

Resilient Design

Transitioning to the New Built Environment



*Eliakim's Way, Martha's Vineyard Massachusetts
photo: South Mountain Company*

Local Solutions:
Northeast Climate
Change Preparedness
Conference
May 19, 2014

Alex Wilson, President
Resilient Design Institute
Founder, BuildingGreen, Inc.

Superstorm Sandy



Ocean Grove, New Jersey, Oct. 29, 2012, Photo: Pameley Palma, New York Times

Blackout of 2012 - New York City

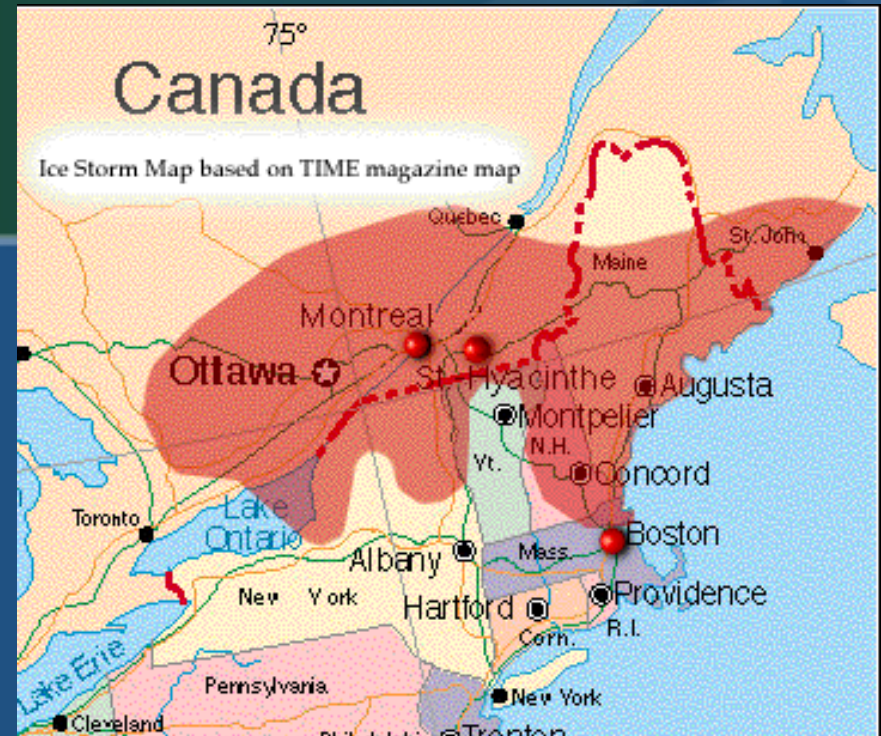


New York City on October 29, 2012 – photo: Eric Chang

1998 Ice Storm



Hydro Quebec pylon - Drummondville, Quebec - January, 1998

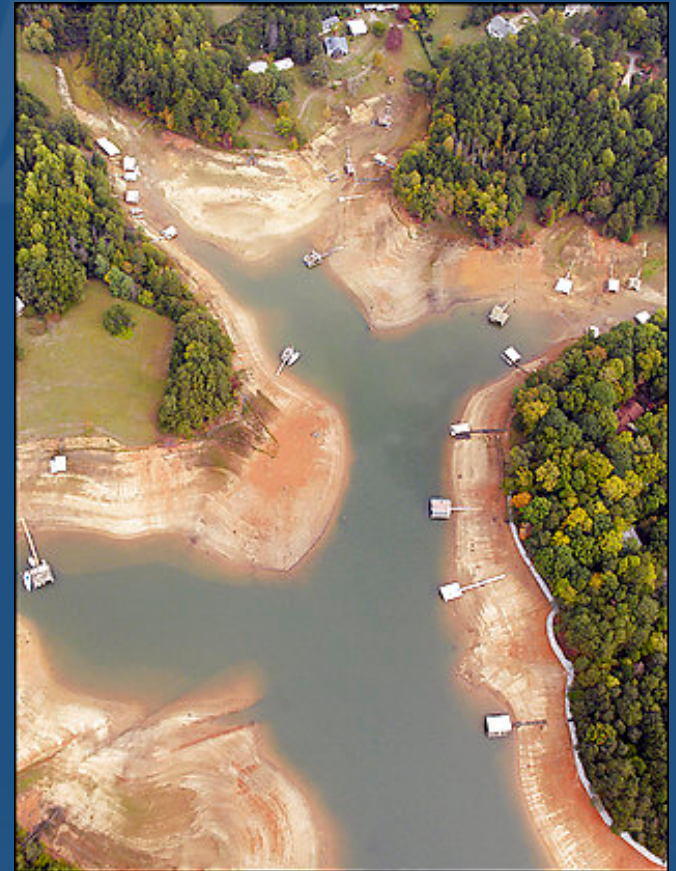


- 3-4 inches of freezing rain January 5-10, 1998
- 130 power transmission towers and 30,000 utility poles destroyed
- 4 million homes lost power; 600,000 families forced from their homes

