
ENERGY - Renewable Energy Goal of 20% renewables by 2010 and 35% by 2030	LADWP, City Council	▪ Phase out contracts with out-of-state coal-fired power plants ▪ Expand solar, wind, biomass and geothermal sources of energy to meet increasing energy demand and address possible future energy scarcity ▪ Address aging infrastructure problem	▪ Resistance to coal phase-out from LADWP labour unions ▪ Environmental conflict: renewables vs. building additional transmission lines (renewable sources cannot be built along existing transmission lines)
ENERGY - Green Building Ordinance	Department of City Planning, Mayor's office, City Council	▪ Promote green building practices in the private sector and reduce the city's carbon emissions by more than 80,000 tons by 2012	▪ Higher initial building cost ▪ Continuing urban sprawl (inability to increase population density and walkability and reduce commuter time without better public transportation system) ▪ A lot more education and outreach is needed to shift practice
WATER - Water and Wastewater Integrated Resources Plan	LADWP, Department of Public Works	▪ Improve water, wastewater and runoff management in the city	▪ Previous water recycling project had failed in the 1990s due to political opposition ▪ Some public uncertainty about tab water quality ▪ City agencies are not yet working together sufficiently
TRANSPORTATION - Reduce carbon intensity of transportation	City of LA, Metropolitan Transport Authority (MTA)	▪ Convert 85% of city fleet and 100% of city refuse collection trucks, street sweepers and buses of the MTA to alternative fuels ▪ Promote and expand transit	▪ NIMBYism – "particularly strong sense of entitlement among rich Americans" (Interviewee, September 2007). Example: delays in expansion of rail lines because certain neighborhoods "don't like the idea of the rail and the noise in their community"
LAND USE - Build transit-oriented developments (TODs)	Department of City Planning	▪ Create a more livable city	▪ Culture – single family homes and several cars per family is still the aspired life-style of people in Los Angeles
WASTE - Curbside co-mingled recycling program; RENEW LA	City of LA, City Council	▪ Recycle 70% of trash by 2015 ▪ Develop facilities that will convert refuse to energy without incineration	▪ Further improve information flows
PORT - San Pedro Bay Ports Clean Air Action Plan (CAAP)	Ports of Long Beach and LA, US EPA, CARB, South Coast Air Quality Management District	▪ Reduce air pollution from oceangoing, cargo-handling and heavy-duty vehicles through alternative marine power	▪ Ships need to be retrofitted ▪ Sea-borne emissions have to be regulated internationally

AIRPORT - Green the Airports	LAWA, LADWP	▪ Fully employ the Sustainability Performance Improvement Management System as requested by City Council ▪ Meet green building specifications, improve recycling, use alternative fuel sources, use recycled water, etc. ▪ Purchase approximately 10 percent green power	▪ Air-borne emissions have to be regulated internationally
OPEN SPACE AND GREENING - Increase green space	City of LA, Environmental Affairs Department, LADWP, TreePeople, Friends of the Los Angeles River	▪ Create 35 new parks by 2010 ▪ Revitalise the LA River as naturalized river ▪ Plant 1 million trees - 1999-2010: 48,000 trees or 4,000 trees per year (half EAD-sponsored programs and half DWP Cool Schools Program) to result in a reduction of 7,521 tons of CO_2 per year ▪ Manage the city as an ecosystem	▪ The public needs to get involved more and become a partner in these endeavors (1 million trees can not be planted by a single person alone) ▪ City agencies are not yet working together sufficiently
GREEN ECONOMY - Promote the green economic sector	City of LA	▪ Identify and promote locations for green businesses ▪ Collaborate with private sector to offer effective incentives for the growth of local green businesses ▪ Certify green businesses	▪ Some industries are still undermining these efforts
Adaptation/ climate proof LA	City Planning Commission	▪ Improve capacity to respond to emergency through education and outreach ▪ Develop comprehensive plans to prepare for climate change effects on the city	▪ Not yet a higher priority

3.1 Leadership

The impetus to provide leadership on the issue of climate change, both within the city and at national and international levels, is a characteristic of the way in which LA's approach to climate change has developed. This is evident in three ways. First, as outlined above, it has been the *political leadership* of Antonio Villaraigosa and his staff, addressing climate change comprehensively and placing it on the political agenda of the city. This political high-level support has let to the development of climate change strategy and ambitious targets for emissions reductions for Los Angeles and to the widespread recognition of climate change as a policy issue for the city. As noted above, motivation to do so is based on multiple drivers, including personal ambitions. It is embedded in the context of the State of California, which has adopted progressive policies on climate change, such as the Global Warming Solutions Act (AB 32).

Second, Los Angeles has drawn on *business and civil society leadership* in the area on climate change to further support its strategies and plans. While "there is a lot of industry fighting and undermining" policy (Interviewee, October 2007), other segments of the business community have shown some leadership in terms of promoting sustainable business conferences and green business solutions. The local environmental community responded to the mayor's initial indications of prioritising the environment by forming a coalition and offering their expertise in the process of drawing up an action plan (see Section 4 below).

Third, *national and international leadership* has been a key element in LA's strategy. According to an interviewee (October 2007), "LA's impact is far greater than just our footprint because we inspire market places around the world. We inspire people to aspire to consume and do more damage probably than any other city." Action is also motivated by the aspiration to become the largest green city in the US. Given the city's multicultural makeup, it sees itself as a potential model for cities around the world. Importantly, LA is collaborating internationally as part of the C40 network "aiming to share emergent best practices and develop a common municipal agenda to address climate change" (City of Los Angeles 2007, p. 28). The C40 network, which emerged from the earlier C20 network, was announced in Los Angeles in August 2006 by the Clinton Foundation, the mayors of Los Angeles, San Francisco and London, Prime Minister Blair, President Clinton and UCLA. Los Angeles is in the C40 steering committee and "very engaged in the process" (Interviewee, October 2007). It displayed its leadership by hosting a workshop on airports in April 2008.

