Welcome

RESILIENCY:

Designing for the next 50 years

Sarah Hong | Group 14 ENGINEERING

Agenda

- Impacts of climate change in the US over the next 50 years
- Vulnerabilities in today's buildings
- Design solutions
- Incentivizing resilience

"Resilience is the capacity of a community, business or natural environment to prevent, withstand, respond to and recover from a disruption."

US-Climate Resilience Toolkit↗

Impacts of Climate Change

Drought

25-50% increase in water withdrawal over next 50 years

Flooding

Flash flooding expected to triple over the next 100 years in Rocky Mountain range

Extreme Heat

Ave temperature expected to rise 2-5 degrees F in next 50 years

Severe Winter Storms

Severe storms can cause power outages and closures of streets, schools, and businesses

Hail Storms

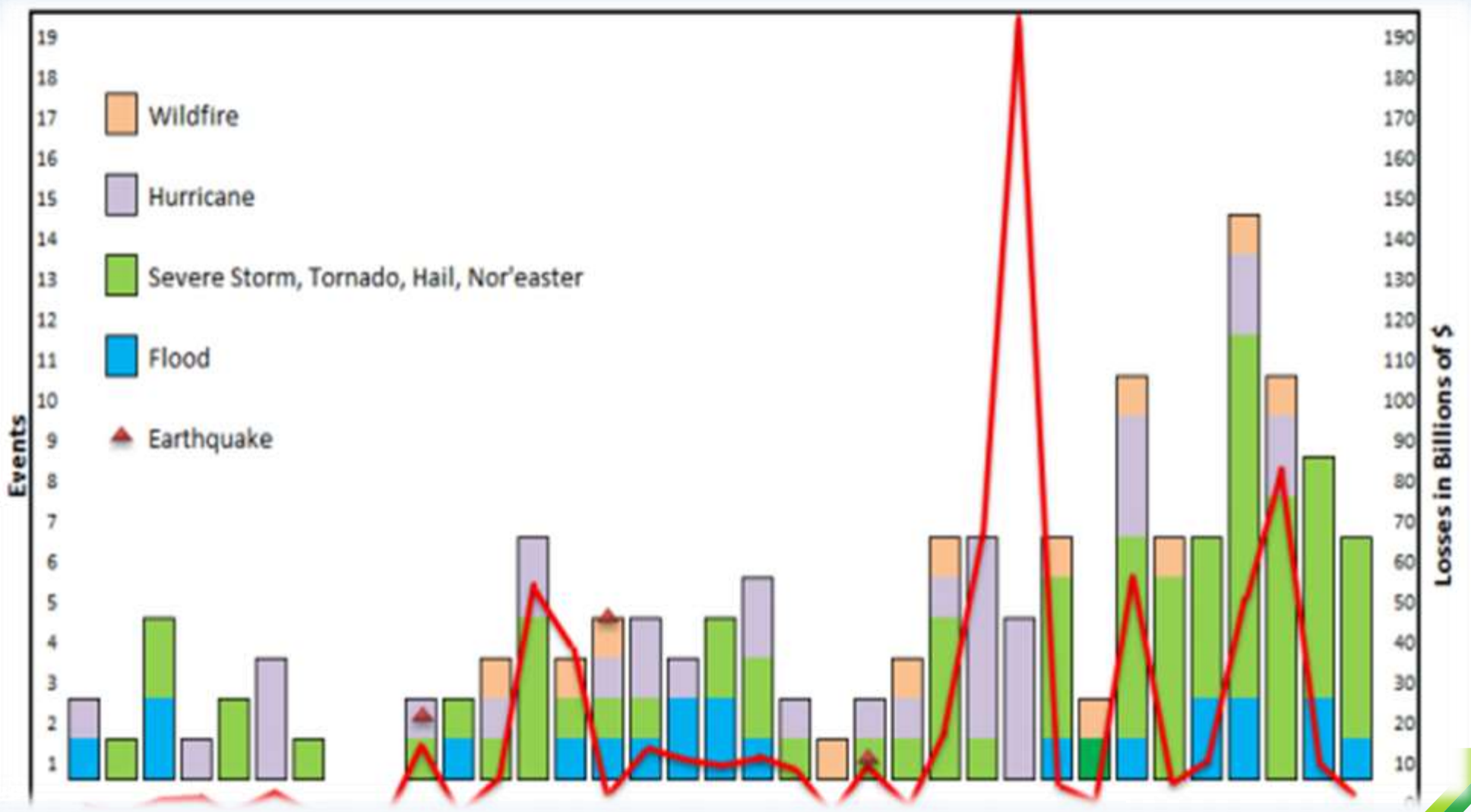
More than $5 billion in damage in CO in past decade