Drought & Water Shortages



Lake Mead, October 2007, Ken Dewey photo



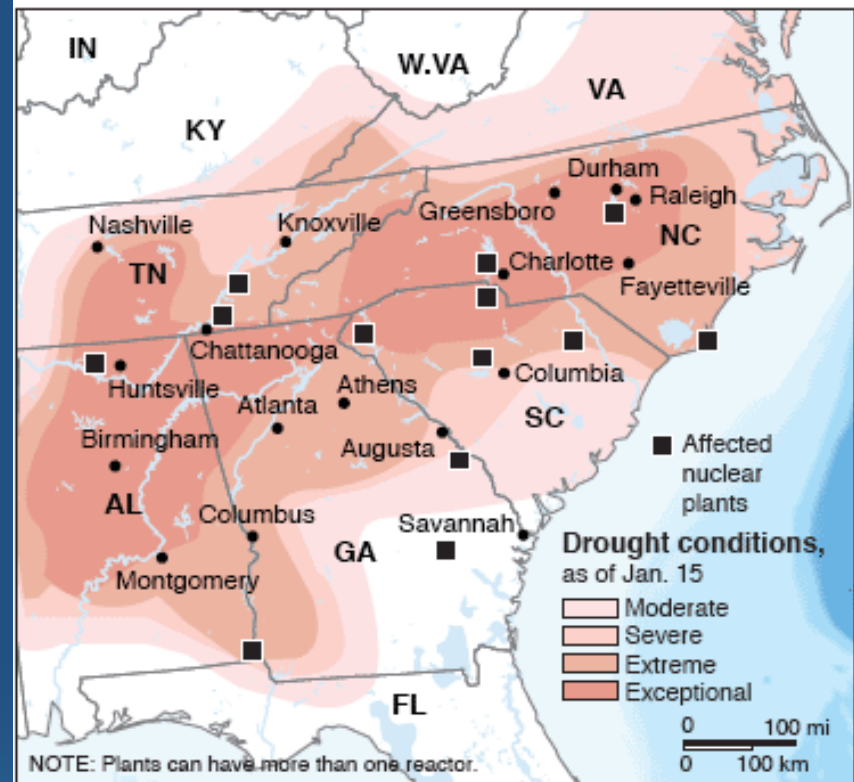
*Lake Lanier, September, 2007
Washington Post photo*

Drought Puts Power Plants at Risk

- 89% of U.S. electricity generation from thermal-electric power plants
- 40% of U.S. fresh water extractions in the U.S. used for power plants
- Vast majority of power plants on rivers
- A nuclear plant in CT shut down briefly in 2012 due to temp of cooling water
- In 2003 drought and heat wave in Europe more than a dozen plants shut down or output reduced

Drought affecting nuclear plants

Twenty-four of the nation's 104 nuclear reactors are in areas experiencing the most severe levels of drought. Rivers and lakes supply power plants with the cooling water necessary to operate.



SOURCES: Nuclear Regulatory Commission; TerraServer USA

AP

1/23/08 AP story on MSNBC

Energy Distribution in the U.S.



- 160,000 miles of high-voltage power lines
- 3,400 power plants
- 150 refineries, half in the Gulf Coast
- 2.5 million miles of oil and gas pipelines



Designing resilient buildings

- Given these concerns, we should be designing buildings and communities
 - That are resistant to damage from storms
 - That will protect occupants from reasonably expected events
 - That will maintain livable conditions in the event of power outages or loss of fuel or water
- An issue both at the building scale and the community scale
- Is resilience the new “sustainability”?