Here, LA's role has primarily been one of enabling – establishing a network through which advice, knowledge and finance can flow (see Table 4 below).

Table 4: Modes of governing climate change

Mode of Governing	Examples
Internal	Organisational performance improvement Demonstration schemes Iconic buildings
Control and compliance	Regulation Planning requirements Contracts Economic instruments
Provision	New infrastructure Low carbon services Public transport
Enabling	Education campaigns Advice Grants Knowledge brokering Planning guidance

3.2 Reconfiguring infrastructures

A second notable facet of LA's approach to addressing climate change has been the emphasis on reconfiguring urban infrastructures, including energy, water and transit. Energy and water supply reconfigurations are being conducted LADWP.

> "The Los Angeles Department of Water and Power (LADWP) is embarking on the most ambitious transformation of any utility in America. In 2005, Mayor Villaraigosa challenged the department to accelerate plans to generate 20% of its electricity from clean, renewable sources from 2017 to 2010. Since then, LADWP has more than doubled its portfolio of renewable energy by purchasing wind, solar, and geothermal power." (City of Los Angeles 2007, p. 4)

The LADWP is faced with the challenge that existent transmission lines cannot meet projected future energy demand at present, projected to increase by 43 percent over the next two decades (*LA Times*, 24 March 2008). The utility is addressing this problem mainly in two ways. First, it is raising electricity prices while at the same time introducing pricing structures to reward those who conserve energy, such as tiered, seasonal, and time-of-use pricing (control/compliance mode of governing – Table 4). Second, it is shifting its power mix away from coal, which currently accounts for about 60 percent of the power source, to renewable energy (provision mode of governing). The question of transmission lines to transport renewable energy is an unresolved problem. Both these strategies respond to the desire on the part of the LADWP governing board to green its operations. In the words of an LADWP representative,

> "One of our specific barriers to whether or not we can actually reach our greenhouse gas mandates is our ability to bring transmission, to develop adequate transmission to bring the green power in. So we are working with various groups in the environmental community to see if we can figure out corridors or some other way that allows us to build transmission, address these concerns of conservation, and habitats and even developments."

The current emphasis is on the latter strategy, shifting the city's energy mix away from coal. There is a sense that this is politically the more viable option, even if the significant challenge of building additional transmission lines remains unresolved. The new pricing structures are too conservative to make a significant impact on GHG emissions. The requirement by state law that Californian utilities supply 20 percent of their energy from renewable sources by 2010 (SB 107) is another reason for why emphasis on shifting power supply is currently prioritised, even if it appears that several California-based utilities may not meet California's renewable portfolio standard. Given that many of the current solar and wind farm projects are based out of state, the intricacies of interstate commerce further complicate the situation. An additional hurdle is that existent transmission lines cannot be used given the new projects' locations and new transmission lines would have to pass through protected areas where it is a question of relative gain between

protecting nature and wildlife versus reducing emissions through expanding renewable energy. Furthermore, the LADWP labour union and its protection of jobs in the traditional power infrastructure has made it difficult for the city to move ahead with restructuring.

As to the second part of the LADWP's portfolio, water, the department is faced with the challenge of securing water for a growing population in a geographic area where demand from other part of the region is increasing and water resources are depleting. In addition, an increase in droughts is expected to further exacerbate the situation. For Los Angeles, water is a crucial issue in the context of climate change because water is imported into the city, which generates significant emissions of GHGs and negatively impacts habitat. 85 percent of water is imported from Northern and Eastern California (the Colorado River). From Northern California, water is transported partly by a water lift over the Tehachapi Mountains, which constitutes a huge expenditure of energy (State Water Project). According to the CA Energy Commission, about 19 percent of total electricity of all sectors combined is related to water, the biggest single source. 20 percent of electricity in Los Angeles is expended merely on the transportation of water into the city. Reducing the amount of imported water to Los Angeles would therefore have a noticeable effect on its emissions level.

Previously, Los Angeles has successfully reduced extraction of water through efficiency improvements and reuse when required to do so in response to environmental harm at Mono Lake, in the Owens Valley system and in the Eastern Sierras. Currently, the LA action plan envisages a decrease in per capita in water consumption by 20 percent through water conservation and recycling, including capture and reuse of storm water (City of Los Angeles 2007, p. 6).

Regarding transit, the city is developing several transit-oriented developments (TODs). While relatively successful in other cities such as Portland or Washington, DC, TODs in Los Angeles are facing a number of obstacles. A study reported on by the LA Times has found that TODs are not yet reducing traffic, rather they seem to increase congestion at such developments as they attract others to their urban infrastructure (shops etc.). It was found that transit is not yet efficient and built out enough for a significant shift from vehicle use to public transport. Jobs and schools are usually not close to transit lines, making it difficult for TOD residents to leave their cars behind. (*LA Times*, 30 June 2007)

3.3 Changing practice

The third key element of LA's climate change policy is an emphasis on the need to change behaviour, particularly with respect to energy and water use in the built environment. Here, the approach has been a mix of enabling, provision and control/compliance modes of governance.

Interviewees shared the impression that California-based business is generally more amenable to a culture of sustainability than companies coming in from out of state; this applies in particular to automobile companies. Companies are said to have adapted to California's more progressive stance: "They have learnt long ago that you don't fight it but shape it the best way you can because they cannot pick up and move from California" (Interviewee, October 2007).

