Climate Change:
Energy and Community Impacts

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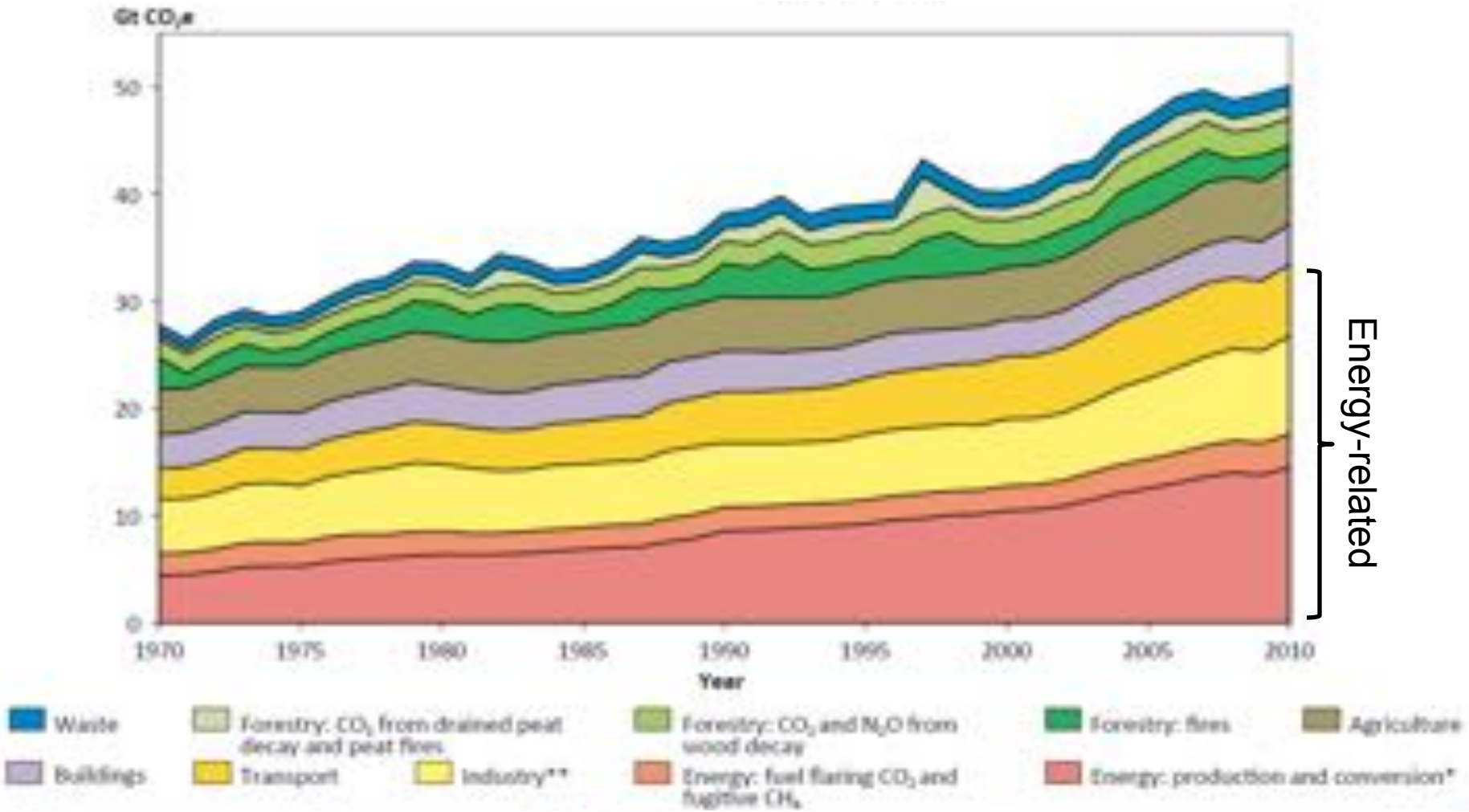
Key Points Up Front

- Climate change is real and will have significant impacts
  - It will have major consequences for the energy sector
  - It is likely to disproportionately affect poor and minority communities
- The emissions that drive the change – and therefore the solutions to the problem – are largely in the energy arena
- Properly designed, our emission reduction strategies can create multiple economic and social benefits – from cleaner air to sustainable communities to good jobs to energy security

