

U.S. GREEN BUILDING COUNCIL

G325

Climate Resilience Strategies for
Buildings in New York State: Part 2

USGBCNYU_CRSB2

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Credit(s) earned on completion of this course will be reported to **AIA CES** for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.



Course Description

Although climate has always been a key consideration for the design, construction, and operation of buildings, many professionals assume that future weather conditions will be similar to what was experienced in the past. Increased exposure to climate-related hazards like Hurricane Sandy and ‘Snowvember’ will require practitioners in New York State to reevaluate their standard practices. Changing climate conditions, including increases in temperature and precipitation, may increase the likelihood of climate hazard events including hurricanes and tropical storms, flooding, severe storms, winter storms, wildfire, sea level rise, heat waves, and pest infestations. Increasing the resilience of buildings in New York State can reduce the negative impacts of these hazards.

This course is approved by the AIA for 1 LU | HSW.



Learning Objectives

At the end of the this course, participants will be able to:

1. Understand the role of neighborhood flood protection, building flood protection, building systems flood protection, building foundations, green infrastructure, gray infrastructure, roof covering, roof drainage, neighborhood fire protection, and building fire protection when developing climate resilience strategies during project planning and design in New York State.
2. Explain climate resilience strategy implementation beyond the physical application of a material, technique, or technology; including planning, occupant health, safety and welfare, costing, and the development of standards, operations, and maintenance.
3. Utilize the information in this course as a tool to assist in the implementation of the covered climate resilience strategies during project planning and design.
4. Understand that all those involved with the building sector, including owners and operators, policy makers, planners, architects, and engineers should play a role in the implementation of climate resilience.



**NEW YORK
UPSTATE**

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Research

Our Approach

Centers and Labs

Initiatives

The UB Affordable Housing Initiative

Adapting Buildings for a Changing Climate

See It Through Buffalo

University Heights Initiative

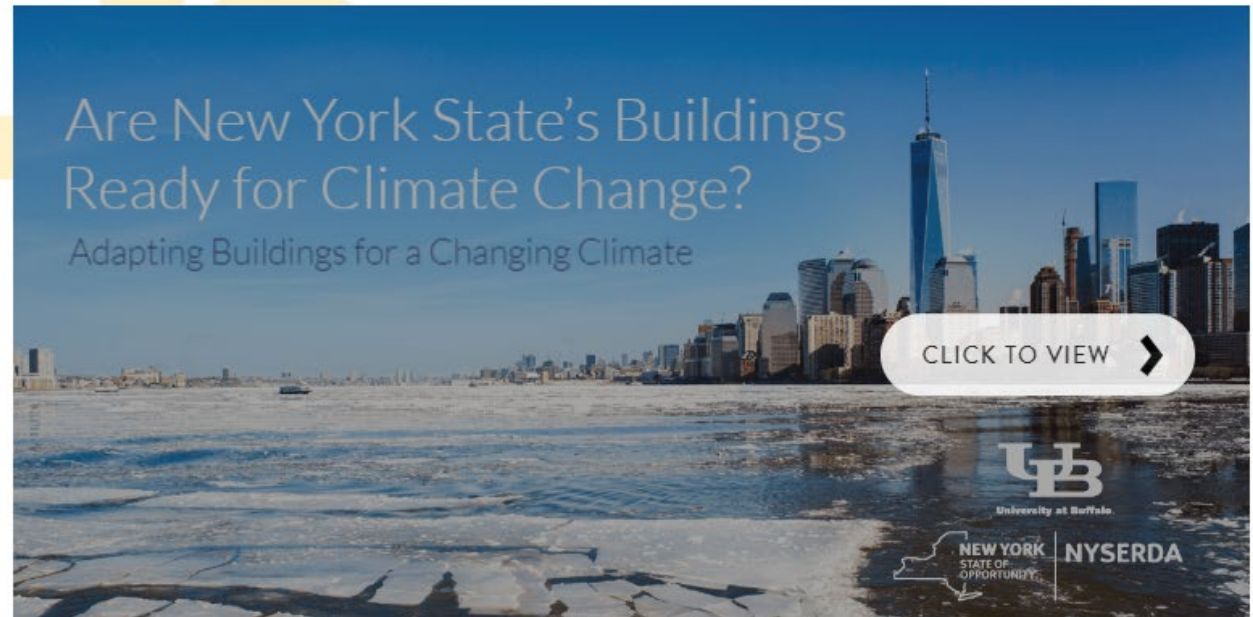
Insights

Related Links

Graduate Research in Architecture

Graduate Research in Urban Planning

Adapting Buildings for a Changing Climate



ap.buffalo.edu/adapting-buildings

New York's climate is changing. Are your buildings prepared?

Climate Resilience Strategies for Buildings in New York State



Final Report | Report Number 18-11 | June 2018



ap.buffalo.edu/adapting-buildings



LOCATION	HAZARDS	RELATED STRATEGIES
<p>LOW MEDIUM HIGH</p>	FLOODING RISING SEA LEVELS HURRICANES / TROPICAL STORMS	Neighborhood Flood Protection Building Systems Flood Protection Building Foundations Roof Drainage Building Operations Potable Water Systems

Tropical Storm Lee

In 2011, New York State was struck by two major storm events within a week.



In the last week of August, Hurricane Irene made landfall in New York State, affecting ClimAID Regions 2, 3, 4, and 5. Then on September 2, the remnants of Tropical Storm Lee dropped nearly a foot of rain in the Southern Tier (ClimAID Region 3). The storms were the second-largest natural disaster in the history of the State,¹² with FEMA awarding more than \$1.5 billion in public assistance and over 33,000 residents registering for individual assistance. Since 1955, NYS experienced 42 flood-related Presidential Disaster Declarations.

DESCRIPTION

Responding to Climate Change in New York State states that [New York will experience changing patterns of precipitation](#),¹ increasing the risk of flooding events statewide. To respond to this growing concern, it is critical to [break the damage-rebuild-damage cycle](#)² and approach building flood resilience with preemptive measures. With the State facing an increased likelihood of inundation, high-velocity flows, erosion, and damage from floating debris, tactics such as [flood resistant building materials](#)³ and flood barriers can help to improve resilience.

The USGS explains the [effects urbanization has on flooding](#),⁴ including changes of land use, the removal of vegetation, and increased runoff from man-made drainage networks and how they can increase the chances of flood events in urban areas. According to the Centers for Disease Control and Prevention, flood waters can instigate [issues with electrical services and mold](#),⁵ which can be devastating, especially in urban areas. Understanding these impacts will help drive improvements to building flood protection in all regions of New York State.

OWNERS AND OPERATORS

There are multiple FEMA documents that owners and operators can use to improve building flood protection. For example, the [Homeowner's Guide to Retrofitting](#)⁶ explains how homeowners can implement building flood protection tactics, including elevating the home, installing flood barriers, and wet flood proofing. Additional information can be found in FEMA's guide to [Reducing Flood Risk to Residential Buildings That Cannot Be Elevated](#).⁷

In 2012, Superstorm Sandy proved that flood zone delineations do not always show the true extent of areas exposed to flooding. As a result, the Superstorm Sandy Recovery Advisories from FEMA explain the need to [prepare for floods above the base flood elevation](#)⁸ to reduce damage during flooding events. Owners and operators can use this document, as well as the Home Builder's Guide to Coastal Construction, for guidance on [improving the performance of residential buildings](#)⁹ during coastal flooding events. [Chapters 14 and 15](#)¹⁰ in Volume II of FEMA's Coastal Construction Manual provide information on maintaining and retrofitting buildings for flood protection based on damage analysis of previous storms. FEMA recommends all owners and occupants should prepare for flooding hazards by purchasing [flood insurance](#).¹¹

POLICYMAKERS AND PLANNERS

Hospital Flood Protection

Dry flood mitigation measures keep critical facilities operational during major storm events.



[Our Lady of Lourdes Hospital](#)¹³ suffered over \$20 million in losses when the Susquehanna River flooded in the summer of 2006. With funding from FEMA, the hospital constructed a flood wall around the hospital. In September 2011 following Tropical Storm Lee, the flood wall was tested when the Susquehanna River flooded once again and devastated many parts of Binghamton, NY. The hospital was able to remain fully operational. The flood wall cost approximately \$7 million and was built over a period of five years.

Policy makers and planners can learn from previous events what type of damage flood events can cause. After Superstorm Sandy, the [NYC Building Resiliency Task Force](#)¹⁴ recommended new legislation and amendments to the New York City Building Codes that can help limit the spread of damage when the next major event occurs. Communities taking part in the National Flood Insurance Program's [Community Rating System](#)¹⁵ can assess risks and improve flood hazard preparedness by understanding and making improvements to the things that make their buildings vulnerable.

According to the DEC,¹⁶ flood recovery efforts should include the implementation of resilience strategies that reduce the likelihood of damage caused by future events. The EPA and FEMA released a document entitled [Planning for Flood Recovery and Long-Term Resilience in Vermont](#)¹⁷ to discuss policy and planning suggestions for flood disaster resilience. This document could be useful for neighboring areas in New York State, including those in ClimAID Regions 5 and 7. FEMA also completed a [Mitigation Assessment Team Report after Superstorm Sandy](#)¹⁸ that documents building failures and suggests low flood-prone areas can adapt and overcome. The failures identified in this document can help policy makers and planners understand what to do and what not to do when rebuilding damaged buildings.

ARCHITECTS AND ENGINEERS

After Superstorm Sandy, changes were made to the New York City Building Code, specifically under [Appendix G Flood-Resistant Construction](#).¹⁹ These changes modified standards dealing with backflow prevention, healthcare facilities, survey data and flood maps, cabling and fuel oil storage, and flood barriers in order to ensure safety, resilience, and limited damage during future flooding events. To help guide the design of flood resilient buildings, FEMA released the [Floodproofing Non-Residential Buildings](#)²⁰ document as a comprehensive guide to flood proofing existing buildings. Designers should be aware of the differences between the requirements in the National Flood Insurance Program and the current New York State Building Code, which references the [American Society of Civil Engineers' 24-14 Flood Resistant Design and Construction](#).²¹

FEMA's [Technical Bulletin 229](#)²² for buildings located in special flood hazard areas provides information on flood resistant materials that correspond with NFIP requirements. Other technical bulletins from FEMA provide [information on other strategies](#),²³ including wet flood proofing, below-grade parking, breakaway walls, and metal connector details. The New York City Planning Department [Retrofitting Buildings for Flood Risks](#)²⁴ guide contains a comprehensive analysis of retrofit options based on building type and use for buildings in the New York City flood plain. Strategies from this document can be used in other flood-prone areas within New York State.

NYCCSC RESOURCES

1. [Sea Level Rise and Coastal Flooding Impact Viewer](#):²⁴ A mapping tool that allows users to visualize potential impacts from sea level rise.
2. [Lake Level Viewer: United States Great Lakes](#):²⁵ A tool to help visualize water level changes in the Great Lakes.
3. [Future Flow Explorer](#):²⁶ Application of flood regression and climate change scenarios to explore estimates of future peak flows.



LOCATION LOW MEDIUM HIGH	HAZARDS FLOODING RISING SEA LEVELS HURRICANES / TROPICAL STORMS	RELATED STRATEGIES Neighborhood Flood Protection Building Systems Flood Protection Building Foundations Roof Drainage Building Operations Potable Water Systems
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tactics, including elevating the home, installing flood barriers, and wet flood proofing. Additional information can be found in FEMA's guide to [Reducing Flood Risk to Residential Buildings That Cannot Be Elevated](#).⁷

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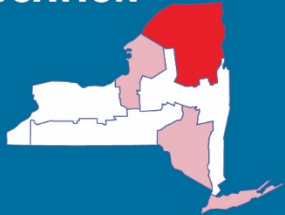
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Neighborhood Fire Protection

LIMITING THE SPREAD OF A DAMAGING HAZARD

LOCATION



LOW MEDIUM HIGH

HAZARDS



WILDFIRE



HEAT WAVES

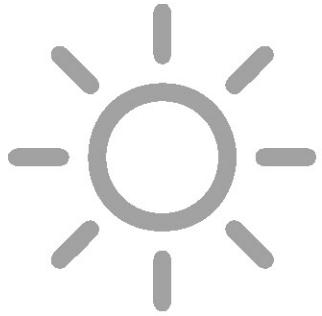
RELATED STRATEGIES

Emergency Management
Building Fire Protection
Neighborhood Development
Building Operations

DESCRIPTION

Adirondack Mountain Fires

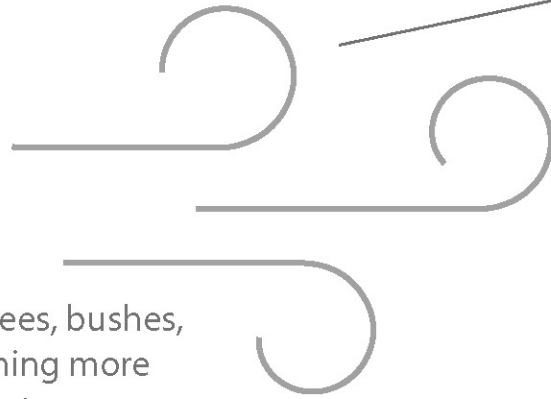
Severe storms with high winds and heat waves that cause droughts and large amounts of dried vegetation increase the possibility of wildfires.¹ New York



Vegetation: living and dead trees, bushes, and grasses, with grasses burning more quickly and less intensely than trees; crown fires move much quicker than grass fires

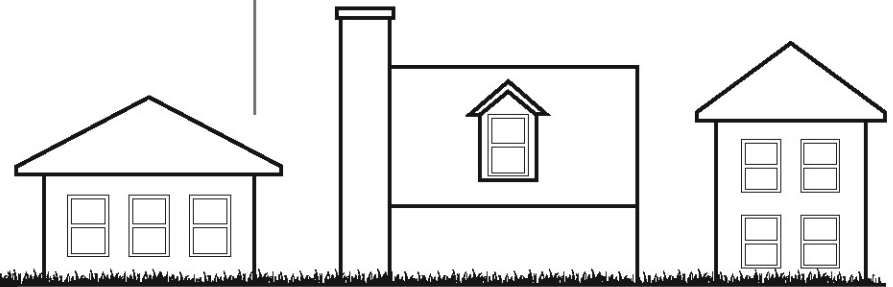


Fuel: vegetation and structure are the two main fuel types on the wildland/urban interface



Weather: higher temperatures, lower humidity, and swift winds increase the likelihood of ignition and the difficulty of control

Structural Density: the closer homes are, the easier it is for flames to spread between them



Slope: hot gases rise in front of the fire, preheating the vegetation up-slope, and causing grass fires to move four times faster and flames to reach two times higher than on level ground

Extended Zone:

30-100' from home

Goals:

- Interrupt fire path
- Keep flames smaller
- Keep flames on the ground
- Minimum of 12' between tree tops (30-60')
- Minimum of 6' between tree tops (60-100')

Intermediate Zone:

5-30' from home

Goals:

- Careful landscaping
- Create breaks to decrease fire behavior
- Minimum of 18' between tree tops

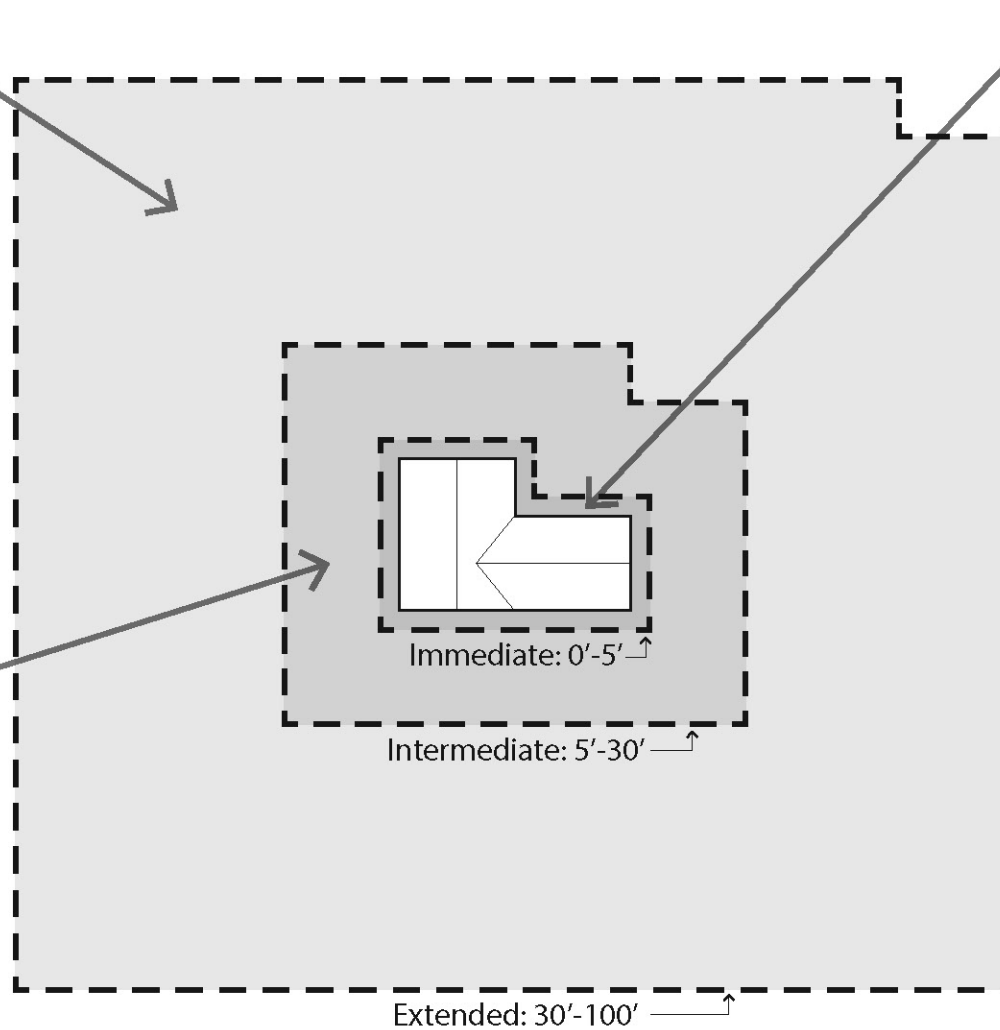
Immediate Zone:

0-5' from home

*Most important zone

Goals:

- Non-combustible area
- Move any flammable materials away from exterior wall (i.e. mulch, plants, etc.)
- Start with house, then move to landscaping



Vision: safely and effectively extinguish fire when needed; use fire where allowable; manage our natural resources; and as a nation, live with fire.

↕
Goals

Restore and maintain
landscapes

Fire-adapted
communities

Wildfire response

↑
Challenges

Vegetation and
fuels

Homes,
communities, and
values at risk

Human-caused
ignitions

Effective and
efficient wildlife
response

Adapted from: Wildland Fire Leadership Council. 2014. *"The National Strategy: The Final Phase in the Development of the National Cohesive Wildland Fire Management Strategy."*

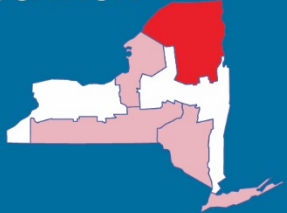
<https://www.forestsandrangelands.gov/strategy/documents/strategy/CSPPhaseIIINationalStrategyApr2014.pdf>



Building Fire Protection

REDUCING BUILDING EXPOSURE AND SENSITIVITY TO FIRE

LOCATION



LOW MEDIUM HIGH

HAZARDS



WILDFIRE



HEAT WAVES

RELATED STRATEGIES

- 1 Windows
- 3 Emergency Management
- 12 Roof Drainage
- 13 Neighborhood Fire Protection
- 22 Building Operations

DESCRIPTION

Due to rising temperatures and drought conditions caused by climate change, buildings can potentially face an increase in exposure to fire. According to

Post-Sandy Retrofitting

Before a Wildfire

Know:

- Monitor weather reports
- Be aware of alerts
- Know evacuation routes
- Plan out transportation and shelter

Practice:

- Communication with family
- Use of fire extinguisher
- Fire prevention
- First aid and emergency response

Store:

- Supplies and documents

Discuss:

- Personal preparations
- Community risk reduction



During a Wildfire

Evacuate:

- 5 P's:
 1. People,
 2. Prescriptions
 3. Papers
 4. Personal needs
 5. Priceless items

If trapped in home:

- Call 911
- Fill sinks and tubs with water
- Stay inside and away from outside walls and windows

If trapped in a vehicle:

- Call 911
- Stay away from fuel sources
- Find a rocky area, a road, or a water source



After a Wildfire

Property:

- Use caution when entering a burned area
- Avoid smoldering surfaces
- Check attic for smoke/flames
- Wear leather gloves and thick soled shoes
- Look for and mark ash pits, smoldering debris, and live embers
- Check/wet down roof/gutters

Insurance:

- Photograph all damage

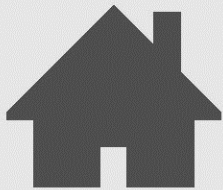


1

Prepare at Home

If a fire starts at home, you might have as little as 2 minutes to escape.

