Cool by Design: The Louisville Urban Heat Management Study

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urban heat and health

assessing heat risk in Louisville, KY

heat adaptation planning elsewhere
2015 Was Hottest Year in Historical Record, Scientists Say

By JUSTIN GILLIS  JAN. 20, 2016
Hurricanes
Floods
Tornadoes
Heat

annual weather related deaths (US)

(2050)
urban areas are warming more rapidly over time than rural areas
the urban heat island effect

loss of vegetation

impervious materials

waste heat

urban morphology
urban warming rankings

- LOUISVILLE
- PHOENIX
- ATLANTA
- GREENSBORO
- DETROIT
- INDIANAPOLIS
- LAS VEGAS
- SYRACUSE
- OKLAHOMA CITY
- TOLEDO
- PORTLAND
- RICHMOND
- WASHINGTON DC
- BATON ROUGE
- ALBUQUERQUE
- EL PASO
- MINNEAPOLIS
- PHILADELPHIA
- ST LOUIS
- NEW YORK
- BOISE
- CHARLOTTE
- HARTFORD
- SEATTLE
- NEW ORLEANS

warming in excess of rural trend (°F/decade)
How does temperature vary across Louisville?
summer daily high air temperatures (°F)
How to cool down Louisville?

- Green roofs
- Cool materials
- Expanded tree canopy
- Reduced waste heat
Cool materials strategies: Reflective roofing and paving
Greening strategies: Minimum green cover by zoning

- Single family residential: 80%
- Multi-family residential: 60%
- Commercial: 50%
- Industrial: 40%
- Parkland: 95%
- Farmland: 100%
- Vacant: 100%
Greening strategies: Street trees

Local street: 50%
Secondary collector: 40%
Primary collector: 30%
Minor arterial: 30%
Major arterial: 20%
Interstates: 0%
Greening strategies: Barren land to grass

80% of barren land to grass
Energy efficiency scenario

% reductions in energy use by 2040

- Buildings
- Vehicles

programmed
scenario
Combined strategies scenario
change in tree canopy under greening scenario (%)
average daily high temperature (current conditions)
average daily high temperature (combined strategies)
area available for strategy

Cool  Green
The pie chart illustrates the area available for strategy, with a larger portion labeled 'Cool' and a smaller portion labeled 'Green'. The bar chart shows the cooling effect per square meter of strategy, with 'Green' having a significantly higher effect than 'Cool'.
relationship between temperature and mortality
estimating heat mortality

![Diagram showing temperature mortality rate graph with average low temperature and average high temperature indicated. The peak mortality rate occurs around 72°F.](urbanclimate.png)
summer heat mortality under current conditions
reduction in summer heat mortality with heat adaptation
Recommendation #1: Convert roofing and paving to cool materials
Recommendation #2: Protect and plant trees
Louisville
Urban Heat Management Study

