The Problem?

- The exponential growth of urban areas has produced what science now calls “ urban heat islands” with the major contributing factor being heat-absorbing roofs.
- The temperature in the air above the urban heat islands can be as much as twelve degrees hotter than the surrounding areas.
- As a result of these higher temperatures air conditioning costs and power consumption are increased.
- An alarming result of this excess heat and its demand for additional energy production for cooling is the high levels of ozone and smog experienced in our cities.

Volatile Organic Compounds + Nitrogen Oxides + Heat = Smog

Nitrogen oxides are produced from fossil fuel combustion by motor vehicles and by power plants. They are highly reactive gases that form when fuel is burned at high temperatures.

The major mechanism for the formation of Nitrogen Oxide in the atmosphere is the oxidization of nitric oxide. A suffocating, brownish gas, nitrogen oxide is a strong oxidizing agent that reacts in the air to form corrosive nitric acid, as well as toxic organic nitrates and plays a major role in the atmospheric reactions that produce ground-level ozone (or smog).

Ozone, (or smog) is very sensitive to temperature and with rising temperatures in our cities, smog becomes worse.

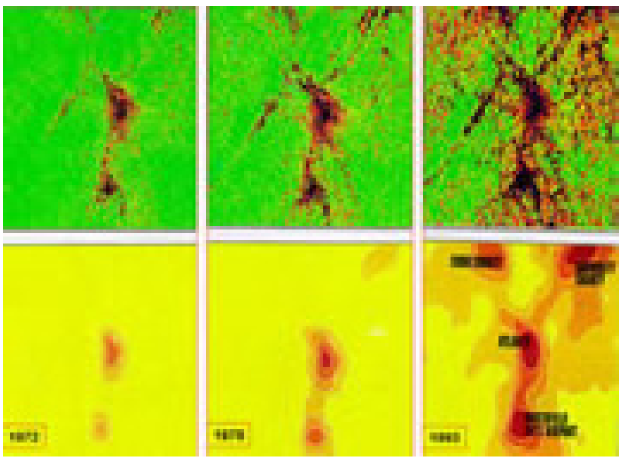
Smog has become a persistent environmental health problem that aggravates allergies and respiratory illnesses, especially in children and the elderly. It is suggested by government authorities that with the increase in city temperatures, smog and health risks will become worse.

Response:

In 1998 the “Urban Heat Island Project” was formed. The project was developed in co-operation with the ENVIROMENTAL PROTECTION AGENCY AND LOCAL GOVENMENTS. The focus of this group is to develop ways to make our cities cooler and thereby reduce pollution, and save energy. Data from these groups has shown there is a steady increase in the "urban heat island" effect over several decades.

Japan is averaging an increase in temperature of 0.60 F per decade; Los Angeles 0.80 F and average minimum temperatures from many stations over most of Australia have shown an increase of between 0.1 deg C and 0.3 deg C per decade since 1951.

The effects of Urban Heat Island in Atlanta Georgia 1978 to 1993. Captured by Satellite thermal imaging.



The Solution?

Solution 1

Test data has shown that on a 37 degree day a Charcoal black roof can have a surface temperature as high as 108 degrees C. On the same day a white roof would reach a temperature of no more than 45 degrees C.

Ideally our first choice of colour to help urban heat should be white as this naturally white keeps buildings cool. Consumers however, want the option of using dark colours as do many regulatory authorities who demand their use to blend with surrounding environments. Understandably, Architects and builders cannot be restricted to the use of white even though this would save energy and help with “urban heat islands”.

The first solution to cooling building surface temperature is summarized in the table below. The table highlights the difference in Solar reflectivity and surface temperatures that would be achieved if our cities were to adopt the entire external use of white, as opposed to Charcoal black as one of the principal dark colours.

Surface Temp and Solar reflectivity of *STANDARD* White on a 37 degree day		
Colour	**%T.S.R.**	**Surface Temperature max**
White	86.2	**45**

Surface Temp and Solar reflectivity of *STANDARD* Charcoal on a 37 degree day		
Colour	**%T.S.R.**	**Surface Temperature max**
Charcoal	5.6	**108**

SUMMARY:

White City:	Total Solar Reflectance 86.2	Surface temperature	**45**

Charcoal City:	Total Solar Reflectance 5.6	Surface temperature	**108**

Solution 2

As previously stated, Architects and builders can not be restricted to the use of white even though this would save energy and help with “urban heat islands”.

The Astec Energy Star Solution is an option where both dark colours and heat reflective functionality can now go hand in hand.

The second solution to cooling building surface temperature is summarized in the table below. The table highlights the difference in solar reflectivity and surface temperatures by comparing standard dark colours with Astec Energy Star dark Coatings. The average is taken across 5 of the most popular colours used in our urban environment today.

Surface temperature and solar reflectivity of *STANDARD* colours on a 37 degree day		
Colour	**%T.S.R.**	**Surface Temperature max**
Charcoal	5.6	108
Slate Grey	16.6	100
Heritage Red	14.2	102
Mist Green	24.5	94
Gull Grey	47.8	76
White	86.2	45
Average	**32.48**	**87.5**

Surface temperature and solar reflectivity of *Energy Star* colours on a 37 degree day		
Colour	**%T.S.R.**	**Surface Temperature max**
Charcoal	32.8	84
Slate Grey	40.3	79
Heritage Red	37.5	81
Mist Green	43.9	76
Gull Grey	68.3	58
White	90.3	41
Average	**52.18**	**69.84**

SUMMARY:

Standard Colours Avg:	Total Solar Reflectance 32.48	Surface temperature **87.5**

Energy Star Avg:	Total Solar Reflectance **52.18**	Surface temperature **69.84**

Result: T.S.R.%	**Total Solar Reflectance increased by**	**19.7%**
Result: Temperature	**Overall temperature decreased by**	**17.66°c**

LINKS:

Heat Island Group	{ HYPERLINK "http://eetd.lbl.gov/HeatIsland/HighTemps" }
Urban Heat Islands Australia	{ HYPERLINK "http://www.earthsci.unimelb.edu.au/~jon/WWW/uhi-melb.html" }
Urban Heat Islands Country Australia	{ HYPERLINK "http://www.earthsci.unimelb.edu.au/~jon/WWW/deniliquin.html" }
Global Warming	{ HYPERLINK "http://www.nrdc.org/globalWarming/heatadvisory/contents.asp" }