Demystifying The Changing Climate:

Lowell Parks & Conservation Trust

November 13, 2018

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Mass Audubon

Protecting the Nature of Massachusetts

Agenda

- Fundamentals of Climate Change
- Climate Change Impacts in Massachusetts
- Mitigating and Adapting to Climate Change
- Cities as Solutions
- What You Can Do

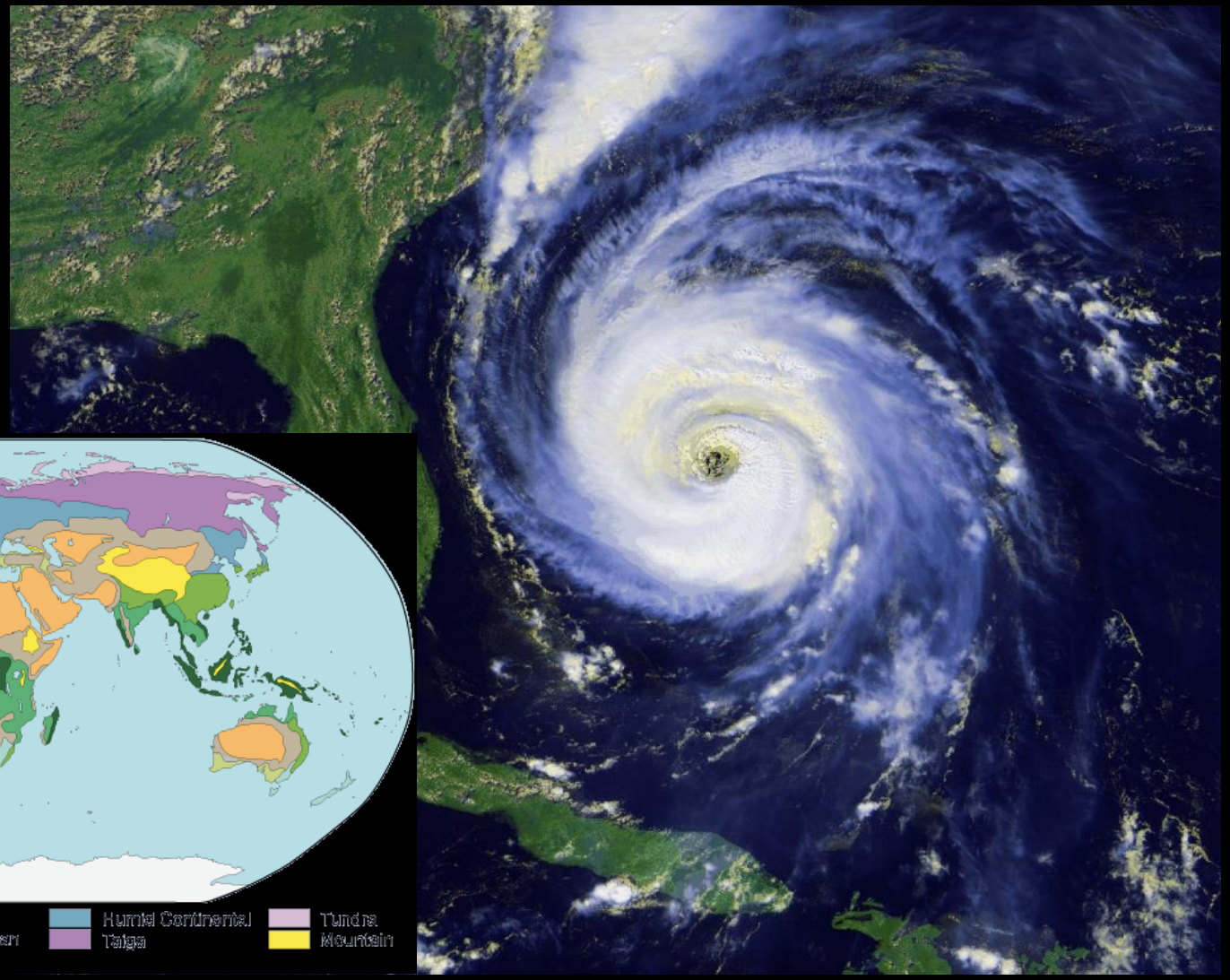
Climate Change:

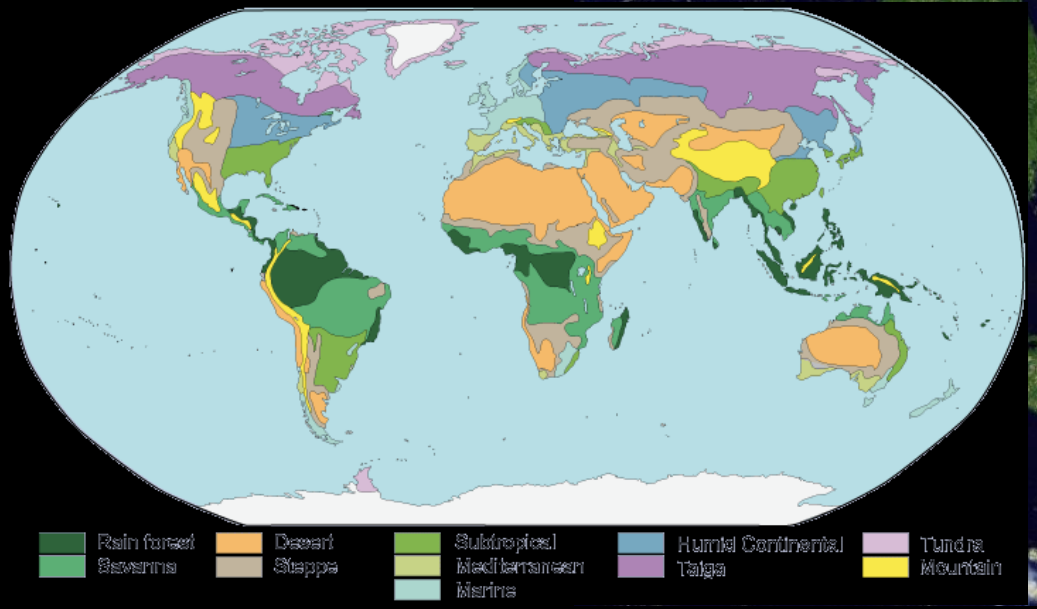
1. **Experts agree.**
2. **It’s real.**
3. **It’s bad.**
4. **It’s us.**
5. **We can fix it!**

Why Care About Climate Change?

Climate regulates life on the planet.
Climate determines how we live.

Climate vs Weather





Why it's easier to project future climate than forecast the weather:

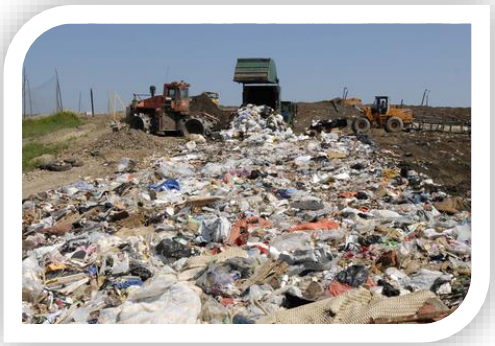
- Over several decades, the climate is affected by relatively few factors.

- Weather is chaotic and influenced by innumerable factors.

- "Weather determines what you wear. Climate determines what you keep in your closet."

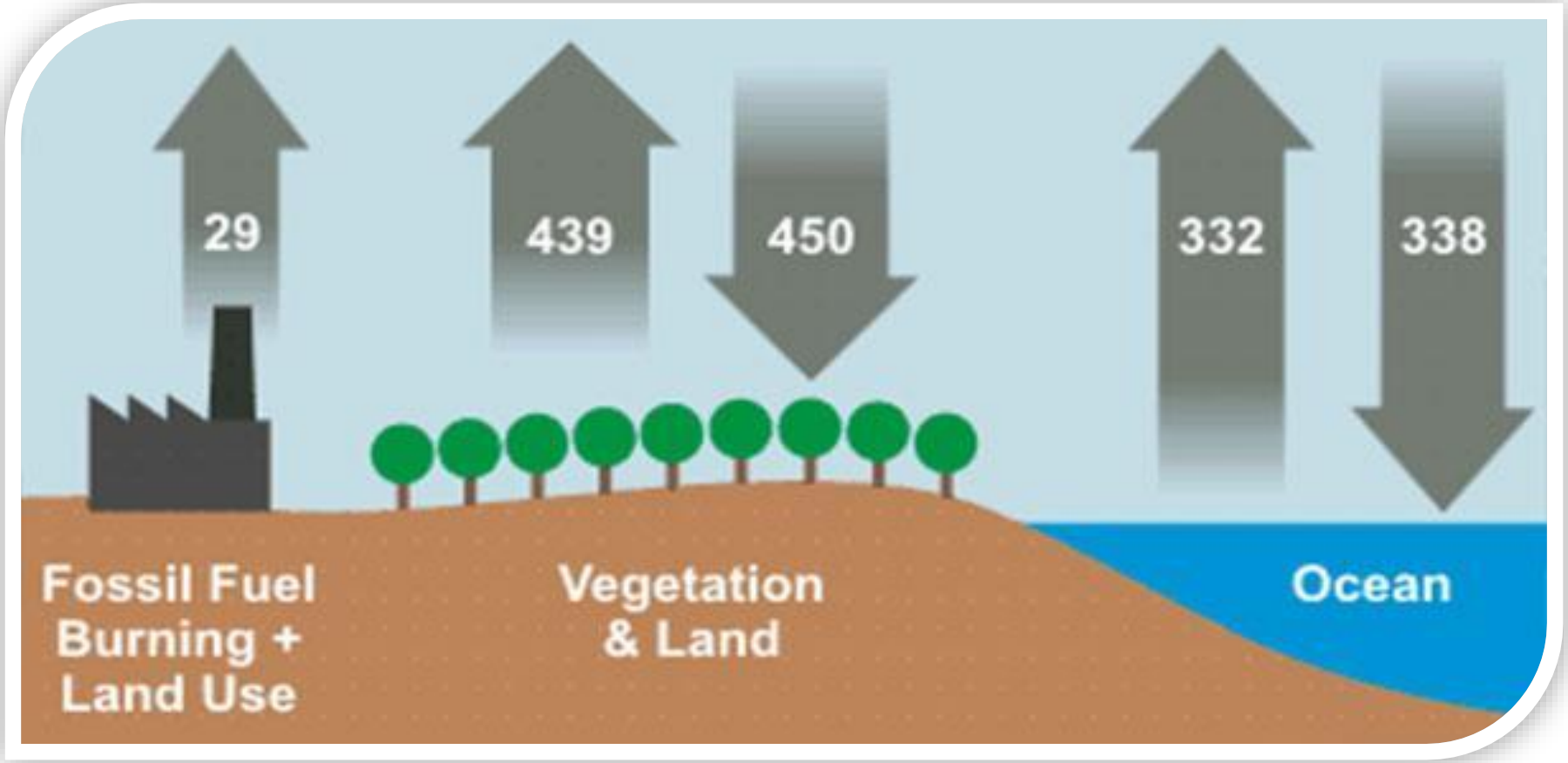
Greenhouse Gases

Carbon dioxide (CO_2)