Designing for flood resilience



Flat Street, Brattleboro, Vermont, Sept, 2011. Photo: Charlie Boswell

- Design buildings to withstand reasonably expected storms
- Build to Miami - Dade County Building Code, or comparable—even if not required
- Install flood barriers
- Use materials that can be wetted and then dry out
- Increase use of nonporous materials (e.g., polished concrete)

Surviving floods



*New England Youth Theater, Brattleboro.
Photo: Jerry Stockman*



*New England Youth Theater, Brattleboro.
Photo: Jerry Stockman*

Surviving floods



Flood barrier from the European company EKO Flood - photo: EKO Flood USA

Elevating buildings above the ground



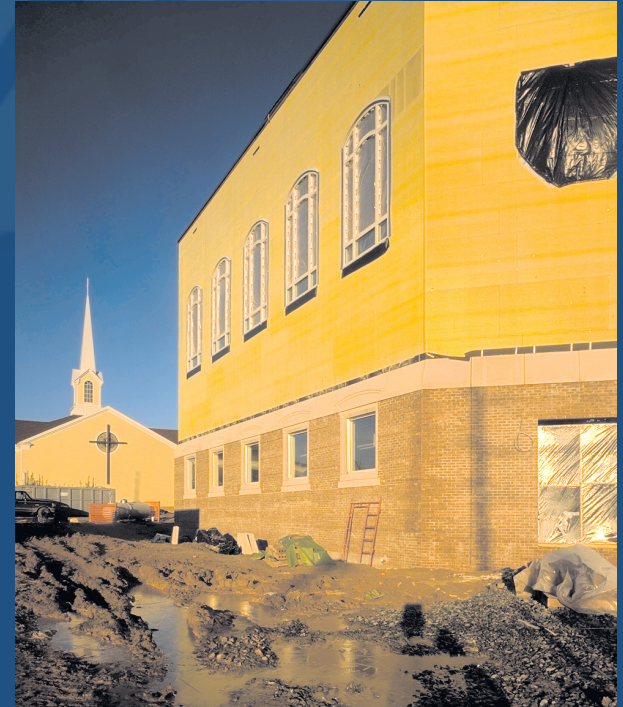
- Most important in flood-prone areas
- Can use pier foundations
- Break-away coverings on piers
- Also elevate mechanicals and electric panels

Post-Katrina home in New Orleans' Lower 9th Ward that is raised 4 feet. Global Green project & photo

Specifying materials that can survive wetting



Polished concrete floor - RetroPlate photo



Georgia-Pacific DensGold

Superb energy performance is critical for resilience *after* the event

- Reasonable “drift temperature” – to protect occupants from cold and heat in the event of lost power or heating fuel
- Extremely high insulation levels
- Extremely tight buildings (with ventilation)
- Passive solar gain and thermal storage



Dan Whitmore's Passive House in Seattle

Maintaining habitable temperatures

27 Maintain Habitable Temperatures Without Power

Issue: Utility failures often disable heating and cooling systems, leaving interior building temperatures dependent on whatever protection is provided by the insulation and air sealing of a building's walls, windows, and roof.

Recommendation: Extend the mandate of the Task Force through Fall 2013 to develop a multiyear strategy for ensuring that new and substantially altered buildings maintain habitable temperatures during utility failures. Clarify requirements for tightly sealing new windows and doors and upgrading roof insulation during roof replacement.