Trend in global greenhouse gas emissions 1970-2010 by sector

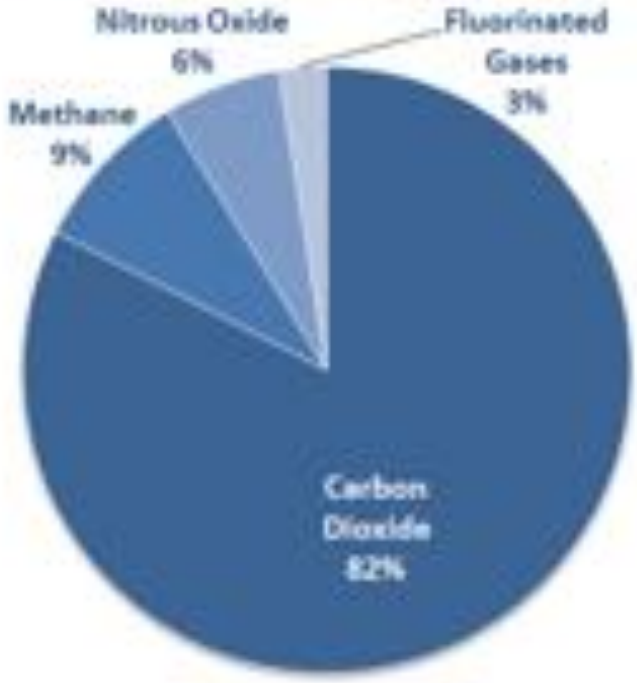


Source: UNEP, Emissions gap report, 2012

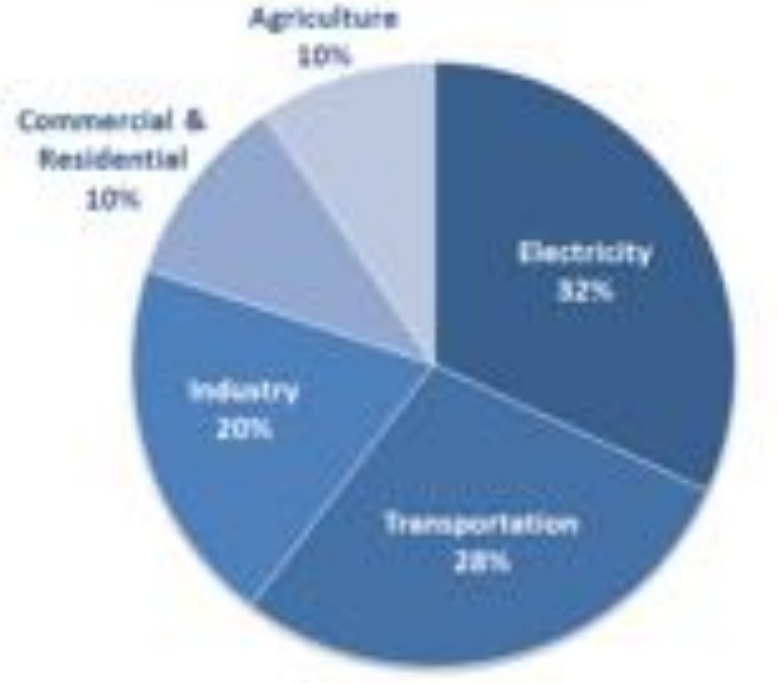
For the U.S., Climate Change is an Energy and Carbon Problem