To "help Angelenos be 'energy misers'", as the LA action plan puts it (City of Los Angeles 2007, p. 5), measures have been adopted ranging from customer rebates and a fund to acquire energy savings to distribution of energy efficient refrigerators and compact fluorescent light bulbs. In addition, the city requires that all new buildings exceeding 50,000 square feet or 50 plus units become LEED (Leadership in Energy and Environmental Design) certified. LEED is a US Green Council award, covering five areas: site; materials; energy efficiency; water consumption; and interior air quality. As building stock turns over every 80 years in Los Angeles, targeting new builds will slowly yield emissions reduction results. This is extremely short compared to the UK's 1000 year building stock turnover. Importantly, for the housing sector the LA Department of City Planning is developing a Green Building programme focusing on the nexus between transit and housing. To this end, the department is developing a standard of sustainability for new building projects in the city, which it intends to regularly strengthen in accordance with technological development. Many interviewees have referred to the substantial cultural barrier around transit. In the words of one (September 2008):

> "There have also been efforts around reducing LA's carbon footprint by putting housing and jobs closer to transit and by increasing housing density in the past ten years. Given the cultural barrier around connecting high-income, single-family districts to the public transportation grid, progress has been slow and the focus has been on creating residential units in commercial quarters and increasing density there. This, however, also requires developing infrastructure (schools, etc.) to encourage families to come into these areas."

Another impediment to building out LA's public transportation system is, as one interviewee (September 2007) noted, "that Southern California disposes of an especially virulent dose of NIMBYism – not in my back yard attitude. There is a sense of entitlement among especially rich Americans where they feel they can act in their narrow self-interest if they want to." One prominent example is that plans for building a new light rail line are being upheld by one particular neighbourhood community because of the associated noise.

There have been requests from members of the business community to the city to put in place codes and regulations on green buildings, but at the same time, there is resistance to such measures from other segments of the community. As a compromise, measures have started low and are being strengthened over time to obtain the buy-in from a larger segment of commerce.

Business behaviour is targeted through a number of initiatives including a green business certification scheme, incentives for the growth of local green businesses and identification and promotion of locations for green businesses. Over 50 buildings are being designed to LEED standards in the private sector and 48 buildings in the public sector have already been completed. (*LA Times*, 16 November 2007)

4. Working together?

Urban responses to climate change can not be neatly contained within the boundaries of the city limits or the corridors of municipal government. Rather, cities such as Los Angeles are required to work together with a range of partners, with local and national government, and in the context of international policy. These interactions can provide additional barriers and opportunities for action at the city level (Research Question 2), as we discuss below.

4.1 Partnership

Partnership has been an important element in Los Angeles' approach to climate change. First, Green LA, the coalition of the major environmental organisations in LA, was contracted by the mayor to help with the details of the LA action plan, providing broad expertise and contributing new policy ideas. Green LA is made up of some 60 environmental groups and a large part of its activity focuses on climate change. For the first time, the issue of climate change has brought together previously opposing environmental groups, such as environmentalists and new urbanists as they realised that increased urbanisation has environmental benefits in terms of the positive effects on transport of denser housing. Second, to help with the implementation of this plan the mayor has set up a climate action team with representatives from every city department. Collaboration with the 15-member City Council, deemed to have the greenest credentials of any to date, has also been important. Third, organisations such as ICLEI and the Clinton Foundation have played important roles in terms of raising visibility and identifying best management practices.

4.2 Collaboration with local community

Collaboration with the local community has been very important for LA for several reasons. First, ownership is shared among community members in collectively reducing the city's carbon footprint. Second, different groups within the community have different different ways of communicating, thereby expanding the overall reach of the city's actions and policies. Third, there is the benefit of the snowball effect whereby the groups reached will communicate with yet other people and knowledge about climate change can spread further. In the words of a local community leader (October 2007):

> "The barrier is politicians are afraid people won't support the policy changes. And so the partnership that has to happen, from non-governmental to governmental, and the ones involving corporations as well...because big players like this country and this city, even though there is Kyoto and other protocols, there is arrogance and resistance to ever going along."

More than on energy, water and housing do efforts to reduce GHG emissions in the transport sector rely on partnership. Because LA's transportation system is financed differently than in most places, the city has to raise 90 percent of the funds locally and would receive only 10 percent from the state, as mentioned above. Building a comprehensive public transportation system is key to significantly reducing emissions from the transportation sector, which make up around 50 percent of LA's emissions. A new tax will be put to the vote in November of this year to finance new rail and metro lines as well as widening existing freeways, requiring a two-thirds majority. Debate among members of the LA County Metropolitan Transit Agency's Board of Directors, including LA County Supervisors, the Mayor of LA and city council members of LA County cities, is currently ongoing about which projects would be included in the proposal. A significant drawback is the length of time – 30 years – it will require to have in place a comprehensive transit system for the city that would present a real alternative to the car.

4.3 Role of state and national government

In the US, environmental programs are structured in a way that much of the implementation of national environmental standards is delegated to the states. They further delegate some powers either to regional government entities or in fact local government or cities. There has for a long time been the acceptance in California that national standards are a floor and that individual states can go above them, which California mostly has.

The withdrawal on the Kyoto Process by the Bush Administration in 2001 is seen mostly as a catalyst for local action, although at some level this is creating more a barrier than a driver as policy measures are hierarchically related. Where the lack of support from the federal government has been most limiting has been in terms of leadership and funding, especially for research, development and commercialization of technology. In addition, segments of interstate commerce are being federally preempted. The current number of lawsuits between private, subnational and federal entities is an indicator for the extent of competition between segments of society in terms of setting the country's policy agenda. For the atmosphere, this is bad news, because "if we had the support of the federal government we could certainly accelerate the pace at which we are actually able to implement" (Interviewee, October 2007).