+ further action

Recommendation from the Building Resiliency Task Force

URBAN
GREEN



REPORT TO
MAYOR MICHAEL
R. BLOOMBERG
& SPEAKER
CHRISTINE C. QUINN

BUILDING RESILIENCY TASK FORCE

JUNE 2013

*Building Resiliency Task Force in New
York City – Final Report, June, 2013*

Drift temperatures

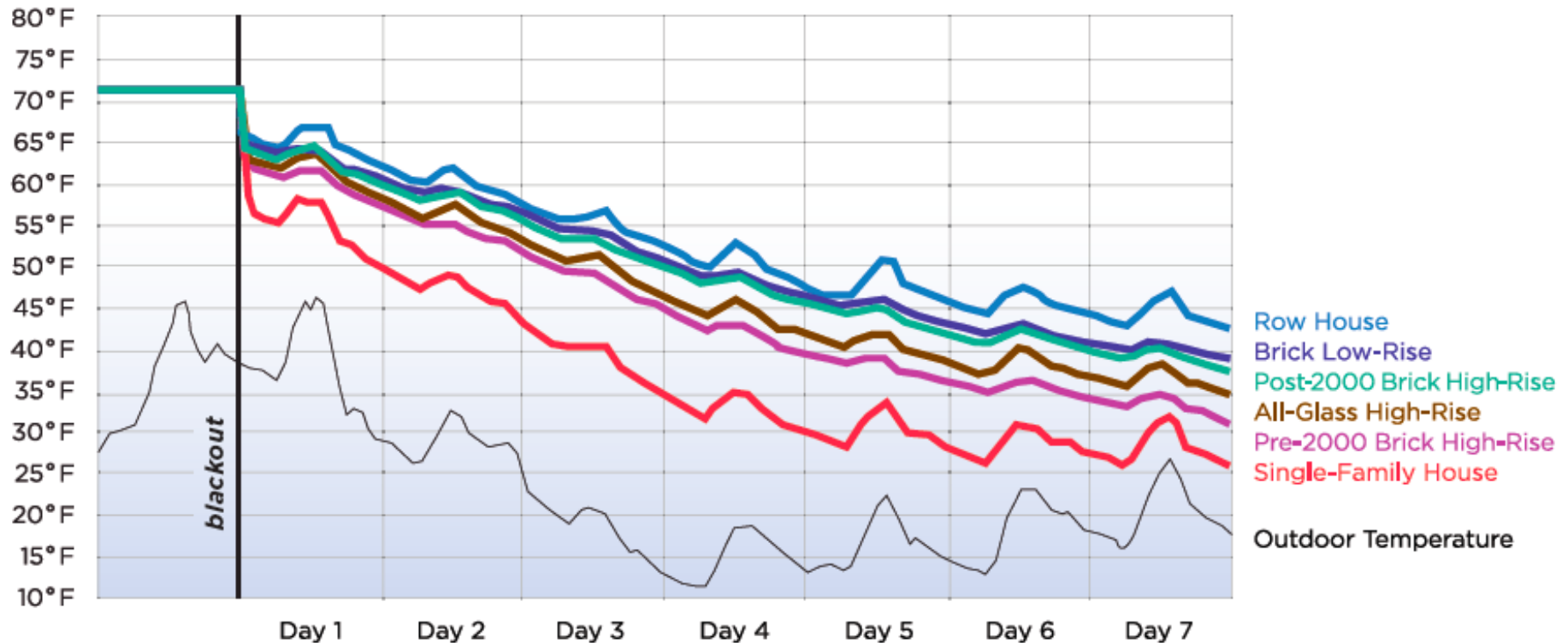
- Modeling high and low drift temperatures
- How quickly will a building heat up or cool down if it loses power or heating fuel?
- Is it just temperature, or do other factors come into play, like humidity and air flow?
- Atelier 10 carried out modeling for the Buildings Resiliency Task Force in NYC



