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"INFLUENCING CLIMATE THROUGH GREENING OUR CITIES"

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Dr Webber

Distinguished Guests

Ladies and Gentlemen

Good evening and thank you for the invitation by the Victorian Chapter of the Australian Institute of Building to address you.

You might well be asking why a former soldier and vice regal office holder with no scientific, engineering, architectural or building experience, has chosen to address you on the urgent imperative for strong and innovative leadership to change the way we manage urban landscapes to help mitigate the impact of climate change.

It is because of my interest in land / water management and its influence on food security and climate change. I maintain that cities are increasingly impacting on both, through their take up of good agricultural land for housing purposes and in their high consumption of water, energy and food. Just as important but less recognized, is how cities can alter local micro-environments via changes to their vegetative cover philosophy and thus influence local water cycles and thereby influence local climates. Hence good urban environmental management needs to be integral to Australia's total landscape regeneration strategy.

I now want you to imagine that you are standing in the middle of a well grassed green field with a house and a large tree with a canopy of about 10 metres in diameter also in it. The temperature in the paddock is some 30 degrees.

When you go into the house or the shaded verandah you find the temperature is about 27 degrees, a bit like being under a parasol or umbrella. You then walk under the tree and the temperature is markedly cooler - perhaps 21 degrees. What has caused being under the tree to be so much cooler than the house or paddock? Patently it is not just due to the shade, as the house and verandah were only 3 degrees cooler. It is of course due to the transpiration by the tree which takes water from the soil onto its leaves which is then evaporated as vapour into the atmosphere along with heat from the tree's environment thereby cooling it. The tree of course also draws down CO_2 from the atmosphere, converts it via photosynthesis into sugars and the production of oxygen on which we and most life on earth depends. This photosynthetic draw down of carbon is how all biomass, terrestrial bio-systems and healthy organic soils have been created; the soil organic matter levels being critical in enabling soils to hold and supply that water. After rising into the atmosphere, cooling and condensing, the transpired and evaporated water then falls again as rain to enable the photosynthesis and cooling processes to be repeated in what is called the small water cycle.

This process of evaporating and transpiring water from the leaves of trees and forests into the upper atmosphere requires vast quantities of heat; thereby cooling the local surface environment. As trees often have 10 times greater areas of leaves than their ground area the cooling effect of these natural solar powered 'air conditioners' can often be significant, as outlined in our example, without involving fossil fuels or adverse emissions.

Let us now imagine we are in a 2 hectare asphalt and concrete car park near the grass field. Instead of just 30 degrees, the surface temperature of the carpark could be 40 or even 50 degrees, 10-20 degrees hotter than the field and 20-30 degrees hotter than under the tree, which had been cooled by the small water cycle.

As no rain water can penetrate the asphalt, the soil underneath may be parched and unhealthy. There is no photosynthetic or cooling small water cycle process. Hence the car park is both effectively dead but also a hot spot; absorbing and re-radiating heat.

Most of the surface area of our cities and suburbs have effectively been turned into such hot spots, re-radiating huge quantities of heat that impact local weather patterns through the destruction of the former natural small water cycles that previously cooled these landscapes. Collectively these local changes can also contribute to the increasing severity of droughts, floods and fires that we need to expect as our climates change.

So what must we do? Broadly speaking, we must revegetate as much of the earth's former natural land surface, including its cities, as quickly as possible, so as to restore the natural, cooling small water cycles. Concurrent with that we need to further reduce the carbon footprint of our activities and cities through using more energy efficient, low carbon building materials, transport alternatives, recycling strategies and energy sources.

Now for some details.

Ladies and gentlemen. Australia is the driest inhabited continent on earth with the most variable weather and increasing climatic extremes. We are in the 'front line' of impacts from these extremes and need to find new solutions for these climatic challenges urgently. Our only options for doing so is in securing and regenerating the health of our environment.

With 93% of our population living in our towns and cities, Australia as the most urbanized country in the world, has not just the greatest responsibility to enhance urban environments, but also considerable opportunity so to do.

Because cities contribute substantially to environmental degradation through loss of precipitation, pollution of streams and rivers, excessive CO_2 emissions from powerstations, transport and industry, social pressures of isolation and overcrowding, health issues resulting from pollution of air and water, increasing volumes of untreated waste and an adverse influence on our climate, particularly via the impairment of the small water cycle, cities must take responsibility for finding solutions and speedily at that.

