

Two Scenarios of the City and the Coming Age of Climate Adaptive Design

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ABSTRACT

This paper argues that there has to be a far more serious engagement with the ways in which climate change will significantly alter the nature of the environment, along with human rural and urban futures. Historically, and pre-historically, climate change has been a major formative and transformative agent of human culture (Rapoport: 1969, Fagin, 2004). We are now at the edge of a moment where the unfolding consequences of this anthropogenically amplified phenomenon will become unambiguously evident in the world around us. The degree to which such change will impact on people and economic life will be directly proportionate to the quality and level of ‘climate adaptive design’ undertaken. This requirement raises crucial issues of ethics and equity.

From outlining the general issue of climate change and human vulnerability, two scenarios are to be presented that contrast moderate and radical action – this to indicate the range and scale of actions that beg to be contemplated and taken. The conclusion will focus on what obstructs positive action and the imperative to overcome them

INTRODUCTION

Many of the historical narratives of humanity present a picture of progressive development – the birth of civilisation, the passage out of ignorance and the formation of cultures of learning, the arrival of the rule of law, post Enlightenment scientific and technological attainment and so on. However, the dialectical nature of these narratives is often overlooked – gains are always at a price. Dominantly, the manifestations of human creation are presented without identifying what was destroyed *en route*. Mostly the mountains of cultural and environmental wreckage left in the wake of humanity’s passage to the future are just not seen. Two linked narratives are now starting to emerge to counter this myopia. The first is the nemesis of the ‘world making’ evident in the ‘world un-making’ of the unrestrained human appropriation of planetary natural resources in the construction of what have become naturalised artificial environments. The second is a contradiction inherent in this act of fabrication – the very world making that was driven by the ambition to make human existence more secure was *de facto* continually increasing the vulnerability of the species. The archaeological evidence of human settlement and climate change tells this story (Fagin: 2004).

Climate change-related extreme weather events as they impact upon ever larger population concentrations are existentially bringing this knowledge into the realisation of popular consciousness. At the very point when the majority of human beings become urbanised, the risk of dense settlement becomes ever more apparent. With some certainty, one can say that human urban existence will increasingly become the target for un-natural disasters.

Of course the populations of cities have been decimated by disease, fire, natural disasters and war for millennia, yet what is now happening has never happened before. Currently, there is a trajectory taking us away from viewing the impacts of extreme weather events on populations as aberrant to seeing them as enfolding a process that requires a re-evaluation of where settlements are built, their size, how they are built, how to retrofit existing settlements and how, irrespective of our culture, we live and materially interact with the environments of our inter-dependence.

At present, the available design and planning regimes, theory and practice are totally inadequate to the challenges they face, including that fact the human utilisation of fossil fuel has created a situation where three times more CO₂ is emitted than natural systems can sequester (Musser: 2004). In this setting it is critical that the relation between emissions reduction and climate adaptive design is understood. It is certainly not a case of either/or. Both are essential, and adaptive design action has to happen because even if more effective ghg mitigation measures were to be taken, significant climate impacts are going to occur for a long time. Obviously the less that emissions are reduced the more the demands there are upon adaptive action. Clearly such action has no ability to erase the problem, all it can do is lessen its intensity.

Facts in context

A few months ago I and a colleague completed a review of the literature on climate change viewed globally, nationally and regionally as part of a project exploring and developing the idea of adaptive design. The project was part of an Australian Greenhouse Office exercise that included commissioning a small series of national case studies. Besides bringing my knowledge of the topic up to speed, I was struck by two things.

First, it was stunning how little is known about the scale and complexity of the problem even in seemingly informed quarters. It was, and is, even more sobering to realise that the majority of the world's population do not even know the problem exists. The majority of these people, it should be remembered, are outside any formal economy – and are thus rendered invisible. Rather being the beneficiaries of globalisation they are its victims. At the extreme there are situations like Sub-Saharan Africa, where there is effectively no formal economy at all. Moreover, in this region of Africa, nations like Ethiopia and Chad have populations of whom 99.4% are slums dwellers. Slums are defined by the UN as habitations that are structurally and pathologically dangerous. Now, many of us were brought up with the idea that those slums that still existed were the residue of C19th industrialisation, and latterly, underdevelopment. The reality is totally at odds with this view: rapid urbanisation and globalisation mean that we are on track for 25% world's population to be

slum dwellers within the next 20 or 30 years. Mike Davis gives a clear picture of this situation in his chilling 'Planet of Slums' article (Davis: 2004). To take just one instance: "Lagos, moreover, is simply the biggest node in the shanty-town corridor of 70 million people that stretches from Abidjan to Ibadan: probably the biggest continuous footprint of urban poverty on earth (Davis 2004:11)".