Wildfire

Fire frequency and intensity increases with rising greenhouse gas emissions

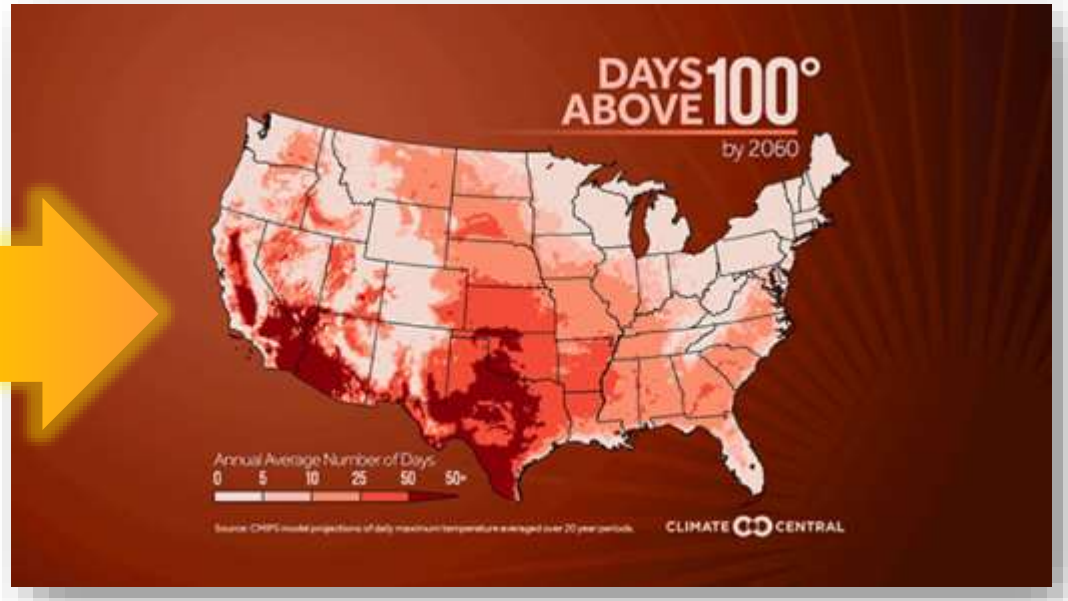
EEBA

Frequency of $Billion+ Extreme Weather Events and Associated Losses



EEBA

Average temperature is likely to increase by 2-5 °F by 2050



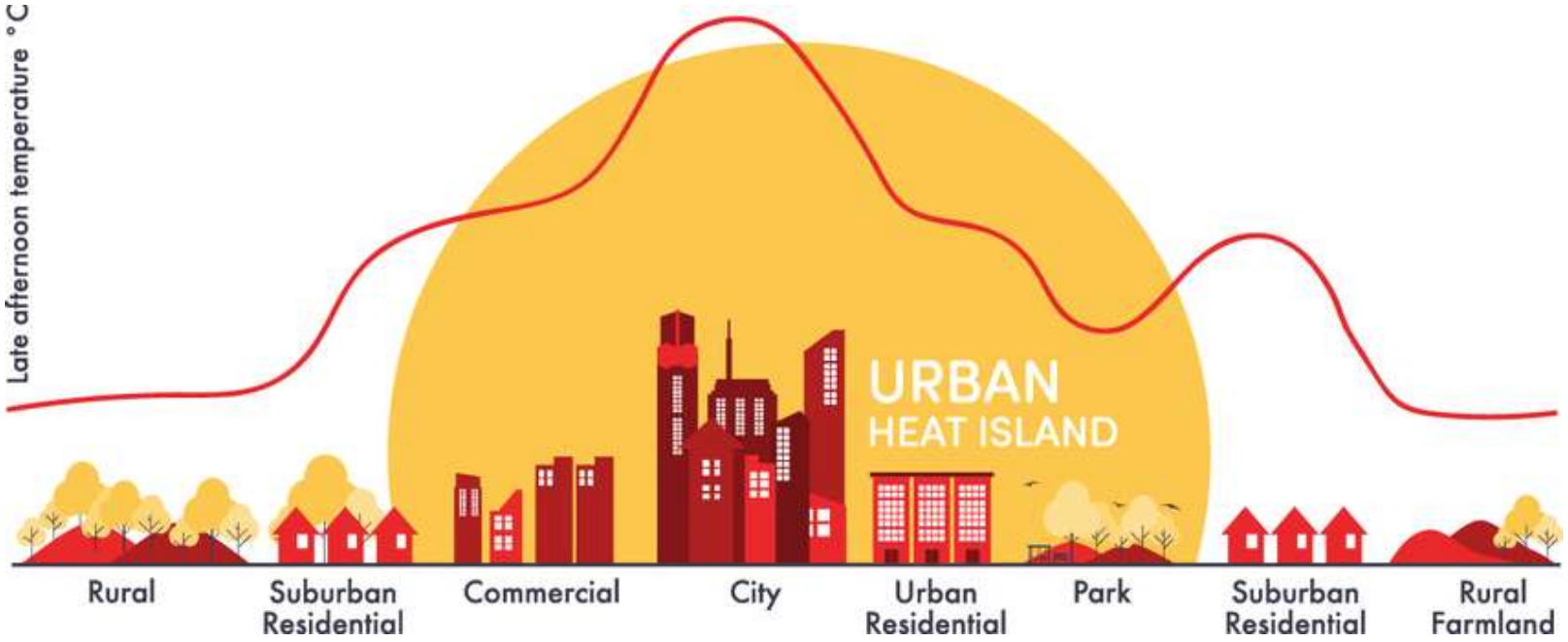
Vulnerable Populations

Extreme heat episodes in much of the region disproportionately threaten the health and well-being of individuals and populations who are especially vulnerable… Communicable diseases, ground-level ozone air pollution, dust storms, and allergens can combine with temperature and precipitation extremes to generate multiple disease burdens.
US Fourth National Climate Assessment – 2018

Mortality rates expected to increase to annual average of 13,000 by 2050. – Natural Resources Defense Council

EEBA

Contributors to Heat Vulnerability

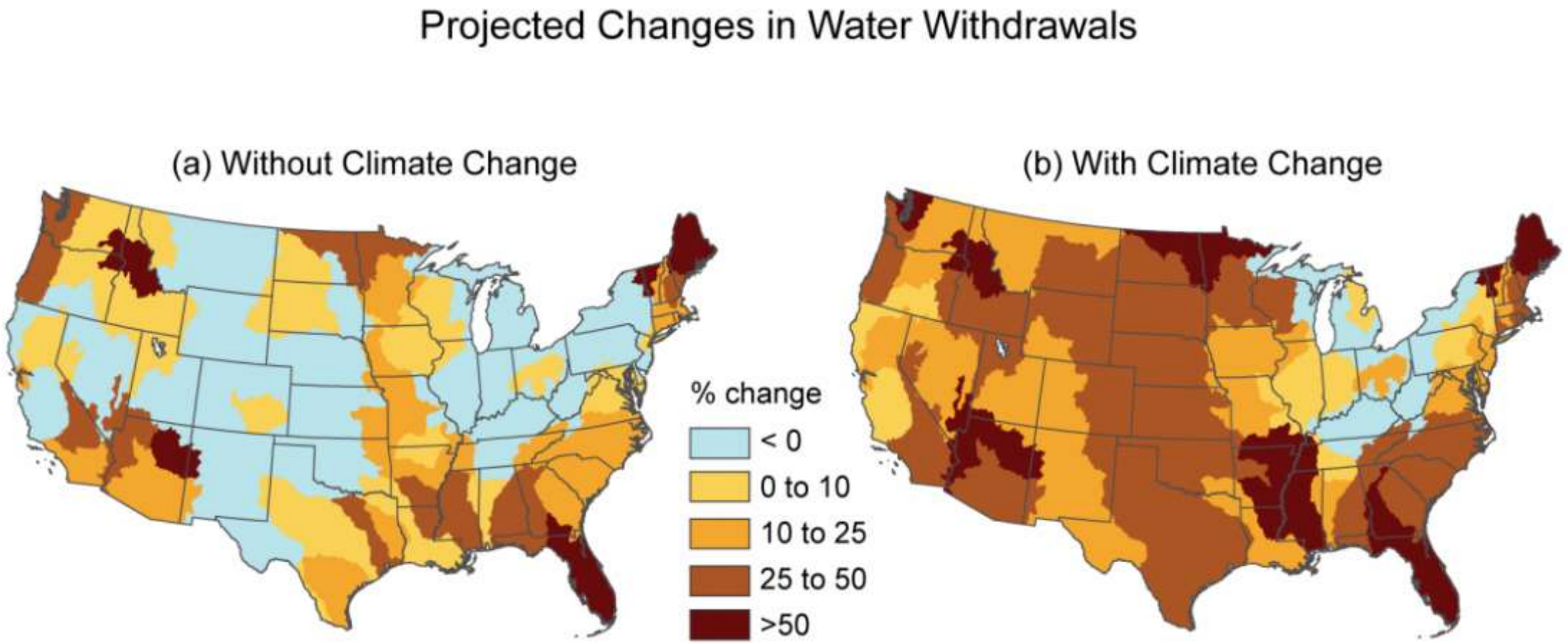


- "Heat Island" effect
- Shading vegetation
- Neighborhood demography
- Vehicle ownership
- Income levels

Heat is one of the biggest climate-related public health threats, according to the CDC