5. International climate policy and the 'new global'

The third research question posed by this project relates to the significance of post-2012 climate policy for global cities, and how developments at the urban level might affect international climate policy. In Los Angeles, in contrast to the importance of relationships with partners, local environmental and business communities and the state government, the international climate policy arena was seen to have less *direct* impact on LA's climate change policy response. The role of climate science was seen as instrumental, especially regarding the projected regional impacts of climate change. The international negotiations, and in particular the detail of what was or was not to be included in a post-Kyoto agreement, was seen to be of little significance. However, the *indirect* impact of international climate policy was noted. First, the importance of an international target and timetable was largely acknowledged, especially in terms of pushing national leaders toward recognition of the urgency of climate change.

Despite the potential importance of the international climate change policy in providing a framework for action, one striking finding was the way in which the failings of the federal and international level to address climate change were providing impetus for action. As one interviewee (October 2007) put it, "it's a clear sense from anybody in the progressive mindset that our national actors, and internationally we're not doing enough." Instead, urban responses to climate change were viewed as more dynamic and effective given the fit with where a large share of emissions is being sourced. The LA climate change response is remarkably autonomous from other levels of governance. Leaders in LA have framed climate change as a local impetus for action and are focussing attention mainly on where there are the biggest opportunities and where mitigation is at the same time adaptation to climate change.

6. Conclusion

Although it is too early to evaluate the success of the particular approach Los Angeles has taken to addressing climate change, it is noteworthy that Los Angeles is acting remarkably autonomously and is focusing on the supply side of emissions which city administrators have control over. That is greening urban infrastructures: energy and water supply as well as housing and ground operations at air and sea ports. At the same time, this focus constitutes a strategy of reducing vulnerability from climate change in the future. Where measures are modest at best is in the area of conservation and transport. Partnership is largely focussed locally, while interplay with state and federal policies is either not sufficiently addressed (state) or constitutes a significant barrier to further reductions (federal). While mayoral leadership has been instrumental in coordinating and pushing city-wide initiatives, LA's mature environmental community is providing crucial social capital in implementing the city's action plan. Impetus to act on climate change has been driven by state leadership, horizontal (C40, ICLEI) structures and individual aspirations. Currently, measures reap 'low-hanging fruits' but may have to be significantly strengthened in the next phase of activity and in the context of an emerging global prerogative under a post-2012 climate framework.

The *failings* of the global community to address climate change are providing a significant impetus for action. In contrast to the seemingly unending arguments at the international level, urban policy is seen as more dynamic, and, as the source of a significant proportion of carbon dioxide emissions, potentially more effective. Los Angeles has a particularly significant role to play in the context of the United States' continued obstruction of international efforts to address climate change. Given its size, economic weight and multicultural makeup, it acts as a significant role model, both domestically and internationally.

Regarding the impacts of, and influence on, the post-2012 international climate policy framework, this report draws three conclusions. First, any agreement will be better than none as it provides direction and a framework for action. The specific details of the international agreement are less important than its general features. Second, the international agreement is likely to have an *indirect* impact on Los Angeles, in particular because of its importance of climate policy positions of the United States and the nature of business engagement on the issue. Third, Los Angeles' influence on the international policy framework is also rather *indirect*. Through its leadership position in the C40 network, Los Angeles, together with London and other global cities, may be affecting the tenor of domestic climate politics in several countries which will be critical in the make-up of the post-2012 policy framework. In this manner, a non-nation state actor such as Los Angeles may be significant beyond its jurisdictional realm.

Bibliography

Bang, G., A. Tjernshaugen and S. Andresen (2005**), "**Future U.S. Climate Policy: International Re-engagement?" *International Studies Perspective* 6, 2, 155-305

Betsill, M. and H. Bulkeley (2007), "Looking Back and Thinking Ahead: A Decade of Cities and Climate Change Research", Guest Editorial, *Local Environment* 12, 5, 447–456

CAR 2006, US Climate Action Report, http://unfccc.int/essential_background/library/items/3599.php?rec=j&priref=6044&suchen=n

CPUC 2005, "Implementation Roadmap for Energy Policies", http://docs.cpuc.ca.gov/published/REPORT/51604.htm

City of Los Angeles (2007), "A Green Los Angeles", http://www.libertyhill.org/common/publications/Greenla/GREENLA_to_print.pdf

Depledge (2005), "Against the grain: the United States and the global climate change regime", *Global Change, Peace & Security* 17, 1, 11-27

EPA (2008), "Notice of Decision Denying a Waiver of Clean Air Act Preemption for California's 2009 and subsequent model year Greenhouse Gas Emission Standards for New Motor Vehicles", *Federal Register* 73, 45

Green LA 2006, A Green Los Angeles, Recommendations to the City of Los Angeles from Green LA, a Working Group for a Just and Sustainable Future, http://www.libertyhill.org/common/publications/Greenla/GREENLA_to_print.pdf

Hanemann, M. (2008), "California's New Greenhouse Gas Laws", *Review of Environmental Economics and Policy* 2, 1, 114–129

Harrison, K. (2007), "The Road not Taken: Climate Change Policy in Canada and the United States", *Global Environmental Politics* 7, 4, 92-117

LA Times, 24 March 2008, "'Corridors' of power are finding resistance", http://articles.latimes.com/2008/mar/24/nation/na-corridors24

LA Times, 16 November 2007, "Bid to make buildings greener Okd", http://www.latimes.com/news/local/la-me-green16nov16,0,1922393.story

LA Times, 30 June 2007, "Near the rails but still on the road", http://www.latimes.com/news/local/la-me-transit30jun30,0,4693321.story?page=3

