Combat Global Warming

Concrete's lighter color makes it cool.
This reduces energy needs, CO_2 levels and global warming!

Concrete: Naturally Cooler

Concrete pavement, because of its lighter colored surface, is more reflective than dark surfaces, like asphalt pavement. This means concrete pavement absorbs less heat and, as a result, has a cooler surface under most conditions. As shown in Figure 1, this results in:

- Less energy consumed through reduced air conditioner (A/C) use in buildings near the cooler pavement.
- Improved air quality through lower ozone, carbon dioxide (CO_2), nitrous oxide (NO_x) and volatile organic chemical (VOC) levels.

Surface reflection is expressed as albedo, the ratio of light energy reflected from a surface to the total incident amount. A perfect absorber (black) has an albedo of 0, and a perfect reflector (white) has an albedo of 1. Asphalt pavement, which typically has a dark surface, has a low albedo, and reflects less of the sun's energy back into the atmosphere. As a result, the absorbed energy heats the pavement and its surroundings. Concrete pavement, with its light-colored surface, has a high albedo, reflects more energy, and stays cooler.

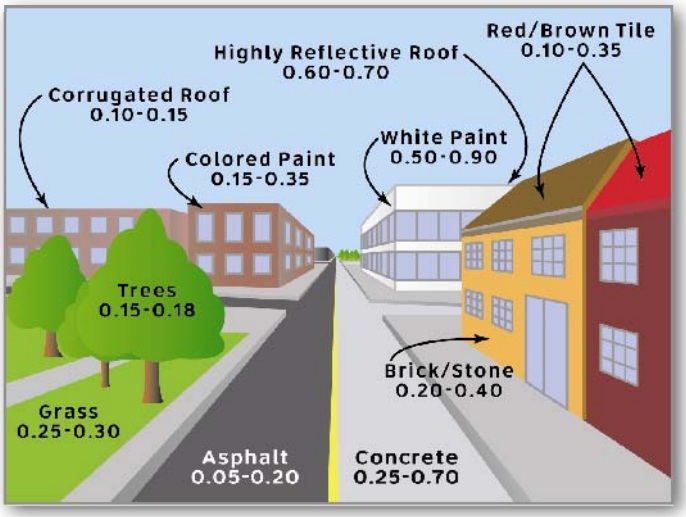

Figure 2. Albedo ranges of various surfaces typical to urban areas. [Sources: NASA, Akbari, and Thayer]

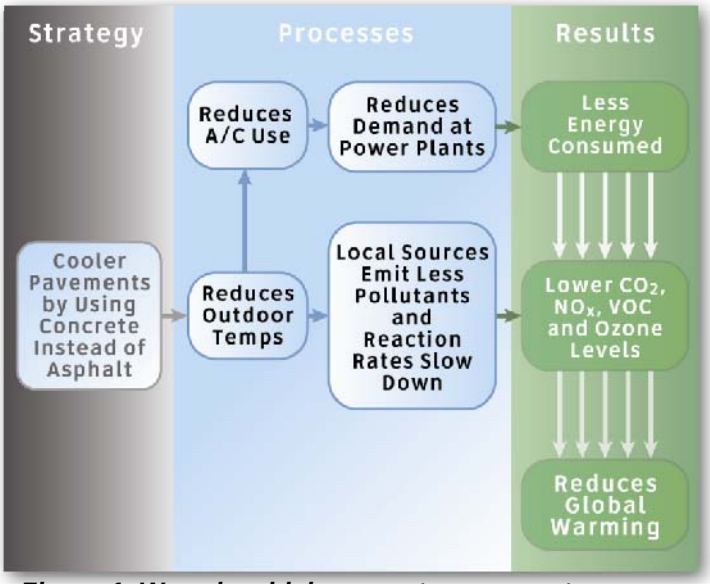

Figure 1. Ways in which concrete pavements can indirectly save energy, improve air quality, and combat global warming. [After: Akbari]

Lighter is Better

Asphalt pavement albedo ranges from about 0.05 to 0.20, depending on the age and makeup of the asphalt. Its albedo typically increases somewhat as its color fades with age.