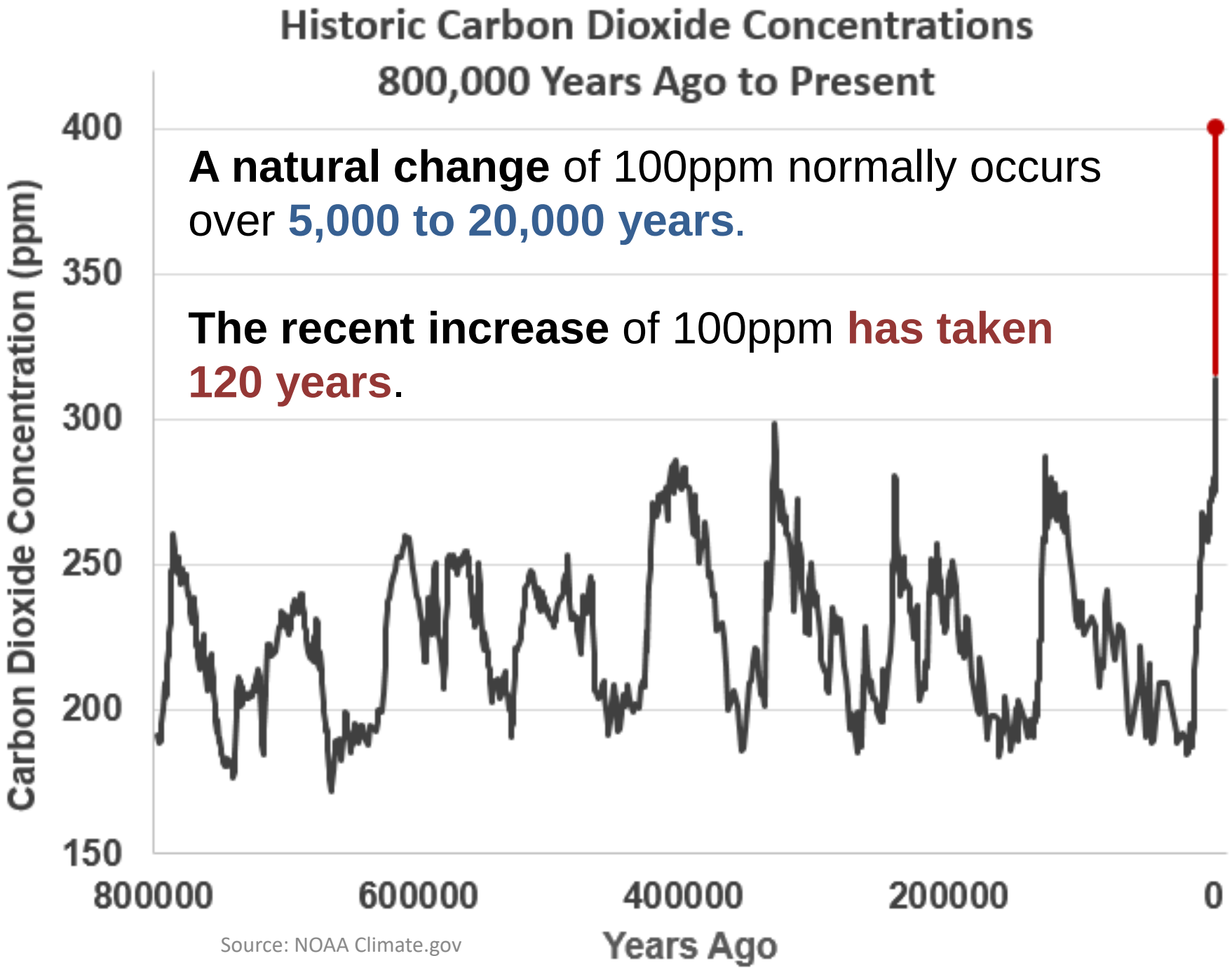
Methane (CH_4) and
Nitrous oxide (N_2O)

Global CO_2 Cycle

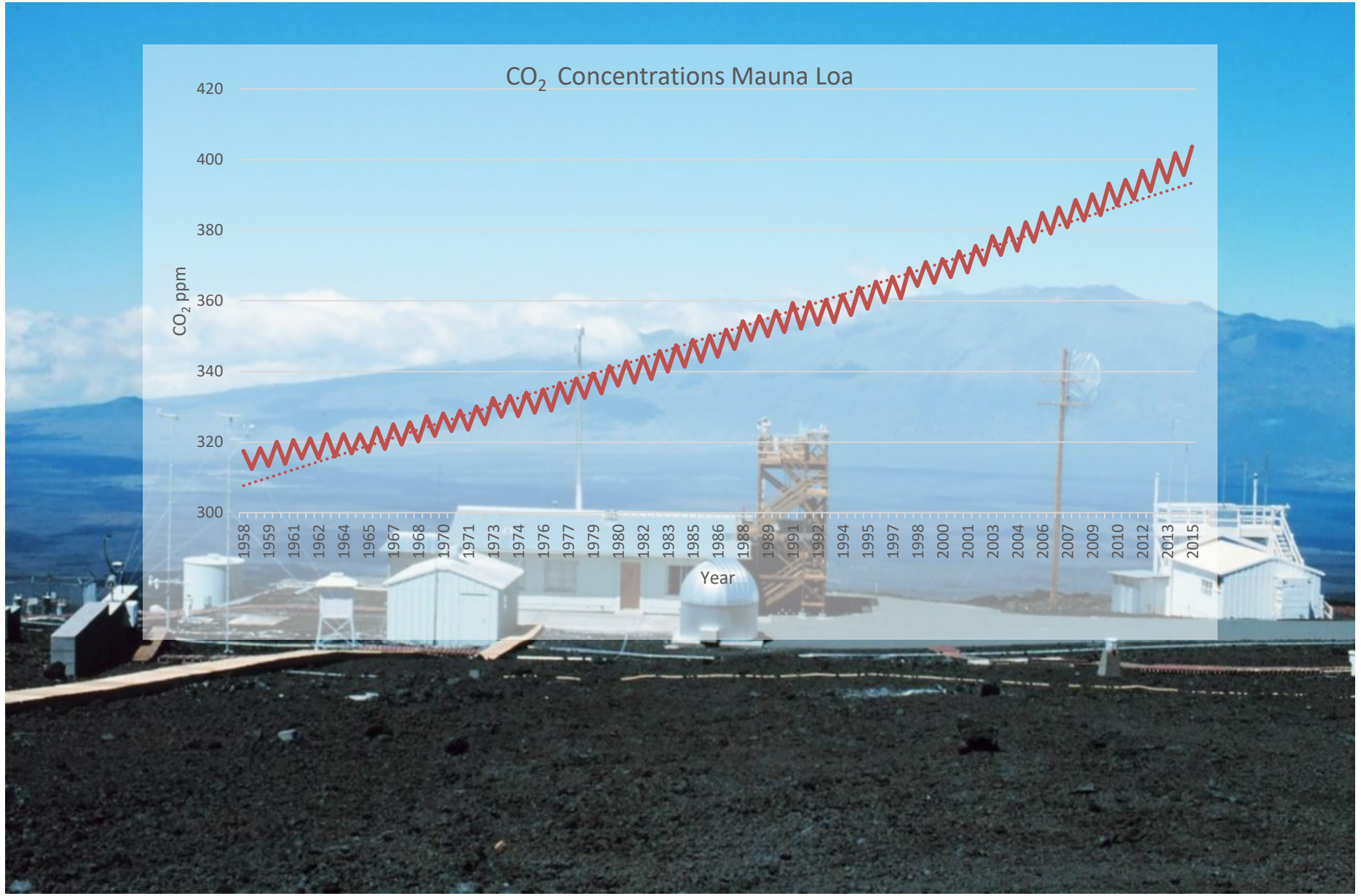


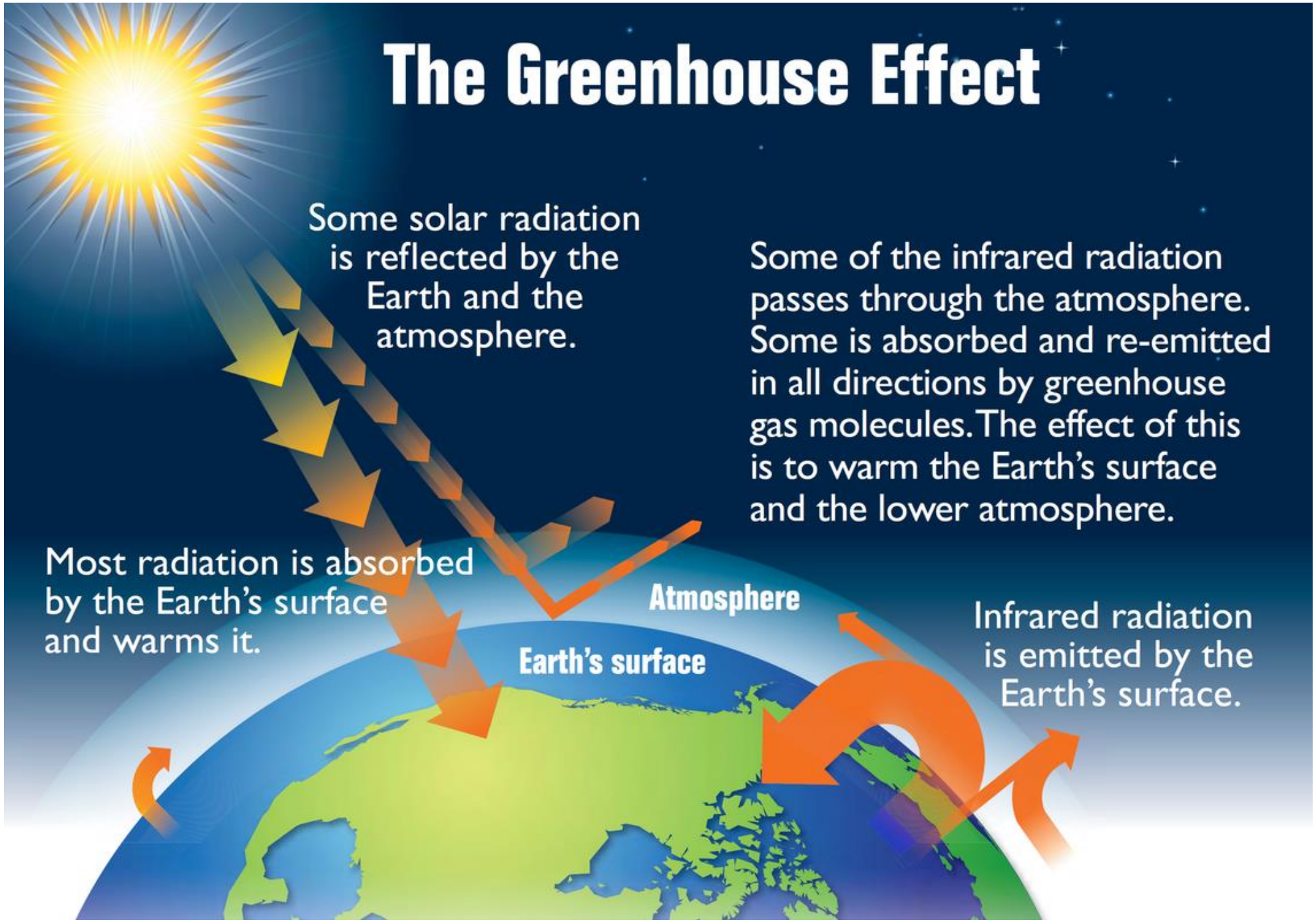
The natural cycle adds and removes CO_2 to keep a balance. Humans add extra CO2 without removing any.

Source: Adapted from Figure 7.3 in the IPCC AR4


Historic Carbon Dioxide Concentrations
800,000 Years Ago to Present
A natural change of 100ppm normally occurs over 5,000 to 20,000 years.
The recent increase of 100ppm has taken 120 years.
Carbon Dioxide Concentration (ppm)
400
350
300
250
200
150
800000
600000
400000
200000
0
Years Ago
Source: NOAA Climate.gov

Keeling Curves




The Greenhouse Effect
Some solar radiation is reflected by the Earth and the atmosphere.
Some of the infrared radiation passes through the atmosphere. Some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the Earth's surface and the lower atmosphere.
Most radiation is absorbed by the Earth's surface and warms it.
Atmosphere
Earth's surface
Infrared radiation is emitted by the Earth's surface.

