Cool District Hot City

From Climate Research to Climate Action
Climate Research to Climate Action
Integration Climate Adaptation (UHI) & Climate Mitigation (GHG)

The Urban Climate Change Research Network Second Assessment Report on Climate Change in Cities (ARC3.2)

Chapter 5: Urban Planning & Urban Design
This scholarship provides a blueprint for how to configure sustainable and climate-resilient urban districts.

Download publication:
www.UCCRN.org

Cities: Our Challenge, Our Solution

Compact settlements reduce GHG emissions
Compact urban form contributes to GHG reduction
Low density areas contribute disproportionately to climate change

Urbanization amplifies climate change impacts
Global climate risk accumulates in urban areas due to increased concentration of people, private/public assets, and economic activities

→ Flood Risks
→ Urban Heat

Source: Mehrotra et al., 2011; Revietal., 2014

Each panel represents an entire metropolitan area (i.e., the city and the continuous urban footprint surrounding it), including often much lower-density suburbs.
Source: A. L. Brenkert, Oak Ridge National Laboratory (maps created by Andreas Christen, UBC)
Regional vs Local Climate Impacts
The Case Against Sprawl

“Adaptive Mitigation” = Climate Change Adaptation + Climate Change Mitigation

Reduce the global greenhouse gas effect, while increasing climate resilience to urban heat and flooding
Land Cover, Form, and Spatial Scales

Human Comfort at Street Level

Local Climate Zones

- Building height
- Street width
- Vegetative cover
- Paved area

Atmospheric Layers

Source: Iain Stewart and Tim Oke
Integrating Climate Adaptation (UHI) & Climate Mitigation (GHG)
Prioritizing Adaptive Mitigation

2019 Present
Urban Heat Island
NYIT – GISS, Urban Land Institute

2050 Business-As-Usual
Urban Heat Island
Y. Eynath, Urban Climate Lab NYIT 2019

2050 Zero carbon
Urban Heat Island
Y. Eynath, Urban Climate Lab NYIT 2019

Net-Zero Carbon
(2019-2050)

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<td>2050 Zero carbon</td>
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Integrating Climate Adaptation (UHI) & Climate Mitigation (GHG)
Prioritizing Adaptive Mitigation

Y. Eynath, Urban Climate Lab NYIT 2019

Dialogue: Heat in the City
Global Heat Health Information Network
July 2020
Decision-Making Framework
Urban Climate Factors: Form & Function

**Urban Function**
1. Efficiency of urban systems: reducing waste heat and GHG emissions through energy efficiency, transit access, and walkability

**Urban Form**
2. Modifying form and layout of buildings and districts
3. Heat-resistant construction materials and reflective surface coatings
4. Increasing vegetative cover
Morphological Catalogue: Archetypal Urban Forms
Solar and Ventilation Impact

Urban Retrofitting
Climate-Resilient Urban Design
Design Intervention Process

1. Climate Analysis Mapping
   - Urban Scale
   - Local Scale

2. Public Space Evaluation
   - Level of Comfort
   - User Groups/Climate Intensities

3. Planning and Design Intervention

4. Post Intervention Evaluation

Urban Climate Lab, NYIT
How to make climate science actionable?

Urban Design Climate Workshops

New York City
Urban Design Climate Workshop
New York Institute of Technology, 1551 Broadway
August 11, 2019
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Bridging Science, Stakeholders & Practice
Ecological functions within high-density urban districts
Scenario Modeling

Current Condition
Baseline
Site as it is today
District’s population 17,462 (28 ppl/acre)

2050 Baseline
Business as Usual
Hypothetical scenario based on NYC DCP Rezoning Plan and “market driven full build-out assumptions
District’s population 65,804 (105 ppl/acre)

2050 Prototype
Best Practice
Based on climate adaptive development considering evidence-based “best-practice” urban climate factors
District’s population 65,804 (105 ppl/acre)
Layers – Heat & Flood

Land Surface Temperature - 2019

Land Surface Temperature - 2050

Flood Map & Underwater Streams
Layers – Density Scenarios

Base Contours  
2019 Present  
2050 Business As Usual  
2050 Best Practice Mock-up
Residential Prototypes

Using solar power has potential to achieve net-zero energy use. Each 4-story building has a 40 kW solar panel array.

In each apartment heating and cooling is provided through ultra-efficient mini-split system eliminating use of fossil fuels.

Heat pump water heater is more than 3x as efficient than typical hot water heaters.

Energy recovery ventilation (ERV) recovers 54% of energy from exhaust air providing large energy savings and constant, filtered fresh air for best practice indoor air quality.

Source: R-951 Residence, Brooklyn
Industrial & Manufacturing Prototypes

Strategies:

- Air Heat Pump
- Solar Roof
- Geothermal System
- Passive Strategy
- SUDS

Sections:
Focus Areas

[Diagram showing various design proposals and urban changes, including "Existing," "Proposed," and "Stepped" scenarios.]
Micro-Climate Analysis: Focus Area

Surface Temperatures (July 21st, noon)

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<th>Current Plan 2019</th>
<th>No Change in Development 2050</th>
<th>Best Practice 2050</th>
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Bridging Science & Action in NYC
Implementation Process: Phasing

Short term
- Cool roofing
- Heat-Resistant Construction Materials

Medium term
- Decreased vehicle emissions and traffic
- Non-motorized bike and pedestrian accessibility
- Smart drainage system
- Green roofs or green façades
- Include Urban Heat Island consideration in environmental impact statements (EIS)

Long term
- District energy
- Increased Sky-View Factor through TDR
- Smart orientation of buildings considering sun path and wind direction
- Diversity of building forms
- Linear Parks

Urban Climate Lab, NYIT, 2017
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Value Proposition

Quality of Life
Deliver quality of life as key performance outcome

Social Equity and Cohesion
People-centered urban spaces
Social cohesion and equity as key to resilience, whose success hinges on people-centred urban spaces

Culture
Climate change to lead us to a culture of sustainability