Second, almost all the climate scientists work for universities, government departments or government funded organisations. In this country, and others, such funding has ideological strings attached that are very noticeable. One detects an imbalance in their presentations. Their analysis is rigorous, they expose an often truly terrifying picture. In contrast, the action they pose are so often extremely conservative, and couched in mild terms. As one prominent scientist said to me "I am pleased that people like you from independent organisations are working in the field. I am so constrained; I cannot speak publicly without getting a sign-off on what I am going to say." Notwithstanding restricted vision of politicians produced by the electoral horizon, it is extraordinary that the picture being presented by high grade scientific research to government seems to be making so little a mark.

Let's look at a snapshot of the situation.

It took 100,000 years for the human population to reach 3 billion; it took 100 for this figure to double (2000). In the next 50 years it will almost double again. These are not, however, the most significant facts. Between 1900 and now 2005 the environmental impact of one person in the industrialised world has increased by a factor of at least 20. I can place these stats in a personal context: the world's population has doubled since I left school and in the last full academic position I held, I was earning 25 times per year more than my father's highest salary on his retirement in 1973 and 80 times per year more than my first job when I left school. This is a massive multiplier, and as more countries industrialise, it becomes even more significant.

Even if population numbers fell, impacts would go on increasing. Our current efforts, as far as sustainability is concerned, are pitiful.

Consider: the atmospheric concentration of carbon dioxide (CO₂) has increased by 31% since 1750. The present carbon dioxide concentration has not been exceeded during the past 420,000 years, and likely not during the past 20 million years. The current rate of increase is unprecedented over at least the past 20,000 years (Pittock: 2003a & b).

About three-quarters of the anthropogenic emissions of carbon dioxide to the atmosphere during the past 20 years is due to fossil fuel burning. The rest is predominantly due to land-use change, especially deforestation. (IPCC: 2001)

In Queensland temperatures are rising at a faster rate than the global average. The projected increases are 0.3°C to 2°C by 2030 and 0.4°C to 6°C by 2070. There are twelve major climate modelling systems in the world, eleven of them agree that because greenhouse gas mitigation measures have been so feeble temperatures will reach the high side of these projections. It's not unrealistic then to look at a 1.5°C increase by 2030 being added to warming trends evident in Australia since 1950, and 4.5°C increase by 2070. (Cai: 2003) What would this mean?

Well, current research indicates 25% of all eucalypt species will not survive a 1°C increase. That Sydney, even Melbourne will be sub-tropical; that there will be a massive loss in biodiversity, more frequent and longer droughts, major bush fires, less ground moisture as a result of more drying and, at the other extreme, more flash floods and soil erosion because what rain that arrives will come in intense extreme weather events. (Hughes: 2003) Heat stress will become a major problem for plants, animals and people, especially the very young and old – you may recall that 34,000 people died of heat stress in Europe in 2004. In coming decades there will be currently populated parts of Australia that will be unliveable. Already graziers from central Queensland are migrating to the wetter northeast of the state. This snapshot is but a fraction of a bigger picture. The sobering thing to remember is we are just in the early phase of a situation and that even if we neutralised it would take over 200 years to adjust. That's how long it would take for deep sea temperatures (the planet's thermostat) to lower and CO₂ levels to fall – CO₂ has an atmospheric life of two hundred years plus.

Are there still any sceptics? Yes of course, but their universe shrinks by the day.

Their view that global dimming (the thickening of clouds by emitted pollutants) would cool things down was wrong, as was the notion that satellite-gained data from the upper atmosphere disproved warming was happening. One merely has to log on to the NASA global watch website and watch the polar ice-caps melt to get a sense of the speed of change.

Are there positives? Yes, but they are mostly short lived. Some farmers look forward, for instance, to increased crop productivity from CO₂ fertilisation, but within a season or two nitrogen and protein levels drop off rapidly.