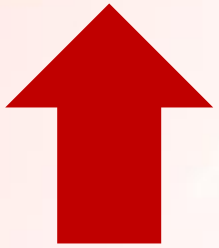
How Does Climate Change Work?

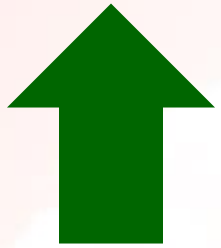
The heat-trapping blanket metaphor as a standard.

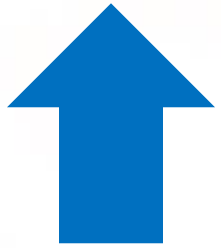
- The atmosphere acts like a blanket that surrounds the earth.
- When we burn fossil fuels like coal and oil for energy, we add too much carbon dioxide to the atmosphere, which is like making the blanket thicker.
- The blanket has become too thick. It's trapping in too much heat, and the planet is warming up too fast.

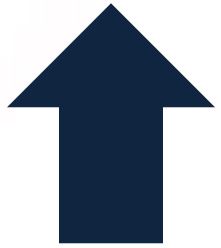
IMPACTS

Key Changes in Massachusetts

Temperature:  **2.9°F** Since 1895

Growing Season:  **11 Days** Since 1950

Sea Level Rise:  **11 inches** Since 1922

Stronger Storms:  **55%** Since 1958

Source: Climate Science Special Report, 2017; NOAA NCEI nClimDiv; NOAA Ocean Service

Future Changes in Massachusetts

Temperature: **3 to 11°F** By 2100

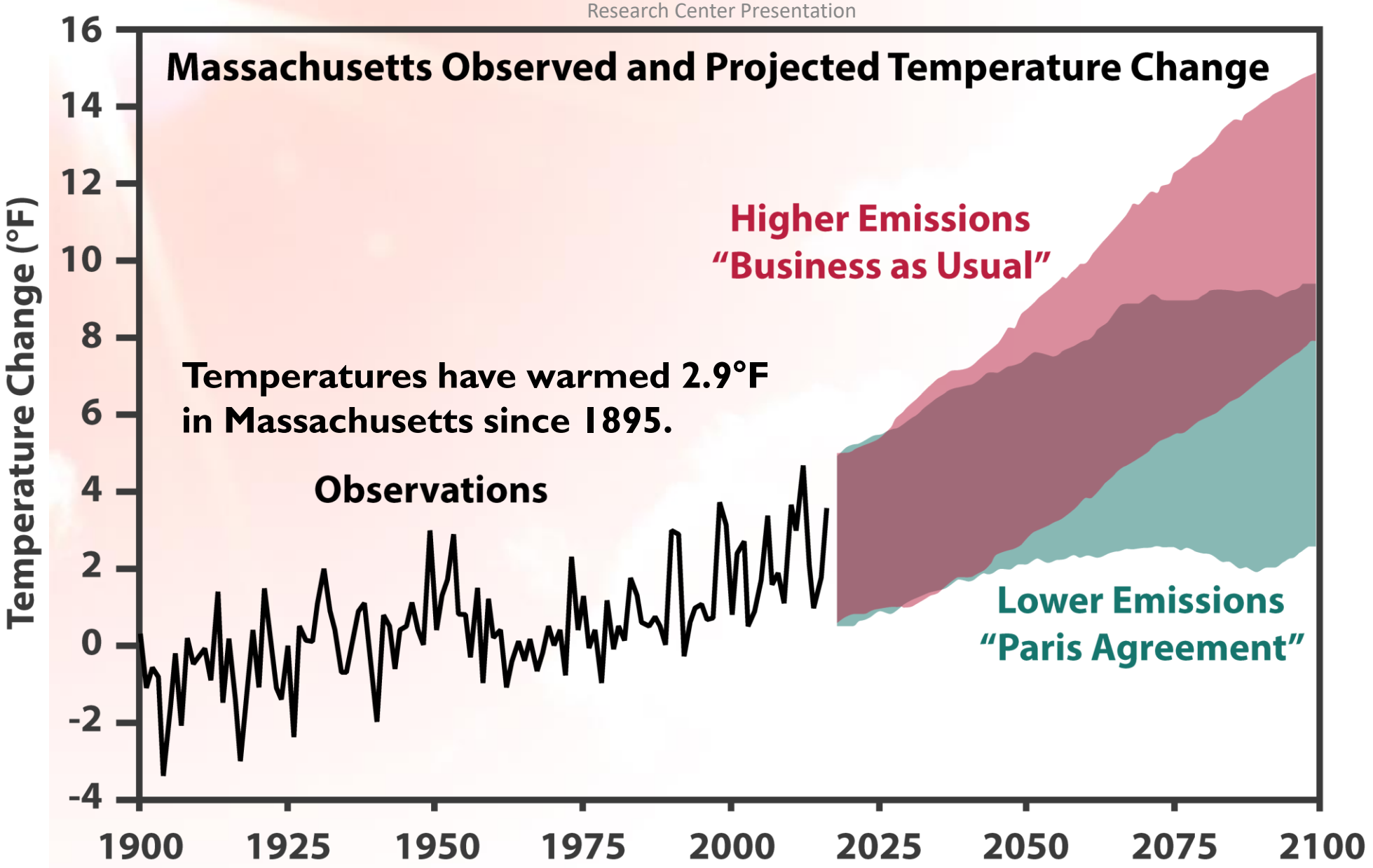
Growing Season: **5 Weeks** By 2100

Sea Level Rise: **3 to 7’** By 2100

More Storms: **47%** By 2100

Source: NCICS State Summaries, Fourth National Climate Assessment, and NE CSC

Source: Adapted from UMass Amherst and Climate System Research Center Presentation



If we don't reduce emissions, temperatures could rise 10°F or more by 2100.

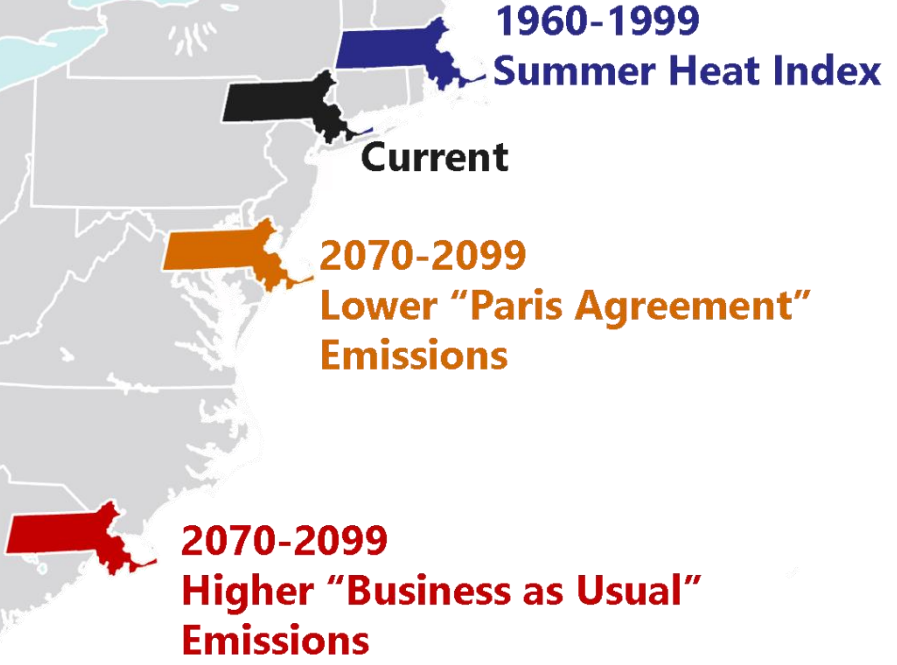
What's in a degree?

During the last ice age, temperatures were 9°F cooler than today.

Data Source: CMIP3 downscaled data.
Graphic source: Union of Concerned Scientists.

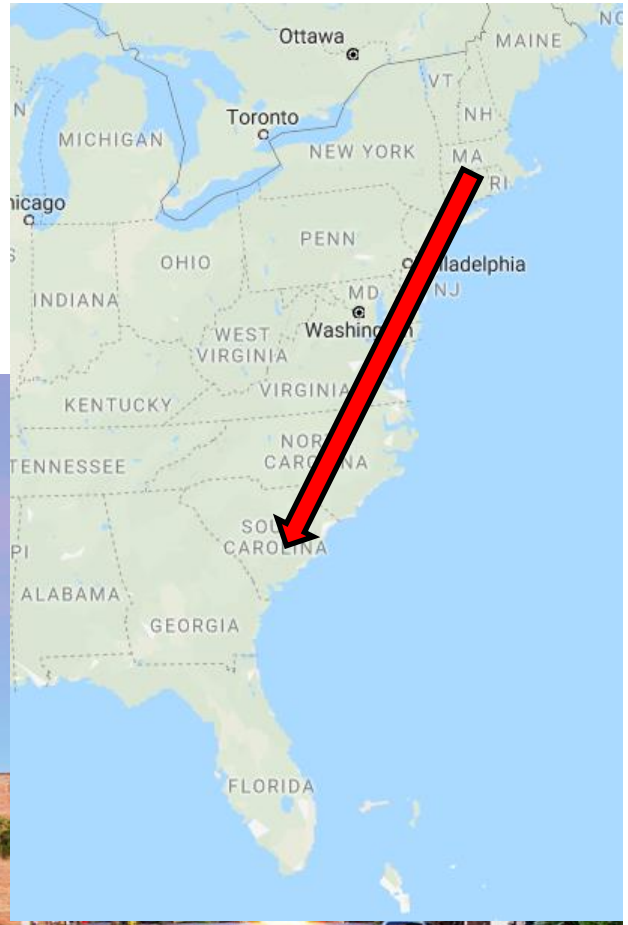
Migrating Massachusetts

By the end of the century, summers in Massachusetts will "feel" more like summers in the South.