EEBA

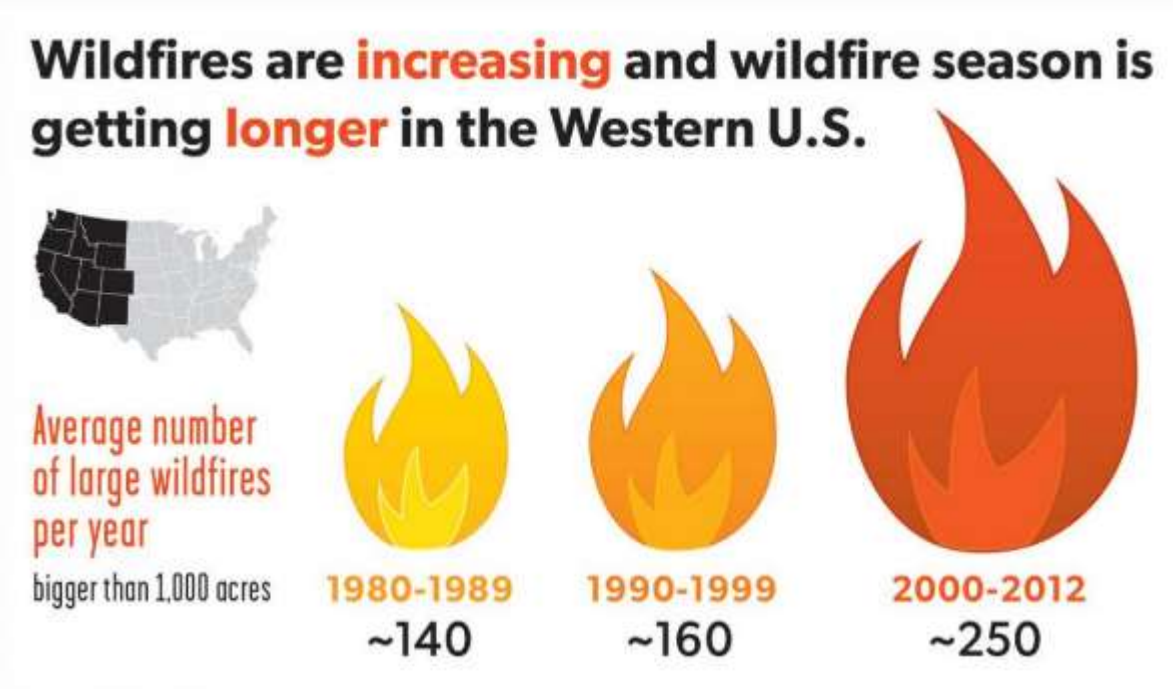
US Water Demand in 2050

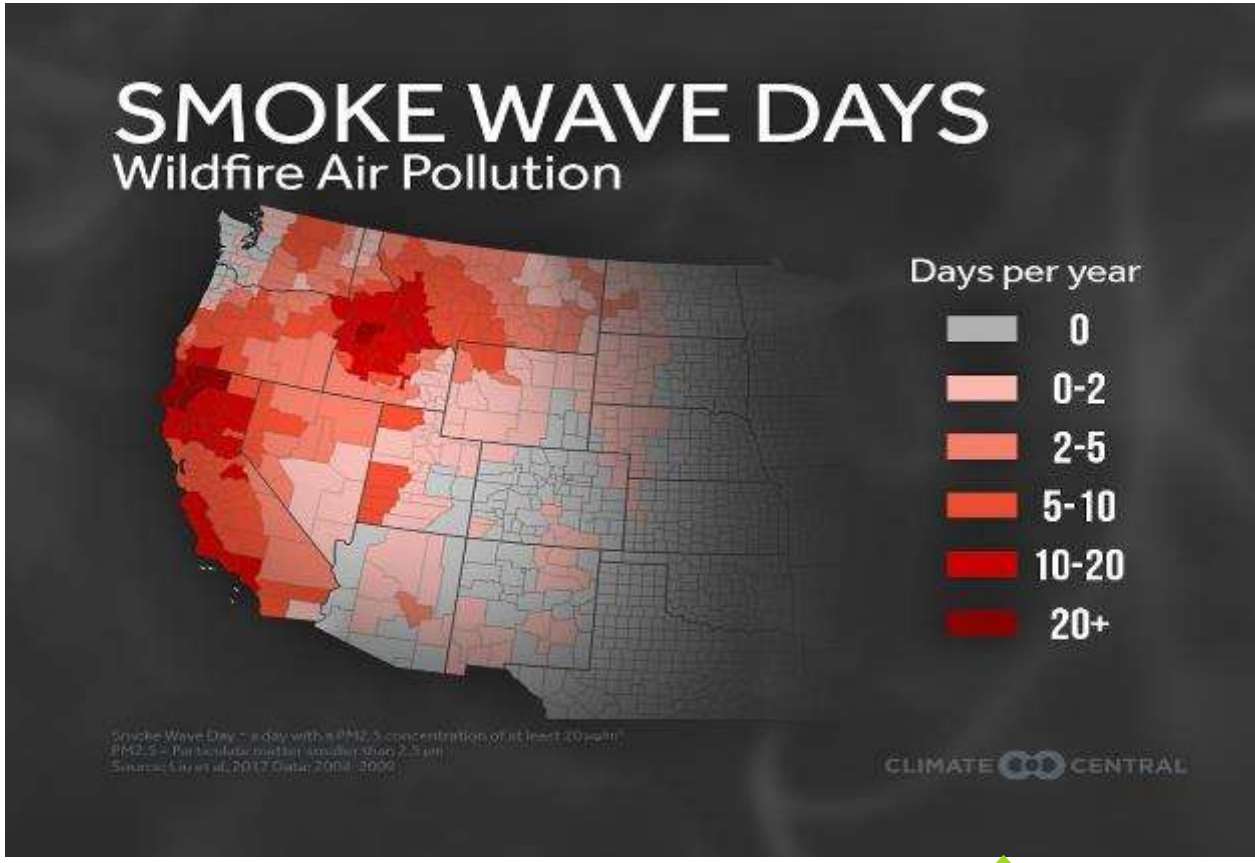


Effects of Drought on the Built Environment

- Water scarcity
- Sinking and shifting of land
- Expanding and shrinking soil
- Flash floods