U.S. Emissions by Greenhouse Gas and Sector
~85% of emissions tied to energy

Emissions by Gas

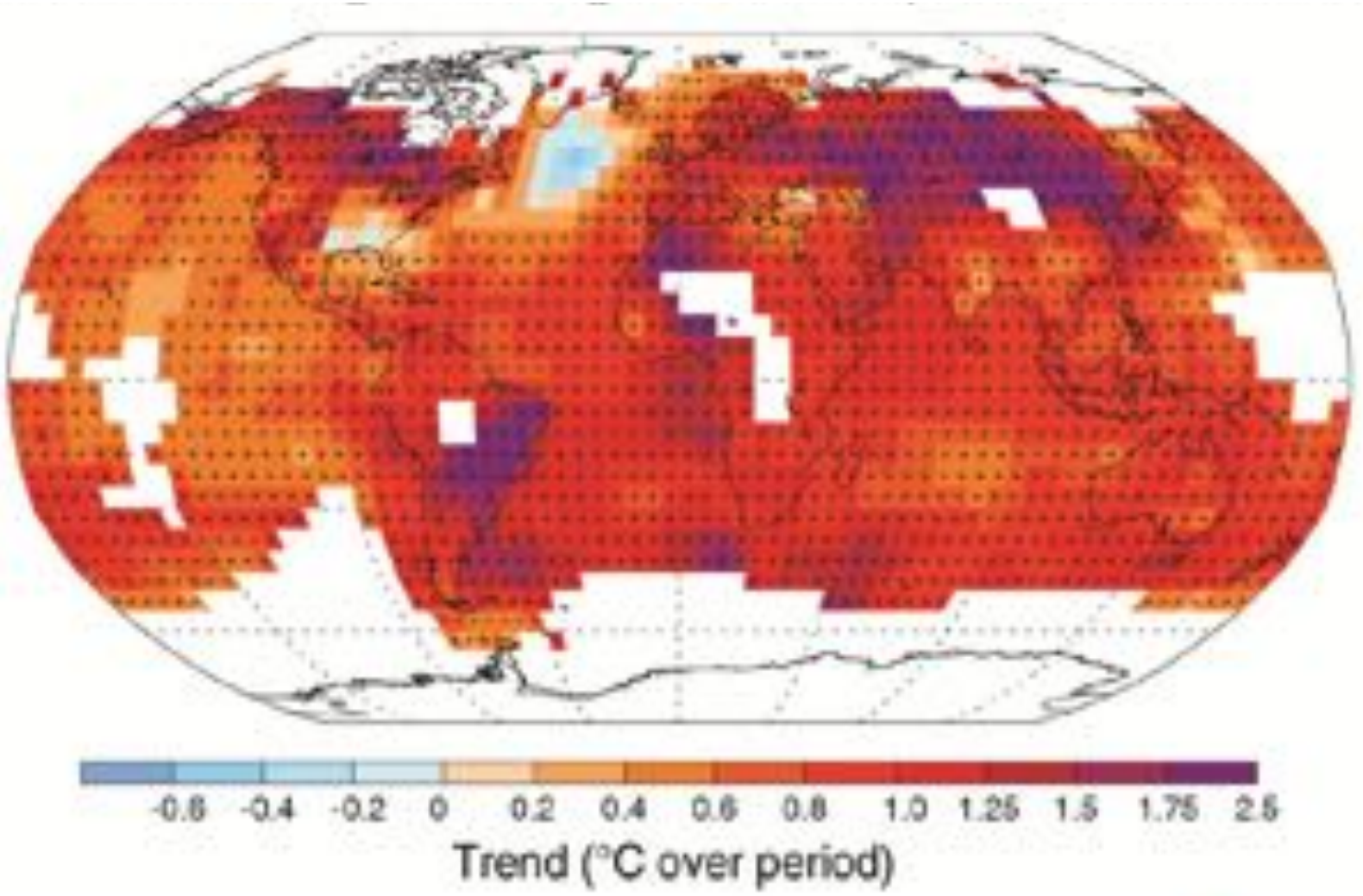


Emissions by Sector



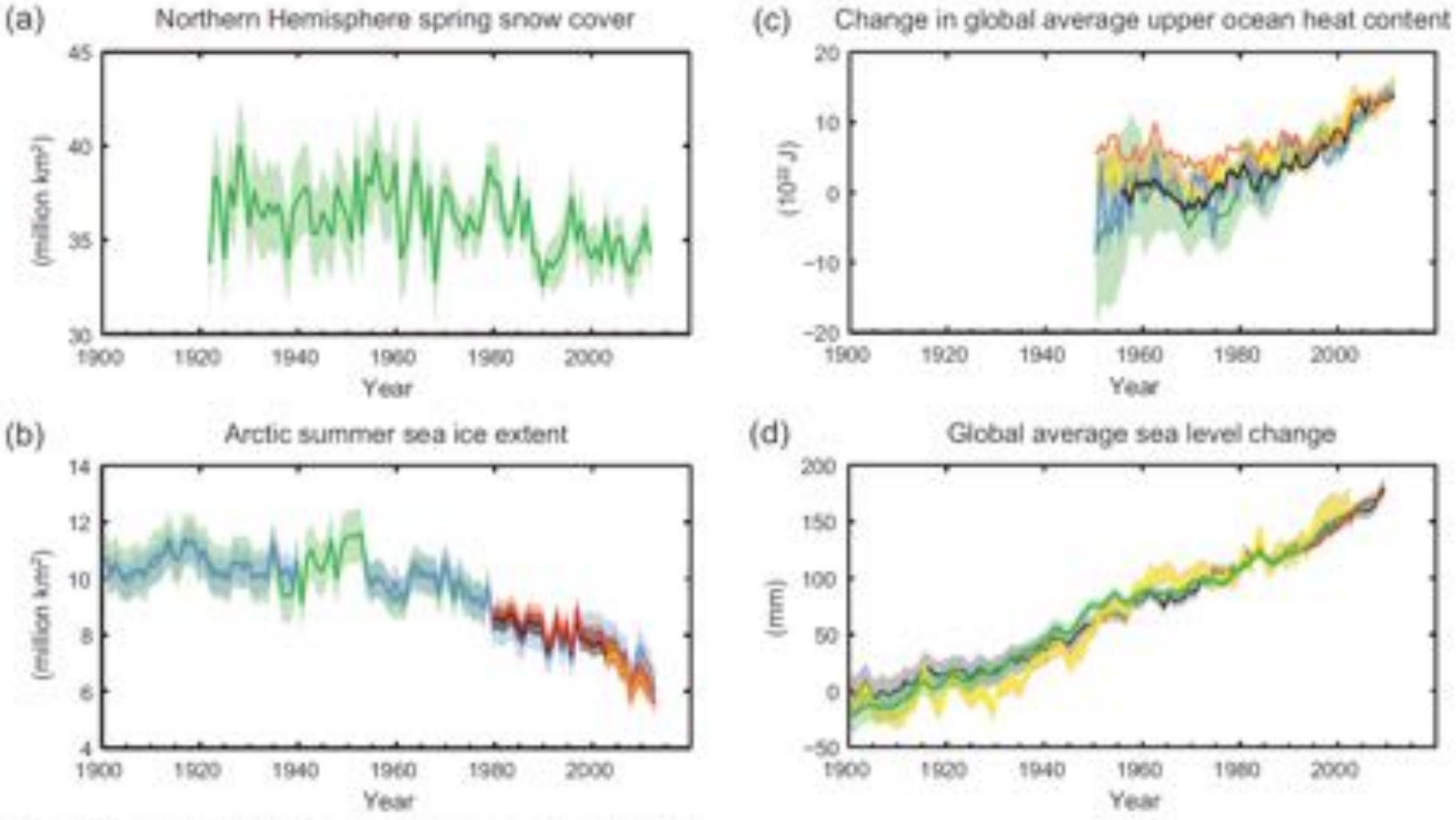