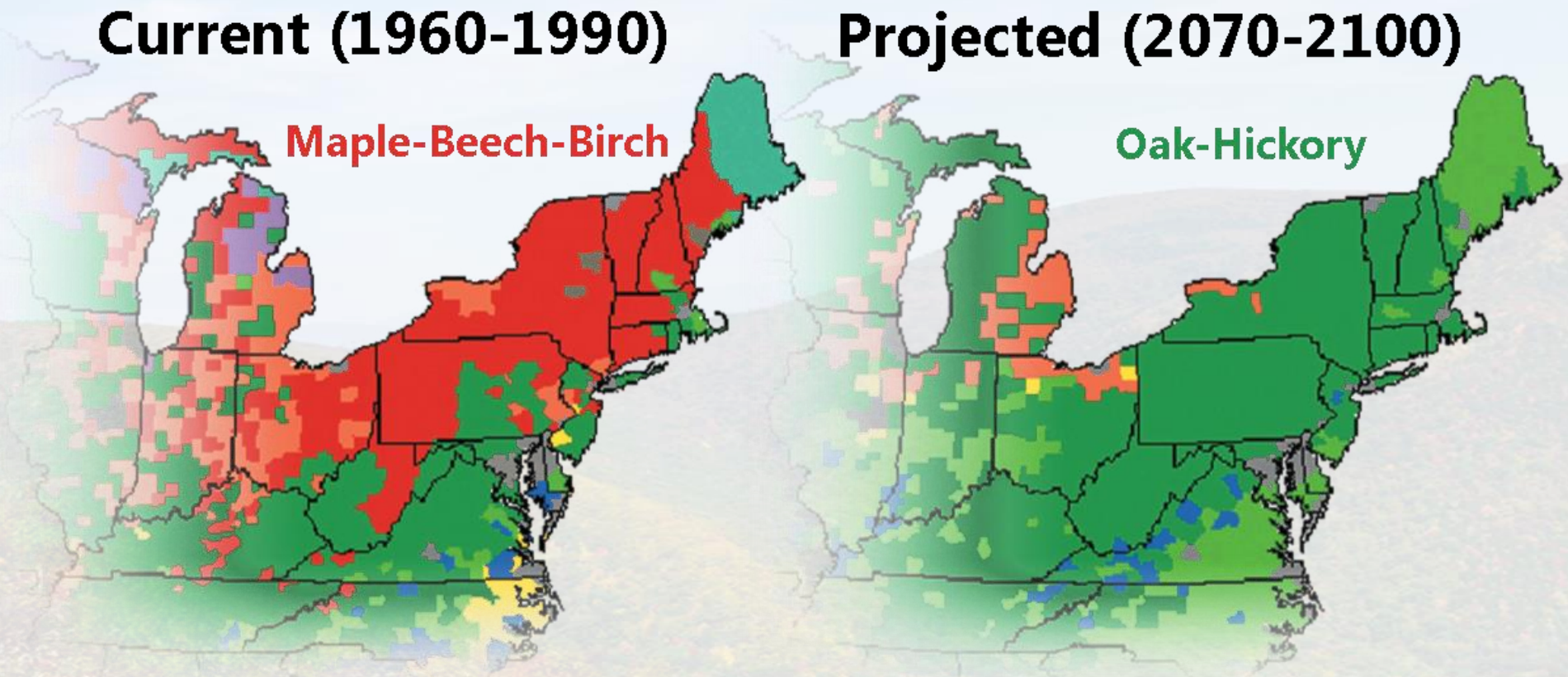
How Summer Temperatures Will Feel Depending on Future Greenhouse Gas Emissions

Who else has 30 days/yr over 90°F?



Source Southeast Regional Climate Center

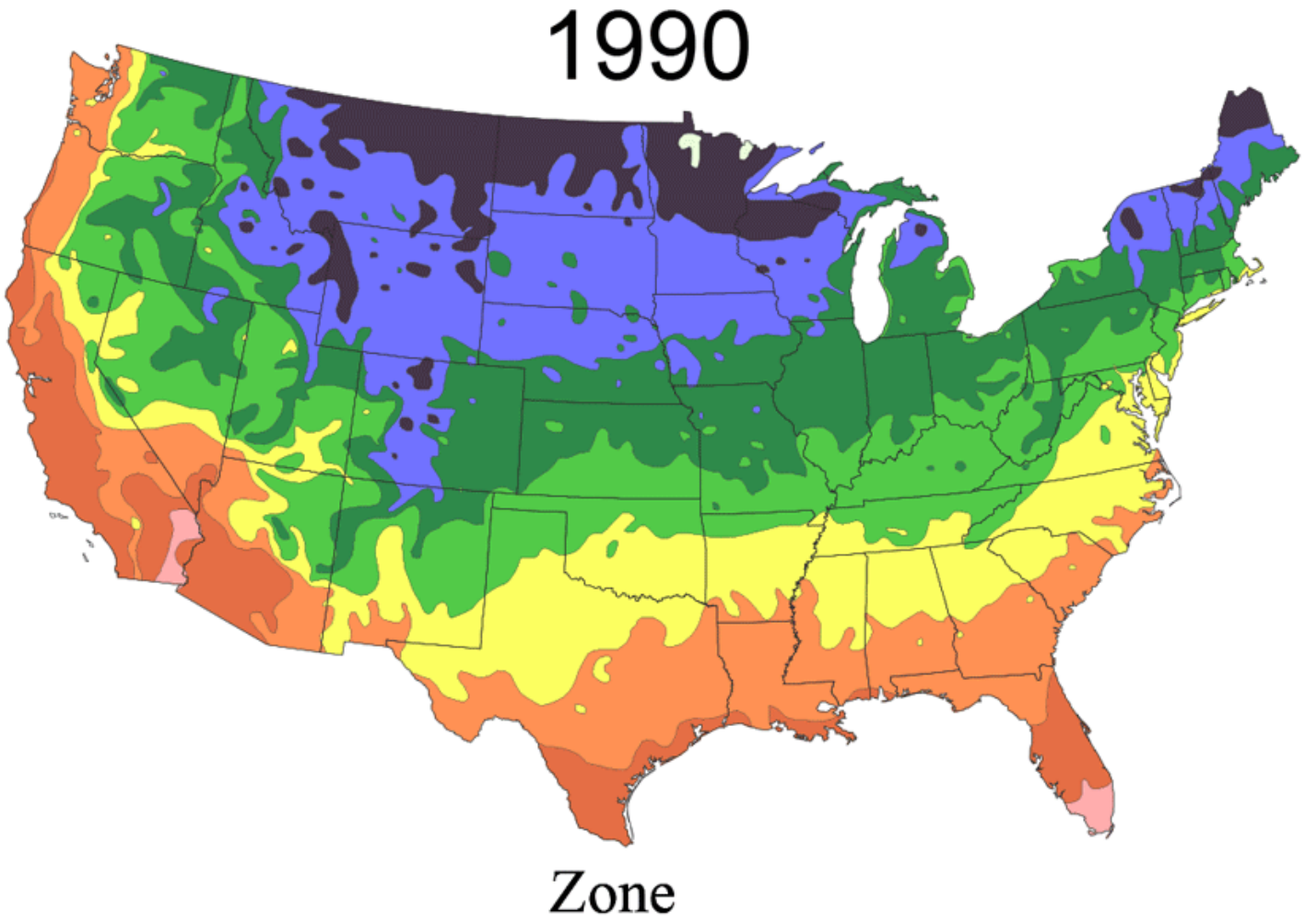
Future Forests



Maple, Beech, Birch → **Oak, Hickory**

Graphic source: USGCRP, 2009

Shifting Plant Hardiness Zones



Maps, modified:
Arbor Day Foundation,
USDA

Warmer Temperatures Challenge Highland Birds

Species that rely on relatively cool climates in high-elevation ecosystems will have fewer options for future habitat.


Blackburnian warbler


Magnolia warbler

Source: State of the Birds, Mass Audubon

Coastal-Nesting Birds

Birds with need of specific coastal habitat will be especially challenged due to sea level rise and increased risk of storms.

American oystercatcher

Piping plover

Source: State of the Birds, Mass Audubon

Blue Crabs Migrate North with Warmer Waters

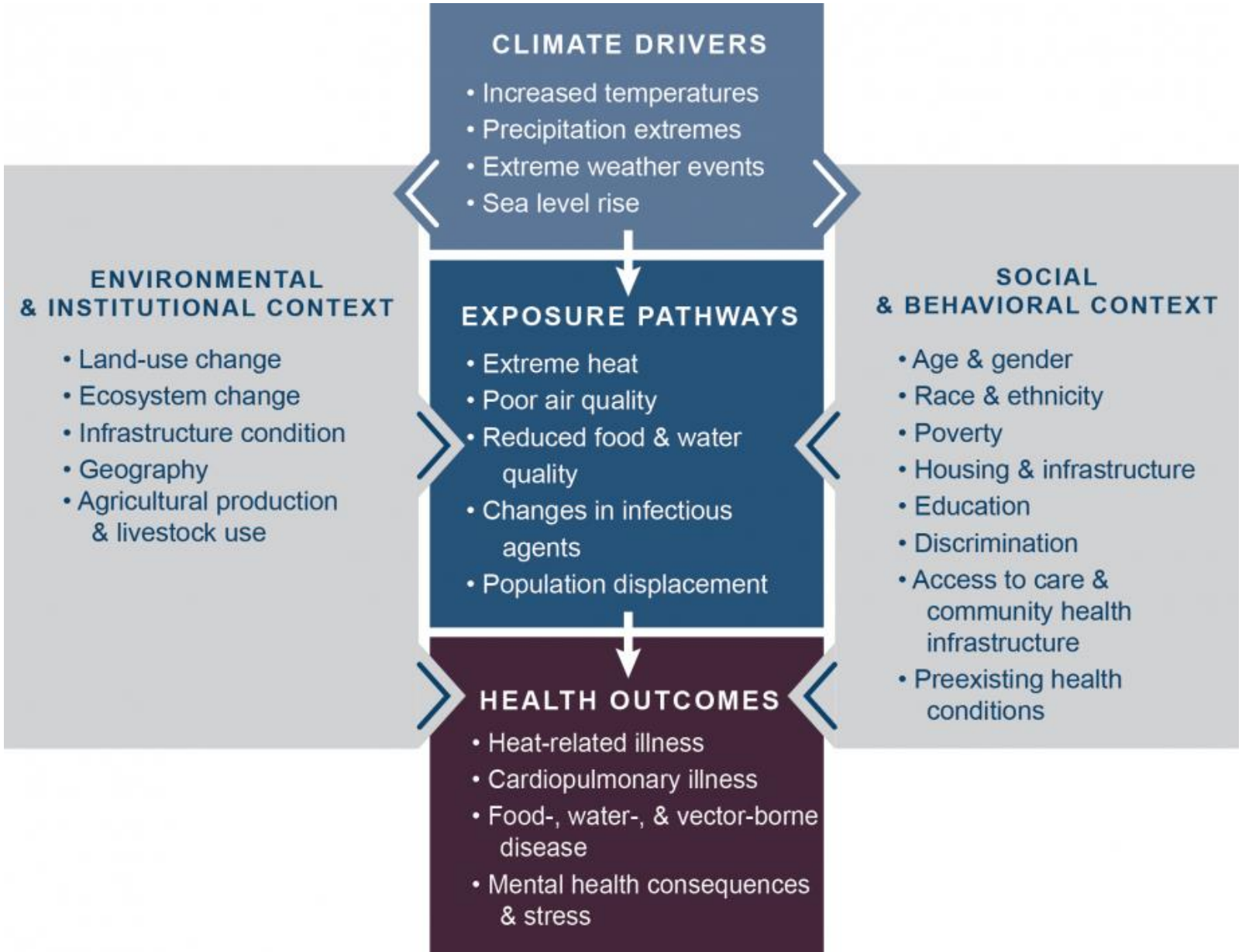
- Historically found south of Cape Cod

- Blue crabs are being found north of Cape Cod in increasing numbers as water temperatures in the Gulf of Maine have increased rapidly

Source:
http://booksandjournals.brillonline.com/content/journals/10.1163/1937240x-00002293