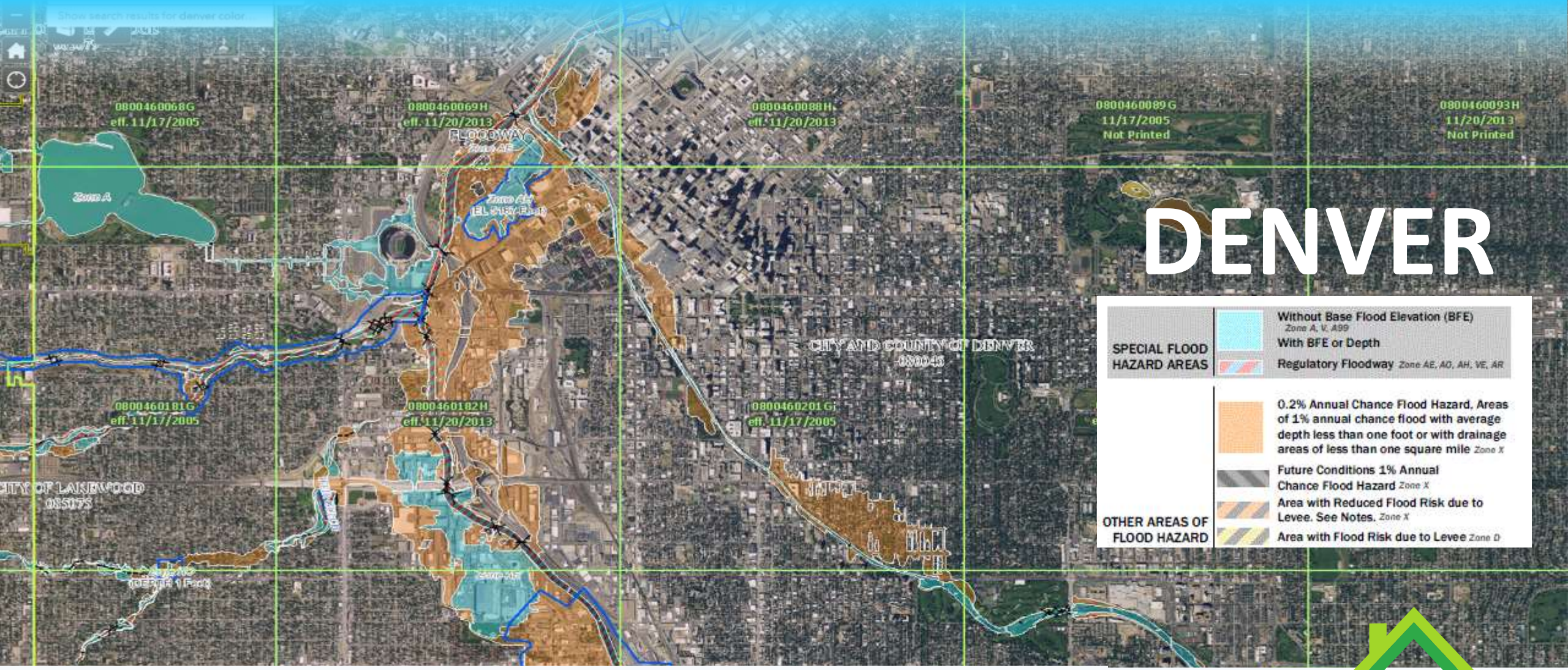
Wildfire and Air Quality





EEBA

FEMA Flood Maps

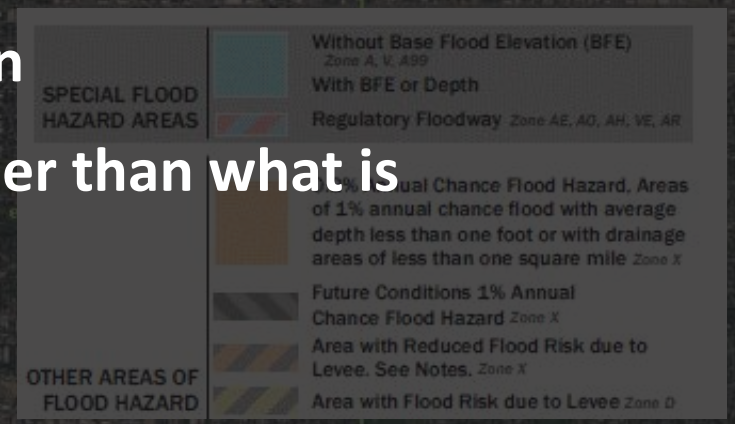


FEMA Flood Maps

17%

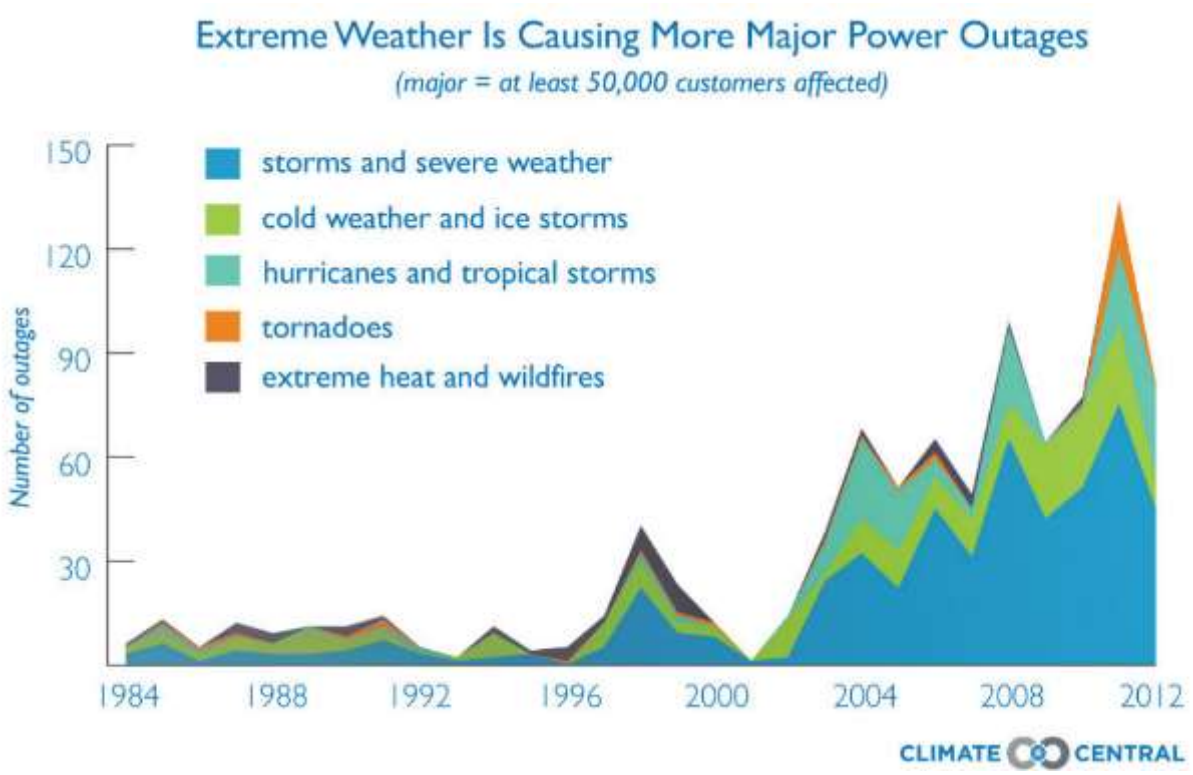
of homes hit by the 2013 floods were outside of the mapped floodplain

- FEMA flood maps based on historical data only
- Takes 2-3 years to update a region
- Study shows actual risk is 3x higher than what is shown in FEMA flood maps



EEBA

70% of Major Power Outages Caused by Severe Storms



EEBA

How vulnerable are our buildings today?