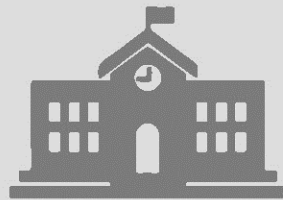
- Install smoke alarms on every floor, in every bedroom, and outside every sleeping area
- Test alarms once a month
- Develop a family escape plan



2

Teach Fire Safety in Schools

- Teach kids about personal and family preparedness
- Teach kids about local hazards
- Help kids understand coping skills

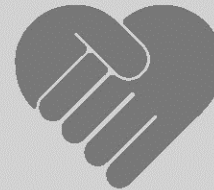


3

Volunteer

Volunteers make up 90% of disaster relief workers.

- Help install smoke alarms
- Teach fire safety practices to communities
- Help others in the aftermath of fires or other disasters



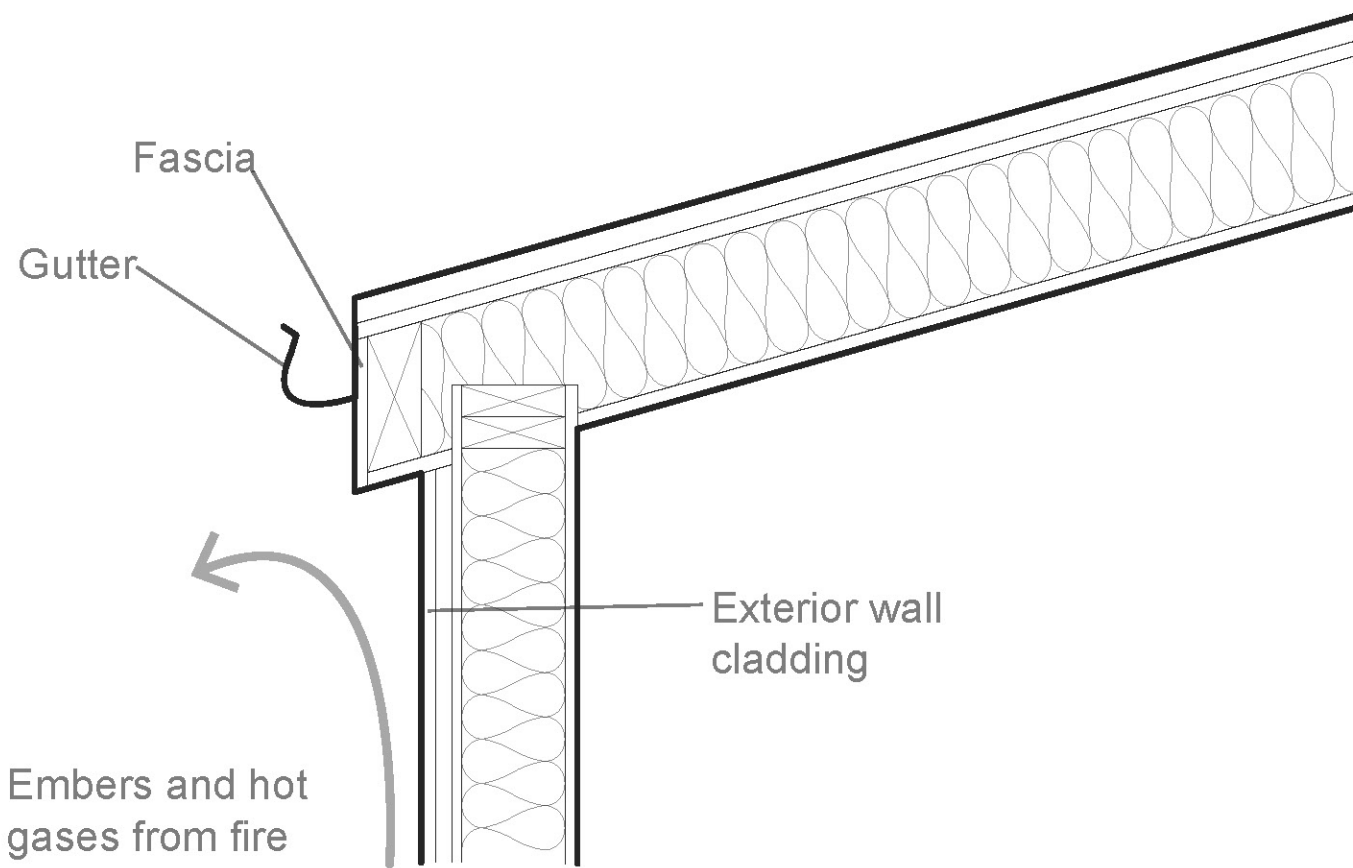
4

Donate

Donations allow volunteers to help people in both the prevention and relief of disasters.

- Install fire alarms in low income or at risk communities
- Provide food and aid to fire victims
- Provide courses on fire safety for communities





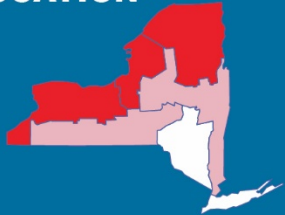
Consider designing buildings with no overhangs to reduce the opportunity for entrapment of hot gases or embers. Use a fire-resistant material for fascia, such as fire retardant-treated lumber or fiber-cement board.



Insulation

IMPROVING THERMAL PERFORMANCE IN THE BUILDING ENVELOPE

LOCATION



LOW MEDIUM HIGH

HAZARDS



HEAT WAVES



WINTER STORMS

RELATED STRATEGIES

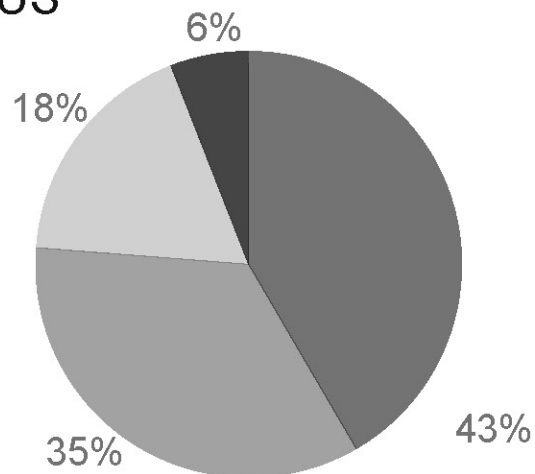
- Windows
- Roof Coverings
- Urban Heat Island
- Building Ventilation
- Passive Building Systems
- Active Building Systems

DESCRIPTION

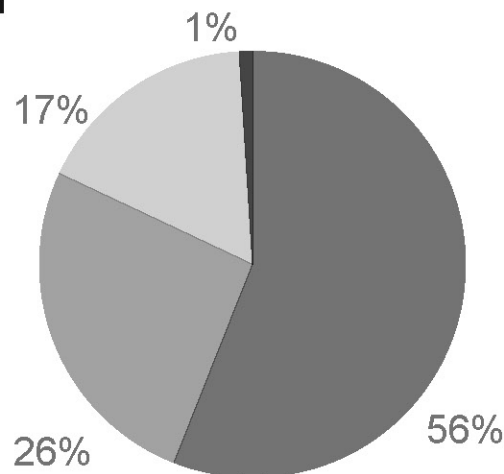
Proper insulation increases the efficiency of the building envelope by slowing heat transfer through exterior walls and roofs. This can help lower the demand



US



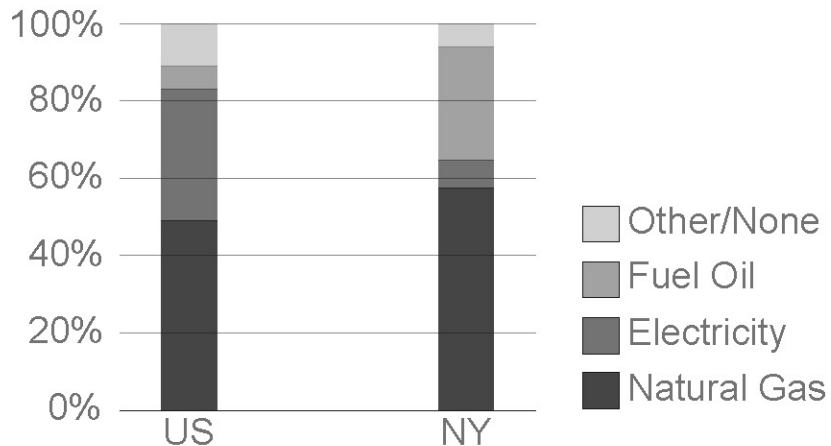
NY



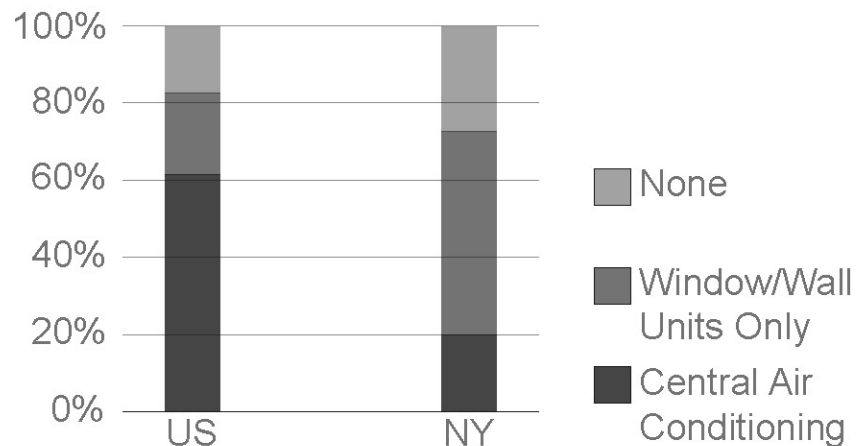
Consumption by End Use

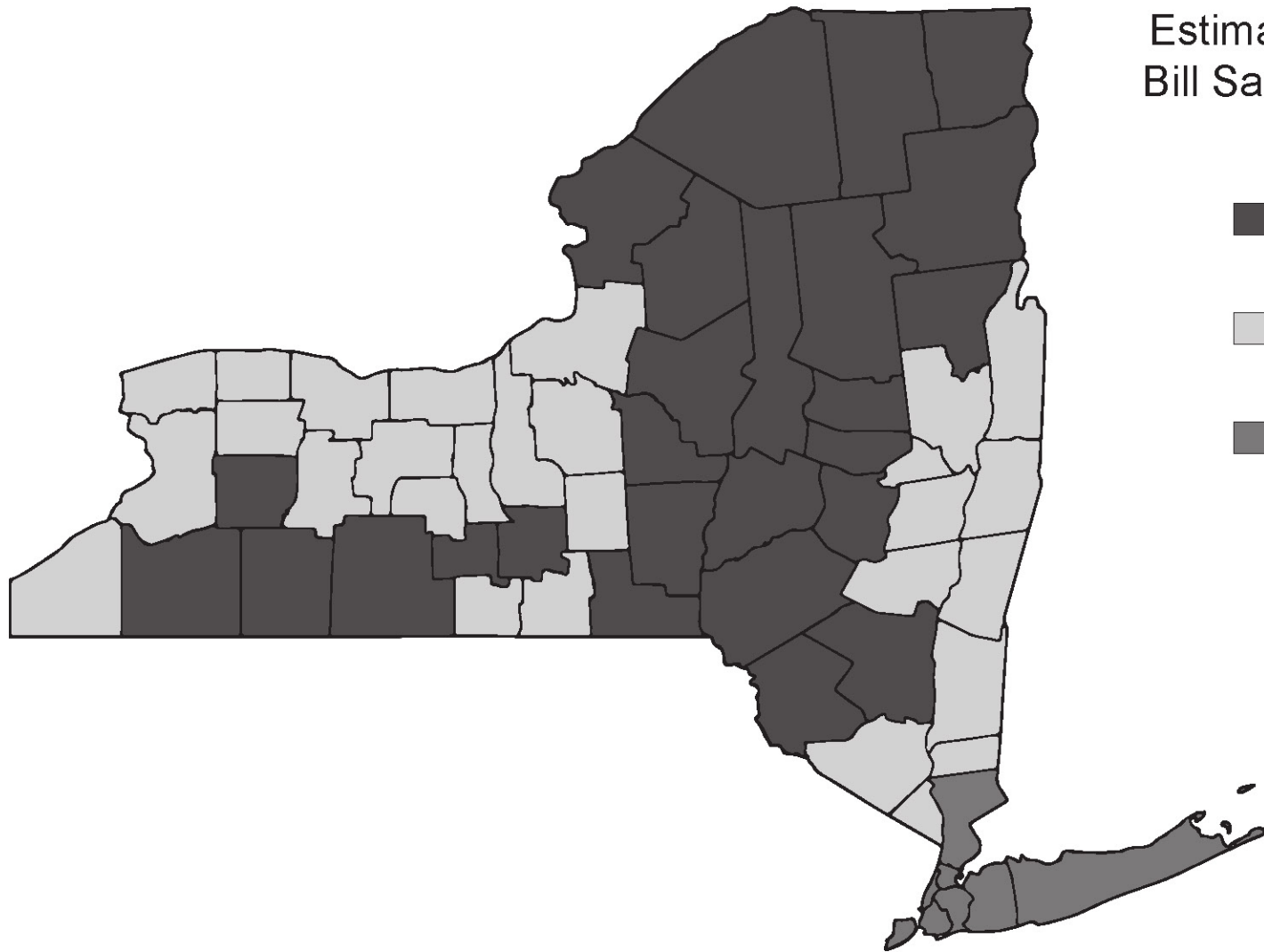
- Air Conditioning
- Water Heating
- Appliances, Electronics, Lighting
- Space Heating

Main Heating Fuel Used



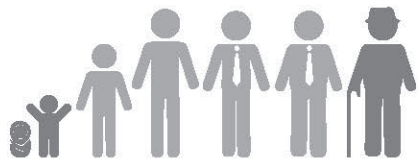
Cooling Equipment Used



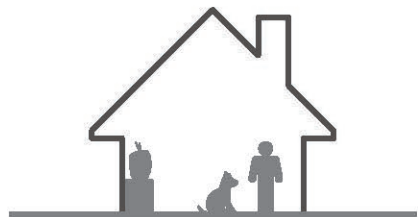


Estimated Annual Utility Bill Savings for a Typical Home

- Heating/Cooling: 18%
- Heating/Cooling: 16%
- Heating/Cooling: 17%



People under the age of 4 and over the age of 65 are at the greatest risk during heat waves.



Along with preexisting or a susceptibility to health issues, isolation impacts wellness during extreme heat conditions. 25% of the general population and 32% of the elderly population live alone.



Half of the people who live below the poverty line live without air conditioning.



Lower income areas tend to have an increased crime rate. A fear of crime drives people to keep windows and doors closed at all times, limiting ventilation.

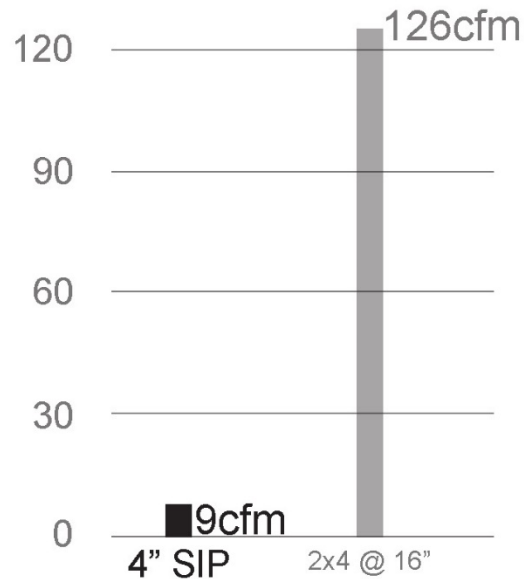
Heat Waves result in an increase of emergency room visits for health issues such as acute renal failure, diabetes, cardiovascular disease, and electrolyte imbalance.



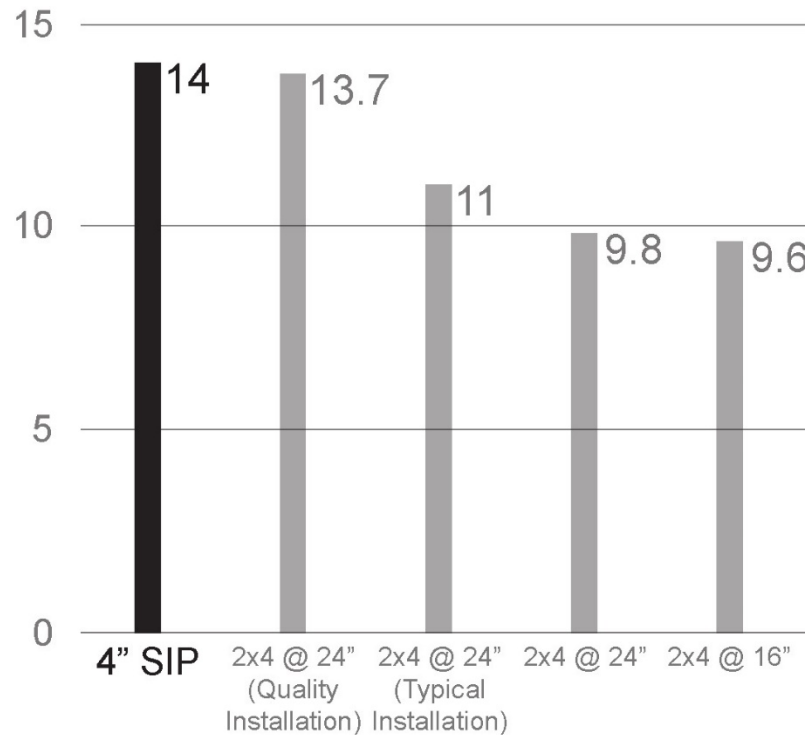
Structural Insulated Panels (SIPs)

Whole-Room Air Infiltration, ORNL Testing

Lower cfm = Higher comfort + Lower energy cost



Whole-Wall R-Value



SIPs:

Foam (EPS) and Oriented Strand Board (OSB)

Less energy and raw materials used in SIP production

OSB: production utilizes 85-90% of log and made from underutilized and less expensive wood species

EPS: consists mostly of air, only 2% plastic and takes 24% less energy to produce than fiberglass

Neighborhood Development

STRENGTHENING COMMUNITIES THROUGH CLIMATE ADAPTATION

LOCATION



LOW MEDIUM HIGH

HAZARDS



HEAT
WAVES



FLOODING



WINTER
STORMS

RELATED STRATEGIES

Emergency Management
Neighborhood Flood Protection
Gray Infrastructure
Neighborhood Fire Protection
Urban Heat Island
Potable Water Systems

DESCRIPTION

Resilient neighborhoods are prepared to adapt to and recover from climate hazard events¹ by maintaining essential functions, structures, and neighborhood

NY Renews



Whole Community Principles

1 Understand and meet the real needs of the whole community

- Every community has unique and diverse needs
- Get to know the community well in order to understand its needs and motivations

2 Engage and empower all parts of the community

- A more engaged community will lead to a stronger local capacity to handle any hazard or threat
- All community members will be part of the emergency management team

3 Strengthen the existing positive community attributes

- Provide support for institutions, assets, and networks that already work for the community's betterment

Whole Community Strategic Themes

1. Understand community complexity
2. Recognize community capabilities and needs
3. Foster relationships with community leaders
4. Build and maintain partnerships
5. Empower local action
6. Leverage and strengthen social infrastructure, networks, and assets

When deciding on landscape features, consider the following:



1. Is the vegetation native to the area?
2. Will it survive, if not improve, the local climate?



3. How much water does it need to survive?
4. Will this amount exceed expected precipitation rates?



5. Will this new green space provide a habitat for native species?



6. Will pesticides be necessary to support the green space?

Green infrastructure is 25% of total urban space.