METRO (2008), **"**Metro Survey Shows Overwhelming Support for Proposed Half-cent Sales Tax", http://www.metro.net/news_info/press/metro_113.htm

Pew Center (2008), http://www.pewclimate.org/

Stern, N. (2006) The Stern Review on the economics of climate change HM Treasury, London
Villaraigosa, A., "City of Dreams", Remarks of Los Angeles Mayor Antonio Villaraigosa, Town Hall Los Angeles, 9 November 2005, http://www.lacity.org/mayor/myrspeeches/mayormyrspeeches280948898_11092005.pdf

Tyndall Centre for Climate Change Research

Tyndall Working Paper series 2000 - 2008

The Tyndall Centre working paper series presents results from research which are mature enough to be submitted to a refereed journal, to a sponsor, to a major conference or to the editor of a book. The intention is to enhance the early public availability of research undertaken by the Tyndall family of researchers, students and visitors. They can be downloaded from the Tyndall Website at:

http://www.tyndall.ac.uk/publications/working_papers/working_papers.shtml

The accuracy of working papers and the conclusions reached are the responsibility of the author(s) alone and not the Tyndall Centre.

Papers available in this series are:

- Wang T., Watson J, (2008) **Carbon Emissions Scenarios for China to 2100**: Tyndall Working Paper 121

- Bergman, N., Whitmarsh L, Kohler J., (2008) **Transition to sustainable development in the UK housing sector: from case study to model implementation:** Tyndall Working Paper 120

- Conway D, Persechino A., Ardoin-Bardin S., Hamandawana H., Dickson M, Dieulin C, Mahe G, (2008) **RAINFALL AND WATER RESOURCES VARIABILITY IN SUB-SAHARAN AFRICA DURING THE 20TH CENTURY:** Tyndall Centre Working Paper 119

- Starkey R., (2008) **Allocating emissions rights: Are equal shares, fair shares? :** Tyndall Working Paper 118

- Barker T., (2008) **The Economics of Avoiding Dangerous Climate Change**: Tyndall Centre Working Paper 117

- Estrada M, Corbera E., Brown K, (2008) **How do regulated and voluntary carbon-offset schemes compare?**: Tyndall Centre Working Paper 116

- Estrada Porrua M, Corbera E., Brown K, (2007) **REDUCING GREENHOUSE GAS EMISSIONS FROM DEFORESTATION IN DEVELOPING COUNTRIES: REVISITING THE ASSUMPTIONS**: Tyndall Centre Working Paper 115

- Boyd E., Hultman N E., Roberts T., Corbera E., Ebeling J., Liverman D, Brown K, Tippmann R., Cole J., Mann P, Kaiser M., Robbins M, (2007) **The Clean Development Mechanism: An assessment of current practice and future approaches for policy**: Tyndall Centre Working Paper 114

- Hanson, S., Nicholls, R., Balson, P., Brown, I., French, J.R., Spencer, T., Sutherland, W.J. (2007) **Capturing coastal morphological change within regional integrated assessment: an outcome-driven fuzzy logic approach**: Tyndall Working Paper No. 113

- Okereke, C., Bulkeley, H. (2007) **Conceptualizing climate change governance beyond the international regime: A review of four theoretical approaches**: Tyndall Working Paper No. 112

- Doulton, H., Brown, K. (2007) **'Ten years to prevent catastrophe'? Discourses of climate change and**

international development in the UK press: Tyndall Working Paper No. 111

• Dawson, R.J., et al (2007) **Integrated analysis of risks of coastal flooding and cliff erosion under scenarios of long term change**: Tyndall Working Paper No. 110

• Okereke, C., (2007) **A review of UK FTSE 100 climate strategy and a framework for more in-depth analysis in the context of a post-2012 climate regime**: Tyndall Centre Working Paper 109

• Gardiner S., Hanson S., Nicholls R., Zhang Z., Jude S., Jones A.P., et al (2007) **The Habitats Directive, Coastal Habitats and Climate Change – Case Studies from the South Coast of the UK**: Tyndall Centre Working Paper 108

• Schipper E. Lisa, (2007) **Climate Change Adaptation and Development: Exploring the Linkages**: Tyndall Centre Working Paper 107

• Okereke C., Mann P, Osbahr H, (2007) **Assessment of key negotiating issues at Nairobi climate COP/MOP and what it means for the future of the climate regime**: Tyndall Centre Working Paper No. 106

• Walkden M, Dickson M, (2006) **The response of soft rock shore profiles to increased sea-level rise.** : Tyndall Centre Working Paper 105

• Dawson R., Hall J, Barr S, Batty M., Bristow A, Carney S, Evans E.P., Kohler J., Tight M, Walsh C, Ford A, (2007) **A blueprint for the integrated assessment of climate change in cities.** : Tyndall Centre Working Paper 104

• Dickson M., Walkden M., Hall J., (2007) **Modelling the impacts of climate change on an eroding coast over the 21st Century**: Tyndall Centre Working Paper 103

• Klein R.J.T, Erickson S.E.H, Næss L.O, Hammill A., Tanner T.M., Robledo, C., O'Brien K.L.,(2007) **Portfolio screening to support the mainstreaming of adaptation to climatic change into development assistance**: Tyndall Centre Working Paper 102

• Agnolucci P., (2007) **Is it going to happen? Regulatory Change and Renewable Electricity**: Tyndall Centre Working Paper 101

• Kirk K., (2007) **Potential for storage of carbon dioxide in the rocks beneath the East Irish Sea**: Tyndall Centre Working Paper 100

• Arnell N.W., (2006) **Global impacts of abrupt climate change: an initial assessment**: Tyndall Centre Working Paper 99