International Building Code Requirements

1/3 of US communities have not adopted or do not fully enforce International Codes

-- National Institute of Building Science

Flood

- Elevate 1+ foot above BFE
- Wet floodproofing
- Dry floodproofing (commercial)

Fire

- Land use planning
- Defensible spaces
- Retrofits for fire mitigation

Landscaping

- Light or green roof (Denver)

Air quality

- Ventilation requirements

Water efficiency

- 1.6 gpf toilets / 2.5 gpm shower
- 2.2 gpm sinks

Envelope Design

- Insulation requirements by climate
- Air-tightness requirements

EEBA

IECC Code Adoption in the US

- No statewide code
- Less efficient than 2009 IECC
- 2009 IECC
- Between 2009 and 2012/15 IECC
- 2012/15 IECC
- More efficient than 2012/15 IECC

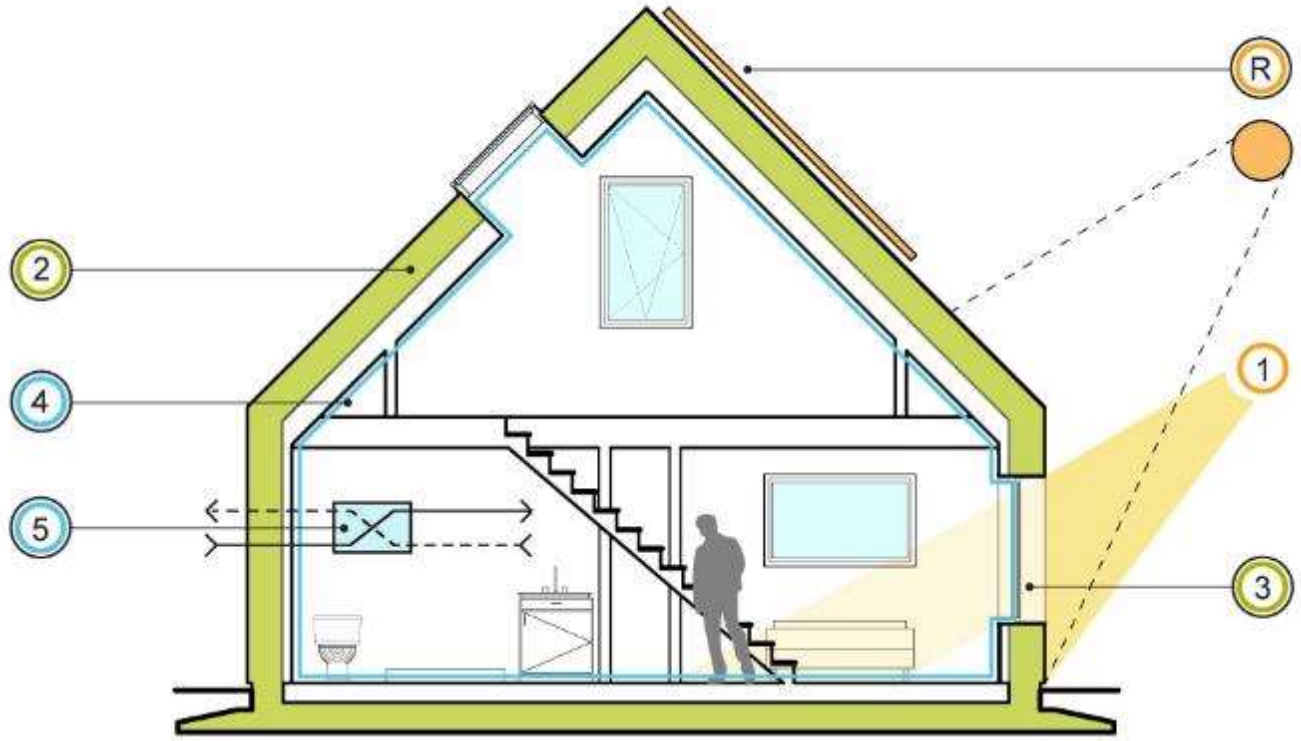
EEBA

Climate-Resilient Design Strategies

Resiliency Principles

- ✓ Redundancy and diversity
- ✓ Simple, passive, flexible
- ✓ Durability
- ✓ Locally available, renewable, and reclaimed
- ✓ Social equity and community

Passive Building Design



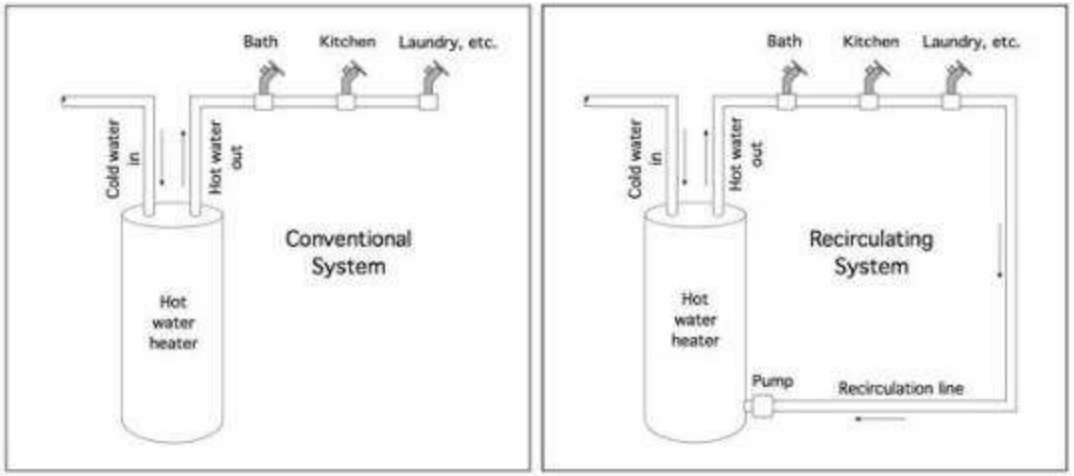
EEBA

Reducing Heat Island Effect

- Install cool and green roofs that is Energy Star Certified or made of highly reflective materials
- Standard grey concrete for pavement instead of asphalt
- Plant trees or vegetation to provide shade - evapotranspiration cools the air around trees.

Drought Mitigation: Water Efficiency

1. **Reduce indoor water consumption**
2. **Greywater reuse**
3. **Rainwater harvesting & on-site water storage**



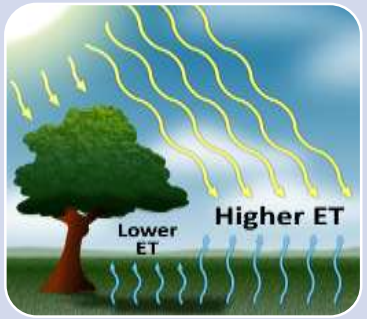
Install low-flow equipment

- Low flow faucets & showers
- Low flow or composting toilets
- Waterless urinals
- Water efficient appliances

EEBA

Site Water Management

Permeable paving allows precipitation to replenish ground water supply instead of being funneled into storm sewer.



Providing shade, especially for riparian areas, helps reduce the rate of evapo-transpiration. Use water-efficient, native species of trees.

Install bioswales to collect and filter stormwater from impervious areas and gutters, allowing stormwater to recharge the groundwater supply.