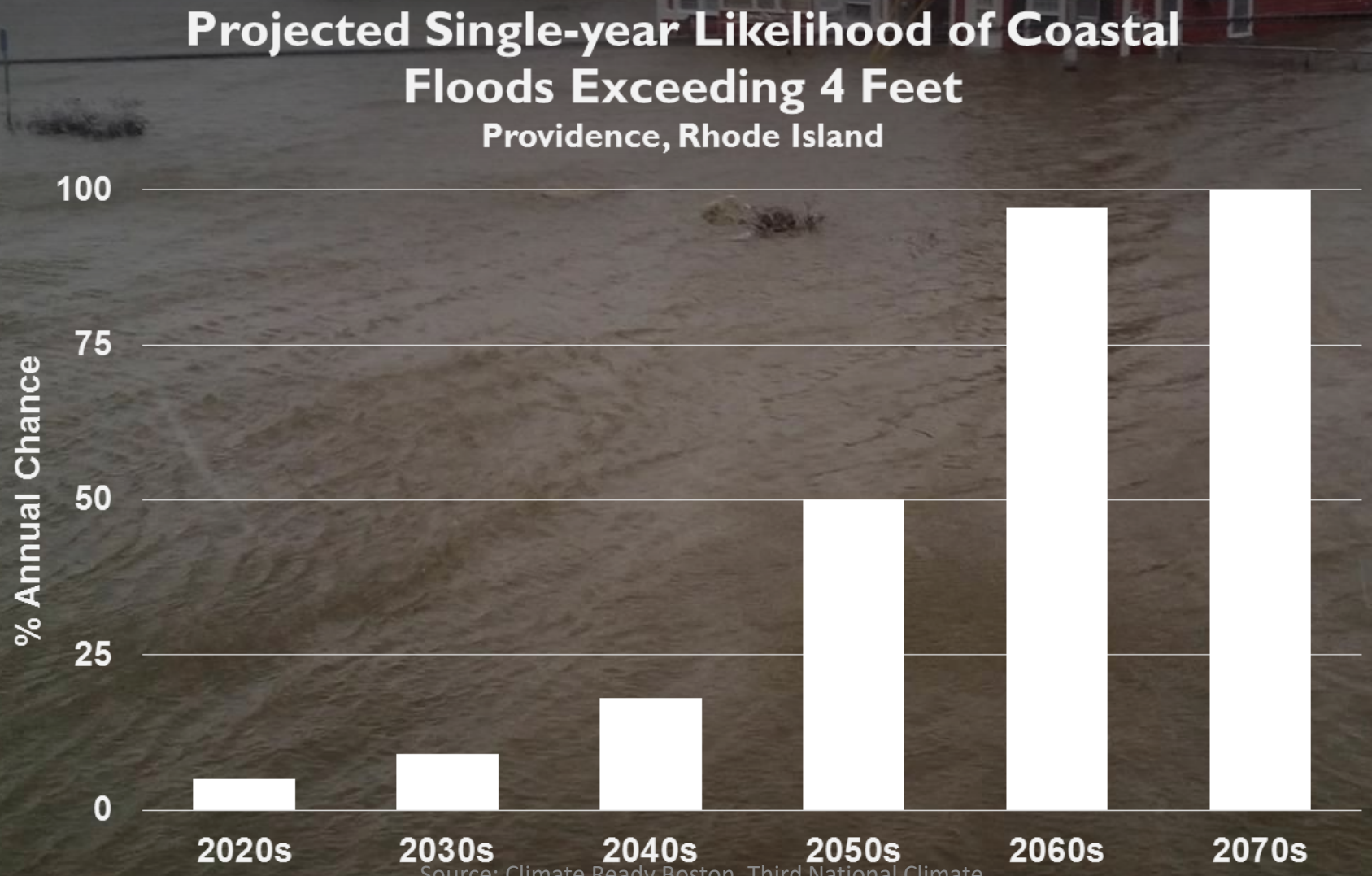
Source: U.S. Global Change Research Program

Climate and Human Health



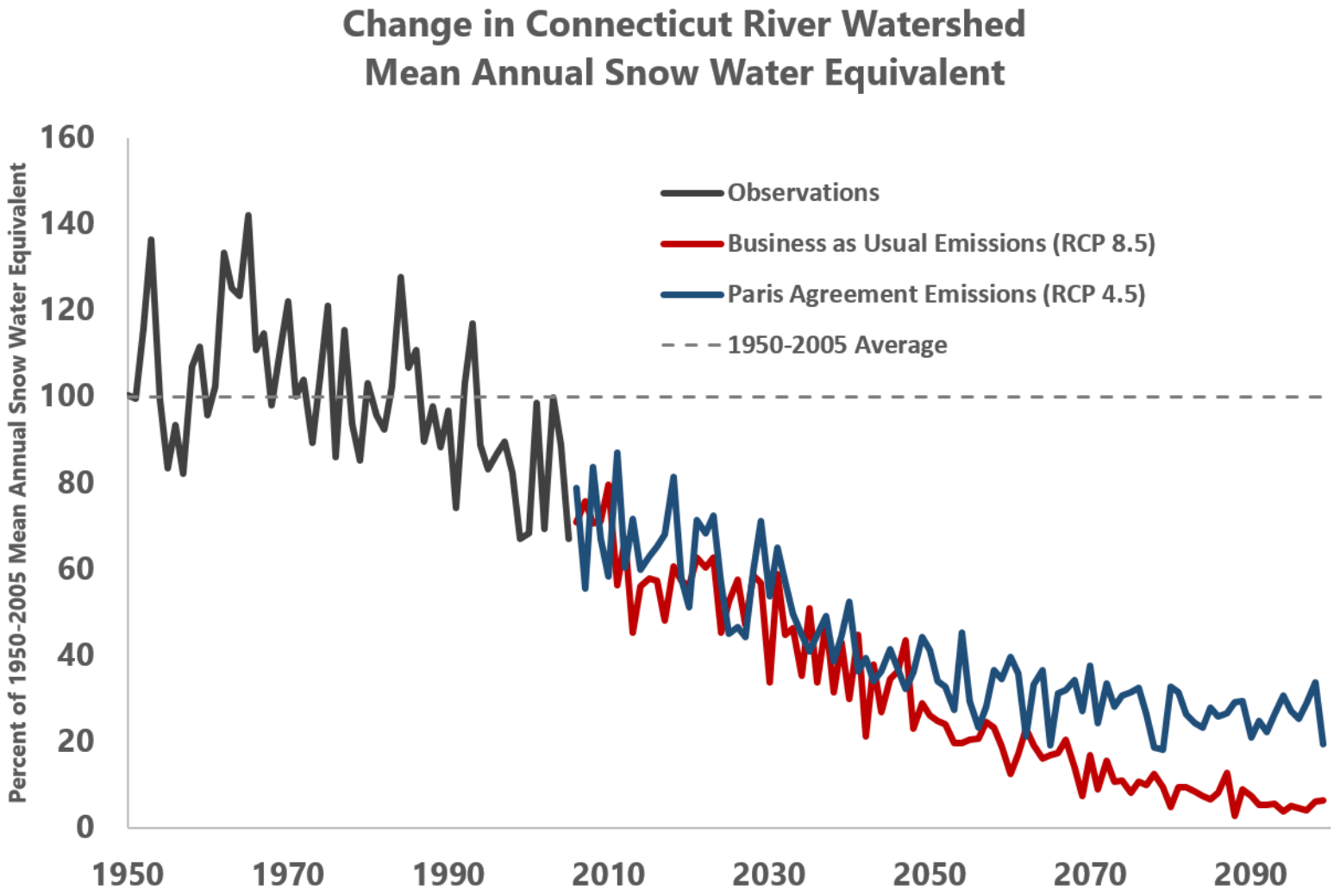

Global Climate Change and Boston Harbor
By the end of the century, many of Boston's coastal landmarks could be at risk due to sea level rise.
Global climate change is warming our oceans and causing the sea to rise. If climate change continues unchecked, the water level right here in Boston Harbor could be 2 to 6 feet higher by 2100.
Landmarks
How the Oceans Are Changing
Taking Action
New England Aquarium

Coastal Flooding



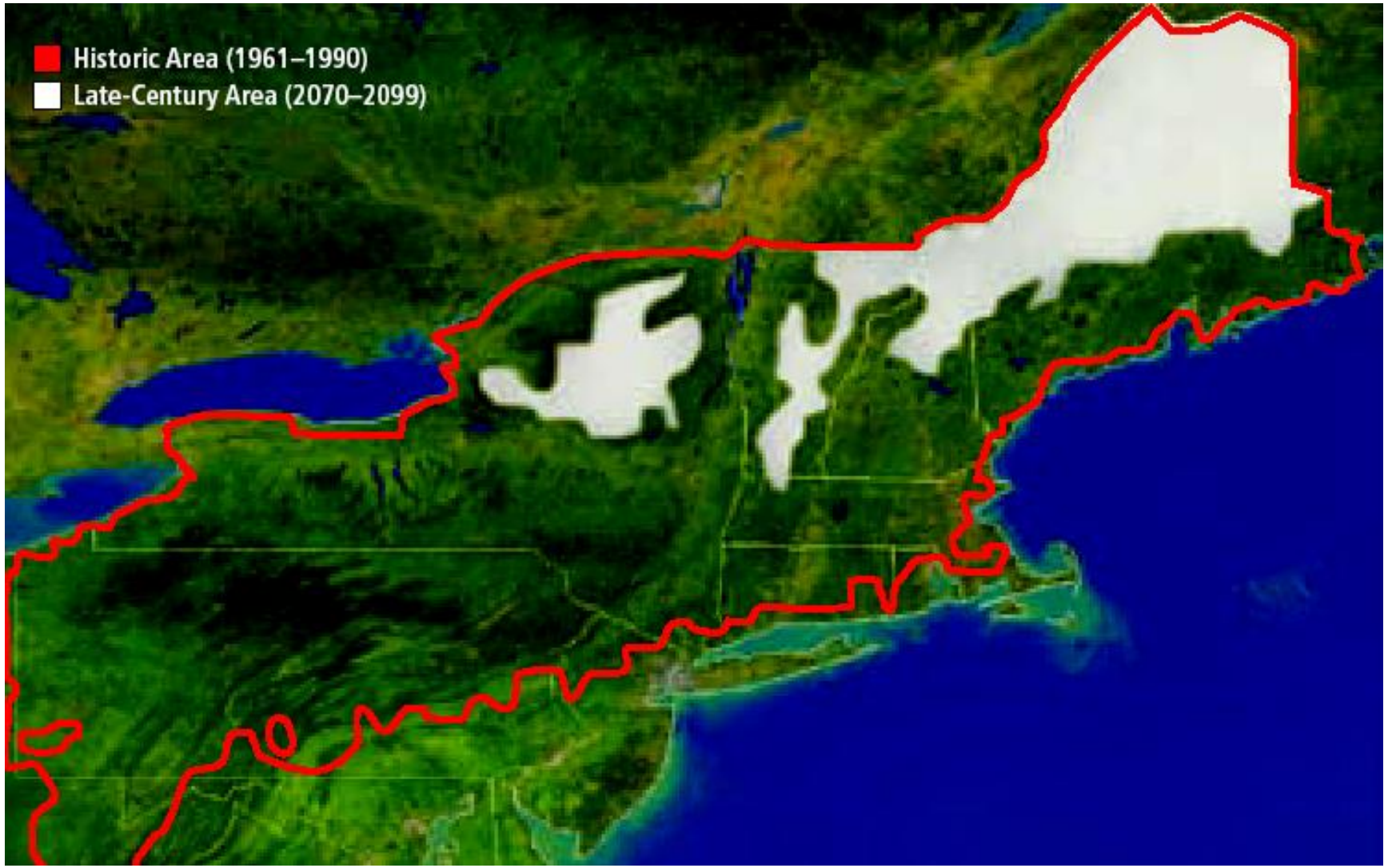
Source: Climate Ready Boston, Third National Climate Assessment

Snow Cover Decreasing



Data Source: [USGS National Climate Change Viewer]

Snow Cover Decreasing



Area projected to have at least 30 days of snow cover per year

Frumhoff, P.C., et al. 2007. *Confronting Climate Change in the U.S. Northeast: Science, Impacts, Solutions*. Synthesis report of the Northeast Climate Impacts Assessment (NECIA). Cambridge, MA: Union of Concerned Scientists


ACTION

Mitigation: To avoid the most dangerous impacts of climate change…

SOURCES OF THE AVERAGE MASSACHUSETTS RESIDENT'S CARBON EMISSIONS

Estimates based on data from the State of Massachusetts and emissions categories from the Union of Concerned Scientists.

