Heat Wave – Chicago 1995

- “Chicago felt tropical, like Fiji or Guam but with an added layer of polluted city air trapping the heat…”
After about forty-eight hours of continuous exposure to heat, the body's defenses begin to fail. So by Friday, July 14, thousands of Chicagoans had developed severe heat-related illnesses. Paramedics couldn't keep up with emergency calls, and city hospitals were overwhelmed. Twenty-three hospitals—most on the South and Southwest Sides—went on bypass status, closing the doors of their emergency rooms to new patients. Some ambulance crews drove around the city for miles looking for an open bed.

~ Eric Klinenberg, author of Heat Wave: A Social Autopsy of Disaster in Chicago
The heat wave was one of the hottest summers on record. This heat wave led to a health crisis in certain countries and combined with drought to create a crop shortfall in southern Europe.

14,802 people, mostly elderly, died in France from heat, according to the country’s largest funeral service.

Even the Alps, which arc across southeastern France, Switzerland, Austria, and northern Italy (just below image center), were very warm. Glaciers were melting rapidly and swelling rivers and lakes to dangerously high levels, which required climbers to be evacuated from Switzerland’s Matterhorn after melting triggered the collapse of a rock face.
The Smog (Ground-level Ozone) Connection

Smog decreases

Temperature drops
Potential Annual Savings from Changing Roof Reflectivity in 11 Metropolitan Areas

**Figure 1:** Annual net cooling energy savings for 11 metropolitan areas.

*Note:* Numbers are in millions of dollars.
Chicago Energy Conservation Code

Commercial Provisions
(Adapted from 2000 IECC® w/ 2001 Supplement)
‘Cool Roofing Materials’
*(Chicago-Centric Properties…since 2001)*

- Reflectance (ASTM E903, E1918, or field reflectometer verified)
  - Low-Sloped roofs (\( \leq 2:12 \))
    - Initial \( \leq 0.65 \), Maintain \( \leq 0.50 \) for 3 years, **BUT**
    - Minimum 0.25 if installed on or before 12/31/2008
    - EPA Energy Star label standards thereafter
  - Medium-Sloped roofs (\( 2:12 < X \leq 5:12 \))
    - Initial \( \leq 0.15 \), Maintain \( \leq 0.15 \) for 3 years

- Emissivity \( \leq 0.9 \) (ASTM E408)

- Exceptions:
  - Roof top gardens
  - Solar thermal systems
  - Photovoltaics
Chicago – §303 Urban Heat Islands

These reflectance and emittance requirements are intended to minimize the urban heat island effect, as defined in the Definitions Section.

1. The portion of the roof that is covered by a rooftop deck covering 1/3 or less of the aggregate area of the roof, or a rooftop garden, or a green roof, is exempted from the requirements of this section.

2. An area including and adjacent to rooftop photovoltaic and solar thermal equipment, totaling not more than three times the area that is covered with such equipment, may be exempted from the requirements of this section.

Solar Reflectance. All roof exterior surfaces shall have a minimum solar reflectance as specified when tested in accordance with ASTM E903, ASTM E 1918 or by testing with a portable reflectometer at near ambient conditions.

Roofing materials used in roofs with slopes of 0 in 12 to 2 in 12 shall meet the following requirements:

1. Roofs installed prior to and including 12/31/08 shall have a minimum solar reflectance, both initial and weathered, of 0.25.

2. Roofs installed after 12/31/08 shall utilize roofing products that meet or exceed the minimum criteria to qualify for an Energy Star label as designated by the USEPA Energy Star program.
Chicago’s City Hall Grows Green Skin

- “Twelve-stories above Chicago’s busy financial district sits an island of greenery snuggled amid a sea of boiling-hot tar roofs…”
Cool Roofs and Green Space

- Light-colored roofs reflect more sun than dark roofs
  - Buildings cooler; Reduces air conditioning demand
  - Inhibits formation of smog
- Trees & vegetation shade walls/windows
  - Evapotranspiration
  - 30-foot tree-crown ~ 40 gal./day
Effect of Reflectivity & Emissivity on Temperature

Produced by Sarnafil Inc., and Adapted by International Code Council, Inc.

- **black asphalt**
  - low reflectivity
  - High

- **aluminum coating**
  - high reflectivity
  - low emissivity

- **white membrane**
  - very high reflectivity
  - high emissivity

June 8, 2007  <CRRC Need 2 Know Heat Islands>
# Emissive & Reflective Properties of Common Products

Produced by Sarnafil Inc., and Adapted by International Code Council, Inc.

<table>
<thead>
<tr>
<th>Roofing Material</th>
<th>Emissivity</th>
<th>Reflectivity</th>
</tr>
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<tbody>
<tr>
<td>Black EPDM</td>
<td>.86</td>
<td>.06</td>
</tr>
<tr>
<td>Gray EPDM</td>
<td>.87</td>
<td>.23</td>
</tr>
<tr>
<td>White EPDM</td>
<td>.87</td>
<td>.69</td>
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<tr>
<td>Smooth BUR</td>
<td>.86</td>
<td>.06</td>
</tr>
<tr>
<td>White Granular Modified</td>
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<td>.26</td>
</tr>
<tr>
<td>SBS Modified Bitumen</td>
<td>.92</td>
<td>.26</td>
</tr>
<tr>
<td>Dark gravel BUR</td>
<td>.90</td>
<td>.12</td>
</tr>
<tr>
<td>White coated BUR</td>
<td>.90</td>
<td>.65</td>
</tr>
<tr>
<td>Sarnafil/GAF white membranes</td>
<td>.92</td>
<td>.83</td>
</tr>
</tbody>
</table>
Owners of the Ross-Ade Stadium at Purdue University, Indianapolis, Indiana saved a lot of future maintenance headaches and nearly $150,000 by choosing Samafil's Décor Profile Roof System over traditional standing seam metal.
More Resources

1. Chicago Department of Environment OR Construction & Permits
   www.cityofchicago.org

2. EPA Energy Star  www.energystar.gov


5. ASTM E06.21.16  Cool Construction Materials  www.astm.org


8. Los Angeles Water & Power Cool Roof Contractor’s  www.ladwp.com

9. Rebuild America  OR  Energy$mart Schools  www.eren.doe.gov