• Lowe T.,(2006) **Is this climate porn? How does climate change communication affect our perceptions and behaviour?**, Tyndall Centre Working Paper 98

• Walkden M, Stansby P,(2006) **The effect of dredging off Great Yarmouth on the wave conditions and erosion of the North Norfolk coast**. Tyndall Centre Working Paper 97

• Anthoff, D., Nicholls R., Tol R S J, Vafeidis, A., (2006) **Global and regional exposure to large rises in sea-level: a sensitivity analysis**. This work was prepared for the Stern Review on the Economics of Climate Change: Tyndall Centre Working Paper 96

• Few R., Brown K, Tompkins E. L, (2006) **Public participation and climate**

change adaptation, Tyndall Centre Working Paper 95

- Corbera E., Kosoy N, Martinez Tuna M, (2006) **Marketing ecosystem services through protected areas and rural communities in Meso-America: Implications for economic efficiency, equity and political legitimacy**, Tyndall Centre Working Paper 94

- Schipper E. Lisa, (2006) **Climate Risk, Perceptions and Development in El Salvado**r, Tyndall Centre Working Paper 93

- Tompkins E. L, Amundsen H, (2005) **Perceptions of the effectiveness of the United Nations Framework Convention on Climate Change in prompting behavioural change,** Tyndall Centre Working Paper 92

- Warren R., Hope C, Mastrandrea M, Tol R S J, Adger W. N., Lorenzoni I., (2006) **Spotlighting the impacts functions in integrated assessments. Research Report Prepared for the Stern Review on the Economics of Climate Change**, Tyndall Centre Working Paper 91

- Warren R., Arnell A, Nicholls R., Levy P E, Price J, (2006) **Understanding the regional impacts of climate change: Research Report Prepared for the Stern Review on the Economics of Climate Change,** Tyndall Centre Working Paper 90

- Barker T., Qureshi M, Kohler J., (2006) **The Costs of Greenhouse Gas Mitigation with Induced Technological Change: A Meta-Analysis of Estimates in the Literature**, Tyndall Centre Working Paper 89

- Kuang C, Stansby P, (2006) **Sandbanks for coastal protection: implications of sea-level rise. Part 3: wave modelling**, Tyndall Centre Working Paper 88

- Kuang C, Stansby P, (2006) **Sandbanks for coastal protection: implications of sea-level rise. Part 2: current and morphological modelling**, Tyndall Centre Working Paper 87

- Stansby P, Kuang C, Laurence D, Launder B, (2006) **Sandbanks for coastal protection: implications of sea-level rise. Part 1: application to East Anglia**, Tyndall Centre Working Paper 86

- Bentham M, (2006) **An assessment of carbon sequestration potential in the UK – Southern North Sea case study:** Tyndall Centre Working Paper 85

- Anderson K., Bows A., Upham P., (2006) **Growth scenarios for EU & UK aviation: contradictions with climate policy,** Tyndall Centre Working Paper 84

- Williamson M., Lenton T., Shepherd J., Edwards N, (2006) **An efficient numerical terrestrial scheme (ENTS) for fast earth system modelling**, Tyndall Centre Working Paper 83

- Bows, A., and Anderson, K. (2005) **An analysis of a post-Kyoto climate policy model**, Tyndall Centre Working Paper 82

- Sorrell, S., (2005) **The economics of energy service contracts**, Tyndall Centre Working Paper 81

- Wittneben, B., Haxeltine, A., Kjellen, B., Köhler, J., Turnpenny, J., and Warren, R., (2005) **A framework for assessing the political economy of post-2012 global climate regime**, Tyndall Centre Working Paper 80

- Ingham, I., Ma, J., and Ulph, A. M. (2005) **Can adaptation and mitigation**

be complements?, Tyndall Centre Working Paper 79

- Agnolucci,. P (2005) **Opportunism and competition in the non-fossil fuel obligation market**, Tyndall Centre Working Paper 78

- Barker, T., Pan, H., Köhler, J., Warren., R and Winne, S. (2005) **Avoiding dangerous climate change by inducing technological progress: scenarios using a large-scale econometric model**, Tyndall Centre Working Paper 77

- Agnolucci,. P (2005) **The role of political uncertainty in the Danish renewable energy market**, Tyndall Centre Working Paper 76

- Fu, G., Hall, J. W. and Lawry, J. (2005) **Beyond probability: new methods for representing uncertainty in projections of future climate**, Tyndall Centre Working Paper 75

- Ingham, I., Ma, J., and Ulph, A. M. (2005) **How do the costs of adaptation affect optimal mitigation when there is uncertainty, irreversibility and learning?**, Tyndall Centre Working Paper 74

- Walkden, M. (2005) **Coastal process simulator scoping study**, Tyndall Centre Working Paper 73

- Lowe, T., Brown, K., Suraje Dessai, S., Doria, M., Haynes, K. and Vincent., K (2005) **Does tomorrow ever come? Disaster narrative and public perceptions of climate change**, Tyndall Centre Working Paper 72

- Boyd, E. Gutierrez, M. and Chang, M. (2005) **Adapting small-scale CDM sinks projects to low-income communities**, Tyndall Centre Working Paper 71

- Abu-Sharkh, S., Li, R., Markvart, T., Ross, N., Wilson, P., Yao, R., Steemers, K., Kohler, J. and Arnold, R. (2005) **Can Migrogrids Make a Major Contribution to UK Energy Supply?**, Tyndall Centre Working Paper 70

- Tompkins, E. L. and Hurlston, L. A. (2005) **Natural hazards and climate change: what knowledge is transferable?**, Tyndall Centre Working Paper 69

- Bleda, M. and Shackley, S. (2005) **The formation of belief in climate change in business organisations: a dynamic simulation model**, Tyndall Centre Working Paper 68