Source: EPA, 2014, Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2012

Observed Change in Average Temperatures 1901-2012



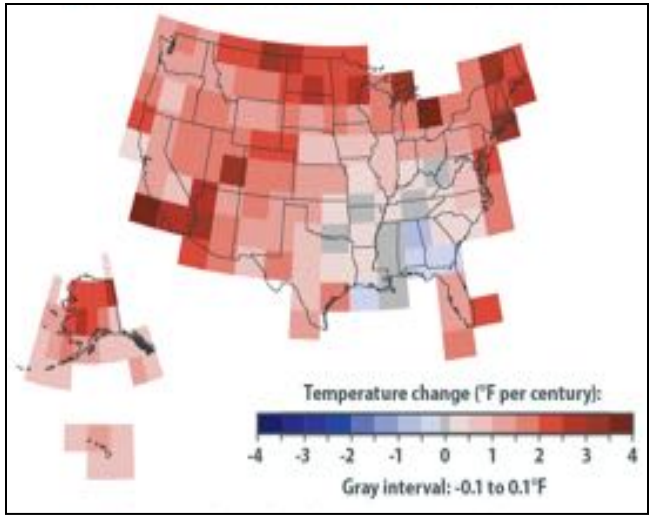
Source: IPCC, 5th Assessment Report, SPM, 2013

