

The Urban Heat Island Effect and Western Sydney

What is the Urban Heat Island Effect?

The Urban Heat Island Effect is localised warming due to the increase in the large amounts of paved and dark coloured surfaces like roads, roofs and car parks as a result of urban development. The sun's heat is absorbed not reflected and causes the surface and ambient temperatures to rise. Anthropogenic heat production, such as the heat produced through car engines and air conditioners also contribute to the Urban Heat Island Effect. On hot summer days, cities can be several degrees hotter than their rural surrounds.

How is it affecting Western Sydney?

Greening Australia has examined the temperature records and found that a strong Urban Heat Island Effect exists for Western Sydney. Western Sydney is particularly exposed, as, unlike the coastal suburbs, it does not receive the moderating influence of a cooling sea breeze.

Greening Australia found that:

- Over the last 40 years all Western Sydney weather stations have experienced a rise in annual temperatures over and above what would be expected through global warming
- The effect is strongest currently in Blacktown but is also clearly apparent in Richmond, Camden, Liverpool and Parramatta.
- The gap between coastal Sydney temperatures and western Sydney temperatures has widened.
- The number of extreme temperature events has risen dramatically

The following analysis is taken from the climate records from Prospect Reservoir (Western Sydney) and Observatory Hill (Coastal Sydney).

Figure 1 January Mean Maximum Temperatures

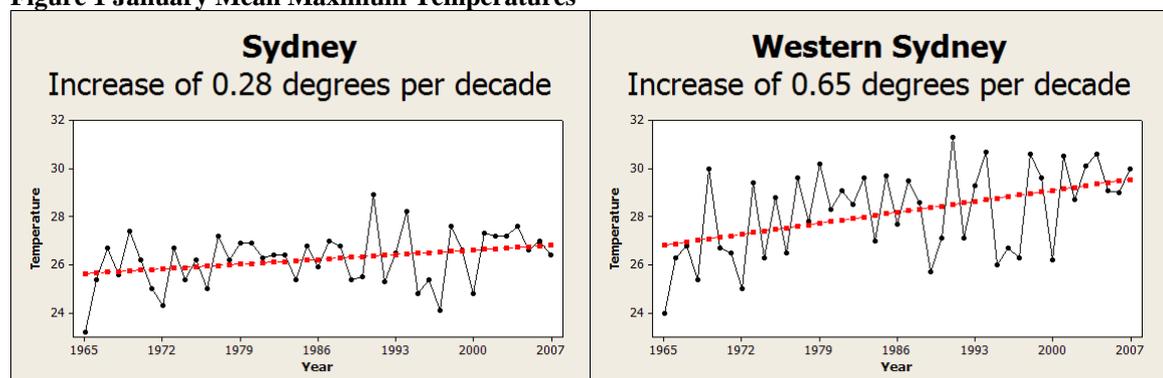


Figure 1 indicates that the January mean maximum temperatures for Western Sydney have increased more than twice the rate experienced by coastal suburbs. It is also more than twice the rate expected from global warming.

Figure 2 Temperature of a hot January day (90th percentile)

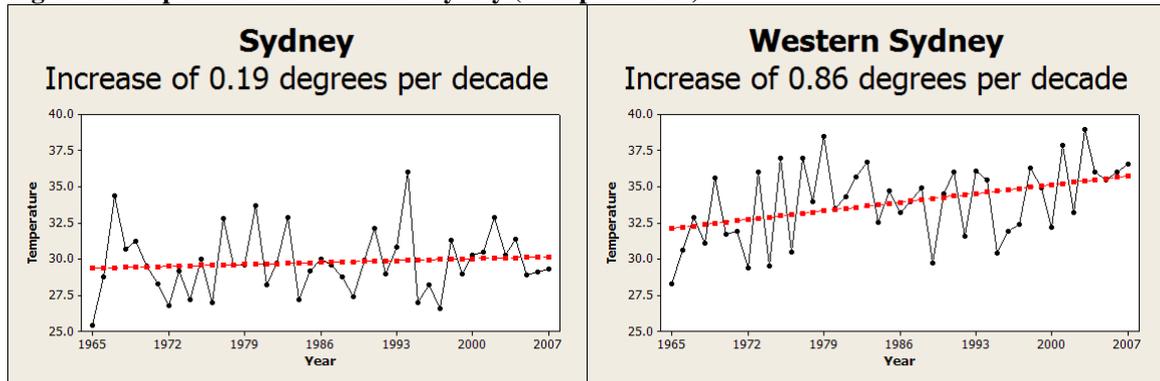


Figure 2 indicates that the temperatures on a 'hot day' in Western Sydney have increased dramatically. In this case a 'hot day' is defined as the highest temperature that occurs three times a month.