Private lawns and gardens make up 50% of this total.

Landscaping decisions have an impact on the environment. Choices can either be an asset to ecosystems or a cause of their destruction.

Neighborhood Plans must include policies which guarantee improvement and attention to climate change mitigation and adaptation.

Plans should have the goal of creating low carbon neighborhoods through the implementation of measures such as renewable energy, efficient energy, and sustainable transport. By building and developing for the future, the plans will benefit the climate and local environment.



Adapted from: Center for Sustainable Energy. 2016. *“Low Carbon Neighbourhood Planning.”*

<https://www.cse.org.uk/downloads/reports-and-publications/policy/community-energy/energy-advice/planning/renewables/low-carbon-neighbourhood-planning-guidebook.pdf>

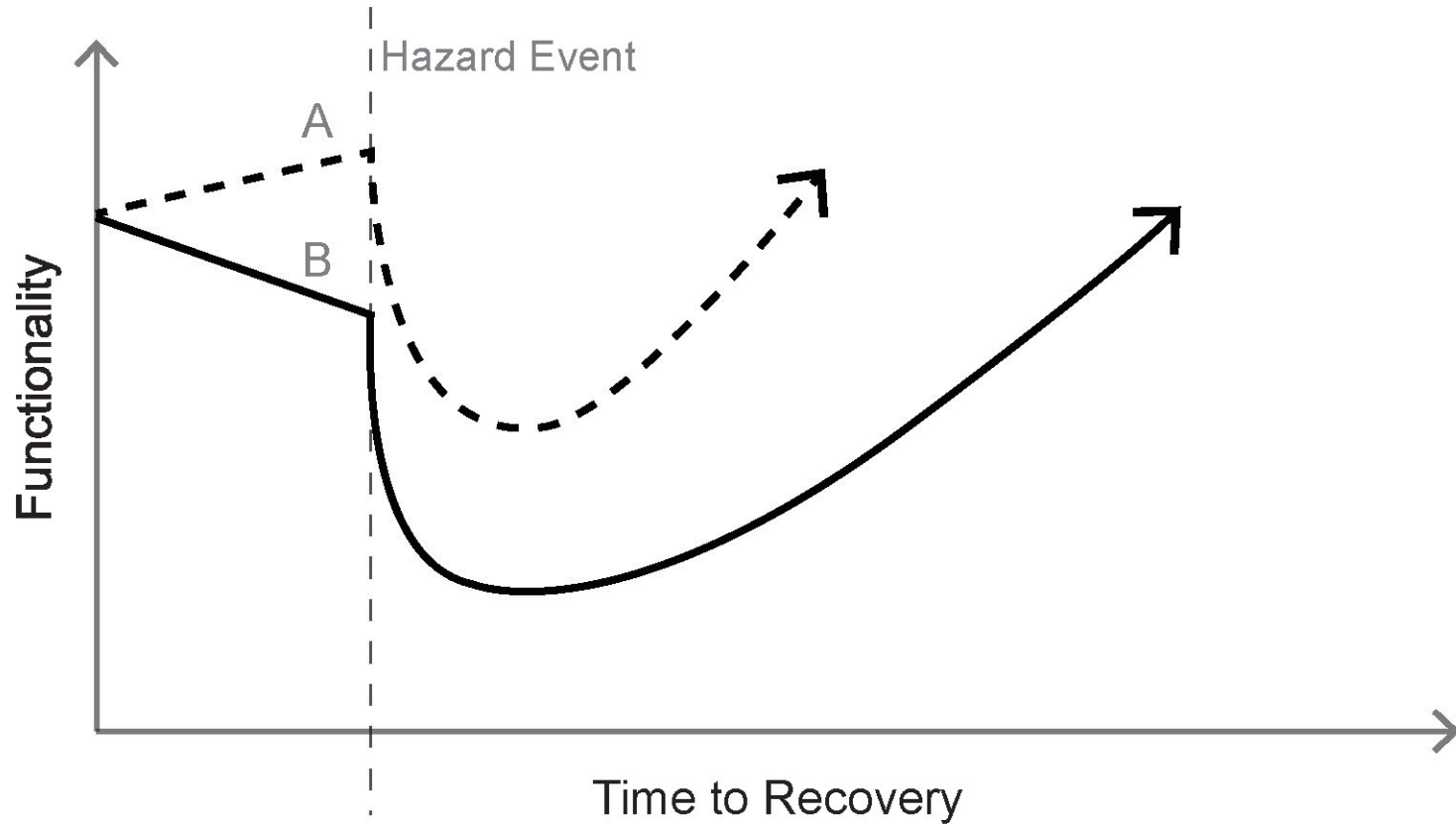


Condition A: Modest loss of functionality following event

- Well maintained
- Good design and mitigation projects
- Improved level of functionality before event

Condition B: Increased vulnerability to hazards

- Degradation of functionality
- Deterioration in the physical system
- Lack of adequate maintenance



Urban Heat Island

REDUCING THE EFFECTS OF EXTREME HEAT IN AN URBAN SETTING

LOCATION



LOW MEDIUM HIGH

HAZARDS



HEAT
WAVES



SEVERE
STORMS



PEST
INFESTATION

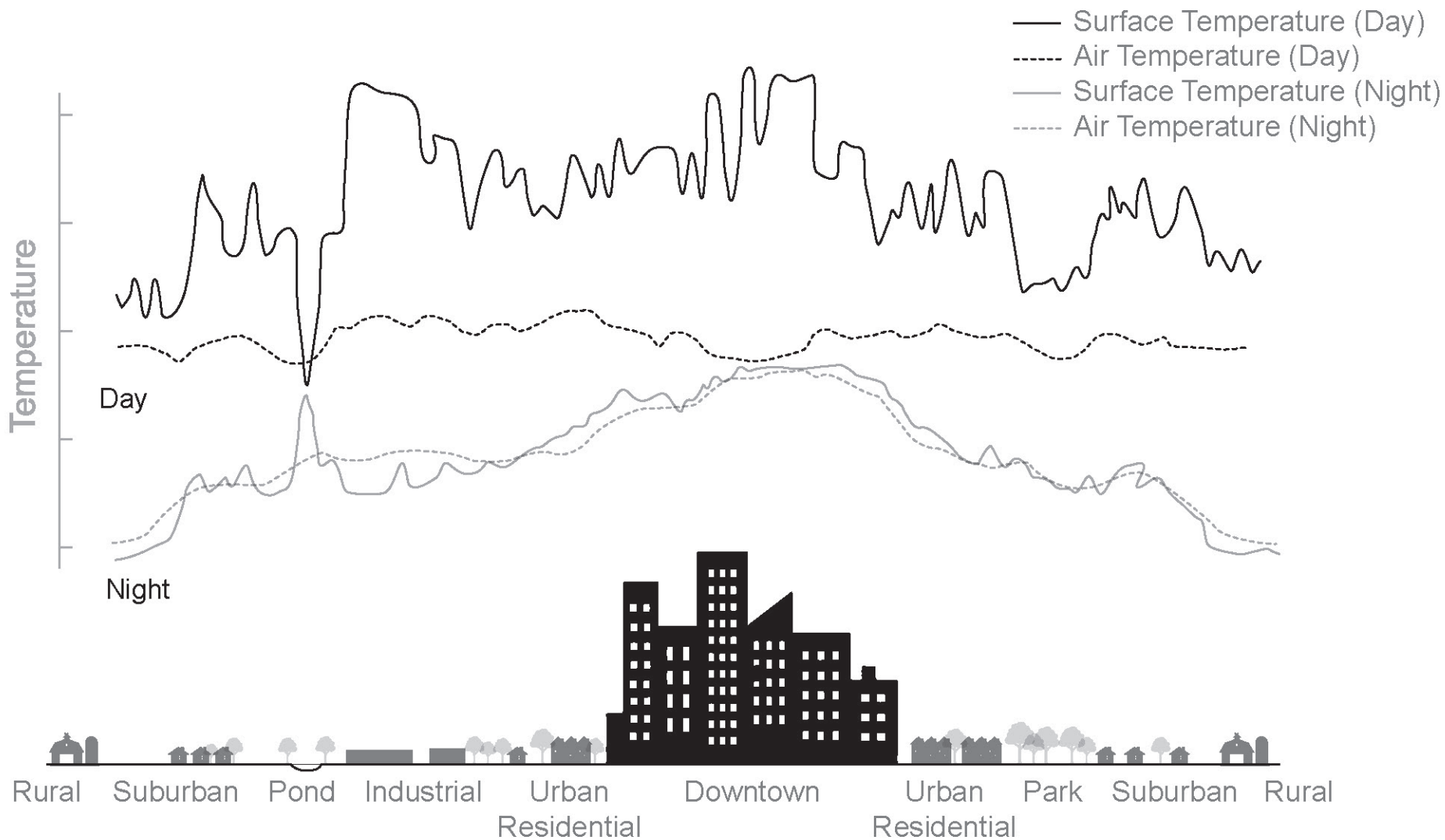
RELATED STRATEGIES

Emergency Management
Green Infrastructure
Roof Covering
Insulation
Neighborhood Development
Building Ventilation

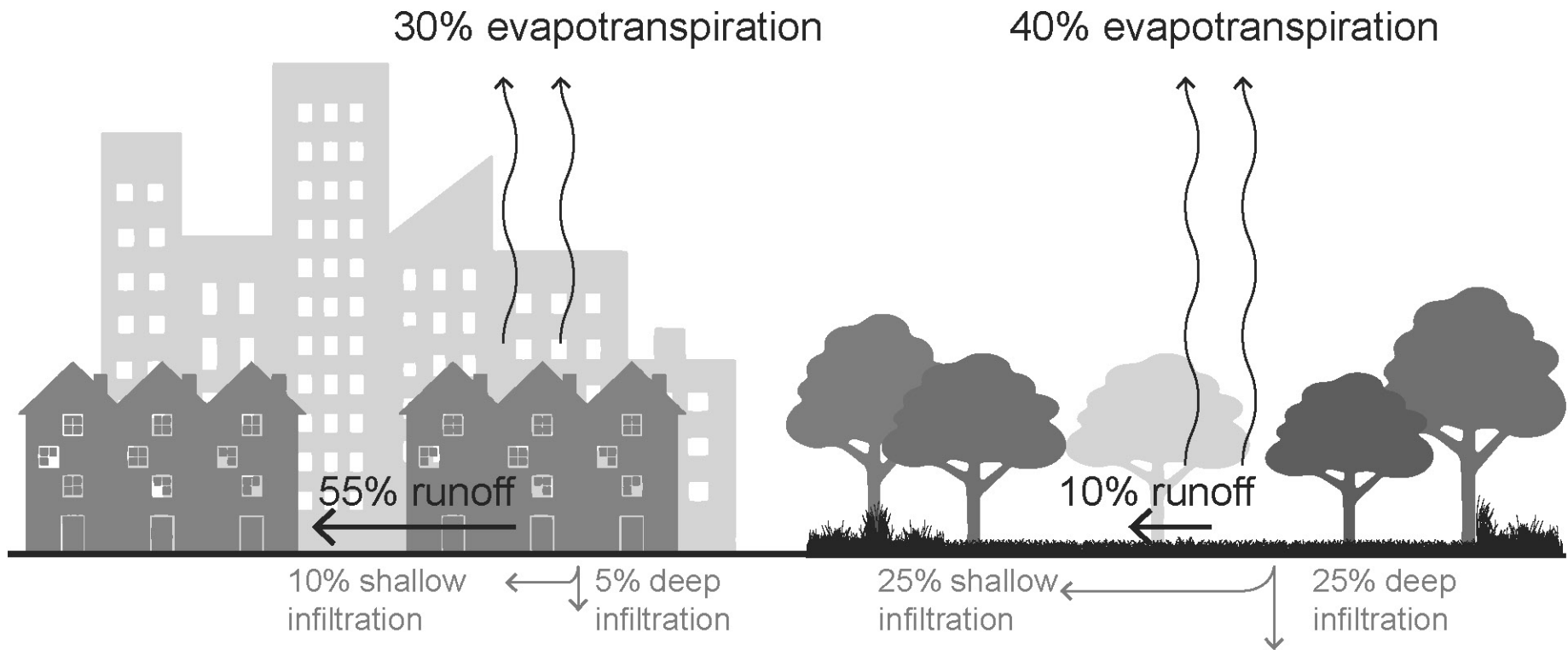
DESCRIPTION

Climate change will lead to longer and more intense heat waves that, according to the [EPA](#),¹ can increase overall energy demand, elevate pollution emissions,

2003 Northeast Blackout



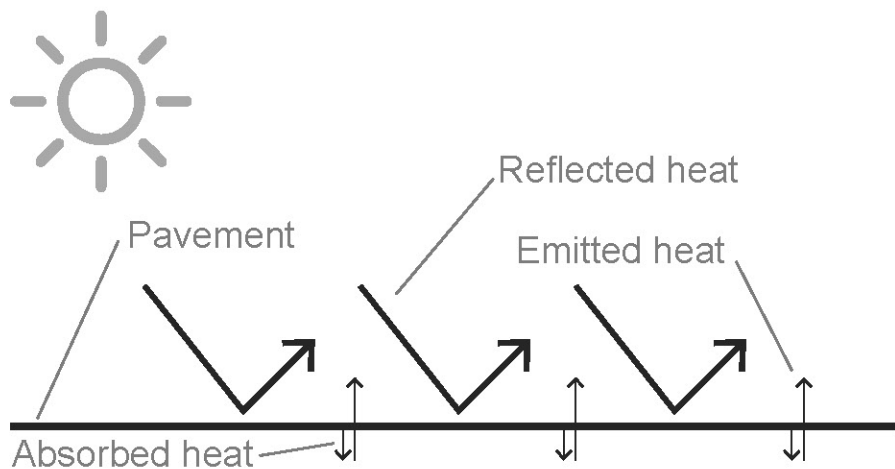
Adapted from: U.S. Environmental Protection Agency. 2008. *Reducing Urban Heat Islands: Compendium of Strategies*.
<https://www.epa.gov/sites/production/files/2014-06/documents/basicscompendium.pdf>



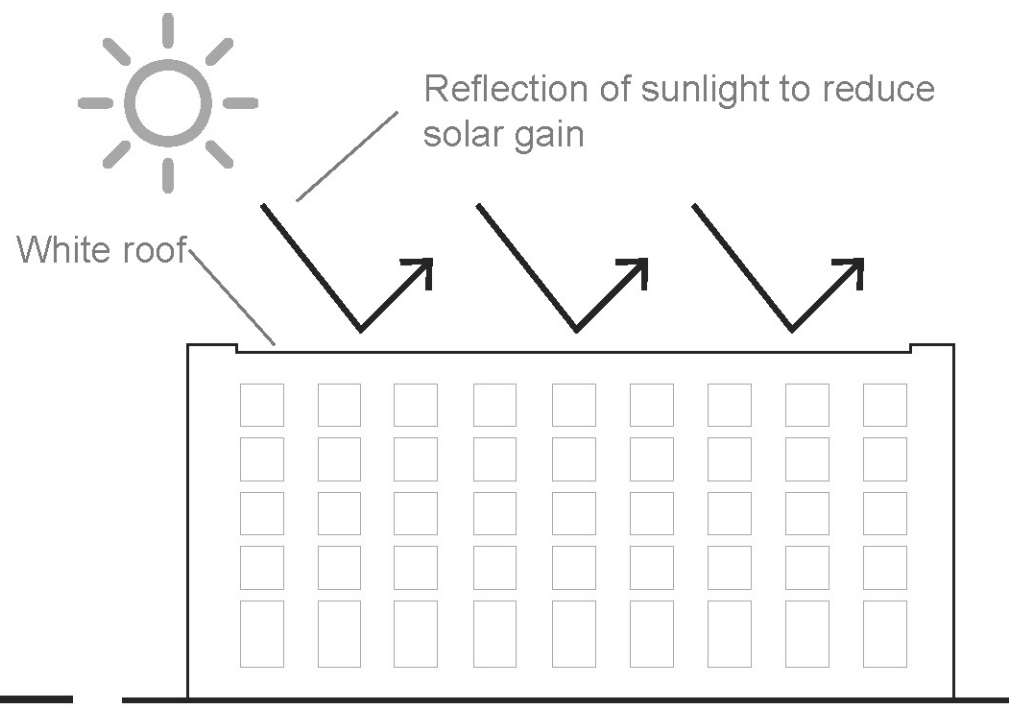
Trees and vegetation provide shade, which lowers surface temperatures.

Evapotranspiration lowers air temperatures by releasing water into the air and dissipating ambient heat.

Urban areas generally are made up of 75-100% impervious surface area, meaning there is less surface moisture available for evapotranspiration.



Cool pavements reflect sunlight and absorb and emit less heat than standard pavements.



White roofs reflect sunlight to reduce heat absorption and cooling requirements.

There are many incentives, programs, and policies laid out by different organizations and levels of government to encourage and enforce the implementation of green design, such as cool roofs, cool pavements, and urban forestry. The incentives and programs include a variety of grant programs, monetary awards, merit awards, educational opportunities, and monetary discounts on vegetation.