- Turnpenny, J., Haxeltine, A. and O'Riordan, T., (2005) **Developing regional and local scenarios for climate change mitigation and adaptation: Part 2: Scenario creation**, Tyndall Centre Working Paper 67

- Turnpenny, J., Haxeltine, A., Lorenzoni, I., O'Riordan, T., and Jones, M., (2005) **Mapping actors involved in climate change policy networks in the UK**, Tyndall Centre Working Paper 66

- Adger, W. N., Brown, K. and Tompkins, E. L. (2004) **Why do resource managers make links to stakeholders at other scales?**, Tyndall Centre Working Paper 65

- Peters, M.D. and Powell, J.C. (2004) **Fuel Cells for a Sustainable Future II**, Tyndall Centre Working Paper 64

- Few, R., Ahern, M., Matthies, F. and Kovats, S. (2004) **Floods, health and climate change: a strategic review**, Tyndall Centre Working Paper 63

- Barker, T. (2004) **Economic theory and the transition to sustainability: a comparison of**

approaches, Tyndall Centre Working Paper 62

- Brooks, N. (2004) **Drought in the African Sahel: long term perspectives and future prospects**, Tyndall Centre Working Paper 61

- Few, R., Brown, K. and Tompkins, E.L. (2004) **Scaling adaptation: climate change response and coastal management in the UK**, Tyndall Centre Working Paper 60

- Anderson, D and Winne, S. (2004) **Modelling Innovation and Threshold Effects In Climate Change Mitigation**, Tyndall Centre Working Paper 59

- Bray, D and Shackley, S. (2004) **The Social Simulation of The Public Perceptions of Weather Events and their Effect upon the Development of Belief in Anthropogenic Climate Change**, Tyndall Centre Working Paper 58

- Shackley, S., Reiche, A. and Mander, S (2004) **The Public Perceptions of Underground Coal Gasification (UCG): A Pilot Study**, Tyndall Centre Working Paper 57

- Vincent, K. (2004) **Creating an index of social vulnerability to climate change for Africa**, Tyndall Centre Working Paper 56

- Mitchell, T.D. Carter, T.R., Jones, .P.D, Hulme, M. and New, M. (2004) **A comprehensive set of high-resolution grids of monthly climate for Europe and the globe: the observed record (1901-2000) and 16 scenarios (2001-2100)**, Tyndall Centre Working Paper 55

- Turnpenny, J., Carney, S., Haxeltine, A., and O'Riordan, T. (2004) **Developing regional and local scenarios for climate change mitigation and adaptation Part 1: A framing of the East of England** Tyndall Centre Working Paper 54

- Agnolucci, P. and Ekins, P. (2004) **The Announcement Effect And Environmental Taxation** Tyndall Centre Working Paper 53

- Agnolucci, P. (2004) **Ex Post Evaluations of CO2 –Based Taxes: A Survey** Tyndall Centre Working Paper 52

- Agnolucci, P., Barker, T. and Ekins, P. (2004) **Hysteresis and Energy Demand: the Announcement Effects and the effects of the UK Climate Change Levy** Tyndall Centre Working Paper 51

- Powell, J.C., Peters, M.D., Ruddell, A. and Halliday, J. (2004) **Fuel Cells for a Sustainable Future?** Tyndall Centre Working Paper 50

- Awerbuch, S. (2004) **Restructuring our electricity networks to promote decarbonisation**, Tyndall Centre Working Paper 49

- Pan, H. (2004) **The evolution of economic structure under technological development**, Tyndall Centre Working Paper 48

- Berkhout, F., Hertin, J. and Gann, D. M., (2004) **Learning to adapt: Organisational adaptation to climate change impacts**, Tyndall Centre Working Paper 47

- Watson, J., Tetteh, A., Dutton, G., Bristow, A., Kelly, C., Page, M. and Pridmore, A., (2004) **UK Hydrogen Futures to 2050**, Tyndall Centre Working Paper 46

- Purdy, R and Macrory, R. (2004) **Geological carbon sequestration:**

critical legal issues, Tyndall Centre Working Paper 45

- Shackley, S., McLachlan, C. and Gough, C. (2004) **The Public Perceptions of Carbon Capture and Storage**, Tyndall Centre Working Paper 44

- Anderson, D. and Winne, S. (2003) **Innovation and Threshold Effects in Technology Responses to Climate Change**, Tyndall Centre Working Paper 43

- Kim, J. (2003) **Sustainable Development and the CDM: A South African Case Study**, Tyndall Centre Working Paper 42

- Watson, J. (2003), **UK Electricity Scenarios for 2050**, Tyndall Centre Working Paper 41

- Klein, R.J.T., Lisa Schipper, E. and Dessai, S. (2003), **Integrating mitigation and adaptation into climate and development policy: three research questions**, Tyndall Centre Working Paper 40

- Tompkins, E. and Adger, W.N. (2003). **Defining response capacity to enhance climate change policy**, Tyndall Centre Working Paper 39

- Brooks, N. (2003). **Vulnerability, risk and adaptation: a conceptual framework**, Tyndall Centre Working Paper 38

- Ingham, A. and Ulph, A. (2003) **Uncertainty, Irreversibility, Precaution and the Social Cost of Carbon**, Tyndall Centre Working Paper 37

- Kröger, K. Fergusson, M. and Skinner, I. (2003). **Critical Issues in Decarbonising Transport: The Role of Technologies**, Tyndall Centre Working Paper 36

- Tompkins E. L and Hurlston, L. (2003). **Report to the Cayman Islands' Government. Adaptation lessons learned from responding to tropical cyclones by the Cayman Islands' Government, 1988 – 2002**, Tyndall Centre Working Paper 35