Observed Impacts

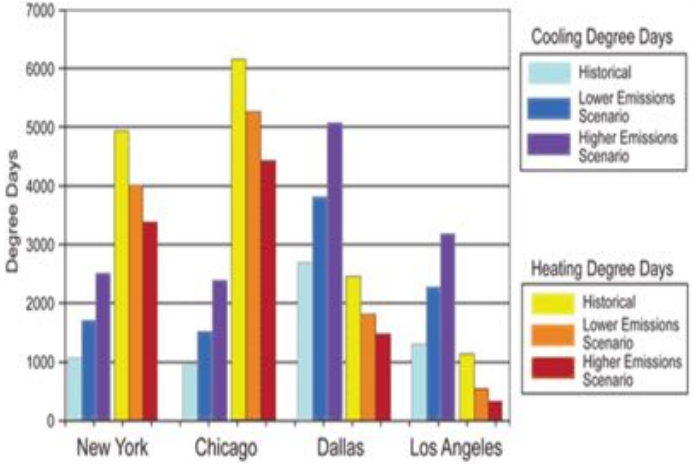


Source: IPCC, 5th Assessment Report, SPM, 2013

Impacts of Increasing Air and Water Temperatures



Rate of warming in the United States by region, 1901–2011 (EPA 2012a)



Changes in cooling degree days and heating degree days in the United States by 2080–2099 (USGCRP 2009)

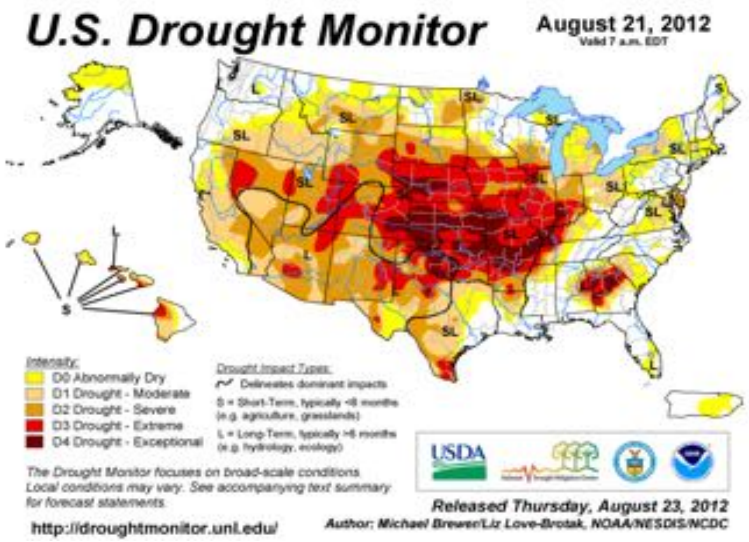
Climate Trends

- Average temperatures have increased across the U.S. over the past 100 years
- Heat waves have become more frequent and intense
- Wildfire season and size of fires have increased
- Sea ice cover has decreased in the Alaskan Arctic, and permafrost has thawed
- Growing season has increased

Key Energy Sector Impacts

- Increasing temperatures will likely increase electricity demand
- Increasing temperatures reduce transmission efficiency, and severe wildfires will increase the risk of physical damage
- Increasing temperatures could decrease available thermoelectric generation capacity and efficiency

Impacts of Decreasing Water Availability



Water stress: Locations of the 100 most vulnerable coal-fired power plants (NETL 2010b)