EPA, https://www3.epa.gov/climatechange/ghgemissions/sources.html

Massachusetts' Commitment

- The Global Warming Solutions Act (GWSA) of 2008
- Requires 25% GHG reduction from all sectors of the economy below the 1990 baseline emission level in 2020
- Requires at least 80% reduction in 2050

First offshore wind in US: Block Island Wind Farm

5 Turbines
30 MW

Power for 17,000 homes

Block Island Wind Farm, DeepWater Wind

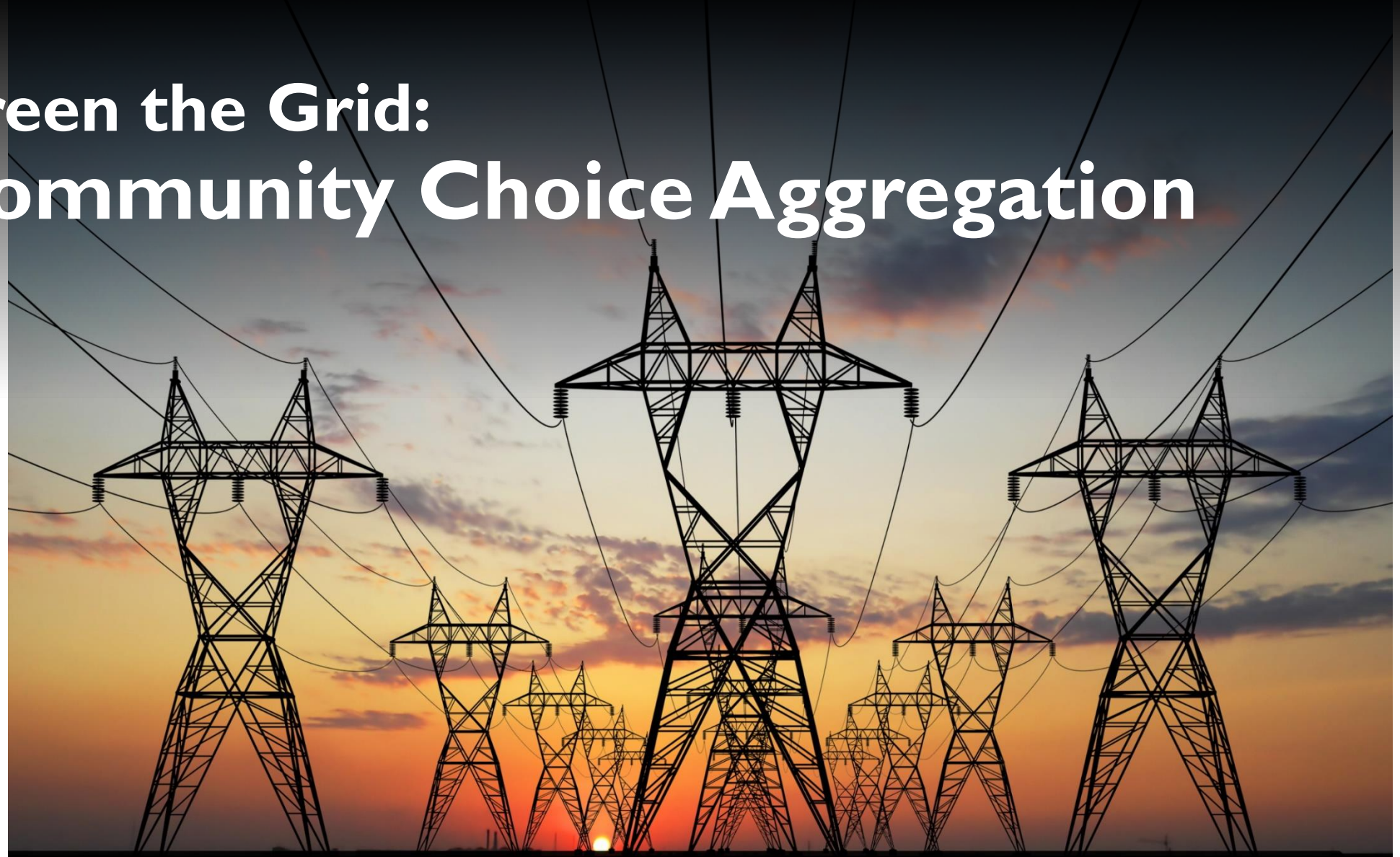
First Commercial Offshore Wind: Vineyard Wind

800 MW

Power for 450,000 homes

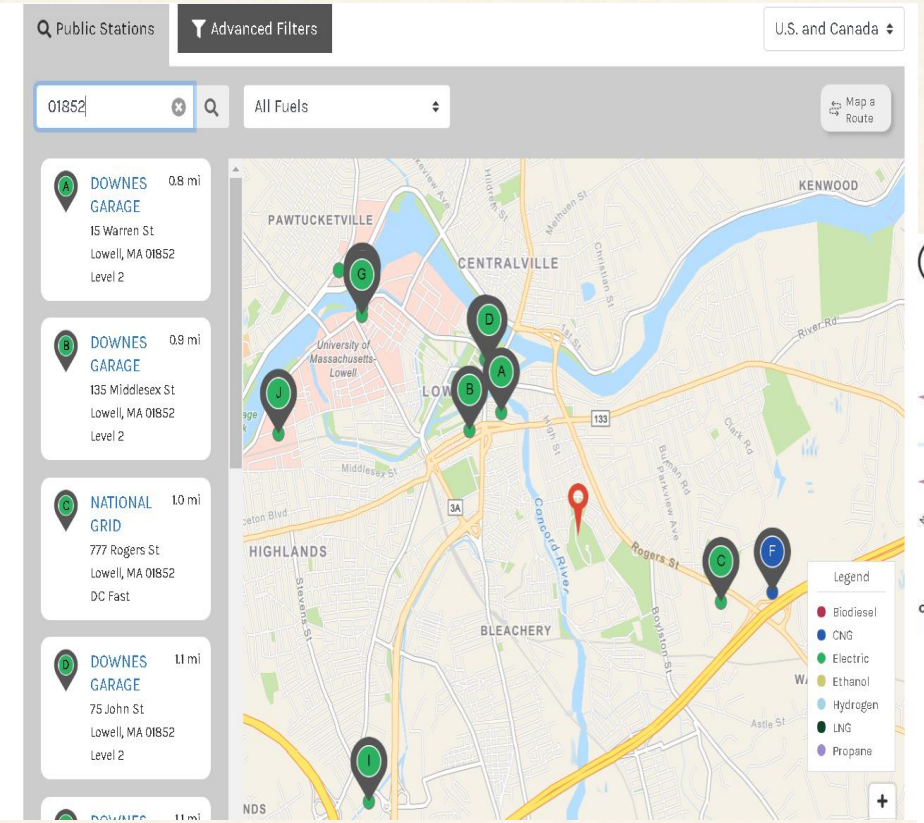
Block Island Wind Farm, DeepWater Wind

Green the Grid:
Community Choice Aggregation



- Municipalities can buy renewable energy
- Individual consumers may opt out

The Problem Child: Transportation



Adaptation: Actions taken to help communities and ecosystems cope with changing climate condition

Conserve available open space providing ecosystem services

Integrate concepts into new development at neighborhood scales

Restore resilience in urban areas at site specific scale

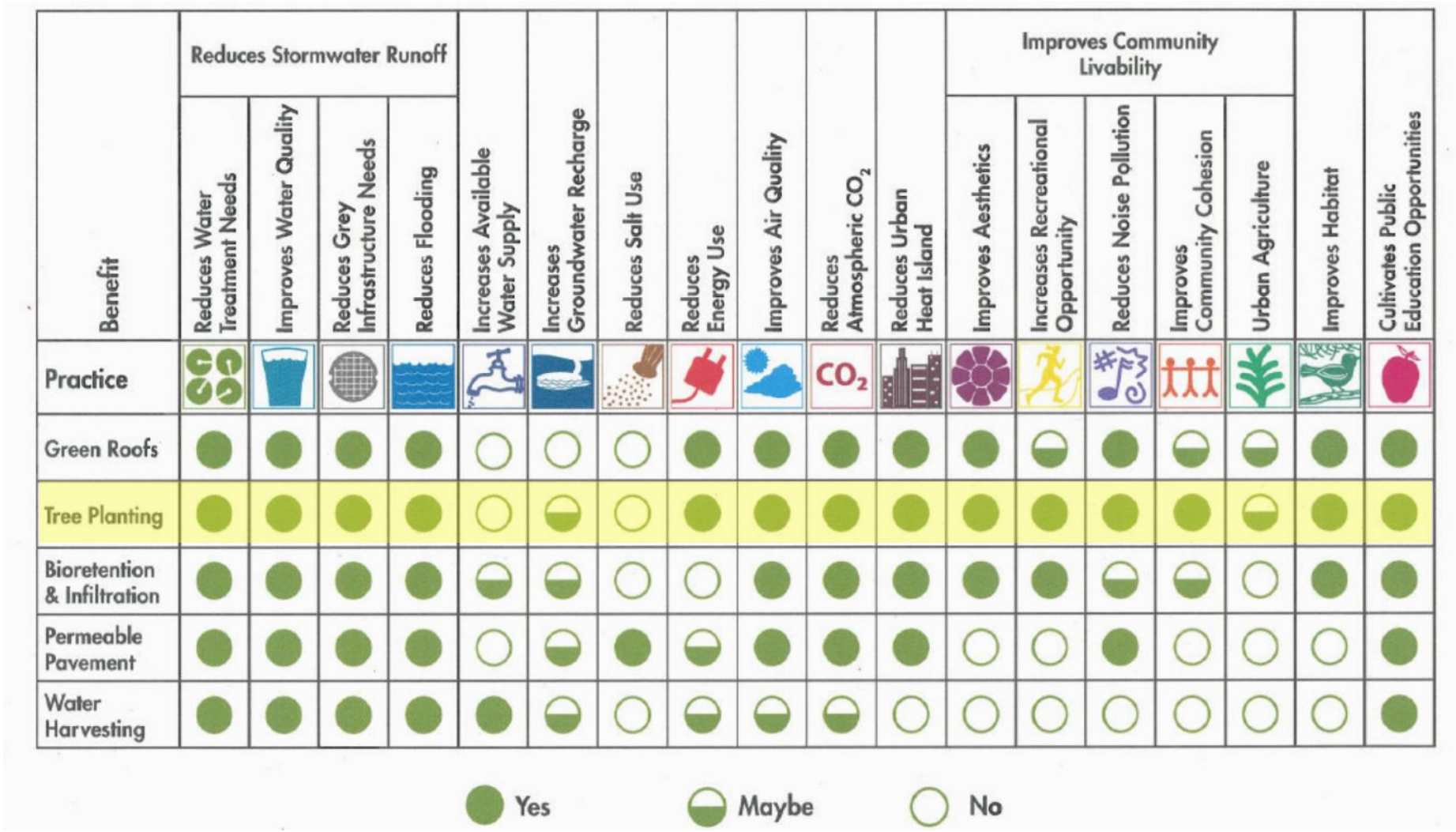
Nature-based Solutions

Nature-Based Solutions *use* natural systems, *mimic* natural processes, or *work in tandem with* traditional approaches to address natural hazards like flooding, erosion, drought, and heat islands.