More fundamentally, the concern rests as much with the unknown as with the known. It has been recognised that change does not always occur in climate systems incrementally but can come from a seemingly minor event cascading and leading to accelerated transformation. Knowing this is one thing, spotting trigger events is another.

Can our cities, we and our existing level of knowledge cope with this situation as it is already unfolding? Currently and unequivocally, the answer is no.

Heat in focus

To illustrate my claim I am going to focus on heat islanding.

As you know 'heat islanding' results from the thermal mass of the city absorbing heat and radiating it day and night. The asphaltic concrete of road; the concrete, steel, bricks, masonry and ceramics of buildings and infrastructure effectively turn the city into a vast storage heater. The exhaust heat from vehicles combined with the exhaust of heating and cooling systems not only makes this situation worse, but add to the emissions that increase global warming. Such actions spin a vicious circle. The two most evident symptoms of 'heat islanding' are the temperature differentials between the city and surrounding rural areas – this can be up to 10°C – and the loss of the day/night temperature gap.

Let's be clear, I am not talking about a prospective danger but one already present and growing. Tokyo is a dramatic example. The city is now experiencing summer weeks and months of 40°C+ temperatures. It's so bad that at various times people are instructed by authorities to take buckets of water out onto the streets and pour them on pavements to cool things down.

For our cities, what has to be contemplated and responded to are the kinds of increased temperatures that can be expected in the coming decades as intensive urban development continues. We should remember that the climatic assumption upon which our cities and towns were built have fallen by the wayside. Certainly many built in a temperate zone are going to become sub-tropical for all or part of the year.

TWO SCENARIOS

We are somewhere in mid 2030s, by now the temperature has risen 1.6°C above its level at the year 2000 (which was more than double the rise of the previous century). One response to the situation was moderate, the other radical.

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Back in the 1980s, Australia had been governed by a radical and progressive regime which decided that unchecked urban sprawl, population concentrations and the projected traffic problems of Sydney and Brisbane could really only be redressed by building two new cities. The NSW city, Greensville, was planned to be between Port Macquarie, and Taree; the Queensland city was to be west of Bundaburg.

Today Greensville is a city of one million plus people; in form, economy, culture and climate it is much like Brisbane. In the political scheme of things its council was regarded as enlightened. It has taken things like public transport, public space, recycling and water conservation all seriously. Because of a major commitment to minimising its urban footprint and the social vitality of its CBD, its inner city was well planned. Although a new city, it developed a great night life, a vibrant small business sector and a flourishing commercial centre. Notwithstanding careful planning, it still unfortunately acquired significant traffic problems – not least because of the large numbers young families its affordable housing attracted. These

people not only opted to live in the suburbs – lots of space for the kids being a big plus for them – but brought the practice of taking their children everywhere by car. The public transport system, although well designed and subsidised, could not displace this practice, became uneconomic and ended up having to be cut back, thus entrenching the very thing it had tried to avoid.

Bankslandia

This city is almost a mirror image of Greenville in size, activity, form and, and until recently, appearance. Up to a year ago you if you drove from one city to the other you would hardly notice the difference between them. This was largely because of the architectural pluralism that ruled the design of both cities. Rather than a singular and coherent design vision for each, they were designed by clusters of prominent, established and ‘promising’ architectural practices whose styles were ‘representative of the best of Australia’. But now things have changed.

Bankslandia elected a radical council. The mayor, Jimmy Case, had spent two years working in Tokyo back in the first decade of the 21st century. Notwithstanding increasing temperatures from global warming, and the failure of the city architects to have sufficiently considered heat islanding, he was determined that Bankslandia would not become such a ‘hot-hole.’ As a result of his attitude, just two months after his appointment he took the city engineer, head of planning, chair of the planning committee and four members of the community, including the president of the youth council, on a one week study tour to Tokyo during one of the city’s water weeks. His aim was to show the team what had to be prevented. On the team’s return home a whole series of briefing sessions were conducted with councillors and council officers to explore the development of a ‘climate change adaptation’ policy and practice for the city. The policy was to have two strands: countering heat islanding; and, the limitation of impacts from extreme weather damage. Policy development was to go hand-in-hand with a series of technical studies. The whole endeavour was launched, along with an exhibition, exactly one year after the council was elected.