Building Ventilation

A PASSIVE STRATEGY FOR ADAPTING TO HIGH-TEMPERATURE EVENTS

LOCATION



LOW MEDIUM HIGH

HAZARDS



HEAT
WAVE



FLOODING

RELATED STRATEGIES

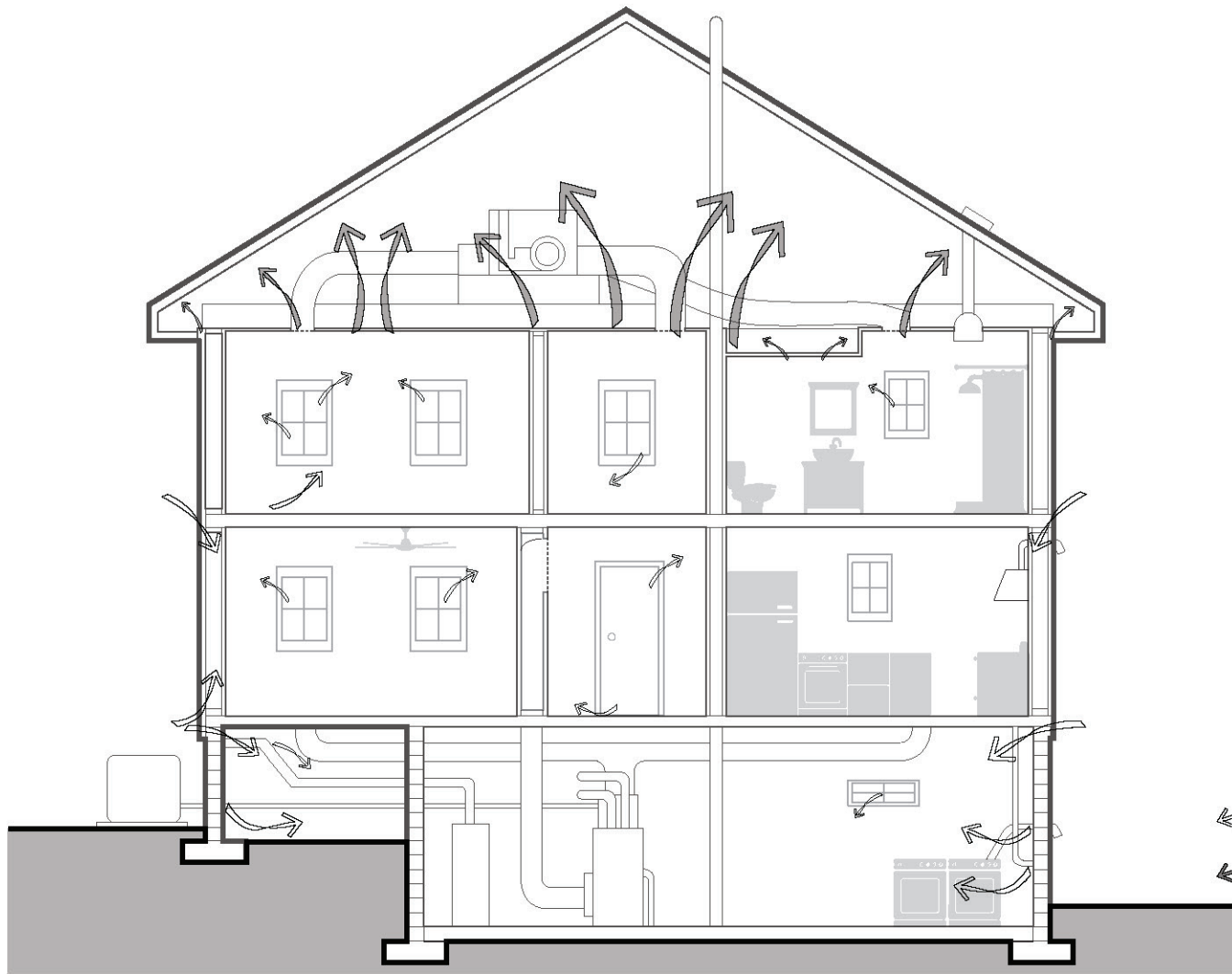
Windows
Insulation
Urban Heat Island
Indoor Air Quality
Passive Building Systems

DESCRIPTION

*Responding to Climate Change in New York State*¹ explains that human health will be compromised due to higher temperatures and increased precipitation.

NIST Planning Guide

Rajkovich, Nicholas B., Michael E. Tuzzo, Nathaniel Heckman, Krista Macy, Elizabeth Gilman, Martha Bohm, and Harlee-Rae Tanner. 2018. *Climate Resilience Strategies for Buildings in New York State*. NYSERDA, Albany, New York.

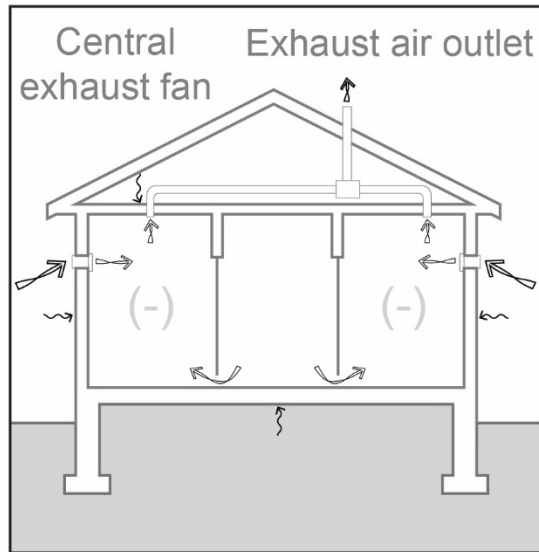


Health:
 Proper ventilation prevents mold and mildew growth, which can help prevent or lessen allergic reactions and asthma attacks

Home:
 Proper ventilation eliminates extra air moisture, which helps prevent window sill rot, peeling paint, insect infestation, heat loss, and mold growth

- ← Air leaking into house
- ← Air leaking out of house

Exhaust Ventilation



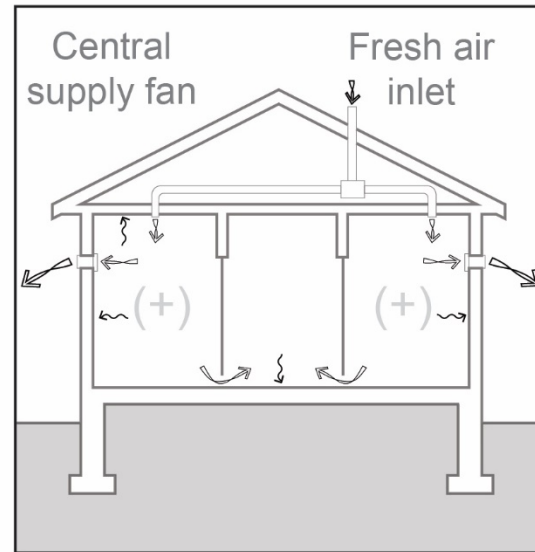
Pros:

- Simple installation
- Good for cold climates

Cons:

- Can let in pollutants, like radon
- Relies on air leaks
- Can raise heating/cooling costs
- Possibility of backdrafts in combustion appliances

Supply Ventilation



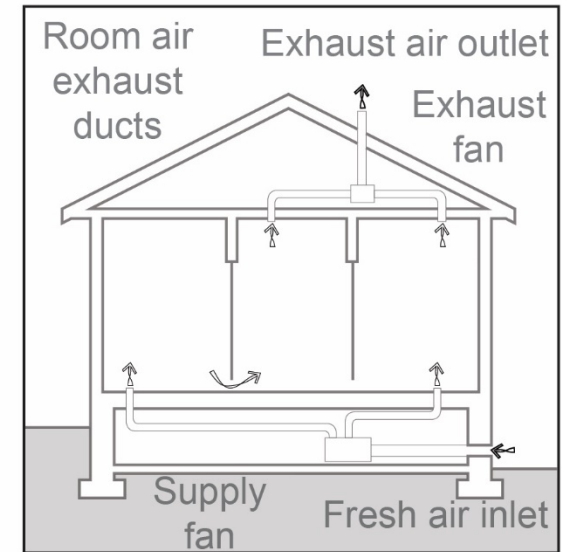
Pros:

- Simple installation
- Reduced chance of backdrafting
- Filters/dehumidifies outdoor air

Cons:

- Potential for moisture problems when cold
- Partially relies on air leaks
- Can raise heating/cooling costs

Balanced Ventilation



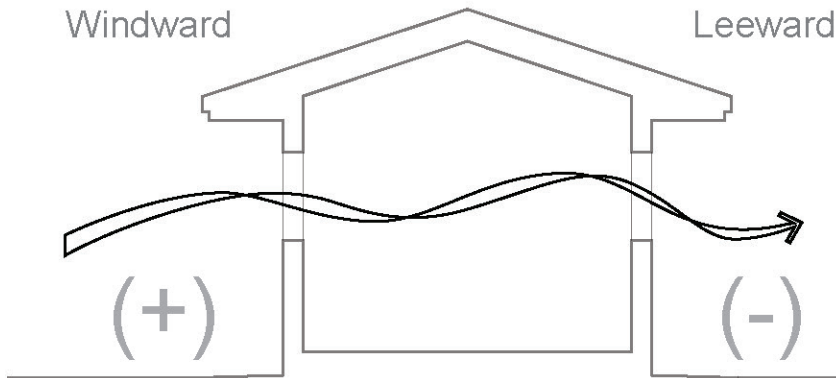
Pros:

- Works well in all climates

Cons:

- Higher installation costs
- Won't temper/remove air moisture
- Possible increase of heating/cooling costs

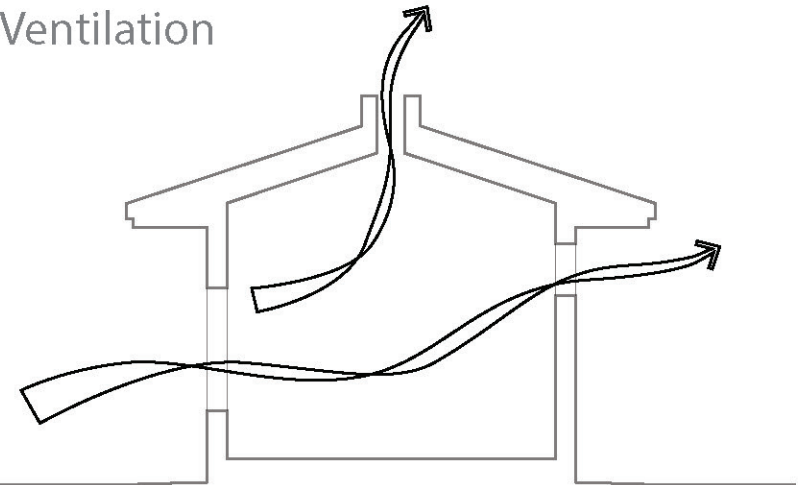
Cross Ventilation



Design Considerations for Passive Ventilation

- Amount of ventilation depends on design of internal spaces and size/placement of openings
- Building should be perpendicular to summer wind
- Naturally ventilated buildings should be narrow
- Windows should be operable for occupants
- Allow for adequate indoor airflow
- Consider application of clerestories and skylights
- Provide attic ventilation
- Consider fan-assisted cooling strategies

Stack Ventilation



Cross Ventilation

- Don't block space between openings
- Don't place openings directly opposite each other

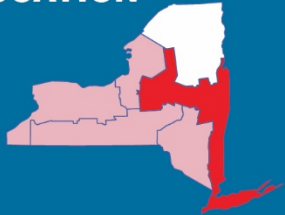
Stack Ventilation

- Humidity and temperature induced
- Air flow based on difference in air density

Indoor Air Quality

REDUCING PUBLIC HEALTH VULNERABILITIES IN BUILDINGS

LOCATION



LOW MEDIUM HIGH

HAZARDS



HEAT
WAVES



FLOODING



PEST
INFESTATIONS

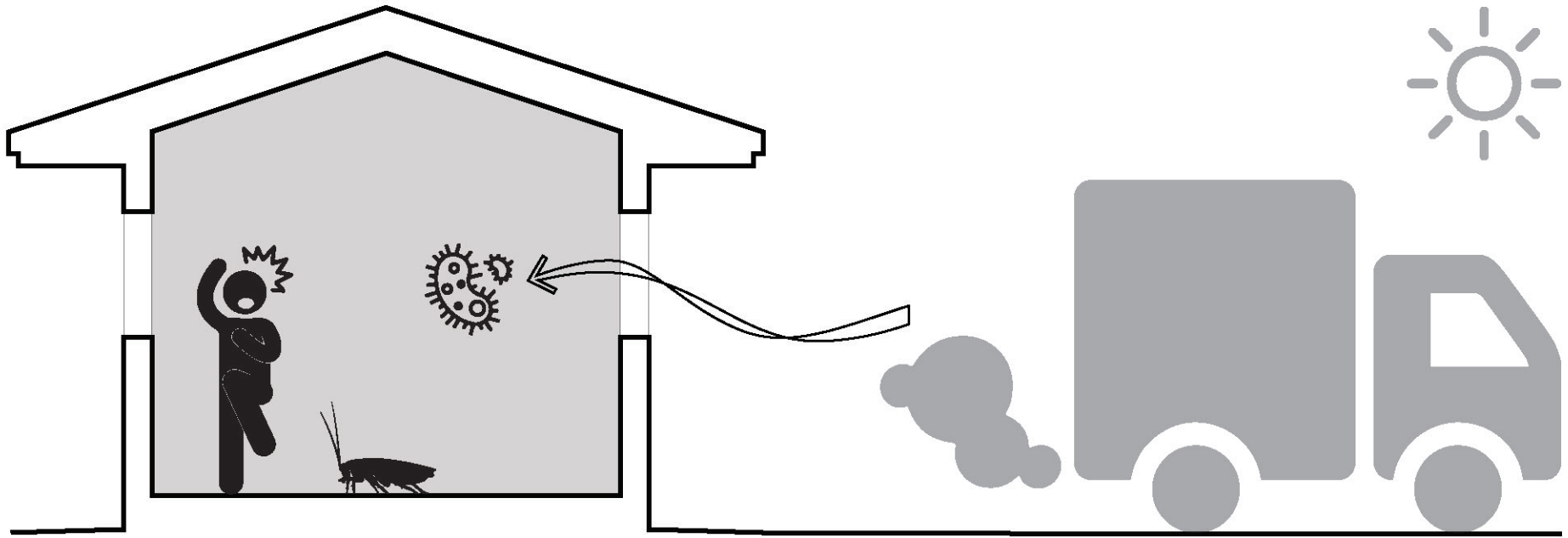
RELATED STRATEGIES

Windows
Building Ventilation
Passive Building Systems
Active Building Systems
Integrated Pest Management

DESCRIPTION

Air pollutants including particulates, sulfur oxides, and ground-level ozone can be influenced by meteorological variables¹ such as temperature and humidity.

Superstorm Sandy



Indoor Emissions:

- Building materials
- Products used/stored in building
- Microorganisms
- Insects or animals that live inside
- Behavior of occupants

Outdoor pollutants can enter a building and mix with/alter indoor air composition.

Outdoor conditions that influence indoor air quality:

- Air temperature and humidity
- Air quality
- Precipitation
- Land surface wetness

1. Select an Indoor Air Quality (IAQ) Manager

They must:

- Understand the building's structure and function
- Communicate with tenants, facility personnel, and building owners/representatives about IAQ concerns



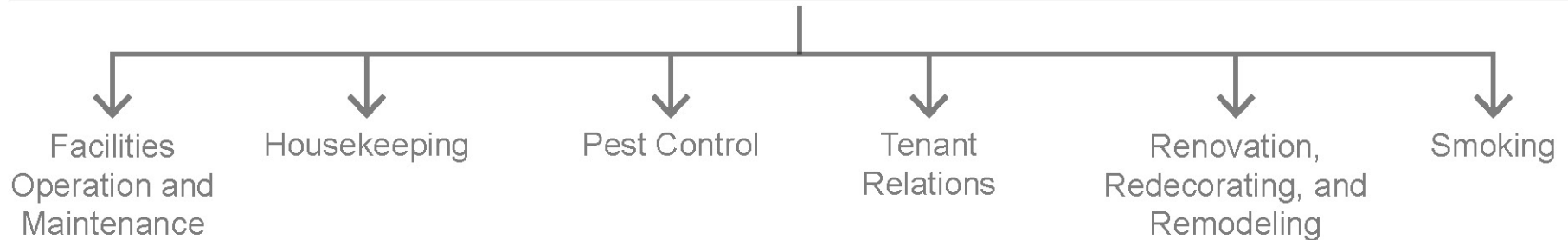
2. Review IAQ Profile and Existing Records

- Identify areas within the building that could have potential IAQ problems and staff/occupants whose Behavior impacts IAQ
- Understand the legal obligations of the building management/occupants in regards to IAQ



3. Assign Staff Responsibilities/Train Staff

- Incorporate IAQ practices into daily routines of the building staff/maintenance crews
- Establish cooperation and communication between different building organizations, i.e. tenants' office management and building management



Environmental Protection Agency

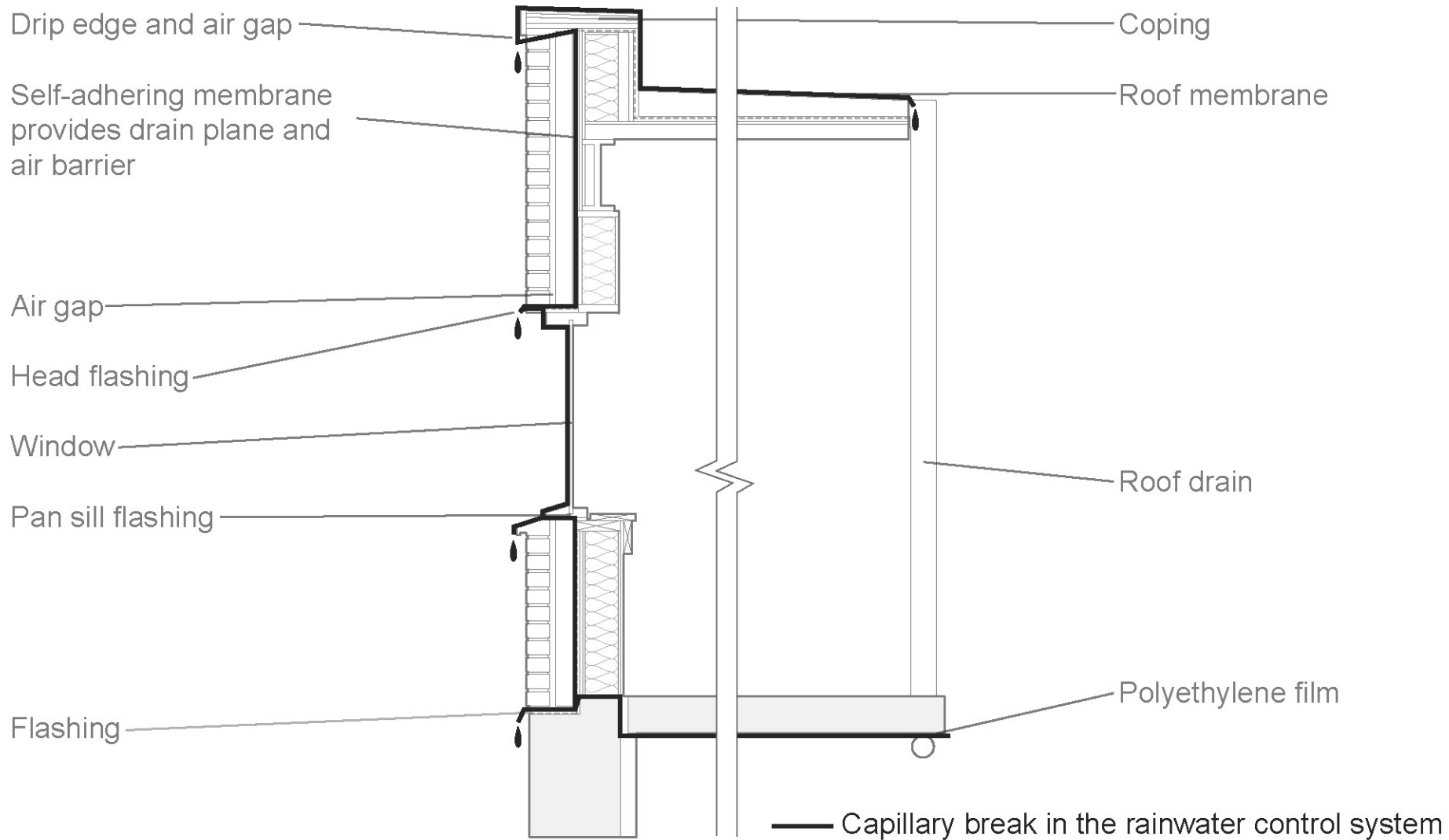
- Tools for Schools Program
- Indoor airPLUS
- A cooperative agreement program (2010) which provided funding to local governments, institutions, and non-profit organizations engage with projects that aimed to lower indoor pollutant exposure

National Institutes of Health

- Administers and funds environmental health research
- Works with EPA to support various Children's Environmental Health Research Centers
- Works with the Department of Housing and Urban Development Office of Lead Hazard Control to administer the National Survey of Lead and Allergens in Housing

Centers for Disease Control and Prevention

- National Center for Environmental Health
- Provides research funding for topics concerning exposure and health issues in relation to extreme weather events



Adapted from: U.S. Environmental Protection Agency. 2013. "Moisture Control Guidance for Building Design, Construction and Maintenance." <https://www.epa.gov/sites/production/files/2014-08/documents/moisture-control.pdf>