4. **Green infrastructure to allow stormwater to replenish ground water**
5. **Xeriscape to reduce need for watering landscape**
6. **Plant drought-tolerant native plants and trees to provide shade**

EEBA

Wildfire Mitigation

Homes with 30’ defensible space and non-combustible roofs have a 85% survival rate in the event of a wildfire.

MITIGATION EFFORTS

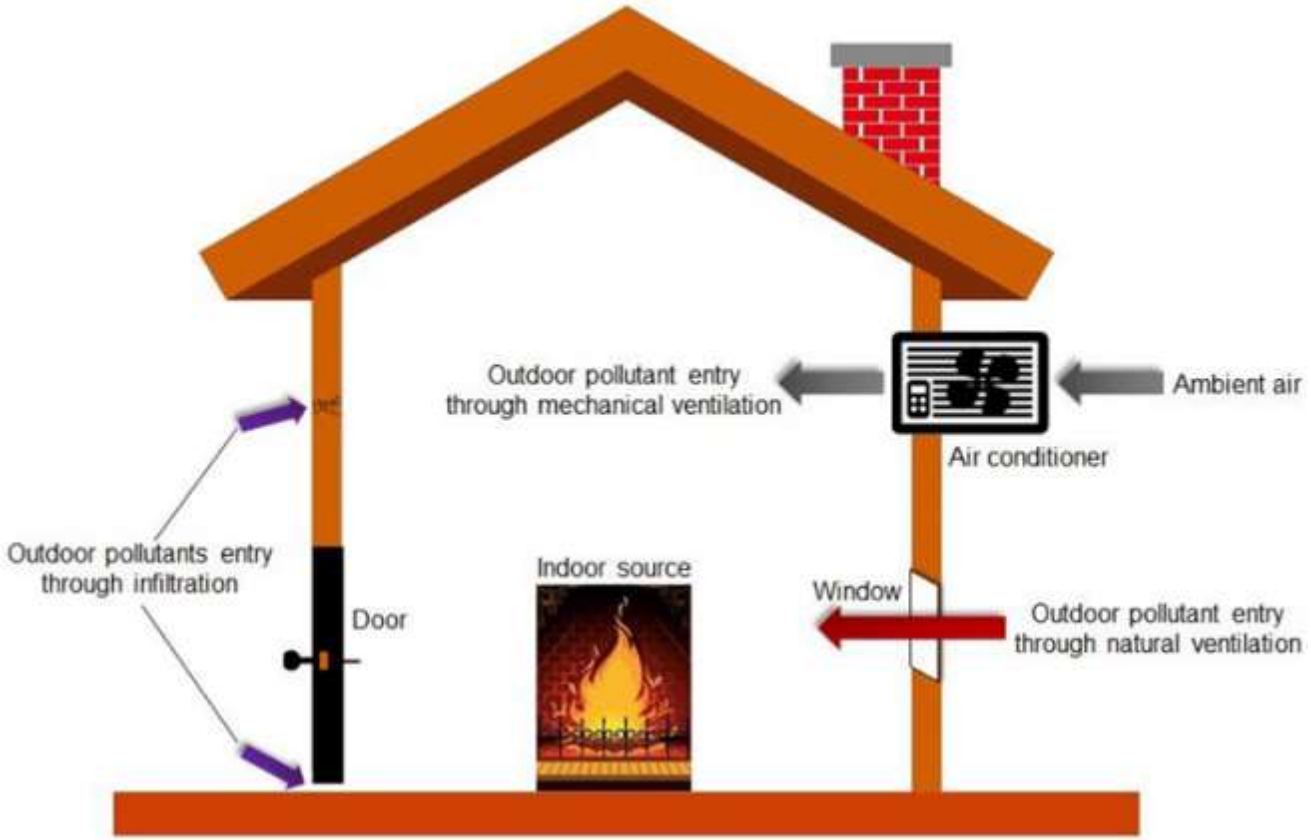
Primary determinants of a home’s ability to survive a fire are **roofing material** and surrounding **defensible space.**

- Break up continuity of horizontal and vertical fuel sources
- Replace wood shingled roofs with non-combustible material
- Prescribed fire control (burns)

EEBA

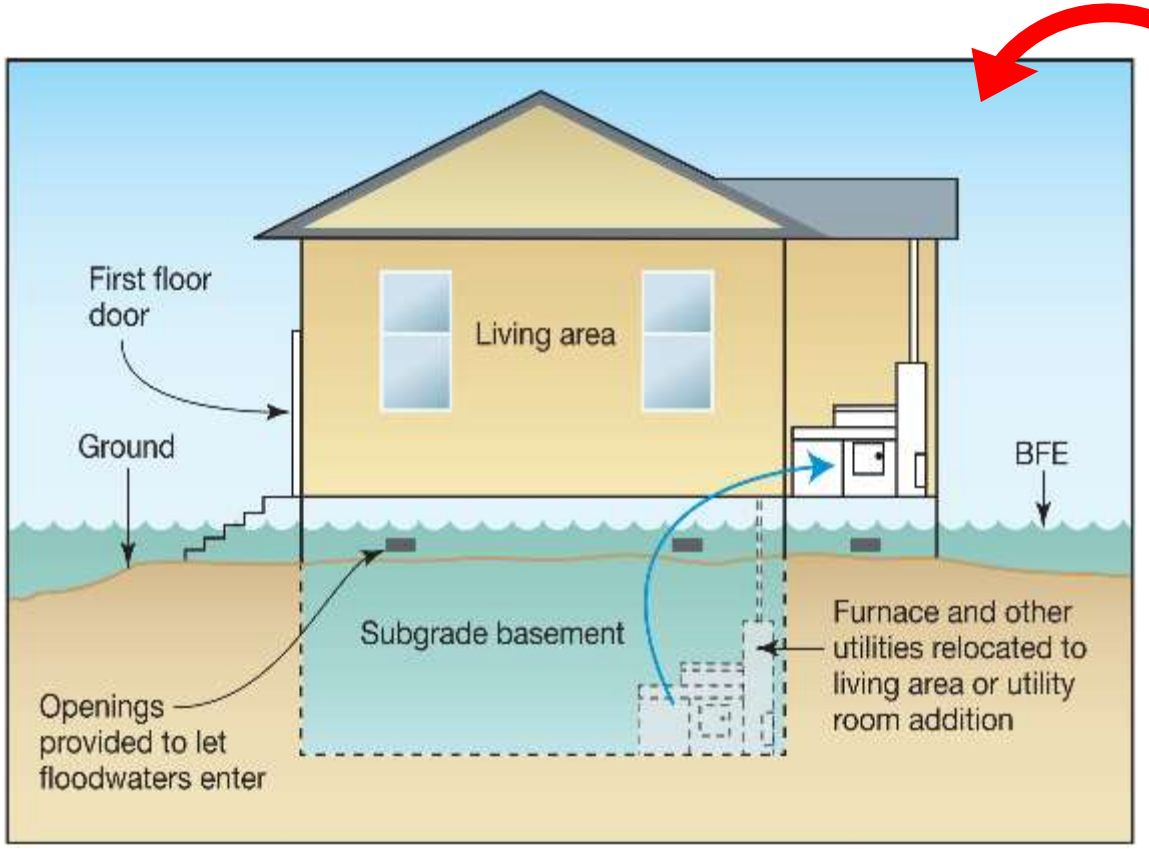
Indoor Air Quality

- Check filters for dust and debris buildup at least every month during heavy smoke seasons
- Mechanical Supply or Balanced Ventilation with minimum MERV 8 filters
- Educate occupants about when to use natural ventilation in emergency situations – run AC with fresh air intake closed off, keep windows and doors closed, close fireplace dampers