Fortunately we have the means to address these challenges, through the ‘ greening’ of our cities by better urban design, better town planning and better use of sustainable, ‘green’ materials in construction and through recycling.

Current Situation in Urban Areas

This is not just a critical issue for Australia. There is growing pressure around the world to increase the number and size of cities. Indeed, the UN forecasts that urban populations globally will reach 5bn by 2030; that is three out of every five persons will be living in cities with the most dramatic increase in Asia and Africa.[1]

In China, for example, it is estimated that a massive 350 million people will move to cities in the next 20 years.

This growth of urban populations has potentially dramatic consequences on the demand for resources, most particularly water.[2] Urban activities have already changed rainfall patterns, including severely reducing the quantity of water that infiltrates the landscape. While rain is

[1] Wikipedia.org- expansion of cities worldwide

[2] Catherine Anderson, Options of Using Urban Water Runoff To Water Cities, FDI July 2011

often perceived as a nuisance in urban areas, with attention being focussed on draining it quickly from roofed and paved surfaces into the public sewage system and thence out to sea, it instead needs to be respected and conserved as a key national, natural, strategic asset. 'We cannot drain the land limitlessly without having an impact on local precipitation, landscape fertility and climate.'[3]

Vegetation as I hope I have demonstrated, has a substantial cooling effect and transpiring plants, especially trees, are the perfect natural air conditioner for the Earth.[4] Cities as 'hot island equivalents; also divert rain bearing clouds and wind movement from urban areas to cooler mountain regions. Increasing weather extremes are often the result.

So what must we do?

Cities represent a considerable wasted water catchment.[5] Australia has the lowest rainfall of any inhabited continent and we are some of the highest per capita consumers of water. Consequently we need to conserve existing water resources and intelligently and efficiently use every drop.

This includes utilising recycled water, desalinated water and urban runoff.

Pervious surfaces such as parks and gardens allow water to penetrate the soil and infiltrate into subsurface aquifers, whereas impervious surfaces like roads, paths and building roof tops do not. As a result from 40 to 70 percent of rainfall is wasted as runoff and is no longer absorbed by the landscape where it is most needed.[6]

Buildings and roads have an enormous potential to catch water. This runoff however, can contain pollutants and needs to be managed safely. High levels of runoff can accentuate stream erosion, wetland destruction and local flooding, often with catastrophic results, as we saw recently in Toowoomba in Queensland.

Water conservation is becoming a feature of contemporary urban development and best management practices are being used to limit urban runoff. For example in Hammarby Stockholm, rainwater is harvested from roofs and recycled for further use.[7] Urban runoff can also be collected, including through infiltration basins, swales and soak wells. Canberra Airport for example, utilizes grassed swales and water detention basins to capture storm water and redirect it to vegetated areas, and pollutant traps and separator systems ensure clean water filters to Pialligo Brook and then into the Molongolo river and Lake Burley Griffin.[8] Similarly, Scotch College in Melbourne utilizes a number of underground cisterns to collect rain and storm water for non potable use.[9]

Singapore, where 86% of its people live in urban high rise buildings, is a water stressed environment. However, the concrete stormwater drains that once funnelled water to the sea have now been replaced by earth structures planted with vegetation so that storm water is naturally filtered as it moves slowly to the many reservoirs that dot the city.

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[3] M Kravcik et al, Water for the Recovery of the Climate, A New Water Paradigm, 2008

[4] M Kravcik et al, Water for the Recovery of the Climate, A new Water Paradigm, 2008

[5] www.percocrete.com

[6] Catherin Anderson, Options of Using Urban Water Runoff to Water the Cities, FDI July 2011

[7] www.howstuffworks.com

[8] www.canberraairport.com

[9] www.ausdrain.com

Similarly Changi Airport diverts rainwater from the runways into reservoirs and the roofs of many of the high rise buildings collect water into roof top cisterns for non potable use. Singapore has also introduced water tariffs and recycles sewage to return clean water to the city's reservoirs.

In Tokyo, roof runoff is collected and stored in underground cisterns and in Berlin rainwater is collected in underground cisterns to limit flooding within the city.[10] In Indonesia the government has introduced rainwater infiltration wells to reduce their dependence on limited groundwater resources.[11]

To slow down water runoff and cool the local environment, innovators are also creating 'green roofs,' wholly or partially covered with vegetation. City Hall in Chicago, for example, has a green roof[12] and several Kevin McLoud Grand Designs ABC television programs recently have featured eco sensitive houses with turf roofs.