Figure 3 Number of very hot (above 35C) days per year

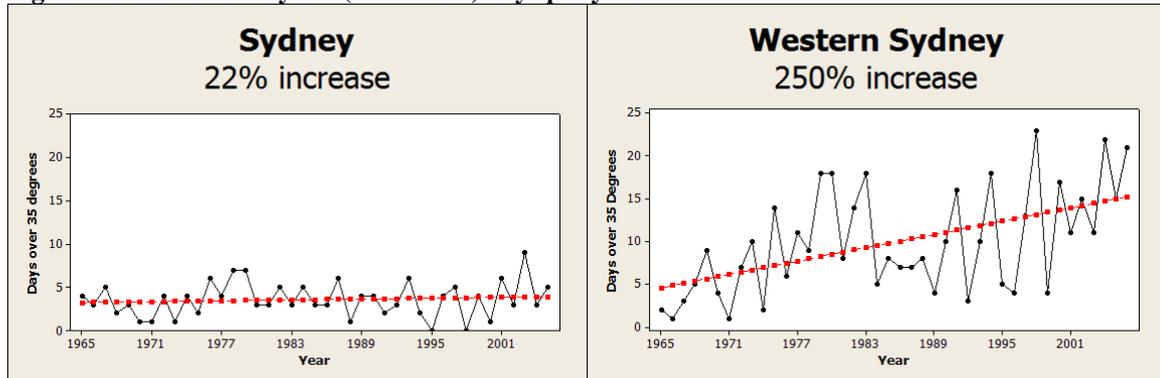


Figure 3 outlines the dramatic increase in the number of days that have occurred each year that has been over 35 degrees Celsius for Western Sydney.

What are the Impacts of the Urban Heat Island Effect?

The Urban Heat Island Effect has the potential to adversely impact a city's public health, air quality and energy use.

- **Poor Air Quality:** Hotter air in cities increases both the frequency and intensity of ground-level ozone (the main ingredient in smog). Smog is formed when air pollutants such as nitrogen oxides (NOx) and Volatile Organic Compounds (VOCs) are mixed with sunlight and heat. The rate of this chemical reaction increases with higher temperatures.
- **Risks to Public Health:** The Urban Heat Island effect intensifies heat waves in cities, making residents and workers uncomfortable and putting them at increased risk for heat exhaustion and heat stroke. In addition, high concentrations of ground level ozone aggravate respiratory problems such as asthma, putting children and the elderly at particular risk.
- **High Energy Use:** Hotter temperatures increase demand for air conditioning, increasing energy use when demand is already high. This in turn contributes to power shortages and increasing carbon dioxide emissions. (Source: <http://www.hotcities.org/> & www.bom.gov.au/info/leaflets/urban_design.pdf)

Other documented impacts as a result of the Urban Heat Island Effect include impacts to agriculture, biodiversity, increased water demand, decreased productivity and even increased rates in domestic violence.

What can we do about it?

Policies and programs that address the causes of the Urban Heat Island Effect can have a real and measurable impact in lowering temperatures at a local level. These include:

- Increasing tree cover as street trees, in backyards and as broad scale revegetation
- Using light coloured roofs instead of dark coloured
- Minimise energy use: especially at peak periods (e.g. through solar hot water systems)

These measures are implemented internationally through legislation, town-planning measures, building codes and standards, incentives and education programs.

To combat the Urban Heat Island Effect the following cities have in place Urban Heat Island Policies or Programs:

- Chicago, USA
- Toronto, Canada
- New Jersey, USA
- Gainesville, USA
- Atlanta, USA
- Houston, USA
- Tokyo, Japan
- Miami, USA
- California, USA
- Arizona, USA
- New York, USA
- Georgia, USA
- Sacramento
- London, UK
- Utah, USA

10 steps to fixing Western Sydney's Urban Heat Island

1. Conserve all large patches of vegetation

The large patches of bushland in Western Sydney moderate the climate of Western Sydney. The trees, shrubs and grasses are natural cooling mechanisms- the evaporation of water from the surface of the leaves cool the air like an evaporative cooler. Many of these large areas are not adequately conserved. If they were to be cleared there would be further increases in local temperatures. This would also have the ancillary benefit of preserving the biological heritage of the Cumberland Plain.