Report from Urban Green in NYC

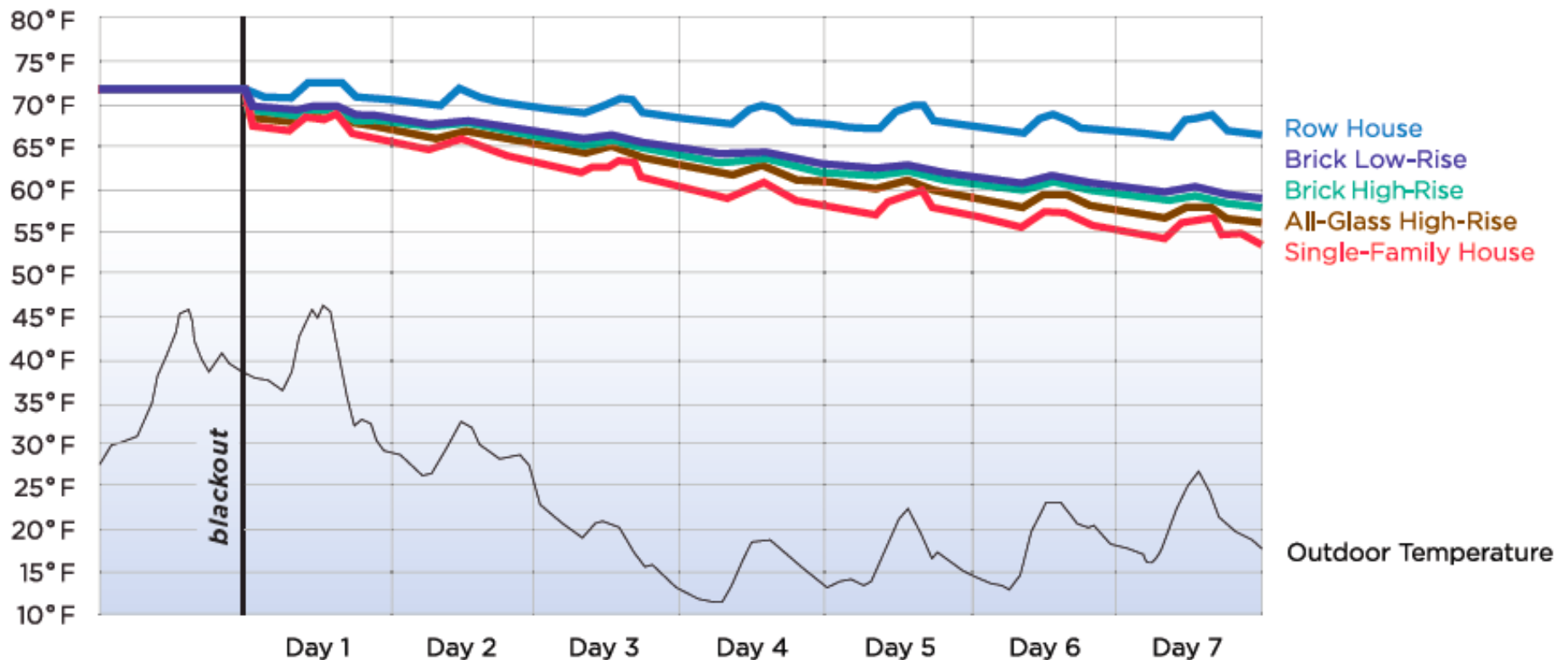
Drift temperatures

Typical Building



Drift temperatures

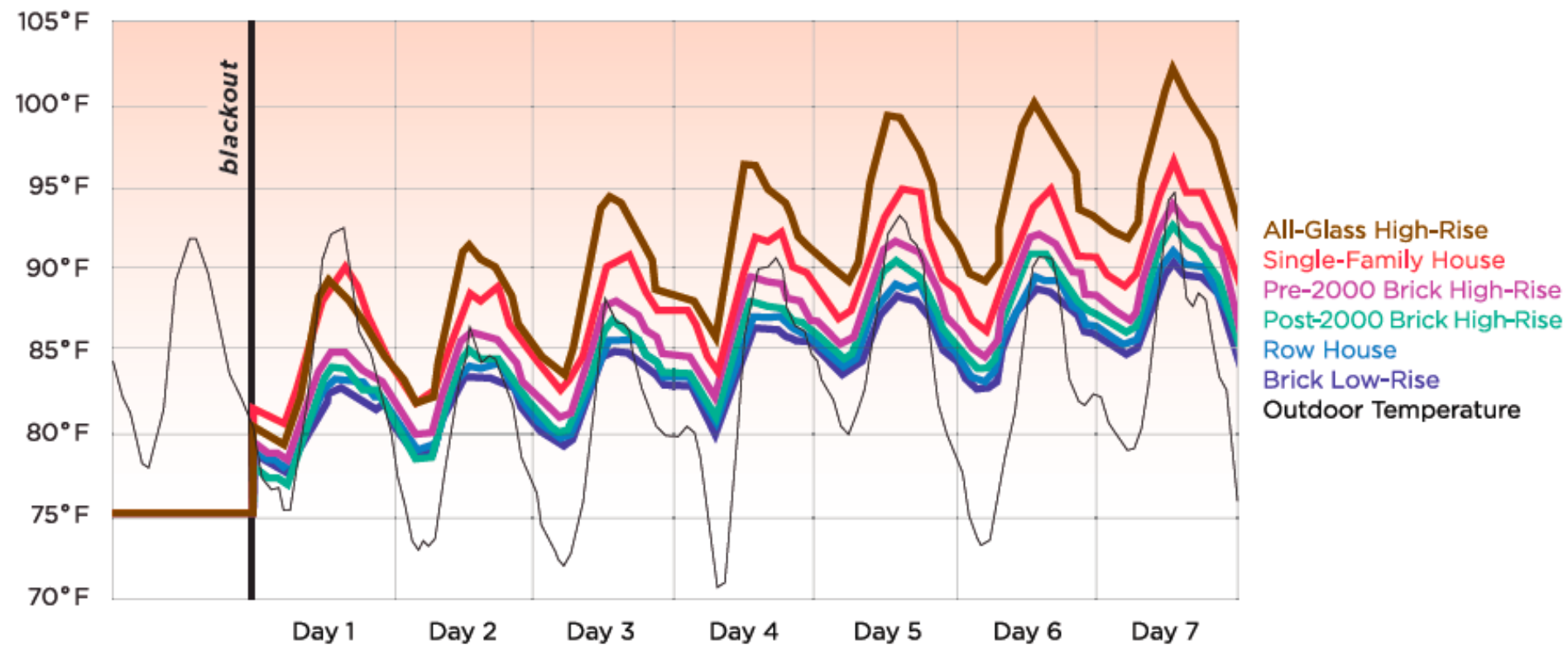
High-Performing Building



Temperature modeling by Atelier Ten for the report "Baby It's Cold Inside," Urban Green, NYC