- Dessai, S., Hulme, M (2003). **Does climate policy need probabilities?**, Tyndall Centre Working Paper 34

- Pridmore, A., Bristow, A.L., May, A. D. and Tight, M.R. (2003). **Climate Change, Impacts, Future Scenarios and the Role of Transport**, Tyndall Centre Working Paper 33

- Xueguang Wu, Jenkins, N. and Strbac, G. (2003). **Integrating Renewables and CHP into the UK Electricity System: Investigation of the impact of network faults on the stability of large offshore wind farms**, Tyndall Centre Working Paper 32

- Turnpenny, J., Haxeltine A. and O'Riordan, T. (2003). **A scoping study of UK user needs for managing climate futures. Part 1 of the pilot-phase interactive integrated assessment process (Aurion Project)**, Tyndall Centre Working Paper 31

- Hulme, M. (2003). **Abrupt climate change: can society cope?**, Tyndall Centre Working Paper 30

- Brown, K. and Corbera, E. (2003). **A Multi-Criteria Assessment Framework for Carbon-Mitigation Projects: Putting "development" in the centre of decision-making**, Tyndall Centre Working Paper 29

- Dessai, S., Adger, W.N., Hulme, M., Köhler, J.H., Turnpenny, J. and Warren, R. (2003). **Defining and experiencing dangerous climate change**, Tyndall Centre Working Paper 28

- Tompkins, E.L. and Adger, W.N. (2003). **Building resilience to climate change through adaptive management of natural resources**, Tyndall Centre Working Paper 27

- Brooks, N. and Adger W.N. (2003). **Country level risk measures of climate-related natural disasters and implications for adaptation to climate change**, Tyndall Centre Working Paper 26

- Xueguang Wu, Mutale, J., Jenkins, N. and Strbac, G. (2003). **An investigation of Network Splitting for Fault Level Reduction**, Tyndall Centre Working Paper 25

- Xueguang Wu, Jenkins, N. and Strbac, G. (2002). **Impact of Integrating Renewables and CHP into the UK Transmission Network**, Tyndall Centre Working Paper 24

- Paavola, J. and Adger, W.N. (2002). **Justice and adaptation to climate change**, Tyndall Centre Working Paper 23

- Watson, W.J., Hertin, J., Randall, T., Gough, C. (2002). **Renewable Energy and Combined Heat and Power Resources in the UK**, Tyndall Centre Working Paper 22

- Watson, W. J. (2002). **Renewables and CHP Deployment in the UK to 2020**, Tyndall Centre Working Paper 21

- Turnpenny, J. (2002). **Reviewing organisational use of scenarios: Case study - evaluating UK energy policy options**, Tyndall Centre Working Paper 20

- Pridmore, A. and Bristow, A., (2002). **The role of hydrogen in powering road transport**, Tyndall Centre Working Paper 19

- Watson, J. (2002). **The development of large technical systems: implications for hydrogen**, Tyndall Centre Working Paper 18

- Dutton, G., (2002). **Hydrogen Energy Technology**, Tyndall Centre Working Paper 17

- Adger, W.N., Huq, S., Brown, K., Conway, D. and Hulme, M. (2002). **Adaptation to climate change: Setting the Agenda for Development Policy and Research**, Tyndall Centre Working Paper 16

- Köhler, J.H., (2002). **Long run technical change in an energy-environment-economy (E3) model for an IA system: A model of Kondratiev waves**, Tyndall Centre Working Paper 15

- Shackley, S. and Gough, C., (2002). **The Use of Integrated Assessment: An Institutional Analysis Perspective**, Tyndall Centre Working Paper 14

- Dewick, P., Green K., Miozzo, M., (2002). **Technological Change, Industry Structure and the Environment**, Tyndall Centre Working Paper 13

- Dessai, S., (2001). **The climate regime from The Hague to Marrakech: Saving or sinking the Kyoto Protocol?,** Tyndall Centre Working Paper 12

- Barker, T. (2001). **Representing the Integrated Assessment of Climate Change, Adaptation and Mitigation**, Tyndall Centre Working Paper 11

- Gough, C., Taylor, I. and Shackley, S. (2001). **Burying Carbon under the Sea: An Initial Exploration of Public Opinions**, Tyndall Centre Working Paper 10

- Barnett, J. and Adger, W. N. (2001). **Climate Dangers and Atoll Countries**, Tyndall Centre Working Paper 9

- Adger, W. N. (2001). **Social Capital and Climate Change**, Tyndall Centre Working Paper 8
- Barnett, J. (2001). **Security and Climate Change**, Tyndall Centre Working Paper 7
- Goodess, C.M., Hulme, M. and Osborn, T. (2001). **The identification and evaluation of suitable scenario development methods for the estimation of future probabilities of extreme weather events**, Tyndall Centre Working Paper 6
- Barnett, J. (2001). **The issue of 'Adverse Effects and the Impacts of Response Measures' in the UNFCCC**, Tyndall Centre Working Paper 5
- Barker, T. and Ekins, P. (2001). **How High are the Costs of Kyoto for the US Economy?**, Tyndall Centre Working Paper 4
- Berkhout, F, Hertin, J. and Jordan, A. J. (2001). **Socio-economic futures in climate change impact assessment: using scenarios as 'learning machines'**, Tyndall Centre Working Paper 3
- Hulme, M. (2001). **Integrated Assessment Models**, Tyndall Centre Working Paper 2
- Mitchell, T. and Hulme, M. (2000). **A Country-by-Country Analysis of Past and Future Warming Rates**, Tyndall Centre Working Paper 1

Tyndall Centre
for Climate Change Research

For further information please contact

Javier Delgado-Esteban