2. Increase vegetation cover across landscape

There is scope to increase the vegetation cover across western Sydney. This can be achieved through strategic revegetation of public open space and agricultural zones. The greatest benefit will be through revegetation along waterways such as the Hawkesbury Nepean River and South Creek. Increased soil moisture near waterways increases the cooling potential of the vegetation. This will have the ancillary benefit of improving water quality and biodiversity values.

3. Maintain green open space

As urban expansion moves further to the west there is an increasing need to incorporate open space into urban development. It is important seek to increase the vegetation cover in these areas. Development of hard surfaces in these areas should be limited. Green open space reduces the likely temperature rise

expected with new development and provides a cool escape for residents during heat waves.

4. Street trees

Street trees are important in that they shade road surfaces and buildings. This can greatly reduce local temperatures. Street trees should be selected on the basis of the level of shade they provide.

5. Light coloured roofing

Light coloured roofing (with high albedo and high thermal emittance) is a genuine way of reducing the expected temperature rise associated with new developments. Especially in mid to high-density developments a light coloured roof can be highly effective in reducing ambient temperatures (by several degrees). They reflect rather than absorb energy from the sun and do not heat up like dark roofs. There is already a bias towards light coloured roofing in BASIX. This bias should be strengthened and development codes should be adjusted to favour their use.

6. Landscaping

Vegetation placed on the east, west and north sides of dwellings block solar radiation reaching buildings and thereby reducing heat storage.

7. Water Sensitive Urban Design

Water sensitive urban design (WSUD) slows the water movement through the urban landscape. Historic urban design sought to shed water off roofs and into stormwater drains quickly. This historic approach results in a drier urban area, which limits the ability of vegetation to cool. WSUD promotes water retention on properties (such as through water tanks) and allows the vegetation around homes to cool more effectively. Water recycling schemes, where residents can use grey water on their gardens, also increases the cooling ability of urban vegetation.

8. Street design

East West oriented street floors are exposed to sunlight all day, while on North South oriented streets; buildings shade the street from radiant heating. However, this limits favourable wintertime sunshine. North West South East and North East South West oriented streets are a good compromise.

9. Reduce energy use

Efforts should be made to reduce energy use in residential homes, especially during peak periods. Light coloured cool roofs are highly effective at cooling homes and reducing cooling demands. Evaporative coolers are far more energy efficient and do not increase ambient temperatures like refrigerative air conditioners. Solar hot water heaters are useful in that they provide greatest benefit during peak periods (hot weather).

10. Mass transport

Shifting commuter travel to public transport reduces private vehicle usage, which is a large contributor of anthropogenic heating.

(This is adapted from Coutts A.M., Beringer J., Tapper N.J. (2007) [Changing urban climate and CO2 emissions: implications for the development of policies for sustainable cities](#). Urban Policy and Research. Submitted May 2007.)

What Greening Australia is doing next?

Greening Australia is working with Professor Andy Pitman of UNSW to develop a research program into Western Sydney's Urban Heat Island effect. There are modelling tools available (supercomputers) that can predict the likely change in temperatures that result from various policy measures (i.e. how much would temperatures decrease if we increased the amounts of street trees in Western Sydney? What would happen if the roofs in the new growth centres were light instead of dark coloured?)

We will also evaluate the impacts of this issue on energy and water use, public health and the environment.

We have partnered with a major corporate sponsor and aim to deliver a communications/education program that will inform developers, planners and architects on ways they can address the Urban Heat island Effect.

Where to go for more information

<http://www.greeningaustralia.org.au>

<http://www.hotcities.org/>

The International Council for Local Environmental Initiatives' online resource for Urban Heat Islands Mitigation

<http://www.epa.gov/heatisland/>

The US EPA's Urban Heat Island Website

www.bom.gov.au/info/leaflets/urban_design.pdf

Australian Bureau of Meteorology information on Urban Heat Island Effect