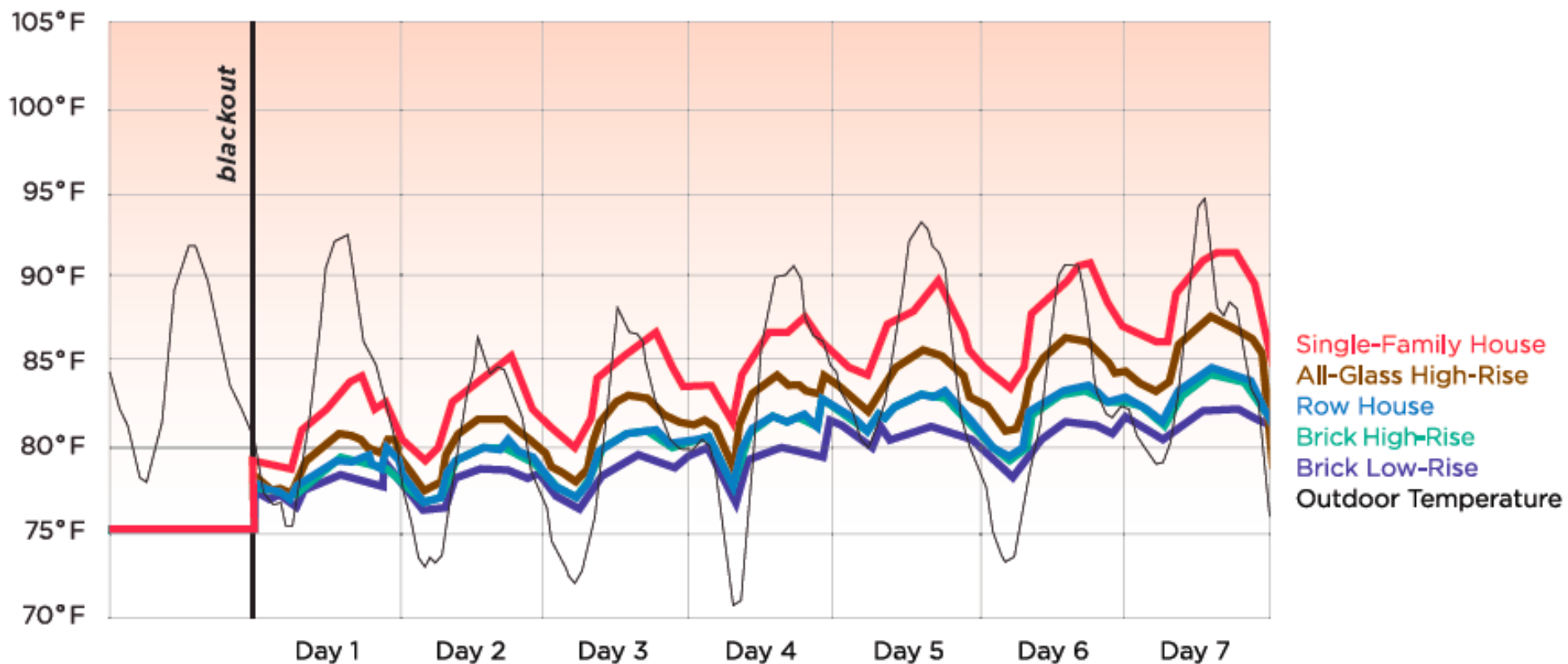
Drift temperatures during outages - summer

Typical Building



Drift temperatures during outages - summer

High-Performing Building



High insulation levels – lots of options



FoamGlas - photo: Alex Wilson



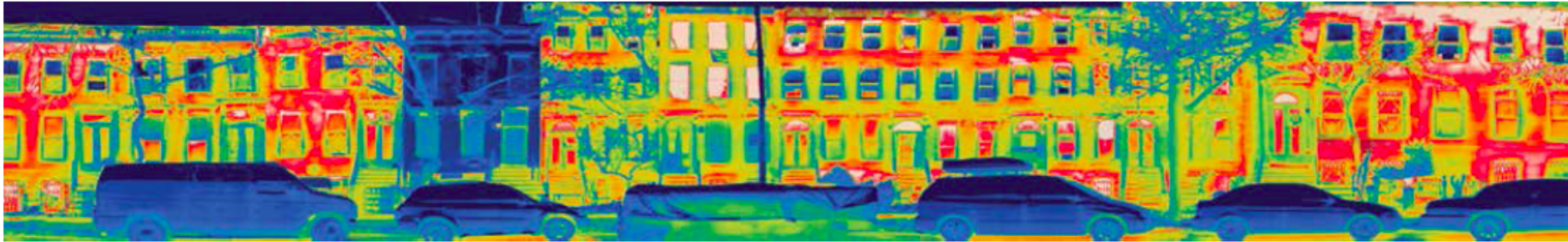
*Cork insulation
photo: Alex Wilson*

High insulation levels – lots of options



Johns Manville Spider spray fiberglass insulation – photos: A Wilson

Low-energy passive house will stay safe



Row houses in Brooklyn, NY. Find the Passive House! – photo: Sam McAfee, sgBUILD.com