Passive Building Systems

REDUCING BUILDING ENERGY CONSUMPTION

LOCATION



LOW MEDIUM HIGH

HAZARDS



HEAT
WAVES



WINTER
STORMS



HURRICANES /
TROPICAL STORMS

RELATED STRATEGIES

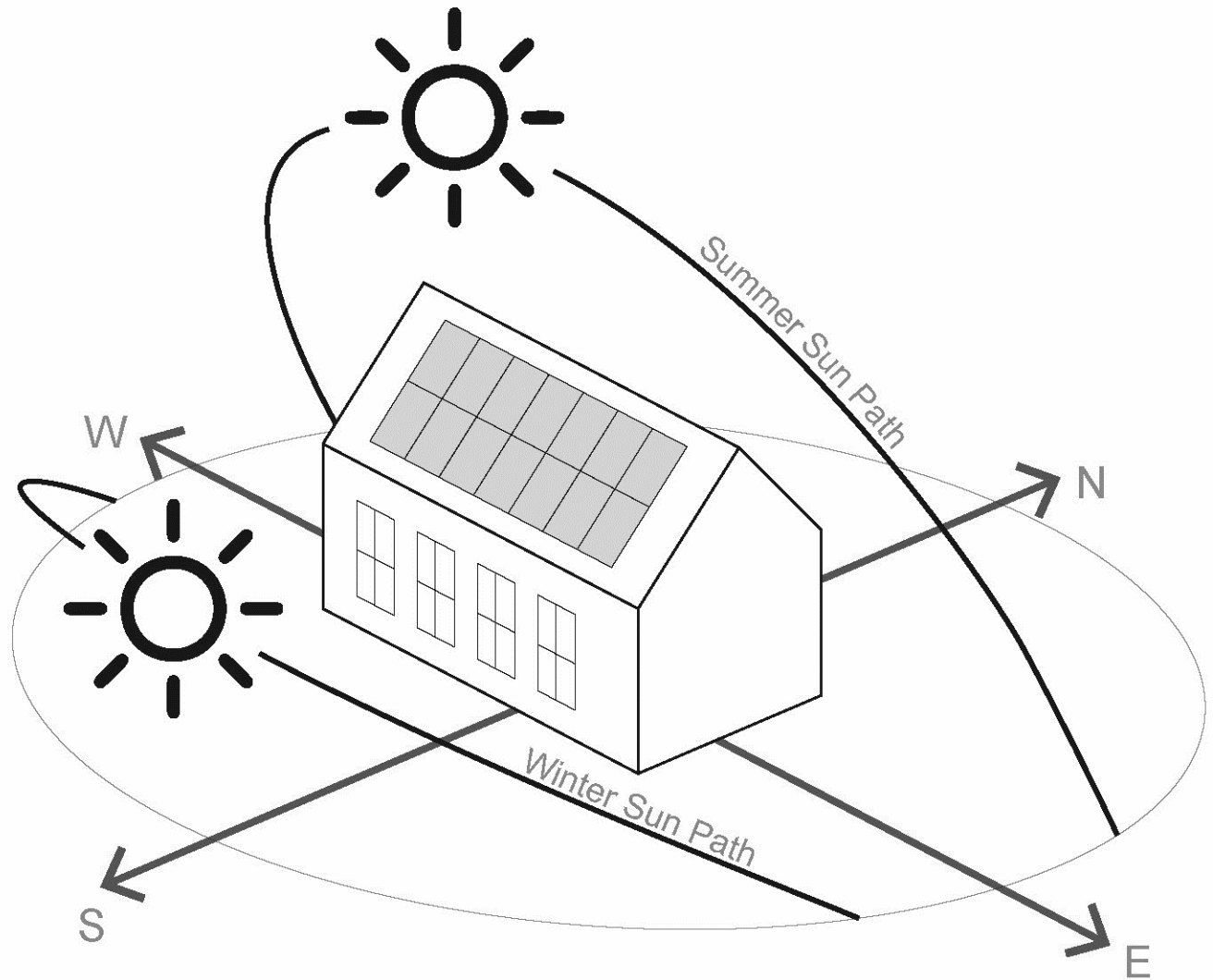
Windows
Roof Covering
Insulation
Building Ventilation
Indoor Air Quality
Active Building Systems

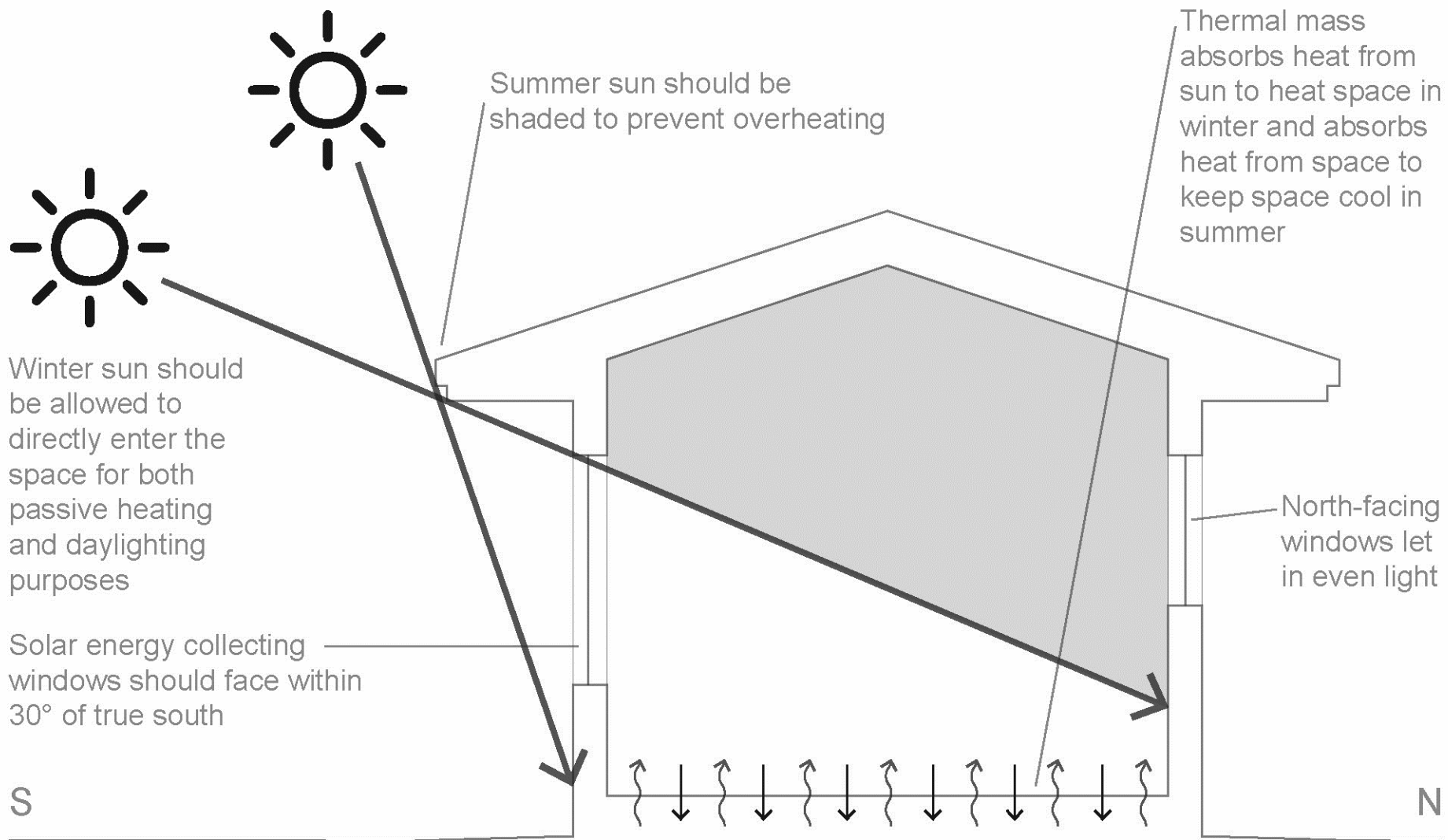
DESCRIPTION

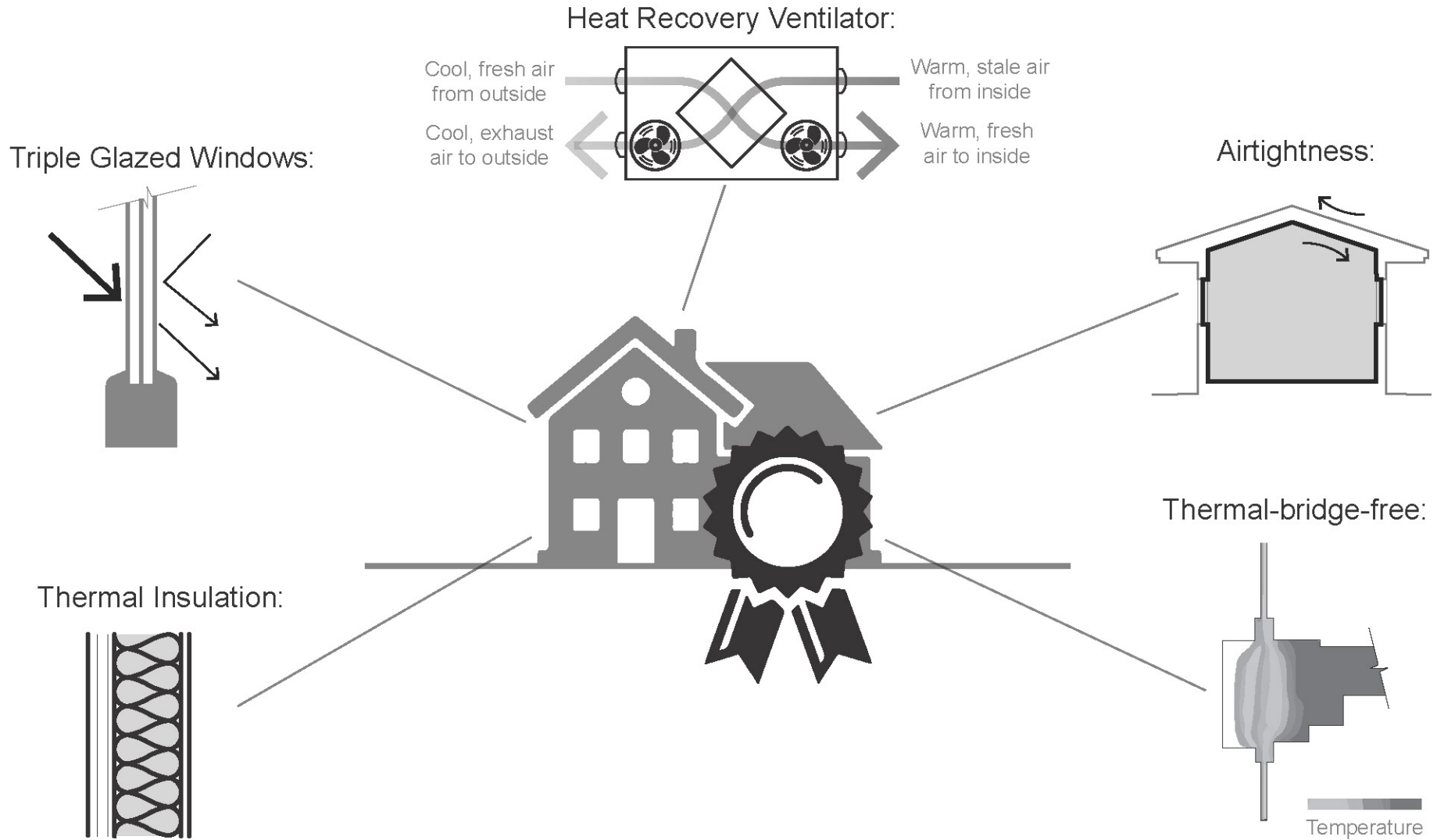
This strategy is intended to increase building energy performance by using passive rather than active systems. *Responding to Climate Change in New York*

8th St. EnerPHit Project

The sun can be harnessed for passive or active systems, such as heating or daylighting.







Adapted from: Bhasin, S., Y. Frank, and R. Yancey. 2015. "Passive NYC: A Snapshot of Low Energy Building Opportunities, Barriers, & Resources." https://be-exchange.org/wp-content/uploads/2017/11/Passive_House_Briefing-5-1.pdf



Active Building Systems

CLIMATE CHANGE ADAPTATION THROUGH EFFICIENT ACTIVE SYSTEMS

LOCATION



LOW MEDIUM HIGH

HAZARDS



HEAT WAVES



WINTER STORMS



HURRICANES / TROPICAL STORMS

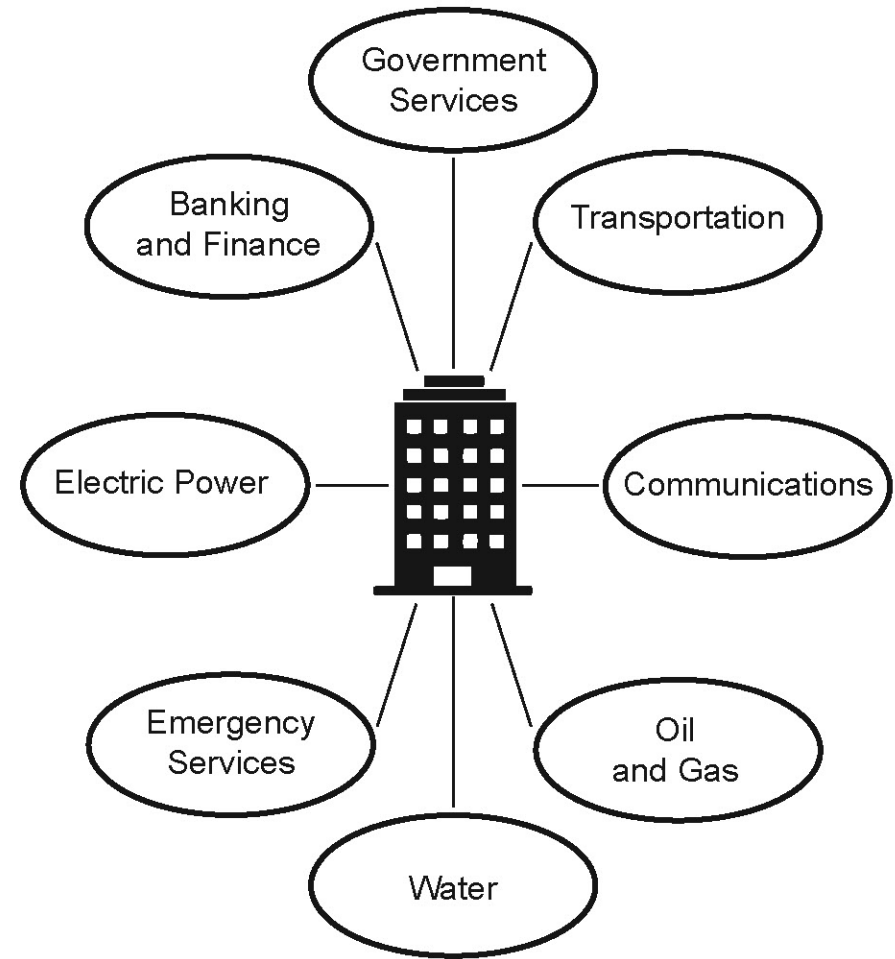
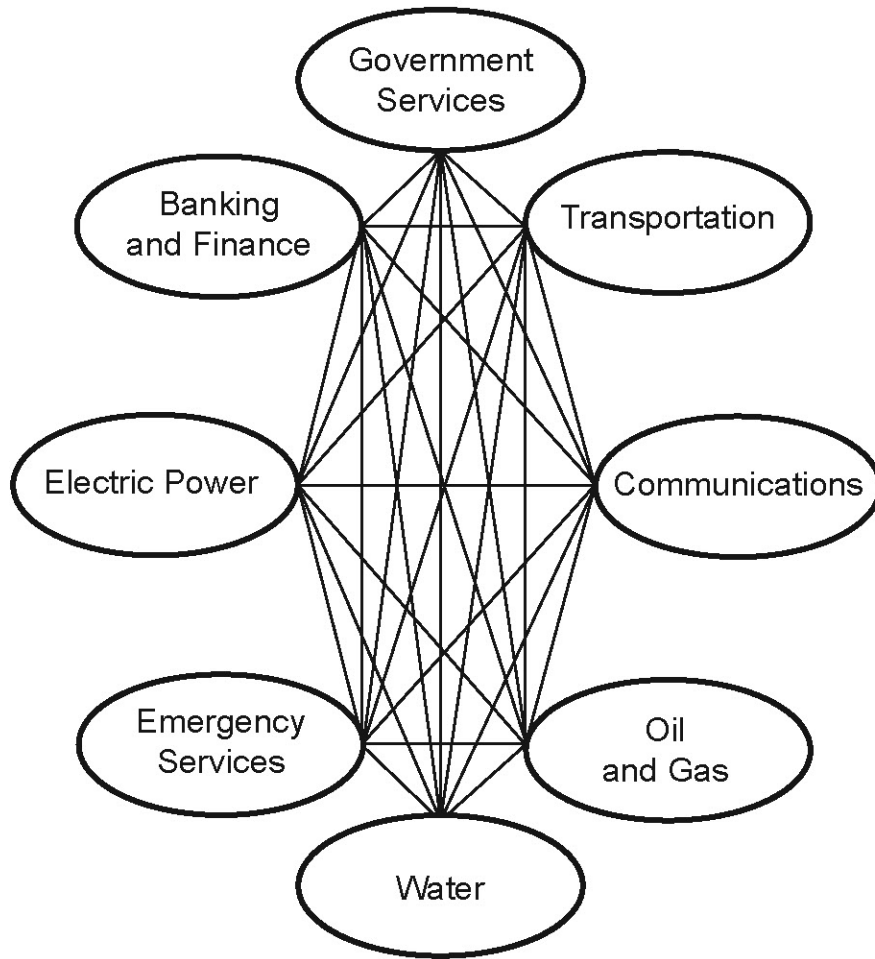
RELATED STRATEGIES

- Redundant Building Systems
- Building Systems Flood Protection
- Insulation
- Indoor Air Quality
- Passive Building Systems

DESCRIPTION

Burrstone Energy Center

According to the *Third National Climate Assessment*, intensifying storms and extreme weather events can increase stresses on infrastructure¹ systems that



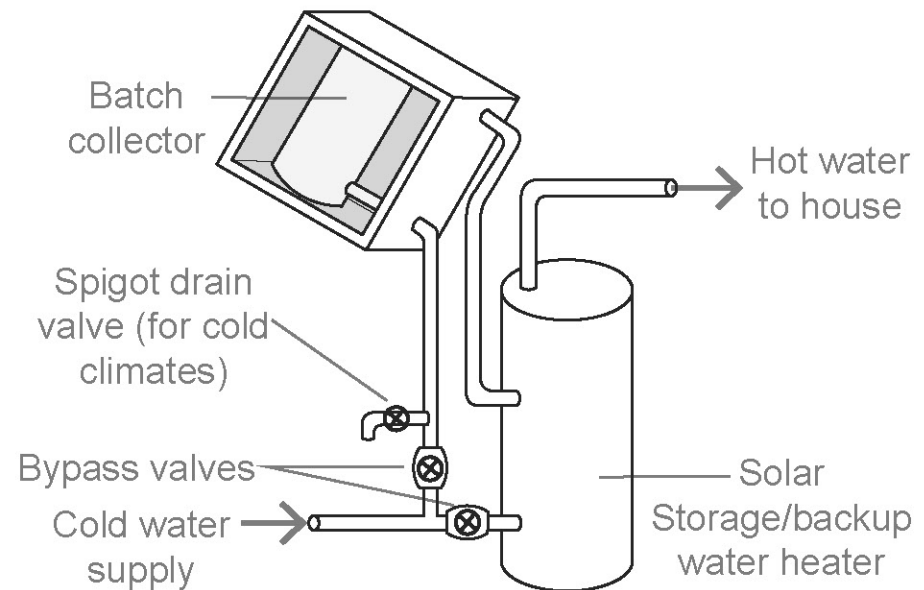
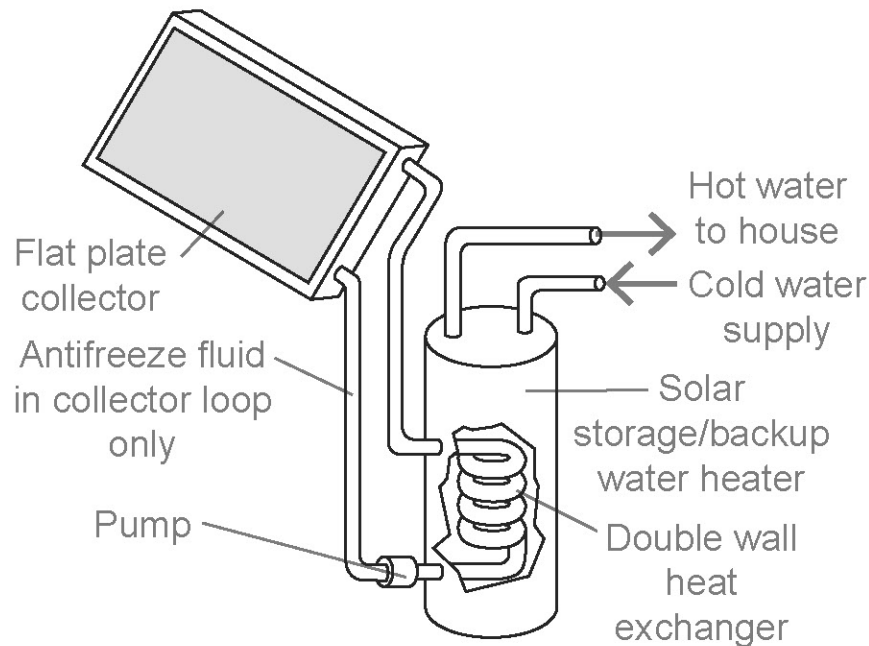
Solar water heaters help to reduce electrical and gas consumption, allowing for a reduction in the stress put on energy systems during extreme events.