Green Infrastructure

Low Impact Development (LID)

Co-benefits of Nature-based Solutions



Source: Center for Neighborhood Technology's The Value of Green Infrastructure

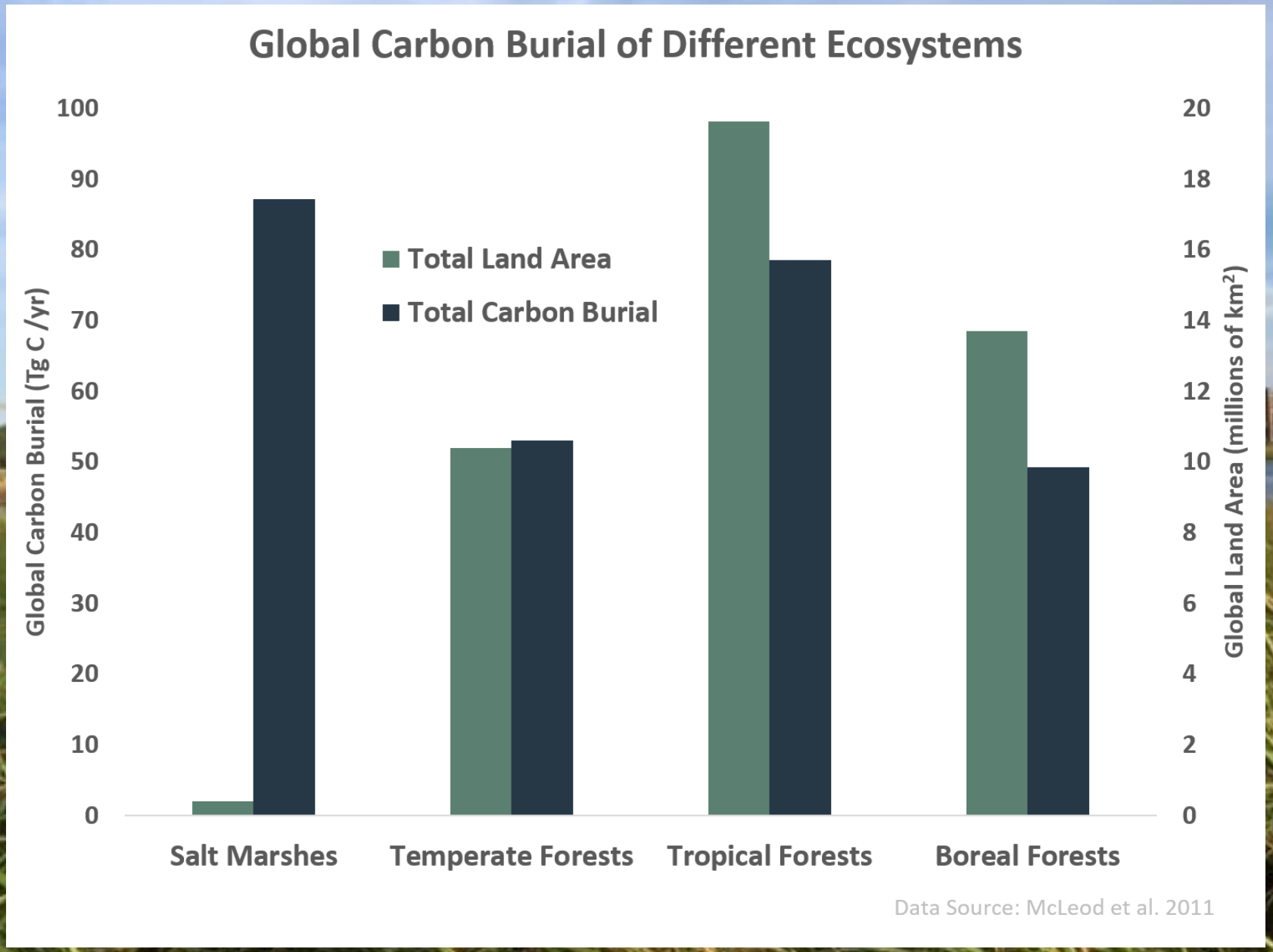
A Recurring Theme: Trees

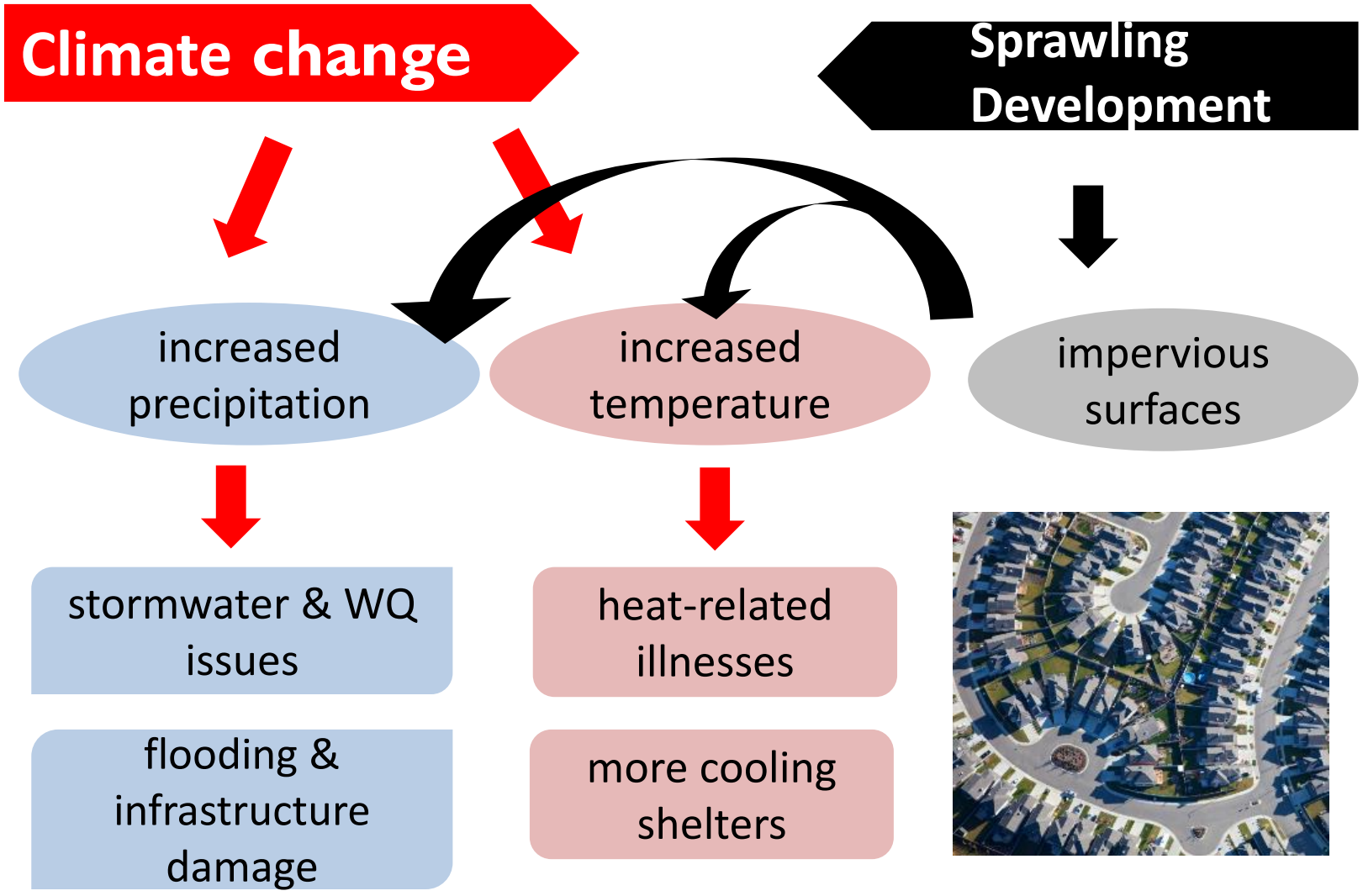
A mature, deciduous tree intercepts 500-2000 gallons of water per year.

A mature evergreen intercepts up to 4000 gallons of water per year.

MA forests sequester 14% of the state's gross annual carbon emissions

Salt Marshes as a Solution





Source: National Climate Assessment, U.S. Global Change Research program

Protecting Resilient Lands – At Multiple Scales

- Identify critical parcels and areas for conservation
  - MAPPR
- Include them in development and conservation plans
  - Master plan, Open Space plan, CPA projects, zoning considerations
- Get involved in local decisions!

Adaptation: Start near home.

Adopt a drain.

Adopt a tree.

Adopt a neighbor.

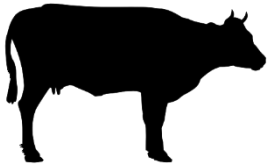
What You Can Do

Unplug: Turn off computers, phones, lights, video games, air conditioners.

Bike or walk

Make the SWITCH

Green the Grid



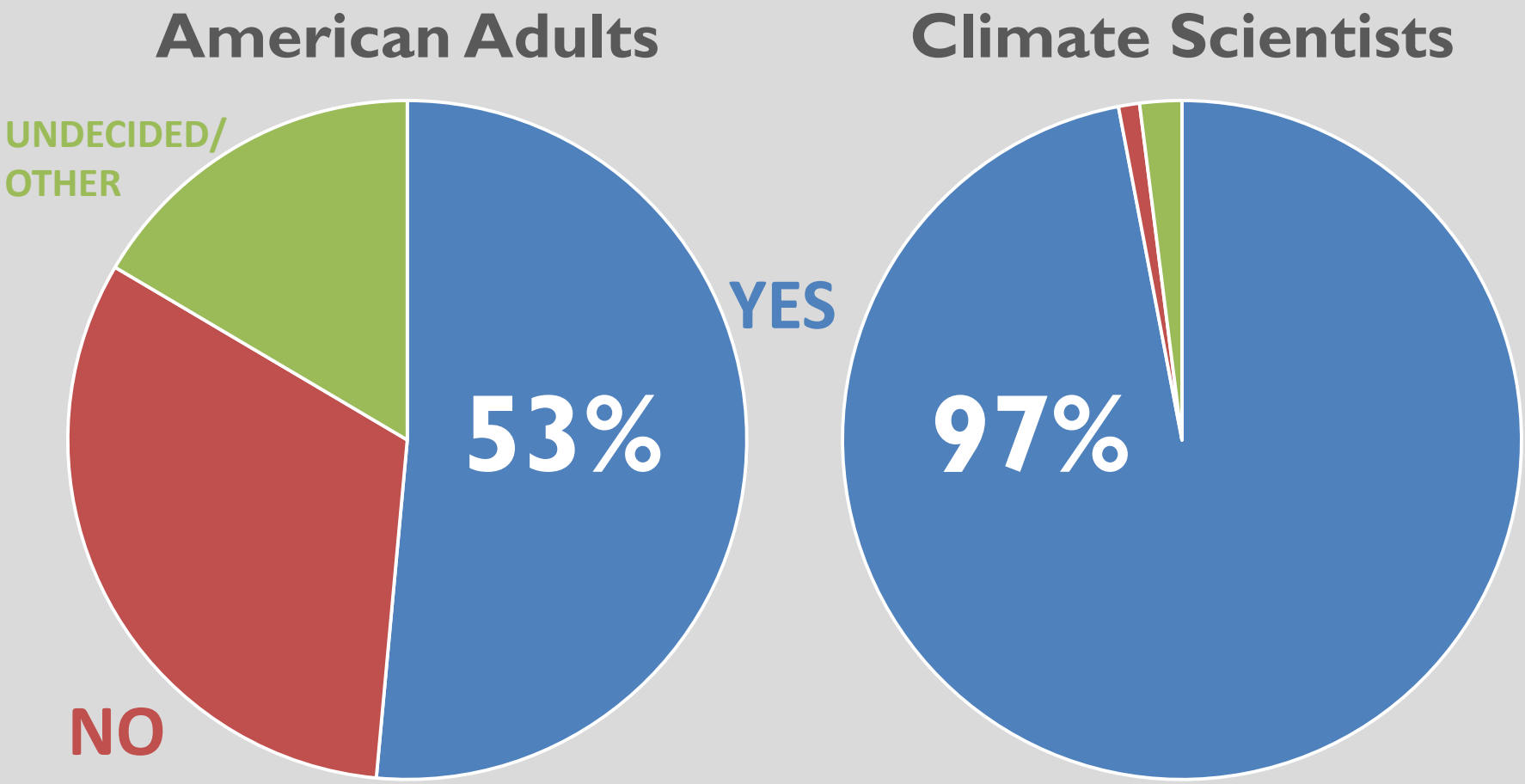
Eat less beef

Talk about it with friends

Join a community organization or board

Talk About It!