Passive House retrofit of 1880s Brownstone in Brooklyn, NY. Photos: Prospect Architecture, PC

High-Performance Glazings

- Huge advances last several decades
- Low-e coatings
 - New low-e coating that can go on the warm side of the window
 - R-5 performance with double glazing and two low-e coatings
- Low-conductivity gas-fill
- Triple glazing
- Tighter construction



*Passive House window in Palo Alto
Photo: Alex Wilson*

Passive Solar Heating

- Most important with smaller, skin-dominated buildings
- Direct-gain + thermal mass
- Energy modeling is key to success (e.g., Energy Plus, REM-Design, PHPP)



Jenny Way, Martha's Vineyard - Photo: South Mountain Co.

Cooling Load Avoidance – Vernacular Design



Passively cooled home in Tupelo, MS. Photo: E.L. Malveney

- Orient buildings on an east-west axis
- Less glass on east & west
- Sun-control glazing
- Exterior window treatments, awnings, roller blinds, overhangs
- Reflective roofs
- Deep overhangs or wrap-around porches
- Vernacular design
- Natural ventilation

Cooling-load avoidance - shading


- Simple shutters
- Can provide some hurricane resistance as well as sun shading
- Common-sense solutions



Simple sun shutter in Matlacha, FL. Photo: Alex Wilson

Cooling-load avoidance – shading

[Twitter](#) [LinkedIn](#) [Home](#) [About This Site](#) [Comments & Feedback](#)

**WINDOW COVERINGS
& ATTACHMENTS**

Intelligent and unbiased guidance on the best window covering for your climate, your needs, your windows.

Help Me Choose **Compare Coverings** Understanding Window Coverings Purchasing Glossary

I live in: **North** My windows are: **Single-pane clear** Show what works with: **No covering**

Show Only [Select All](#) [Deselect All](#) [Interior Only](#) [Exterior Only](#) [Start Over](#)

Interior

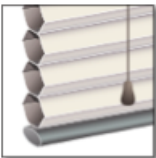
- ☐ Interior panel
- ☐ Interior solar screen
- ☒ Cellular shade
- ☐ Louvered blind
- ☐ Drape/Curtain
- ☐ Pleated shade
- ☐ Applied film
- ☐ Interior roller shade
- ☒ Window quilt
- ☐ Interior louvered shutter
- ☐ Sheer shade
- ☐ Roman shade

Exterior

- ☐ Exterior storm
- ☐ Exterior roller shade
- ☐ Retractable awning
- ☐ Exterior louvered shutter
- ☐ Exterior solar screen
- ☐ Fixed awning
- ☐ Roller shutter

Recommended Window Coverings [print this list](#)

Some other coverings have better scores [Include in Results](#)



Cellular shade: multi-cell, side track

Score: 79%

Recommended Options

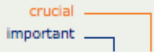
- opaque - manual operation - bottom-up
- semi-opaque - manual operation - bottom-up

These are important to me:

Thermal

- Insulation ☐ ☐
- Airtightness ☐ ☐
- Solar Heat Control ☐ ☐
- Winter Comfort ☐ ☐
- Summer Comfort ☐ ☐
- Condensation Resistance ☐ ☐

crucial
important



Screen shot from *EfficientWindowCoverings.gov*.

Cooling-load avoidance – cool roofs



Volunteers painting a dark roof with reflective white elastomeric paint on the Bowery Mission in New York City, 2010 – photo: David Epstein

Wood heat as back-up

- In more rural areas, install wood heat at least for emergency use
- Choose low-pollution models (less than 3 grams per hour EPA rating)
- Avoid use during high-pollution days



*Smallest Jötul
wood stove we
could find*

Photo: Alex Wilson

Daylighting

- Balance of natural light without too much unwanted heat gain
- Exterior windows
- Skylights, clerestory windows, roof monitors
- Tubular skylights
- Proper glazing specification is key (high visible light transmittance, low SHGC)
- Reflective ceilings and walls
- Lightshelves to distribute light deeper into building