A typical concrete pavement has an albedo of about 0.35 to 0.40 when constructed; the values can decrease to about 0.25 to 0.30 with normal usage. With the incorporation of slag or white cement, a concrete pavements can exhibit albedo readings as high as 0.70.

As shown in Figure 2, concrete pavement has a significantly higher albedo value than asphalt pavement, new or old. In fact, concrete pavement usually has a higher albedo value than almost every other surface that is typical to urban areas, including grass, trees, colored paint, brick/stone, and most roofs.

Cooler Roads = Cooler Planet

Researchers at the Lawrence Berkeley National Laboratory in California are working to better understand the impact surface reflectivity has on the environment. Researchers are studying the albedo of the urban fabric (see Table 1) and looking at strategies (including cool pavements) to increase our cities' average albedo. The goal is to positively impact energy use, as well as to reduce smog formation, CO_2 levels, and ultimately, global warming. Recent research suggests:

- Urban areas (cities) cover between 1.2 to 2.4% of the earth's land mass.
- Paved areas in 100 of the world's largest cities cover an area of about 630 billion square yards.
- By using concrete pavement, it is possible to increase the albedo of paved surfaces in the world's top 100 cities by an average of 0.15.
- This increase in albedo is accompanied with lower surface temperatures, lower energy use, and lower CO_2, NO_x, VOC and ozone levels.
- **Increasing the albedo of paved surfaces by 0.15 in 100 of the world's largest cities (switching from dark to light-colored) can offset as much as 20 billion tons of CO_2 released into the atmosphere annually!**

As a result of this research, a proposal to the United Nations is being considered to implement cool pavement and similar cool roof strategies to help reduce global warming.

Table 1. Urban Fabric of Various Cities in the U.S.

City	Plants	Roofs	Pavements	Other
Sacramento	20%	20%	**45%**	15%
Chicago	27%	25%	**37%**	11%
Houston	37%	21%	**29%**	13%

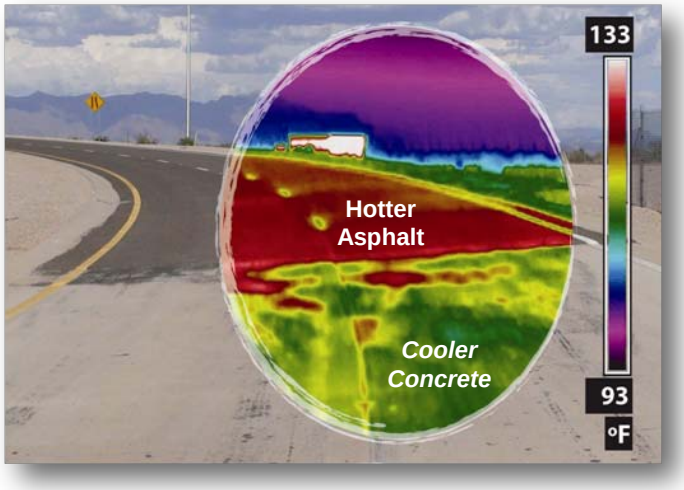

Figure 3. Thermograph of a highway in Mesa, Arizona, illustrating the temperature difference between concrete and asphalt pavements.

But Wait, There's More…

Lawrence Berkeley National Laboratory researchers identified other considerations as well, including the energy consumption and smog associated with higher temperatures in urban areas:

- The demand for electricity increases because of cooling demands as outside temperatures rise. In Los Angeles, for example, the demand for electric power rises 2% for every 1°F increase in the maximum daily temperature.
- The probability of smog formation increases 5% for every 0.5°F rise in daily maximum temperatures above 70°F.
- **Decreasing urban temperatures by as much as 9°F by using concrete pavement surfaces, would reduce electric power demand and smog development.**

Concrete pavements are the right choice, right now!

Sources

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