Flood Mitigation

Dry floodproofing:
Seals buildings to keep water out



Wet floodproofing:
Allows unoccupied portions of building to be flooded

EEBA

Wet Floodproofing for New Construction

Elevate living spaces

Reserve sub-DFE for parking, storage, entryways

Floodwater vents

Allow water to flood lower levels

Stormwater management

Permeable paving, green roofs and bioswales infiltrate excess stormwater

Elevate mechanical equipment

Boilers, furnaces, water heaters, fuel storage tanks, elevator machine rooms, ductwork, electrical systems.

If not on roof, on raised platform.

EEBA

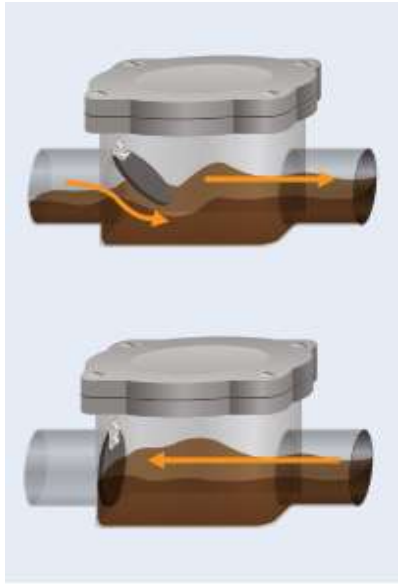
Low-cost Retrofit Floodproofing Measures

Sump pumps

Remove water that accumulates at lowest point in building

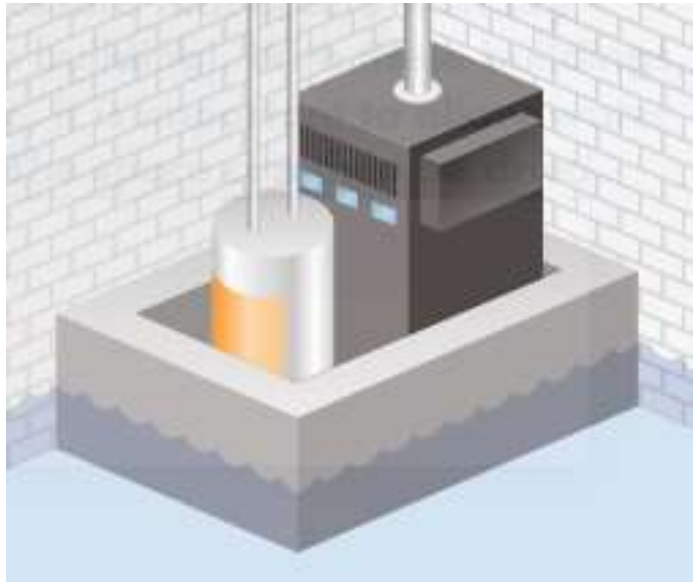
Backwater valves

Prevent sewage backflow



Protect mechanical equipment

Build barrier around critical systems if it can't be elevated



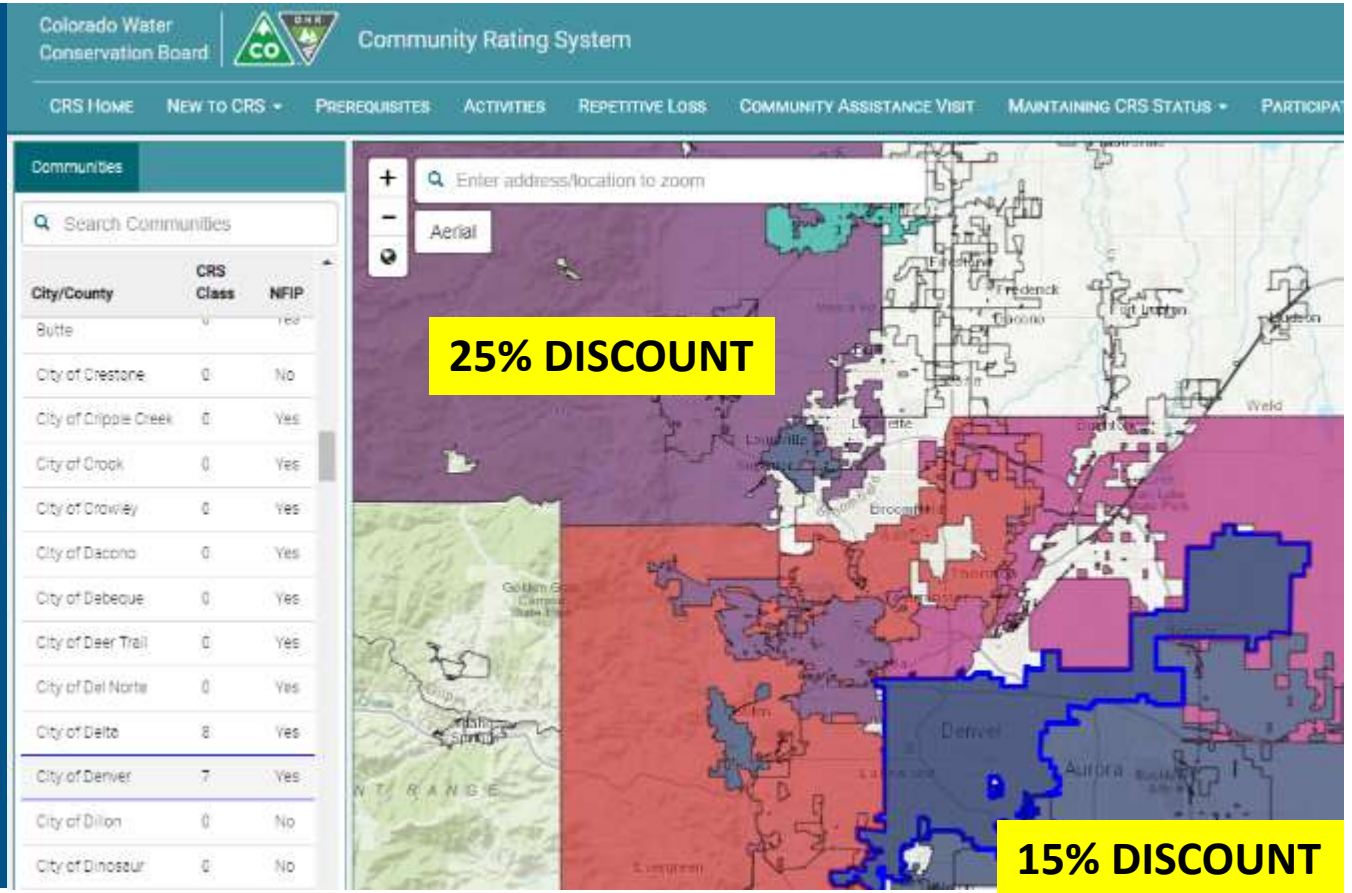
EEBA

Flood risk measures = lower insurance premiums

DID YOU KNOW?