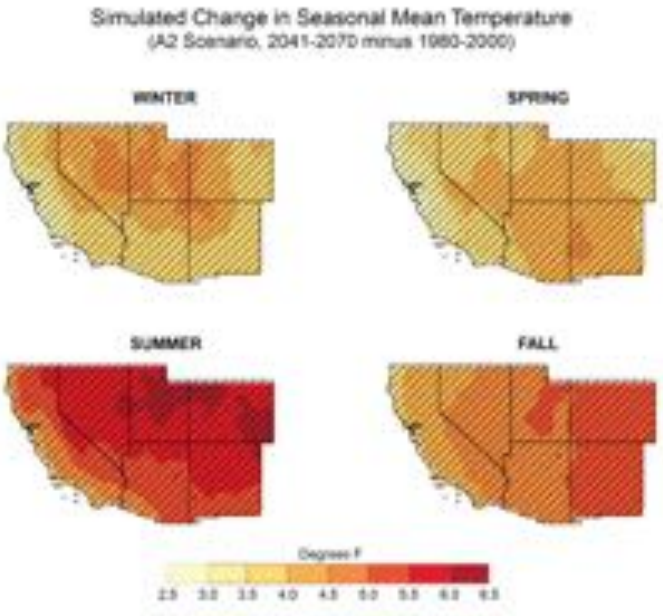
Climate Trends

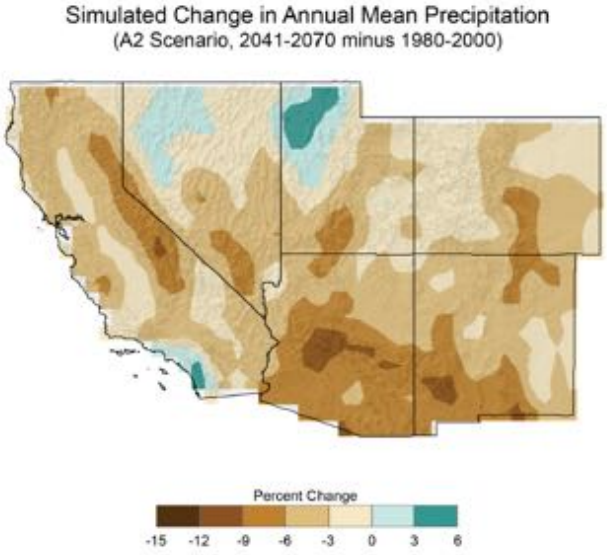
- Precipitation patterns have changed, causing regional and seasonal decreases and more frequent and severe droughts
- Snowpack levels have decreased, resulting in lower summer streamflows
- Ground and surface water levels have declined

Key Energy Sector Impacts

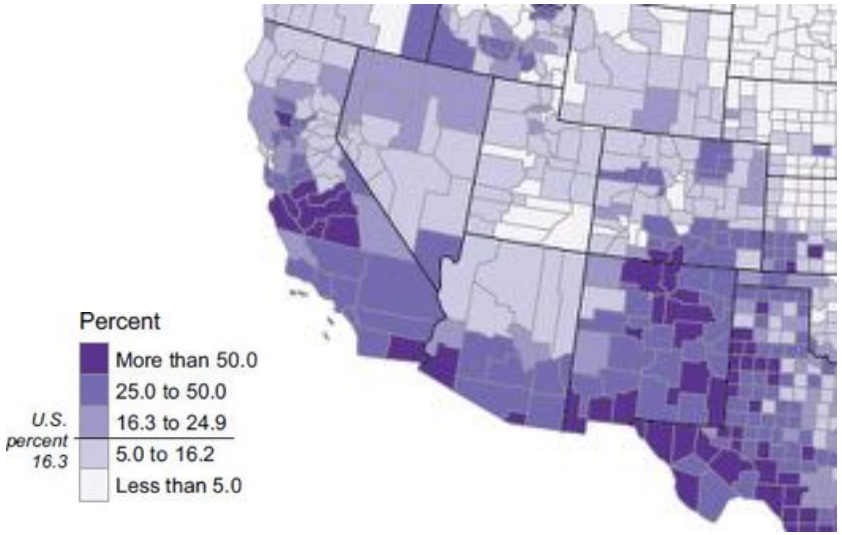
- Decreasing water availability for cooling at thermoelectric facilities could reduce available generation capacity
- Decreasing water availability could impact oil and gas production
- Reductions in river levels could impede barge transport
- Changes in precipitation/decreasing snowpack could decrease available hydropower generation capacity
- Decreasing water availability could decrease bioenergy production

Example: Regional and Local Impacts in the Southwestern U.S.