The turf on the roof not only retains rainfall but evaporates it back into the atmosphere thus moderating temperature extremes, particularly in very cold and hot dry climates.'[13]

Similarly the inclusion of parks and gardens in the design and construction of cities can profoundly and positively effect 'the small water cycle' and its hydrology and cooling.

Of course, much is already being done to conserve water with the implementation of half flush toilets, water saving shower heads and the recycling of grey water, and where relevant the use of composting toilets.

There is also an urgent need to review how materials and designs can contribute to greener urban design outcomes. The heat island effect of urban environments is a concern for all cities especially as urban concrete infrastructure is projected to increase twofold by 2025. [14] For example the temperature in Tokyo has already risen by 3 degrees centigrade over the past eighty years resulting in a significant rise in the demand for energy, particularly for cooling in summer.[15] Surely with more concrete based building planned, such heat effects may rise dramatically.

As the building industry is responsible for approximately a third of our CO_2 emissions, greener 'building materials and designs have the potential to significantly reduce our emissions and their environmental impact.[16] Australia has the opportunity to help lead the way in this key area. Lend Lease, for example, has developed an online program that demonstrates how design and use of buildings can be changed to reduce their environmental impact.[17]

[10] www.rainwaterharvesting.wordpress.com
[11] www.unep.or.jp/ietc/publication/urban
[12] www.howstuffworks.com
[13] M Kravcik, Water for the Recovery of the Climate: A New Water Paradigm,2008
[14] www4.unw.edu/cbu/Papers/2007
[15] West & McCardle A Comparative Analysis of Building Development Technologies
[16] www4.uwm.edu/cbu/Papers/2007
[17] www.thefifthestate.com.au/archives

Moreover, many of today's buildings are not being built to last and will need modification, repair or rebuilding in a relatively short space of time. Developers, architects and engineers need to be given incentives to design and construct buildings that last and utilize durable low impact materials that do not require frequent restoration or replacement.

For example, magnesium carbonates can be used in the manufacture of cement to not only make it cheaper, but also aid the environment by absorbing and drawing down carbon dioxide from the atmosphere, thereby reducing the net carbon footprint of that building and city.

There are many other brilliant building innovations that need to be adopted more widely. Bligh 1 in Sydney is a high rise where good ideas have made a world class green building. Real air, chilled beams, solar panels, water recycling and sewage mining have all been incorporated into the construction. The building is shaped as an ellipse to increase the volume to surface area ratio so as to minimise heat transfer, energy use and wind turbulence.

Whereas the large area of glass would normally generate catastrophic heat gains, the use of louvres prevents the sun reaching and warming the inner skin of the building.[18]

The Australian Pavilion at the Shanghai World Expo 2010 similarly leads by example with sustainable design. The building has solar panels, each 40 metres square to achieve a significant reduction in power use. The building also harvests rainwater which is then treated for use in the toilets and for landscaping. Sensor fans and smart lighting run only on demand.[19]

White or silver roofs have also been promoted as a means of reflecting solar heat and cooling buildings.[20] Whilst valid, the reflected heat also makes the atmosphere above hotter. Consequently, vegetation to shade roofs and open spaces may be a more effective means to cool buildings. The risk of fires from such vegetation would of course need to be assessed, particularly in Australia, but could be mitigated by the use of suitable vegetation and improved urban design. To reduce fire risks there is an argument for buildings to have no guttering at all, runoff being captured and stored in tanks below ground, from drains constructed around the roof line.

Ladies and gentlemen, roads collect giga litres of water and this water, generally mixed with pollution, is usually redirected into rivers and streams and eventually into the sea.[21]

Both urban and rural roads throughout Australia are largely impervious and this encourages maximum wasteful run off. Pervious roads, on the other hand, have a permeable pavement surface with the capacity to store water underneath and promote infiltration of water into the sub soil.

For example, the construction of pervious pavements using lime mortar, aggregate and gap grading with only a paste of bitumen, has the capacity to filter water falling on them, releasing it slowly in sub surface drains or aquifers, with little run off to carry rubbish and

[18] Elizabeth Farrelly, The Sydney Morning Herald Thursday Setember 8 2011
[19] www.thefifthestate.com.au/archives
[20] Prof David Karoly, ABC Radio Interview, Monday 26 September 2011
[21] John Harrison, Creating a sustainable Future, www.tececo.com 2010

pollutants into drains and rivers. Roads could also act as massive carbon sinks, as aggregates used in their construction can be made out of carbonates and making the construction of roads more 'open' allows the ground beneath to breathe, thus reducing heat generation.[22] In Tokyo, for example, porous cement pavements have demonstrated the capacity to absorb CO_2.[23]

Another significant issue in the increasing urbanization of the globe, is the direct effect this will have on food security. The United Nations Environmental Program estimates that up to 1% of arable land worldwide is lost to city development annually. Local councils, State and Federal governments need to protect the best and most versatile arable land on the urban fringe from reckless development, as well as mining. Parameters for urban development need to be well articulated and faithfully followed with careful infrastructure planning.