*Project FROG modular building in San Francisco
Photo: Alex Wilson*

Minimizing Water Consumption

*Delta H2Okinetics 1.5
gpm showerhead*



*Duet clothes washer and
dryer from Whirlpool*



*Niagara Stealth 0.8 gpf
vacuum-assist toilet*

- Water-conserving toilets
- Low-flow showerheads
- Water-conserving faucets
- Water- and energy-efficient clothes washers and dishwashers
- Xeriscaping (landscaping note dependent on irrigation)

Rainwater Harvesting



Rainwater cisterns at the Chesapeake Bay Foundation headquarters. Photo: Alex Wilson



Rain barrel - photo: Kelly Lerner

Access to water – hand pumps



Deep-well pump. Photo: Simple Pump



A hand pump that can be installed in the same well will an electric pump. Photo: Alex Wilson

Photovoltaic (solar-electric) power

- Can be the ultimate in resilience during power outages
- Most grid-connected systems don't work during an outage
- Greatest resilience with battery back-up



Dummerston, Vermont barn with 18 kW “group-net-metered” PV system - photo: Alex Wilson

PV power with battery back-up

- Sunny Island 5048 inverter
- Combined with a standard inverter to provide “islanding” operation during power outage
- Some battery storage required to generate the waveform voltage after grid power is lost
- Expensive!

*Sunny Island inverters from SMA Americas
with battery bank – photo: Alex Wilson*



Less expensive option provides some access to solar power during outages



Photo: Alex Wilson

New SMA transformerless inverter

- Lighter-weight, quieter inverter
- TL inverter in 3, 4, and 5 kW sizes
- Outlet can provide up to about 15 amps when the sun is shining, even if the grid is down
- Ideal for charging cell phones, laptop computers, powering cable modem and wireless router
- “Soft-start” refrigerator or freezer using extension cord



Photo: Alex Wilson

Resilience Reports



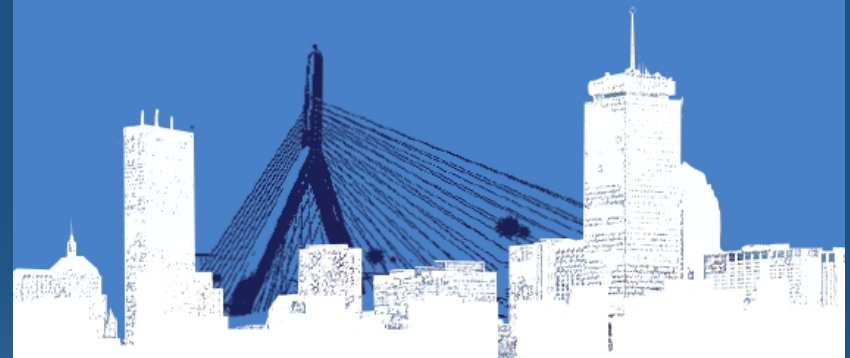
REPORT TO
MAYOR MICHAEL
R. BLOOMBERG
& SPEAKER
CHRISTINE C. QUINN

BUILDING RESILIENCY TASK FORCE

JUNE 2013

BUILDING RESILIENCE IN BOSTON

"Best Practices" for Climate Change Adaptation and
Resilience for Existing Buildings



Prepared By:
LinNean Solutions | The Built Environment Coalition | The Resilient Design Institute

Resilient Design Institute

www.ResilientDesign.org

The screenshot shows a web browser window with the URL www.resilientdesign.org. The browser's address bar and tabs are visible at the top. The website itself has a green header with the "RESILIENT DESIGN INSTITUTE" logo and a navigation menu. The main content area features a large image of a road destroyed by a landslide, with a text overlay titled "Designing Homes for More Intense Storms". Below this, a quote is displayed.

RESILIENT DESIGN
INSTITUTE

About RDI » Resilient Design » Programs Client Services News & Blogs » Contact

Designing Homes for More Intense Storms

Anybody who was in Vermont one year ago this week and witnessed the raging floodwaters of Hurricane Irene and the havoc they wreaked, understands the vulnerabilities we face from intense storms and flooding. In the Northeast, there was a 67% increase in heavy rainfall events...

[Read More](#)

"If they lose electricity, few buildings in the U.S. can provide as much comfort as my backpacking tent."

— Terry Brennan, Westmoreland, New York, quoted in the *Environmental Building News* feature article, "Passive Survivability: A New Design Criterion for Buildings," May, 2006

Thank you! - Questions?



Old Lyme, Connecticut - Alex Wilson photo