Active solar water heating systems

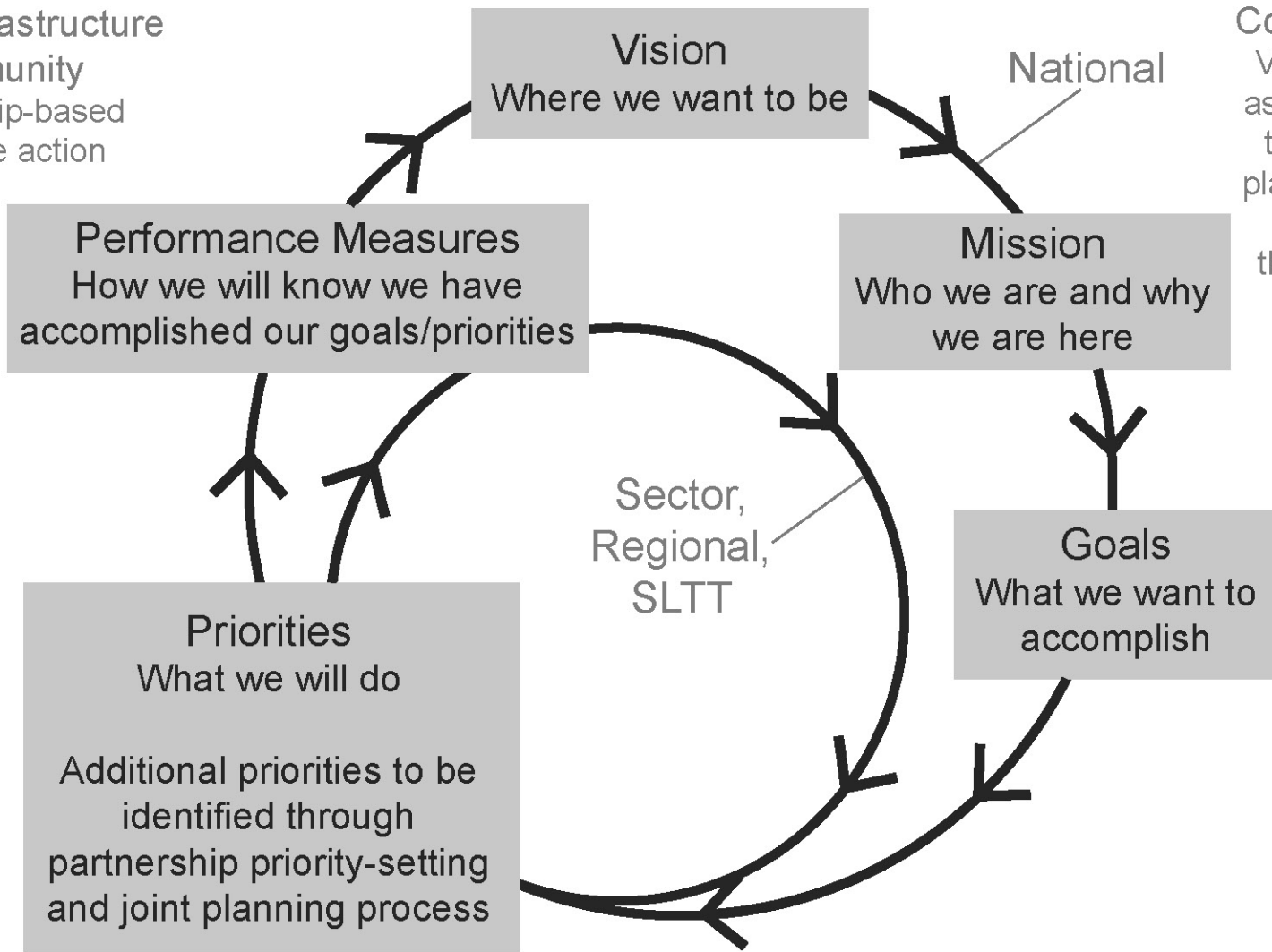
- Direct circulation systems: water is pumped directly from collectors into the home
- Indirect circulation systems: a non-freezing fluid is pumped through collectors and then heats up the water that flows into the home

Passive solar water heating systems

- Integral collector-storage passive systems: work best in freezing climates
- Thermosyphon system: water flows when warm water rises and cold water sinks, it is reliable but more expensive



Critical Infrastructure
Community
Partnership-based
collective action



Core Tenets
Values and assumptions that guide planning and activities throughout cycles

Passive Survivability calls for design to allow continued livability without power, fuel, and/or water for an extended period of time.

Cooling Load:

- Orient buildings on EW axis
- Minimize windows on E and W sides
- Use reflective roofs
- Incorporate built and vegetative shading techniques

Maintain Temperature:

- Ensure well sealed and highly insulated envelopes
- Incorporate thermal mass

Ventilation:

- Incorporate passive ventilation without fans or with fans powered by solar energy or batteries
- Include operable windows
- Include solar chimneys

Lighting:

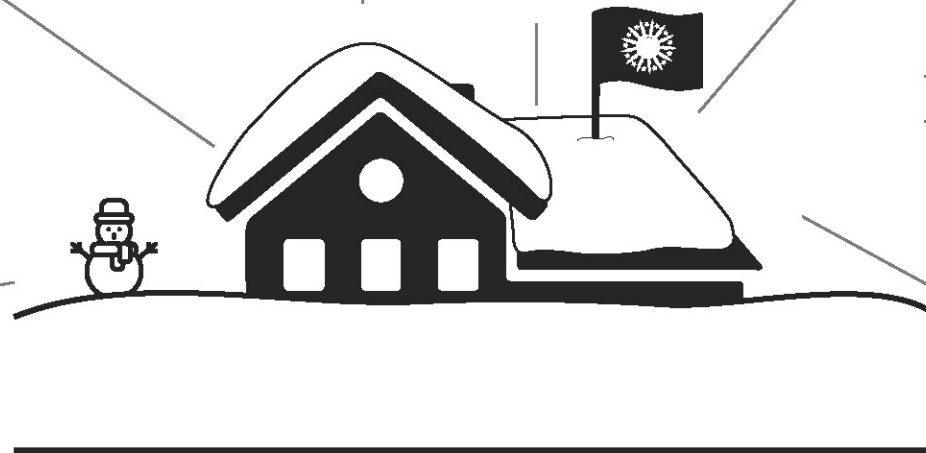
- Incorporate daylighting strategies: skylights, clerestory windows
- Ensure proper glazing: high visual light transmittance, low SHGC

Food:

- Store food that doesn't require cooking
- Store stoves and fuel

Water:

- Store drinking water
- Collect/store rainwater (non-potable uses)
- Use low-flow or composting toilets
- Use low-flow showerheads

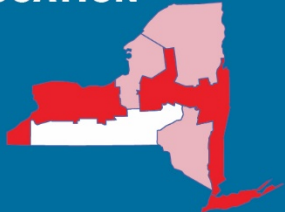




Building Operations

IMPROVING EFFICIENCY IN BUILDING MAINTENANCE AND PERFORMANCE

LOCATION



LOW **MEDIUM** **HIGH**

HAZARDS



HEAT
WAVES



HURRICANES /
TROPICAL STORMS



WINTER
STORMS

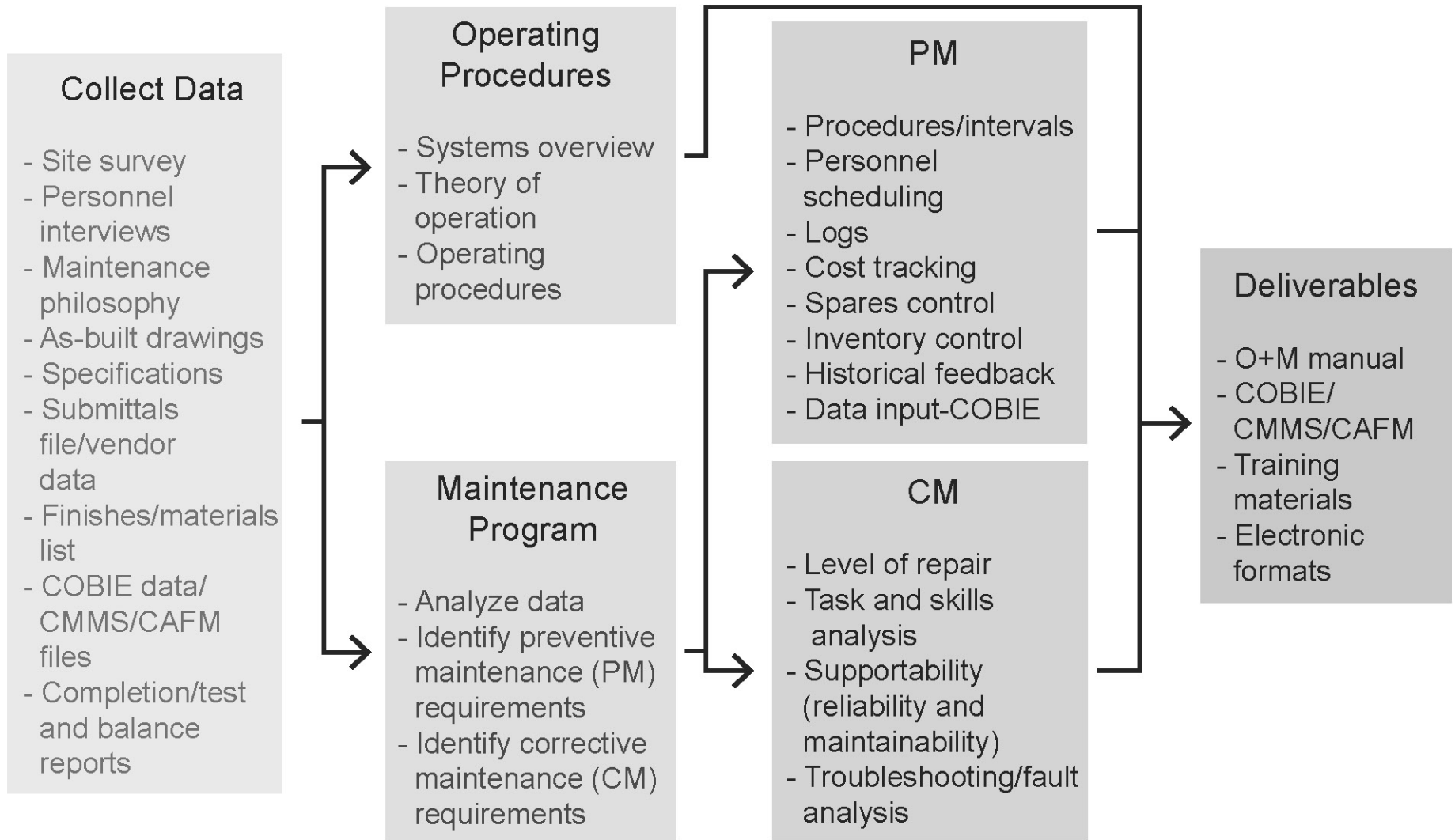
RELATED STRATEGIES

Redundant Building Systems
Building Systems Flood Protection
Building Fire Protection
Indoor Air Quality
Active Building Systems

DESCRIPTION

As climate change alters temperature and precipitation patterns, buildings will need to operate in extreme conditions that go beyond their initial design

Emergency Operations



Sustainable buildings require proper and sustainable operation and maintenance, taking into consideration the health, safety, comfort, productivity, and actions of the occupants.

Building systems should be easy to maintain.

Operation and maintenance workers should be a part of the design/construction process.



The plan, program, and practices should include:

- Training occupants and staff in sustainable practices
- Using efficient and eco-friendly cleaning products
- Reducing waste production
- Performing regular energy audits
- Updating to higher efficiency equipment and durable materials



Computerized Maintenance Management System (CMMS)

- Schedules and records operation and maintenance of equipment
- Records, manages, and communicates on a daily basis
- Collects data used to assess operational effectiveness
- Optimizes resources
- Keeps maintenance inventory, provides feedback information, and reduces costs through efficiency



Operation and Maintenance of Safe Rooms

The purpose of a safe room is to provide life-safety protection during both the warning period and entire duration of the event.

Safe rooms are usually considered as either:

- A community or a private safe room
- A stand-alone or an internal safe room
- Multi-use or single-use safe room

A safe room's operation and maintenance plan should:

- Be specific to the intended occupant group
- Provide emergency provisions and safety supplies
- Provide security by controlling movement in and out of space
- Account for all occupants after an event
- Provide regular maintenance to the room to ensure its readiness for emergencies
- Keep an inventory checklist and schedule



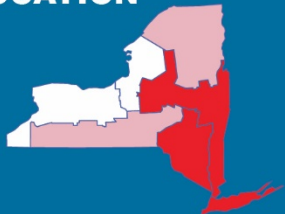
Adapted from: Federal Emergency Management Agency. 2015. "Safe Rooms for Tornadoes and Hurricanes."

http://www.fema.gov/media-library-data/1467990808182-0272256c8a35a4e8c35eeff53dd547/fema_p361_July2016_508.pdf

Potable Water Systems

PROTECTING WATER FROM WASTEFUL USE AND CONTAMINATION

LOCATION



LOW MEDIUM HIGH

HAZARDS



HEAT WAVES



HURRICANES / TROPICAL STORMS



FLOODING

RELATED STRATEGIES

Emergency Management
Redundant Building Systems
Building Flood Protection
Gray Infrastructure
Neighborhood Development
Reclaimed Water Systems

DESCRIPTION

Humans require on [average 20-50 liters of clean water⁴](#) for drinking, cooking, and sanitation daily. The Center for Disease Control and Prevention explains

NYC Water Tanks

1. Coagulation and Flocculation

Positively charged chemicals are added to the water to neutralize negatively charged particles/dirt within the water. The particles and chemicals bind together, creating larger particles, or floc.

2. Sedimentation

Floc is heavier than water, causing it to settle at the bottom of the water supply.

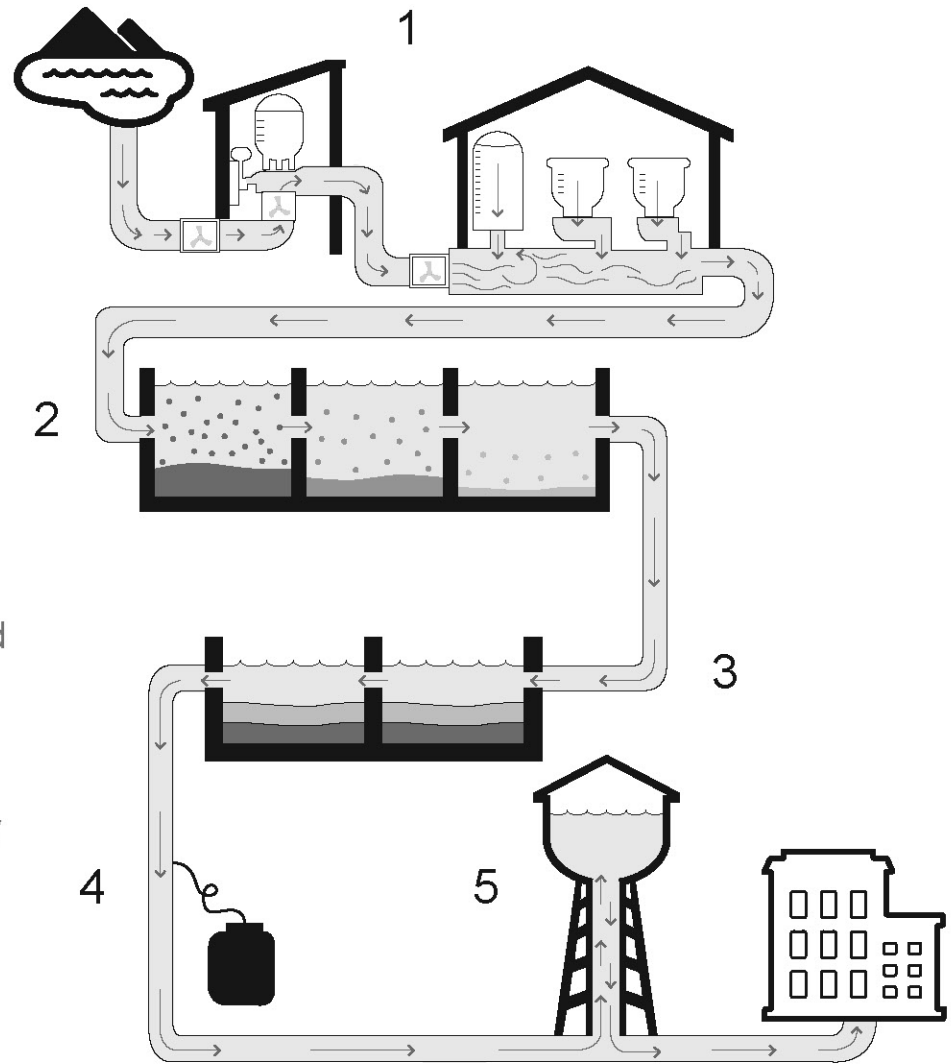
3. Filtration

The now clear water passes through filters with different compositions and pore sizes, such as sand, gravel, and charcoal. This process removes dissolved particles like dust, bacteria, and chemicals.

4. Disinfection

A disinfectant, like chlorine, might be added to kill any parasites, bacteria, or viruses that may remain in the water.