This may mean consideration of policy change where relevant, from the ever expanding low density housing in suburbs to more medium density housing and apartment dwellings.

There is also a real place for 'urban farming' and 'green belts' within the urban environment. In 1835 Colonel William Light was appointed Surveyor General of South Australia and is credited with the design of the city of Adelaide and its 690 hectares of green space. Even then people recognized the need for the citizens of the city to breathe fresh air.[24]

Recreational parks, sports fields, municipal gardens , shelter belts in green spaces, must all be integral to any urban landscape, but these green spaces could also be productive community gardens such as in Havana, Cuba, London or Melbourne, where citizens are actively engaged in inner city food production.

Urban waste is another of the key environmental issues of our time and there is no question that significantly more waste needs to be recycled and composted for use in green spaces, building construction, or to generate energy to assist in powering city buildings. The Paris Opera House, for example, is heated by recycled garbage as is the Hammarby Project in Sweden.[25]

While many local councils provide different waste bins for different types of waste, more urban waste needs to be separated at source and recycled. The New York Waste Management Act requires neighbourhoods to provide for and ensure the collection, separation and recycling of waste rather than hiding it as landfill.[26]

Recycling more newsprint, for example, could reduce deforestation for the production of paper. Similarly, composted organic waste could reduce the need for non organic fertilizers to enhance soil health and sustainable food production.

Our surfeit of used car tyres, particularly in urban areas, remain as stockpiles in local tips. However, recycled tyres are now being used to ameliorate noise in high rise buildings, through the recycled rubber being used in wall insulation and in flooring. It is also used in playgrounds, in the construction of roads and in the manufacture of pavers.

[22] New Scientist
[23] F Pearce, New Scientist, July 2005
[24] Wikipedia, Colonel William Light
[25] www.howstuffworks.com
[26] www.dec.ny.gov

Transport, ladies and gentlemen, is an important challenge in the urban environment. Just how do we best transport citizens so that they can economically and environmentally responsibly access their work, their community infrastructure, their recreation and so on? Today there are 540 million cars on the road and with the rapid increase of drivers in India and China that number is projected to be 3bn by 2030.[27] Today, transport accounts for 20% of worldwide energy use and without rapidly reducing fossil fuel usage is therefore unsustainable. Our Australian culture of individual car ownership and driving everywhere, may need to change. We need to embrace the idea of vehicles powered by natural gas, hydrogen and electricity and create more bike paths in our cities or perhaps even introduce a congestion tax as has been done in London?

We need to move heavy traffic out of cities by constructing more city bypasses and transport nodal points and maximize the use of heavy rail for haulage as well as construct light rail for public transport within our cities.

So How Can We Catalyse The Changes Needed?

Ladies and gentlemen, I recognise that catalysing the changes needed will be difficult. While we have many of the technologies needed to change the urban environment, effecting the needed changes in the culture and attitude of those planning and building our cities and those who live in them, may be our greatest challenge. Encouraging behavioural change incorporating a paradigm shift in urban planning thinking, presents a substantial leadership problem requiring a continuing dialogue with a wide range of stakeholders.

Conclusion

Although much recent focus has concentrated on regenerating our agricultural and catchment landscapes, managing the urban environment must be an integral part of that process. We may also be running out of time. Time to address the challenges of climate change such as rising temperatures, fluctuating climate events, water security, land degradation, future energy options, population growth and the need to increase our food production. The globe is losing its arable land to urban development and people all over the world increasingly are living in ever expanding cities.

It is vital therefore, that all those involved in urban living, planning, design and construction, recognise that there needs to be fundamental change in the way we build and manage cities because of their impact on climate and then have the will to implement such change. Citizens, architects, town planners, local government councils and builders in this country have an unique opportunity to lead the way globally through greening our cities to positively influence climate and substantially reduce carbon footprint.

So go to it and make a difference.

Thank you.

[27] www.ourfutureplanet.org