<table>
<thead>
<tr>
<th>Neighborhood</th>
<th>Total Trees Planted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airport</td>
<td>3,498</td>
</tr>
<tr>
<td>Algonquin</td>
<td>4,118</td>
</tr>
<tr>
<td>Bashford Manor</td>
<td>2,156</td>
</tr>
<tr>
<td>Beechmont</td>
<td>4,738</td>
</tr>
<tr>
<td>Bon Air</td>
<td>5,349</td>
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<tr>
<td>Bowman</td>
<td>2,545</td>
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<tr>
<td>Brownsboro Zorn</td>
<td>1,533</td>
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<tr>
<td>Buechel</td>
<td>4,036</td>
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<tr>
<td>Butchertown</td>
<td>3,606</td>
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<tr>
<td>California</td>
<td>5,298</td>
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<tr>
<td>Central Business District</td>
<td>7,925</td>
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<tr>
<td>Cherokee Triangle</td>
<td>3,015</td>
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<tr>
<td>Chickasaw</td>
<td>2,391</td>
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<tr>
<td>Clifton</td>
<td>1,811</td>
</tr>
<tr>
<td>Cloverleaf</td>
<td>1,674</td>
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<tr>
<td>Crescent Hill</td>
<td>4,053</td>
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<tr>
<td>Deer Park</td>
<td>1,898</td>
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<tr>
<td>Edgewood</td>
<td>2,203</td>
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<tr>
<td>Fairgrounds</td>
<td>6,586</td>
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<tr>
<td>Germantown</td>
<td>2,202</td>
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<tr>
<td>Hazelwood</td>
<td>1,857</td>
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<tr>
<td>Highlands Douglass</td>
<td>2,208</td>
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<tr>
<td>Highview</td>
<td>6,702</td>
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<tr>
<td>Hikes Point</td>
<td>3,545</td>
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<tr>
<td>Industrial East</td>
<td>3,148</td>
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<tr>
<td>Industrial West</td>
<td>3,974</td>
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<tr>
<td>Jacobs</td>
<td>1,787</td>
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<tr>
<td>Klondike</td>
<td>1,844</td>
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<tr>
<td>Newburg</td>
<td>10,070</td>
</tr>
<tr>
<td>Old Louisville</td>
<td>7,348</td>
</tr>
</tbody>
</table>
Recommendation #3: Combine cool and green strategies in all districts
Recommendation #4: Reduce waste heat through energy efficiency
City of Melbourne Climate Change Adaptation Strategy

June 2009
cascading impacts of extreme heat
<table>
<thead>
<tr>
<th>Proposed potential adaptation measures</th>
<th>Risks Influenced / controlled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implement changes to urban form to reduce heat island affect; urban and rooftop gardens; lighter building; roof and road colours; more extensive network of stormwater fed urban wetlands</td>
<td>H1  H2  H3  H4  H5  H6  H7  H8  H9  H10 H11 H12 H13 H14</td>
</tr>
<tr>
<td>Revised building standards incorporating passive cooling, ventilation, and suitably rated materials</td>
<td>H1  H2  H3  H4  H5  H6  H7  H8  H9  H10 H11 H12 H13 H14</td>
</tr>
<tr>
<td>Storm water street sprinkling/cooling mist facility</td>
<td>H1  H2  H3  H4  H5  H6  H7  H8  H9  H10 H11 H12 H13 H14</td>
</tr>
<tr>
<td>Emergency/grid independent generation (e.g. solar) for ventilation</td>
<td>H1  H2  H3  H4  H5  H6  H7  H8  H9  H10 H11 H12 H13 H14</td>
</tr>
<tr>
<td>PT system improvements to reduce knock-on effects of individual breakdowns or service failures e.g. rail tunnel, bus service expansion</td>
<td>H1  H2  H3  H4  H5  H6  H7  H8  H9  H10 H11 H12 H13 H14</td>
</tr>
<tr>
<td>Continued long term replacement of aged train/tram stock to provide greater resilience to hot conditions</td>
<td>H1  H2  H3  H4  H5  H6  H7  H8  H9  H10 H11 H12 H13 H14</td>
</tr>
<tr>
<td>Development and implementation of revised engineering standards for infrastructure</td>
<td>H1  H2  H3  H4  H5  H6  H7  H8  H9  H10 H11 H12 H13 H14</td>
</tr>
<tr>
<td>Ongoing efforts to redesign design public realm for comfort and enjoyment of all in hotter conditions: shading; cool places; public water facilities</td>
<td>H1  H2  H3  H4  H5  H6  H7  H8  H9  H10 H11 H12 H13 H14</td>
</tr>
</tbody>
</table>

Legend: **Control Critical**  ✔* Active Management ✔  Periodic Monitoring ✔  No Major Concern

Table 16: Adaptation measures: extreme heat - long term
Tech climate network
cool paving in Phoenix
Chicago green alleys program
New Orleans resilience district
Thank you!