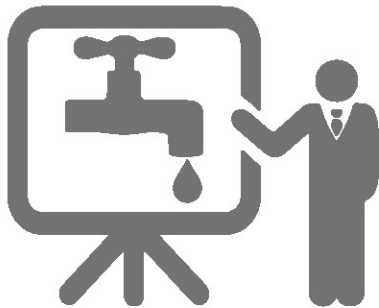
5. Storage



Conserving Water...

as a Building Owner or Developer

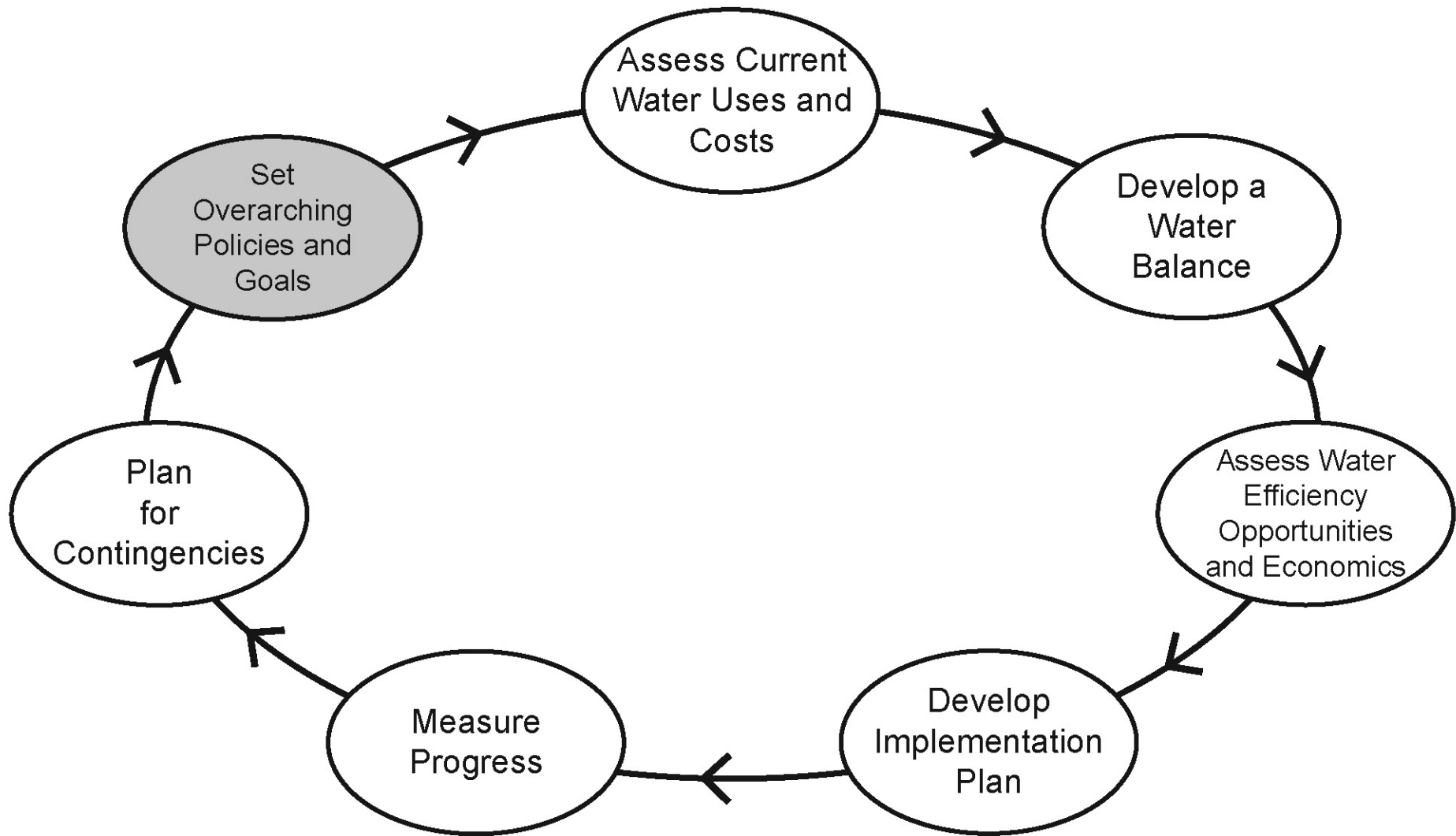
- Use high efficiency fixtures and water conserving cooling towers
- Eliminate leaks
- Use water and air economizers and off-peak cooling to save water and energy
- Improve water quality by installing a storm water settling pond, kitchen grease-traps, eliminate garbage disposals, and eliminate lead-bearing products
- Recover graywater for on-site use
- Consider living machines

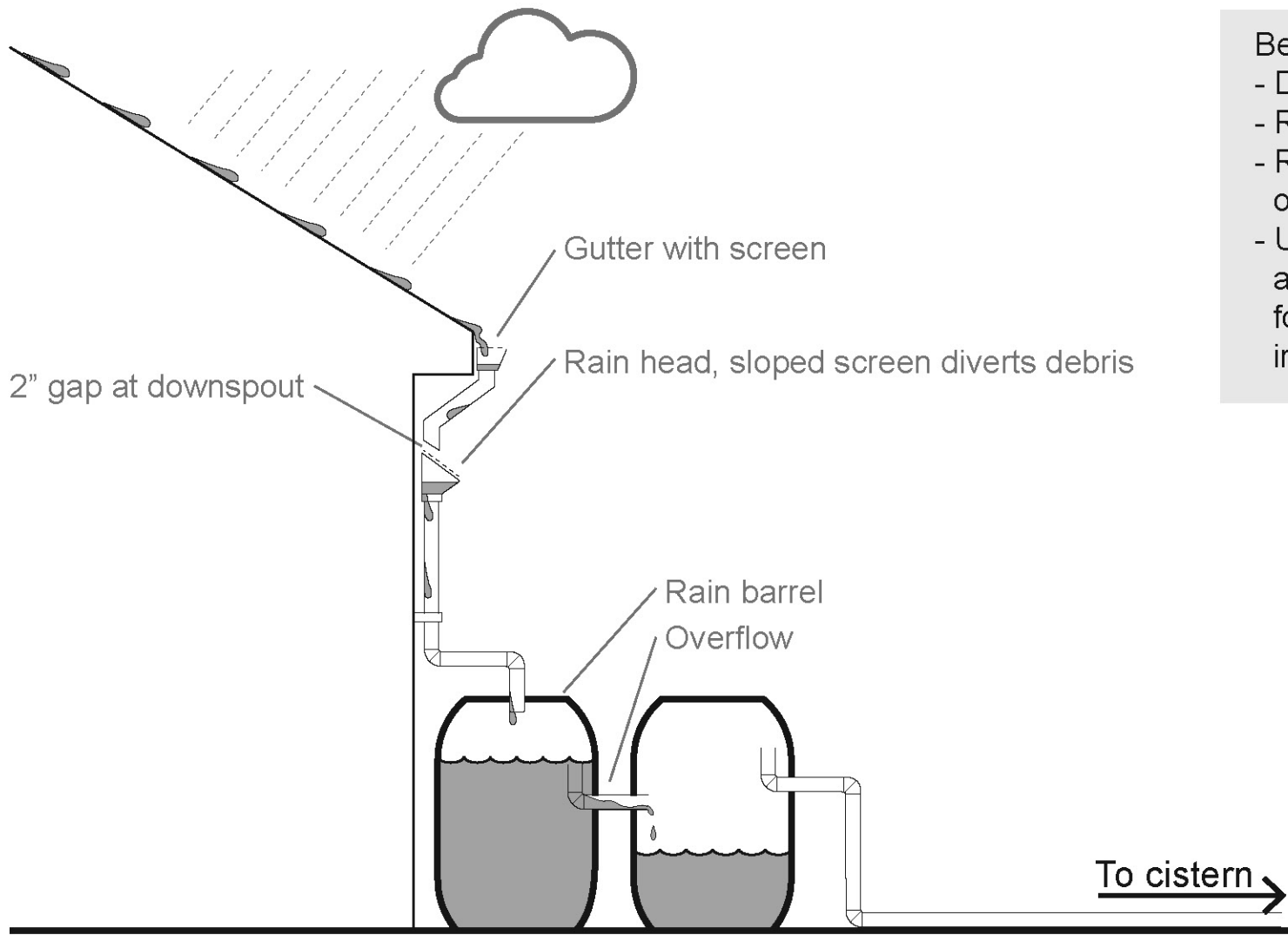


as a Home Owner or Occupant

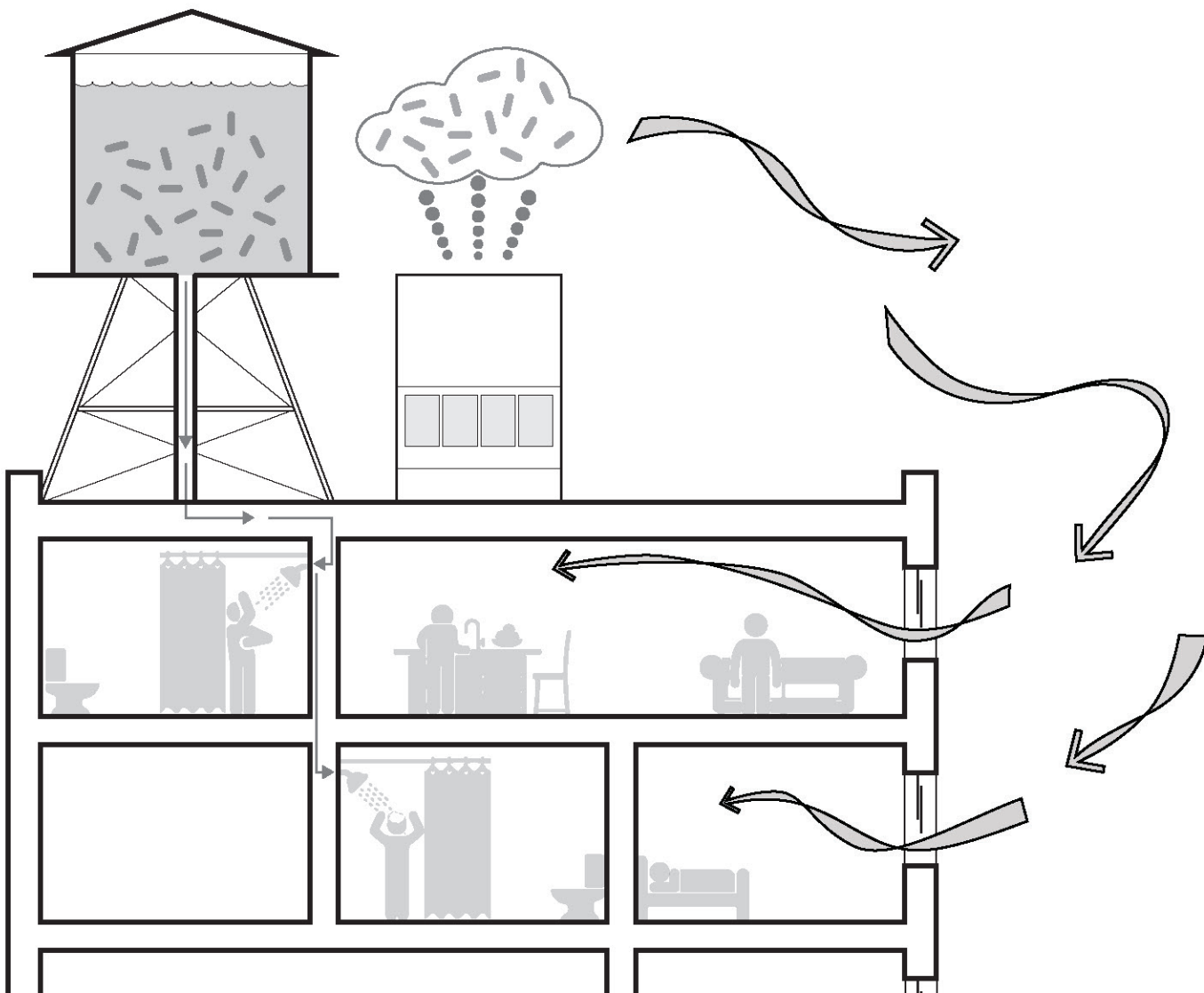
- Take short showers (save 5-7 gallons/minute)
- Install water-saving toilets, showerheads, and faucets
- Turn off water while shaving, washing hands, and brushing teeth (save 2-3 gallons/minute)
- Throw toilet paper/trash in wastebasket, not in toilet
- Repair leaky faucets (save 15-20 gallons/minute)
- Only run dishwashers and washing machines when full
- Turn water off when washing dishes or fill sink/basin
- Don't rinse sidewalks and driveways with hose
- Don't overwater plants or lawn







- Benefits:
- Decreased erosion
 - Reduced utility bills
 - Reduced amount of harmful runoff
 - Used for cleaning, as drinking water for animals, and for irrigation



Legionella grows where water is stored at warm temperatures, such as in large and complex building water systems.

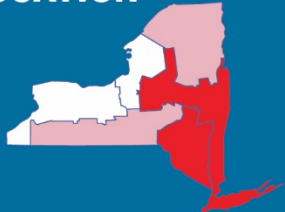
As water particles become airborne and are inhaled by humans, the bacteria is able to infect the lungs, potentially leading to Legionnaires' disease.

People over 50 years old, smokers, and those with a weakened immune system are more susceptible to contracting this disease.

Reclaimed Water Systems

INCREASING EFFICIENCY IN EVERYDAY WATER USE

LOCATION



LOW MEDIUM HIGH

HAZARDS



HEAT WAVES



SEVERE STORM



FLOODING

RELATED STRATEGIES

Green Infrastructure
Roof Covering
Roof Drainage
Passive Building Systems
Potable Water Systems

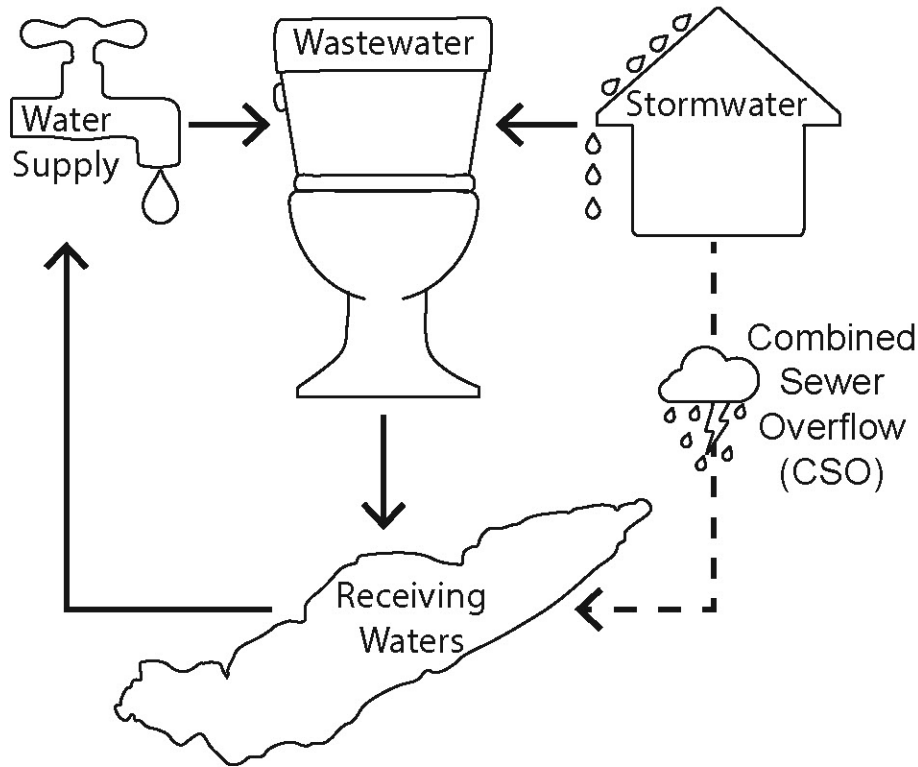
DESCRIPTION

According to *Responding to Climate Change in New York State*, anticipated changes in [New York State's climate](#)¹ have the potential to bring extended

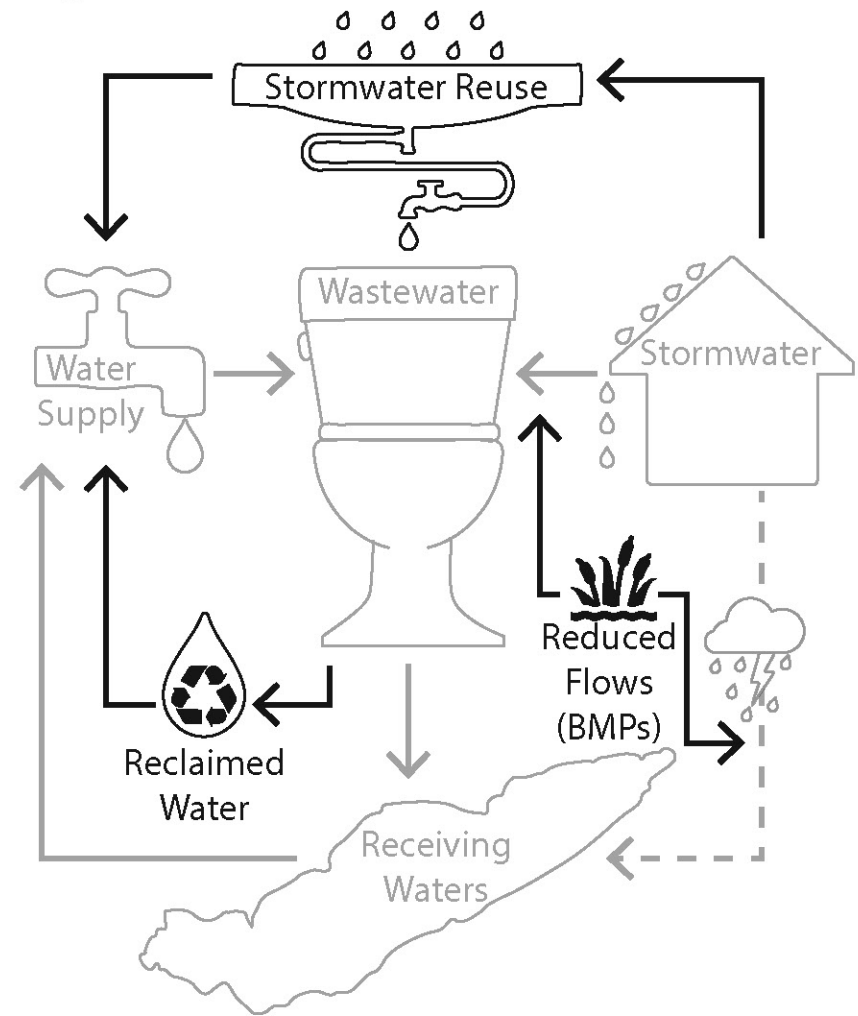
Oneida Water Reuse

Rajkovich, Nicholas B., Michael E. Tuzzo, Nathaniel Heckman, Krista Macy, Elizabeth Gilman, Martha Bohm, and Harlee-Rae Tanner. 2018. *Climate Resilience Strategies for Buildings in New York State*. NYSERDA, Albany, New York.