Community Rating System (CRS) is a voluntary incentive program that recognizes communities for implementing floodplain management practices that exceed the Federal minimum requirements of the National Flood Insurance Program (NFIP). Policyholders in communities that participate in the CRS program can receive reduced flood insurance premiums for their buildings within the community.

When your community participates in CRS, you can qualify for an insurance premium discount of up to 45% if you live in a high-risk area and up to 10% in moderate- to low-risk areas.



EEBA

Passive Survivability

3 Strategies to address winter storm occurrences:

1. **Backup power + disaster preparedness plan**
   Fuel-fired backup generators, solar with battery storage, micro-grid
   Snow removal plan for building ingress/egress

2. **High performance building enclosure in case of power outage**
   Passive solar strategies (orientation, thermal mass, high SHGC windows)
   Tighter, higher performance envelopes

3. **Provide access to potable water**
   Rooftop storage, gravity-fed

EEBA

Incentivizing Resilient Building Design

Real Estate Risk Factors

- **Catastrophes**
  - Increased Insurance Premiums
  - Capital Expenditures
  - Higher Operating Costs
  - Decrease in liquidity and value of buildings
- **Transitional Risks**
  - Locational decrease in value
  - Obsolescence of assets

"Investors acknowledge that using insurance as the main protection for asset value is not an effective solution to mitigate the risk of devaluation, because premiums currently are largely based on historical analysis and are not likely to consider future climate risk."

– ULI, Climate Risk and Real Estate Investment Decision-Making

EEBA

Stakeholder Incentives to Invest in Resilience Measures

Home / Building Owner:	Reduced insurance premium, tax reduction, later building owners may pay more for resilient buildings. Reduced repair costs, accelerated recovery, reduced chance of mortgage default
Occupant:	Enhanced safety
Builder:	Increased market value of building
Insurer:	Reduced portfolio risk
Loan Provider / Financer:	Increased loan security, increased financing opportunities, asset risk reduction

EEBA

Benefit-Cost Ratio of Mitigation Strategies

National Benefit-Cost Ratio Per Peril *BCR numbers in this study have been rounded	Exceed common code requirements	Meet common code requirements	Utilities and transportation	Federally funded
Overall Hazard Benefit-Cost Ratio	4:1	11:1	4:1	6:1
Riverine Flood	5:1	6:1	8:1	7:1
Hurricane Surge	7:1	Not applicable	Not applicable	Too few grants
Wind	5:1	10:1	7:1	5:1
Earthquake	4:1	12:1	3:1	3:1
Wildland-Urban Interface Fire	4:1	Not applicable	Not applicable	3:1

EEBA

CASE STUDY

Location
132 Jackson St., Hoboken, NJ

Scale
6 Units

Cost
$25,000

Description:

A multifamily building located in the AE flood zone in New Jersey installed 9 flood vents as a wet floodproofing strategy after suffering heavy damage from Superstorm Sandy. The owner also raised the flood to ground level by adding 9 inches of gravel and concrete fill.

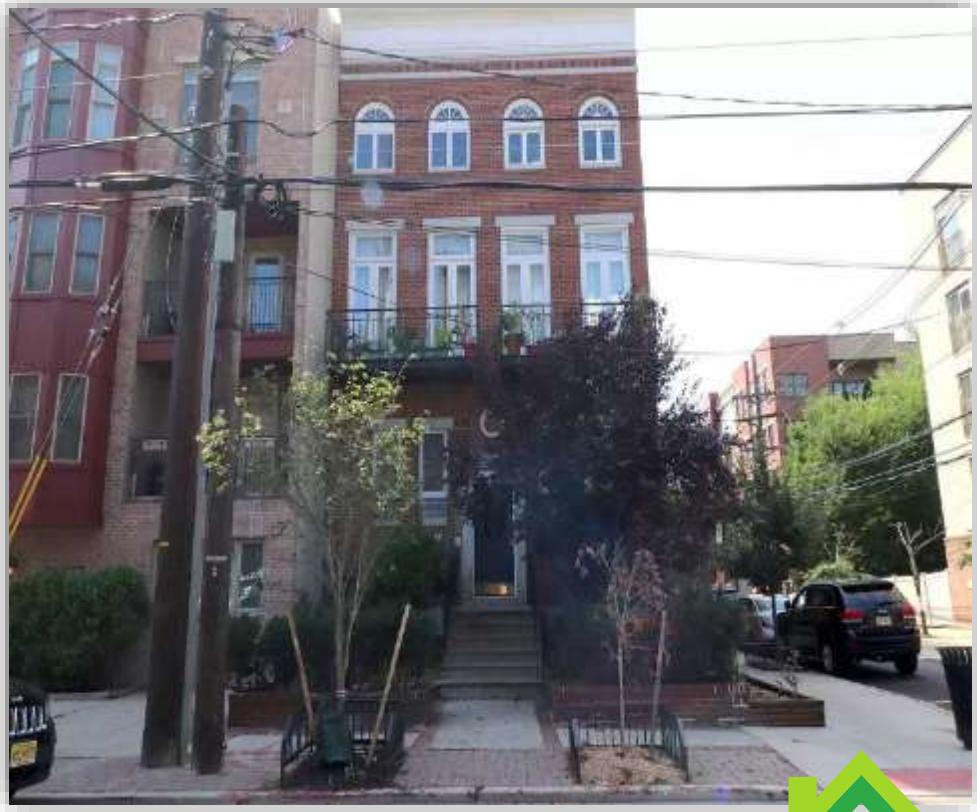
COST SAVINGS

Individual insulated flood vent = **$200-250 each**
Total Cost of renovation = **$25,000**

After retrofit, building experienced 83% reduction in flood insurance cost policy.

BEFORE: Paid $12,000 for $300,000 coverage
AFTER RETROFIT: Paying $2,000 for $820,000 coverage
ROI = 2.5 years

Due to reduced insurance premiums, flood mitigation efforts have a 5:1 financial payback *(Source: National Institute of Building Sciences)*



EEBA

Resilient Design in Green Building Certification Standards

- LEED ReLi credits
- Passive House Institute
- Army Corps of Engineers
- Enterprise Green Communities
- International Green Construction Code (IgCC)

Resilience starts with strong, regularly updated, and properly implemented building codes.
- International Code Council (ICC)


AND THEY SAID
I WAS CRAZY

Thank you!

Stay in touch!

Sarah Hong
shong@group14eng.com

Group 14 ENGINEERING

Join the conversation - #EEBASummit2019
Save the dates for next year:

EEBA

HIGH PERFORMANCE HOME SUMMIT 2020

SEPT 29 - OCT 1 \ DENVER