The city was stunned. Uproar followed, it lasted for months, and hundreds of thousands of people thought the council was mad and out to destroy the city. But slowly after a massive media blitz, numerous public meetings and the distribution of very well thought out publicity material, these people started to realise that the future of the city, their future, was on its way to being secured. Support grew.

Within six months of the launch, a massive retrofit program was to be put in place.

It would be paid for by public funds and a special rates levy based on projected energy savings over ten years. This scheme allowed businesses and householders to borrow to undertake approved retrofit works against these saving and repay via their energy bills.

A vast street and school playground covering shade structure program was also to be implemented. The centres of numerous streets would be ripped, edged and planted with palms and broad leaf trees. A major park and suburban street tree planting program would be introduced. Water for this 'green plan' would come from sub-surface storage of stormwater run-off to be created under hard and soft landscape surfaces through the city. This water would be pumped by a network of solar pumps to where it would be needed. Hundreds of public and corporate buildings would have their eastern, western and northern faces transformed by cables and nets for vines to grown on – this from a whole range of free standing and hung planter boxes. Flat roofs were to either have fly-roofs added to them or roof gardens. All of this planting, in order to shade concrete.

A 'day of the week' colour traffic code would be introduced. Cars would display windscreen sticker applicable within a city 'colour drive zone' – based on a three kilometre radius from the centre of the CBD. The basis of the scheme was that it was only possible to drive to the city '1-in-3'. What it aimed to do was to force a culture of car sharing into existence.

Because the city was already having large energy demand problems driven by air conditioning and chillers in hot weather a 'de-gridding' program would be introduced that required all this technology to be put on a dedicated circuit within two years – this to be powered by a reticulated mixed technology renewable energy program sponsored by the council.

As far as extreme weather was concerned, shade protection would be designed to double-up as hail protection (some of it sacrificially), flash flooding from intense rain would be mitigated by road form modification to better manage overland flow and increased ground recharge capacity (including that created by all the tree planting plus whatever could be deflected into the new ground storage). Additionally, stormwater drainage would be sized up to direct as much water as possible to an urban covered dam that was to be built. The fitting of HWDPS (high wind-speed damage prevention shuttering) was made compulsory for all public buildings and schools. Householders would be encouraged, via a small installation grant program, to fit shutters to any unsheltered window. All light-weight buildings were required to have anchorage inspections and undertake all work as required within 36 days. Finally, wind fences and shelters were built throughout the city.

The costs of all this work were staggering, but so was the level of economic activity it generated. What was not really grasped before the exercise begun was the level of interest the project would create world-wide. Visits, TV documentaries and news, magazine and newspaper articles, books – all this virtually created another local industry which was a major boost for the local economy and council.

Besides major material adaptive actions there was a dramatic cultural restructuring that equally changed the nature of the city. The core of this cultural program was the redesign of work and the working day.

The routine of offices, shops, factories and education establishments of all kinds was transformed, this by the afternoon being a 'turn-off and close-down' time for 90% of the city. For most people the working day started at 5am and finished at 1pm, or conversely started at 5pm and ran to 1am. Additionally, a whole heap of architectural design innovation was brought to workplaces to support these changes, this especially around the creation of un-serviced intermediate workspaces. Basically new and existing verandas were covered and shaded, unglazed outdoor work shelters were built and exterior facing rooms were retrofitted to improve day-lighting and natural ventilation. All these structures were netted to keep insects out and were un-serviced except for a 'light-load' power supply.

Of course there were problems. There was cheating with car colour stickers, some of the workmanship on 'green-leafing' the buildings was not as good as it should have been. A considerable number of trees and vines died because contractors failed to employ seasonal forecasting when they planted. Even so the results were remarkable. The summer city/rural night temperature differential changed from 7.6°C to 2.1°C, the city's energy load was reduced by 17.4%, heat stress mortality fell from 207 people to 12, air quality was perceptibly better, absenteeism fell by 4.3%, hotel occupancy rates were at an all-time high and the city was on the map.

Greenville

As for Greenville, its council tried up-to-a-point to deal with the changing climate, but things did not go that well. Their voluntary energy efficiency program had a mixed take-up and was overwhelmed by a massive surge in demand from air conditioning system installation and upgrades. A climate adaptation program was instigated, there was a great deal of rhetoric about how important the issue was, but only a modest budget was allocated to doing anything. The result didn't go much beyond tree planting, shade structures in parks and playgrounds and a publicity campaign. As time passed, the inner city got hotter and more unpleasant. Heat islanding rather than being a topic known about by the few became one of constant everyday conversation.