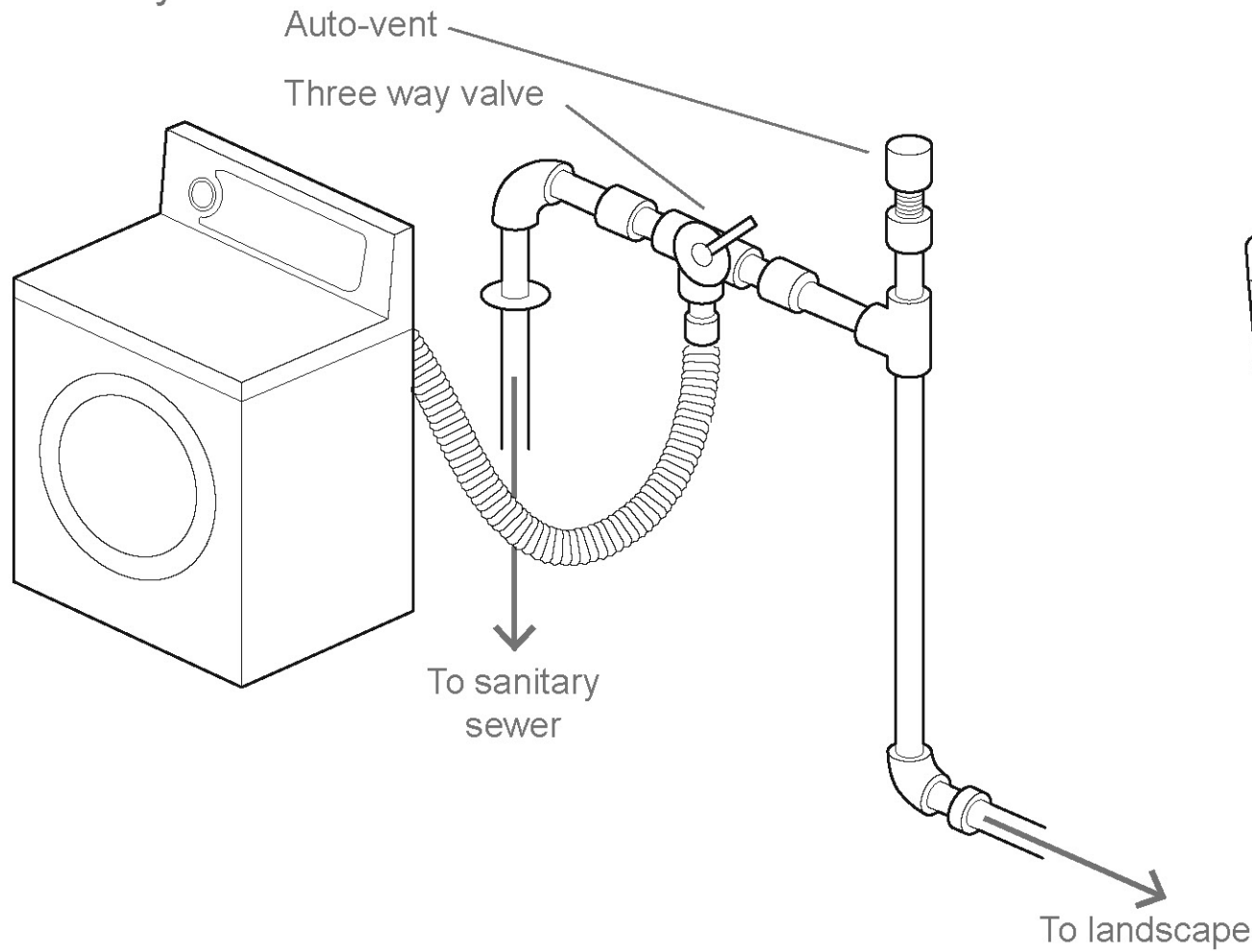
Traditional Water Management



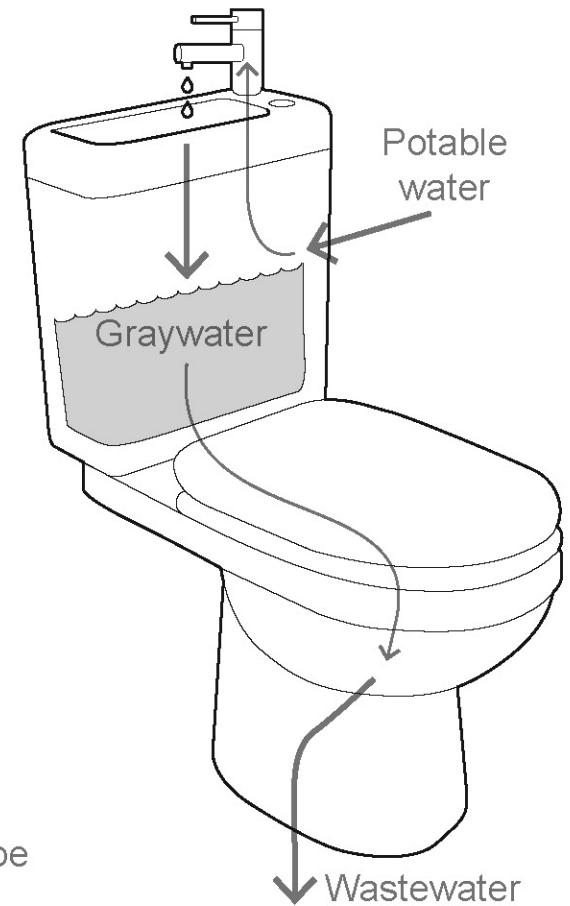
Integrated Water Resources

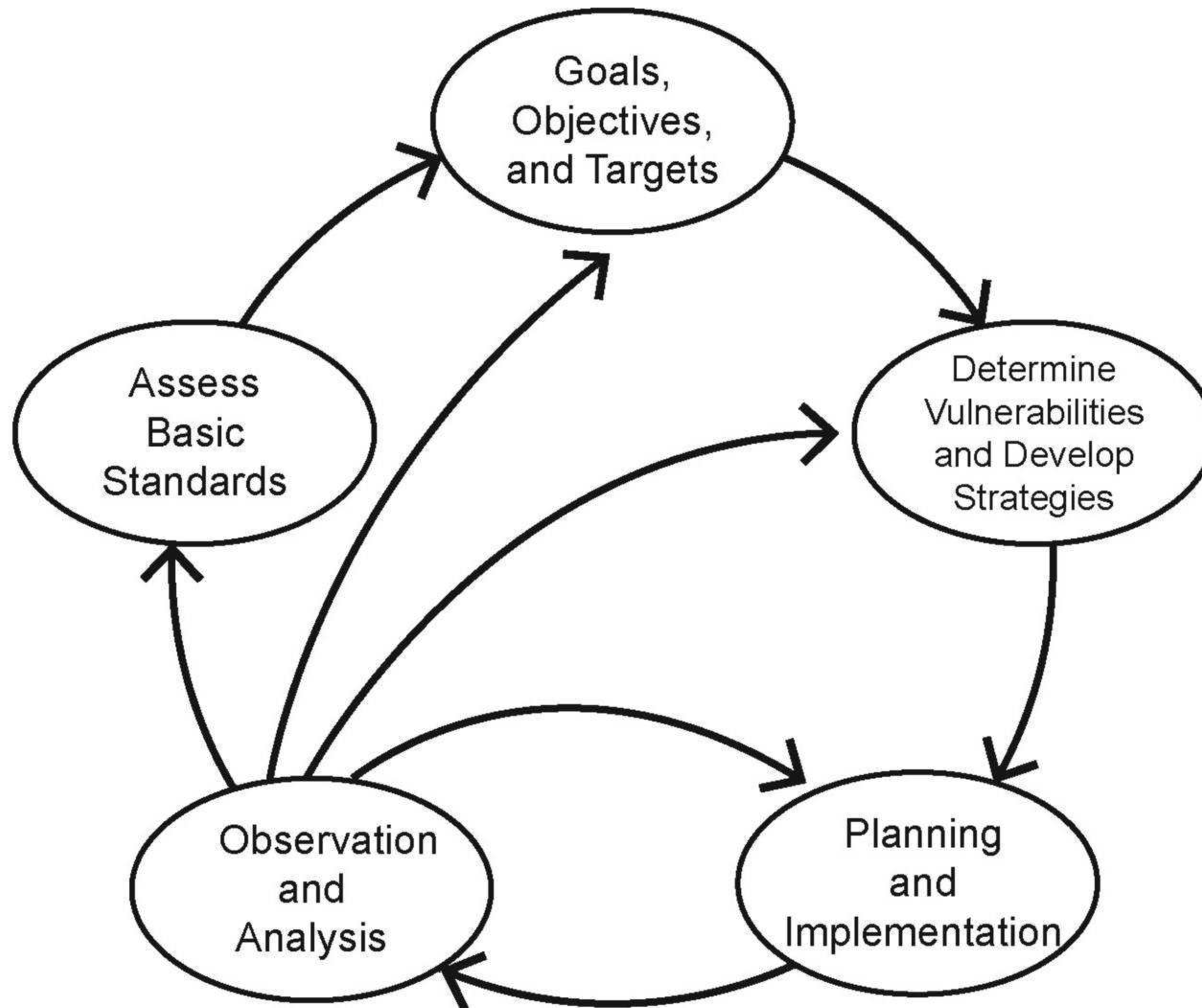


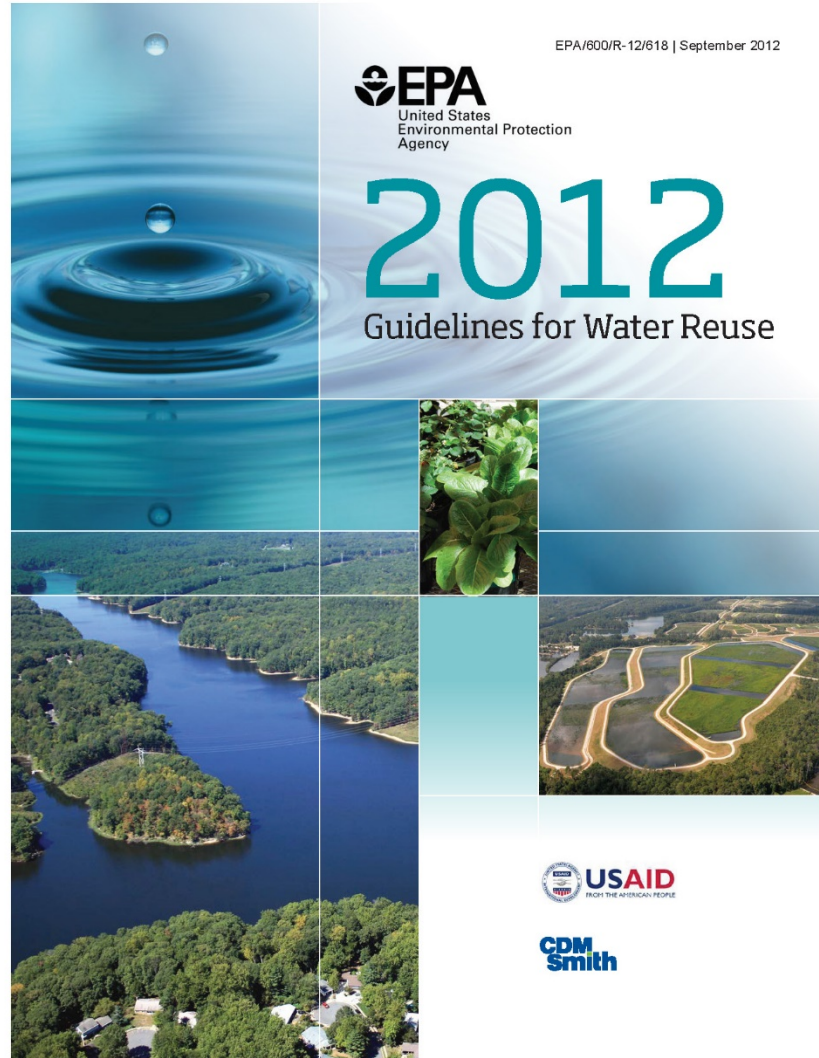
Laundry



Bathroom







Planning and Management Considerations

Types of Reuse Applications

State Regulatory Programs
for Water Reuse

Regional Variations in Water Reuse

Treatment Technologies for Protecting
Public and Environmental Health

Funding Water Reuse Systems

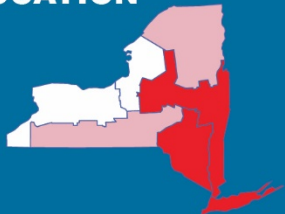
Public Outreach, Participation, and
Consultation

Global Experiences in Water Reuse

Integrated Pest Management

PROTECTING BUILDINGS FROM PESTS

LOCATION



LOW MEDIUM HIGH

HAZARDS



PEST
INFESTATION



HEAT
WAVES

RELATED STRATEGIES

Windows
Building Foundations
Insulation
Indoor Air Quality

DESCRIPTION

This strategy is intended to protect buildings from animals and pests that may damage building structures and materials or pose a threat to human health. As

NYC Public Housing

Identify Pests and Track Development

Knowing which pests are in the building allows the correct prevention methods to be put in place and for a limitation of pesticide use.

Keep track of pest populations, areas vulnerable to pests, and the efficiency of prevention methods.



Determine Action Thresholds

The action threshold is the level at which a pest population becomes a nuisance, a health hazard, and/or an economic hazard.



Implement Prevention Measures

Eliminate conditions that attract pests by:

- Removing clutter
- Sealing openings in the envelope of the building where pests might enter
- Keeping food areas clean
- Eliminating standing water
- Removing garbage



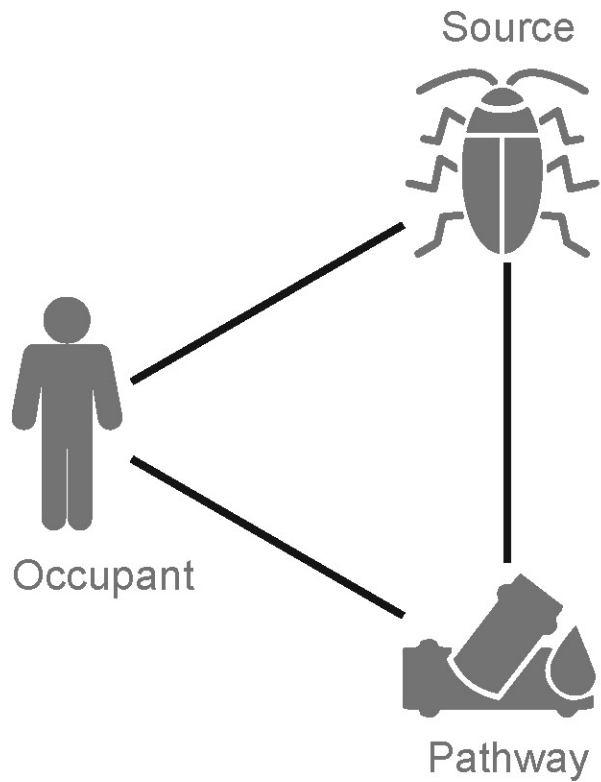
Implement Control Measures

Control measures are needed when the action threshold is surpassed. These measures include:

- Pest traps
- Heat/cold treatments
- Physical removal
- Pesticides

Document all control actions taken.





IPM:

Integrated
Pest
Management



Pest
complaints
dropped by
as much as
90%



Pesticide
use dropped
by as much
as 92%



Schools
can save
\$1000 to
\$20,000
annually



Reduce
asthma
triggers and
sick days



Smart:

Provides a
healthier and
safer learning
environment



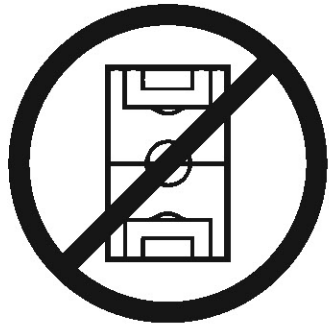
Sensible:

Utilizes
practical
strategies to
prevent and
control pest
infestations



Sustainable:

Focuses on
long-term solutions
and prevention,
creating an
economically
efficient approach



Pesticides cannot be used on athletic fields, playgrounds, or playing fields that are on the grounds of schools or daycare centers.

The term “pesticide” covers a range of products, including, but not limited to: insecticides, herbicides, fungicides, and rodenticides (there are 6 types of pesticide products that are not included under this new law, meaning they can be used on or in these areas).

Alternative pest control/maintenance without the use of pesticides:



- Be aware of possible pest locations, such as dumpsters
- Understand the site and which areas already have, are prone to, or have the potential to get infestations or diseases



- Determine the action threshold and if any areas need special attention
- Make sure the soil is healthy: it’s draining well, it has a healthy and neutral pH, etc.
- Choose plants that are well suited to the environment and that are resistant to insects and diseases
- Make sure through periodic checks that all plants and fields are healthy

Termite Control/Prevention Methods:

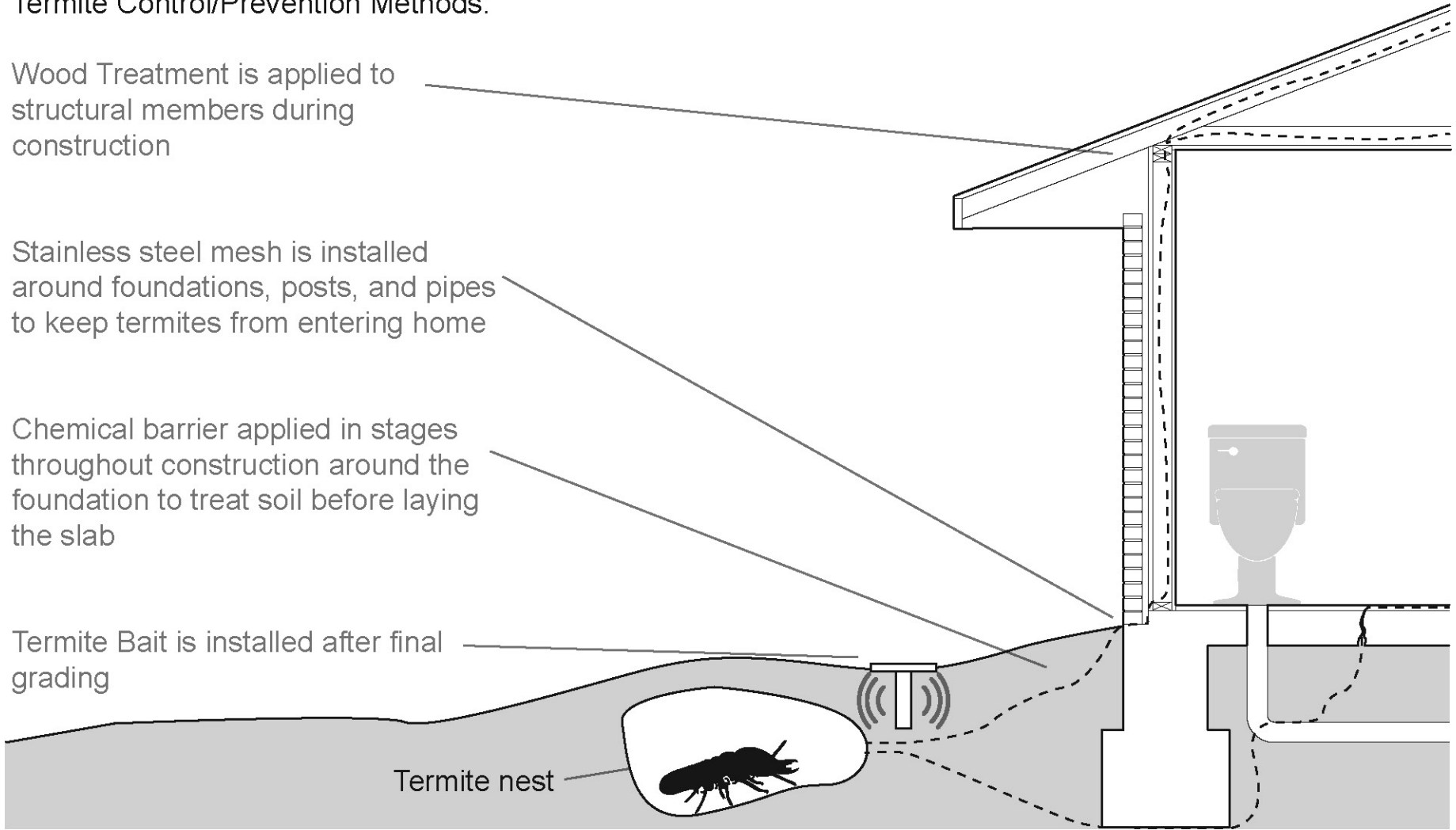
Wood Treatment is applied to structural members during construction

Stainless steel mesh is installed around foundations, posts, and pipes to keep termites from entering home

Chemical barrier applied in stages throughout construction around the foundation to treat soil before laying the slab

Termite Bait is installed after final grading

Termite nest





**NEW YORK
UPSTATE**

Presentation prepared by:

Nicholas B. Rajkovich, Elizabeth K. Gilman, Hope Forgas, and Thomas J. Mulligan



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SEARCH

HOME RESEARCH INITIATIVES ADAPTING BUILDINGS FOR A CHANGING CLIMATE

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Our Approach

Centers and Labs

Initiatives

The UB Affordable Housing Initiative

Adapting Buildings for a Changing Climate

See It Through Buffalo

University Heights Initiative

Insights

Related Links

- Graduate Research in Architecture
Graduate Research in Urban Planning

Adapting Buildings for a Changing Climate



ap.buffalo.edu/adapting-buildings
ap.buffalo.edu/rajkovich

New York's climate is changing. Are your buildings prepared?