Only about half of Americans understand climate change is real and human-caused.



Sources: Yale Project on Climate Communication (2015) and Cook et al. (2013)

But I Don’t Want To!

I don’t know enough

- You do! Keep it simple and focus on solutions
- Help inoculate deliberate misinformation

People won’t want to hear it

- People *think* no one else wants to talk about, but they do
- Frame it around values everyone can get behind
- Fear of "deniers," but in fact they're rare

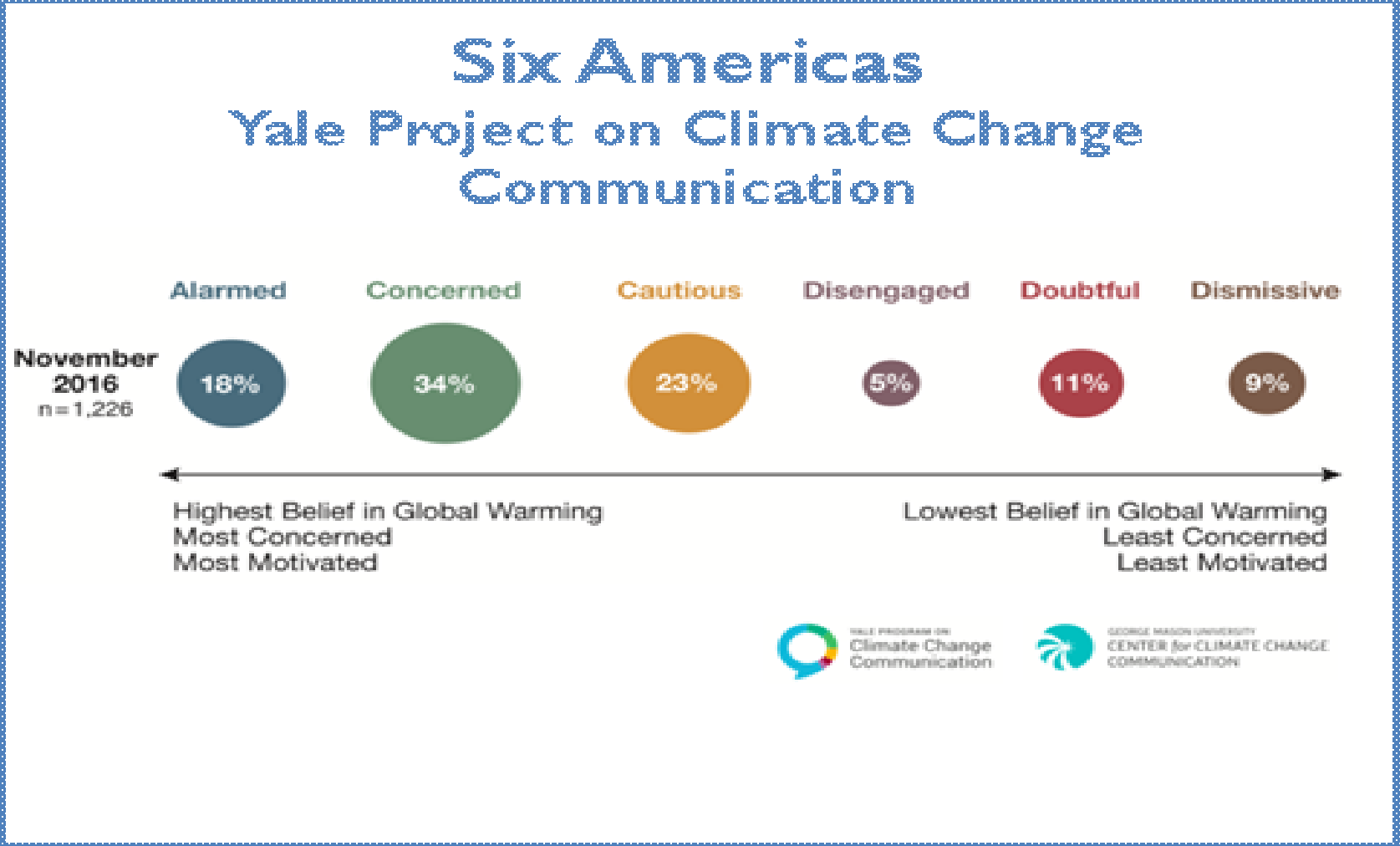
ARTICLE · Jan 23, 2017

How to Inoculate the Public Against Misinformation About Climate Change

"Prior studies have found widespread **public misunderstanding** about the scientific consensus that human-caused global warming is happening…**simply informing people of the fact that 97% of climate scientists are convinced human-caused global warming is happening, significantly increases public understanding of the consensus.** In turn, the increase in public understanding of the scientific consensus is associated with smaller, but potentially important **increases in respondents' own conviction** that global warming is happening, human-caused, and a worrisome threat that requires action"

Know Your Audience:

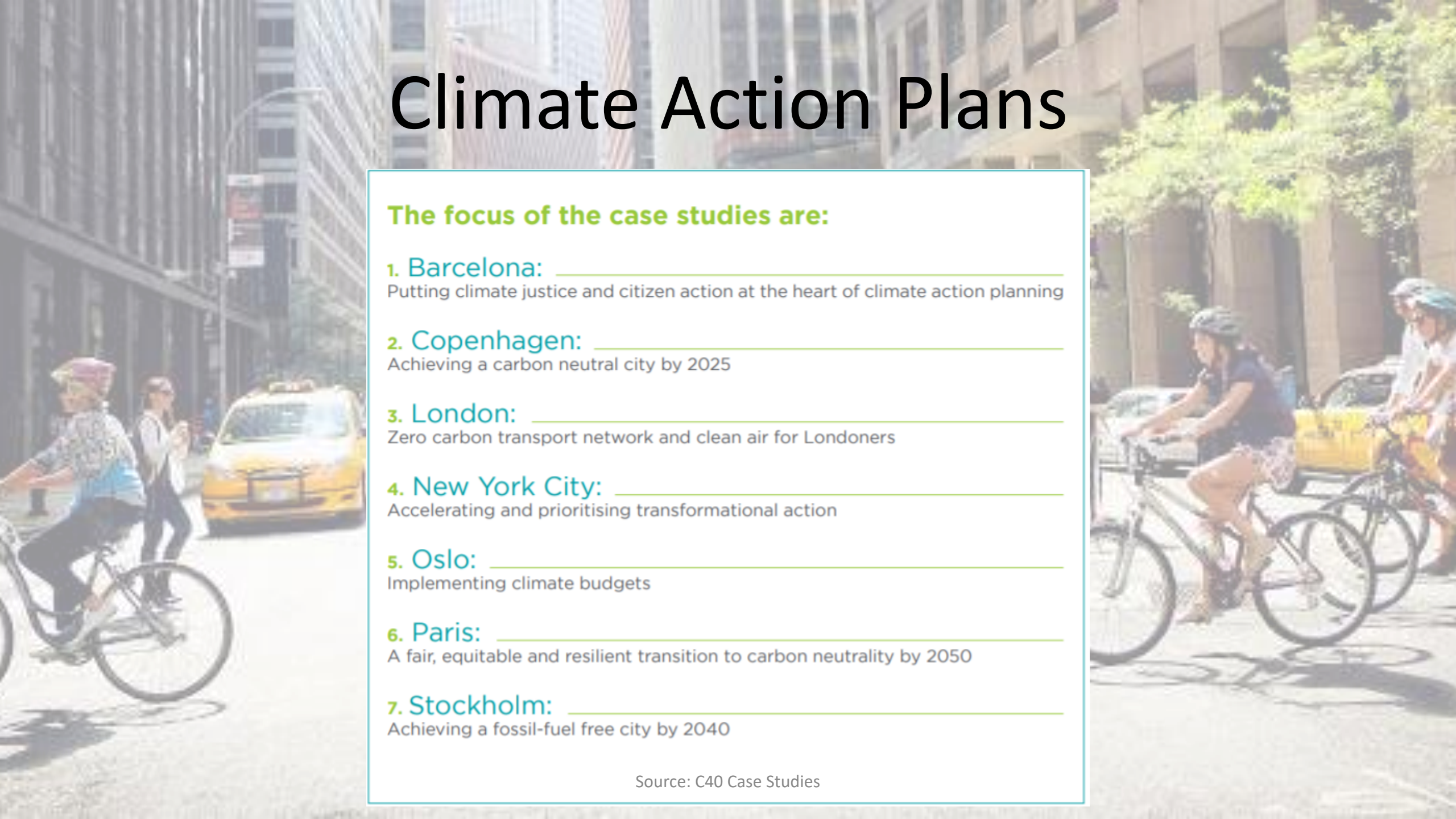
Six Americas



Cities As Solutions

- Urban density presents a greener way to live
- Local elected officials are directly accountable to their constituents
- Collaboration and idea sharing among cities is already happening
- Financial effects of climate change will be felt by cities --> Driving Action

Climate Action Plans



The focus of the case studies are:

1. Barcelona:
Putting climate justice and citizen action at the heart of climate action planning

2. Copenhagen:
Achieving a carbon neutral city by 2025

3. London:
Zero carbon transport network and clean air for Londoners

4. New York City:
Accelerating and prioritising transformational action

5. Oslo:
Implementing climate budgets

6. Paris:
A fair, equitable and resilient transition to carbon neutrality by 2050

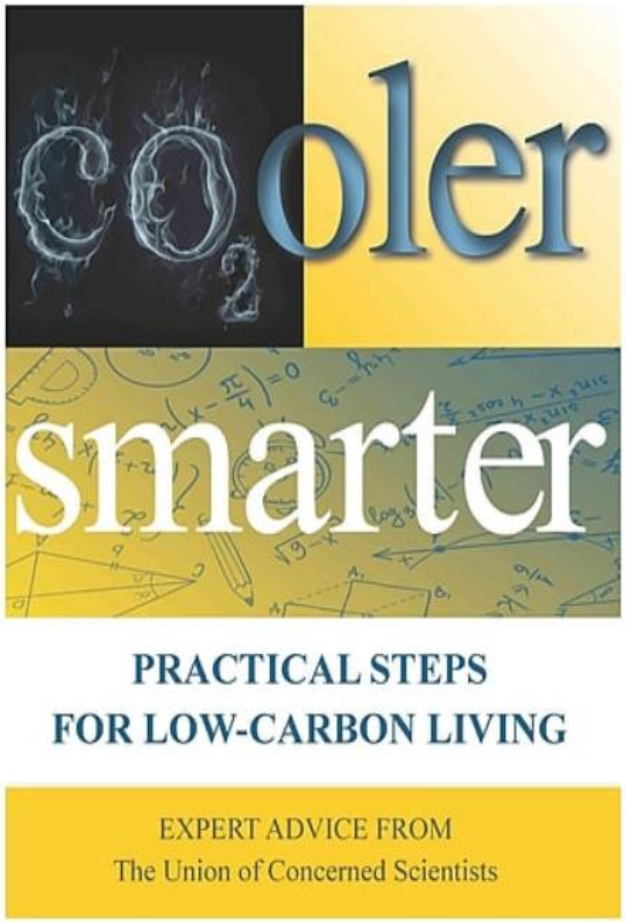
7. Stockholm:
Achieving a fossil-fuel free city by 2040

Source: C40 Case Studies

Need More Resources?

C40 CITIES
CLIMATE LEADERSHIP GROUP

YALE PROGRAM ON
Climate Change
Communication



resilient MA
Climate Change Clearinghouse for the Commonwealth