All of those people who could afford it moved out to the suburbs. The result: the once attractive buildings and streets became drab, property values fell, crime increased and then the trees and grass of the parks started to die from heat stress, lack of water and the absence of care. By this time, the council was fighting a rear guard action. No matter what campaigns they launched, leaflets they mailed, rates rebates they came up with, as impacts grew the drift toward ever greater discomfort and dysfunction grew. Added to this situation, a series of extreme weather events over three years did a great deal of damage to the fabric of the city. A bridge was lost, many buildings were seriously damaged, the city's stylish street lights, and large numbers of the street trees, were blown down. The biggest problem, however, was that the sewerage works was put out of action for three months. In desperation, the council adopted a 'batten down the hatches' approach – shutters were fitted to the windows of government and commercial buildings and damaged buildings were

boarded–up. Thereafter, the city staggered on with ‘a dead centre’, a shrinking population and relocation of a great deal of its commerce to fragments on its edge.

A reflection

While these scenarios are far-fetched, they assist in making a few very pertinent points:

- to deal with heat islanding, radical action needs to be taken now
- moderate action is not a viable option if the problem is taken seriously
- the transition from research, development and planning to practical action has to be rapid, having said this, there is already a lot of knowledge already available begging to be tapped
- the problem of heat islanding can be lessened to a degree by technology but technology itself cannot solve the problem.
- heat islanding should be an issue and major agenda item of planning, architectural design and building construction, education and professional development
- although not completely linked to climate change, it will be, with water shortages, one of its most overt urban manifestations
- economically, the cost should be immediately confronted. Not dealing with the problem will be infinitely more expensive
- change depends on the creation of a political will.

BACK TO NOW

It’s true that adaptation to climate change is now on the agenda of a few research organisations and government departments. But notwithstanding the quality of a good deal of current research, the extent and practical implications of the challenge is still not being confronted. At worst some current activity is little more than managerial busy work and ‘risk to government’ evaluation. In fact the moment in which the actual identification of obstacles to the taking of positive action has not even arrived.

Certainly, Australia, and the developed world in general, has failed to do the best and most appropriate thing – mitigate global warming by dramatically reducing ghg emissions. If there is an equal failure to embrace substantial adaptive action, then the human race is really in even deeper trouble.

There are faint glimmers of hope – climate adaptive design has started creeping onto the agenda of the Australian Greenhouse Office (AGO 2005). More significantly, the greatest degree of leadership is coming from the recognition of the problem in the rural sector (Howden: 2003). Work on the urban lags behind this sector.

Conclusion

Clearly, much still obstructs heat islanding, and adaptive action in general, being taken seriously. There is certainly a lack of knowledge, political will and imagination.

In the discourses of planning, urban design, architecture and urban studies the issue of climate change, and the related condition of heat islanding, is still of subordinate status. Implications are just not being grasped. For instance, these issues create an immediate collision with current debates on urban consolidation not least because heat islanding places a massive question mark against any action which increases the overall volume of the city's consolidated thermal mass. Certainly the form of the city now has to be seen via the prism of human vulnerability. More dramatically, questions of the abandonment and resettlement, in whole or part, of some of the cities and towns that are, or will be, at risk needs discussion and contingency planning well before a critical moment arrives. More frequent cyclones, increased danger of fire, lack of water, biological systems breakdown, a terminal agricultural economy – these will become real risks for thousands of urban or rural dwellers. Globally the number of environmental refugees already outstrips those created by war. Environmental destruction resulting from climate change also has the ability to trigger a breakdown of the social fabric, and so produce lawlessness and chaos. As for instance recent conflicts on the border of Ethiopia and Kenya over water illustrate, these are no longer film script fantasies but real dangers to which Australia will not be immune.

One might ask, how many of our city councils are exploring such prospects and how to avoid them? Less futuristically, how many of them are materially and culturally planning to retrofit part, or all, of an existing city so it can function in the climate zone heading toward it?

Finally, getting these issues identified, aired and actioned is not a capitulation to negativity, but the registration of responsibility. Doing such work publicly is critical in two senses: it is a way to contribute to the public being made aware of the seriousness of the unfolding situation; and it is essential for planning preventative action and disaster mitigation.

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