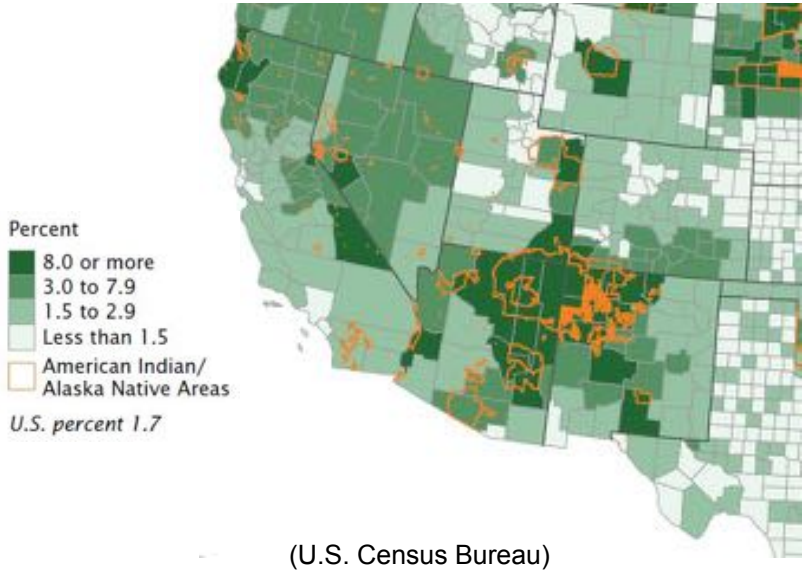




Hispanic or Latino Population as Percent of Total, 2010

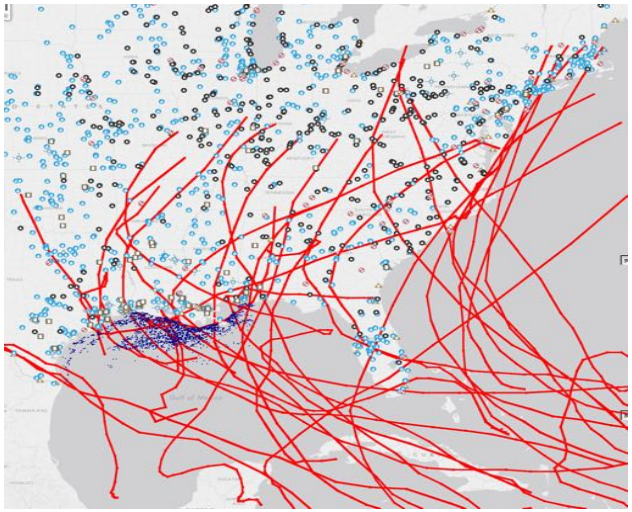


Native American Population as Percent of Total, 2010

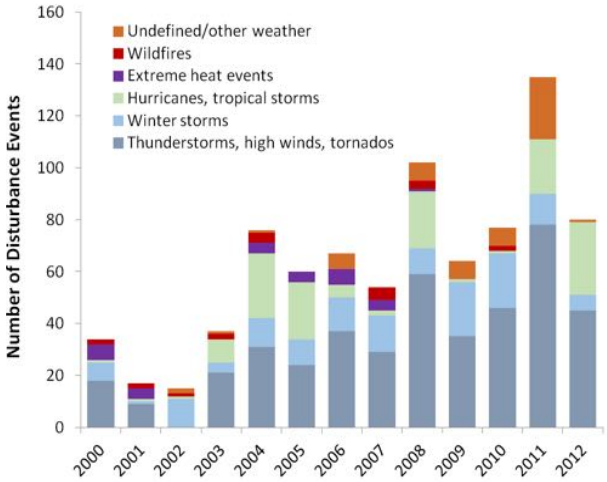


(U.S. Census Bureau)

Impacts of Increasing Storms, Flooding and Sea Level Rise



Hurricane storm paths (1980-2012) and locations of U.S. energy infrastructure
(NOAA 2013a,NOAA 2013d, NOAA 2013h, EIA 2013b)



Weather-related grid disruptions, 2000–2012
(DOE2013b)

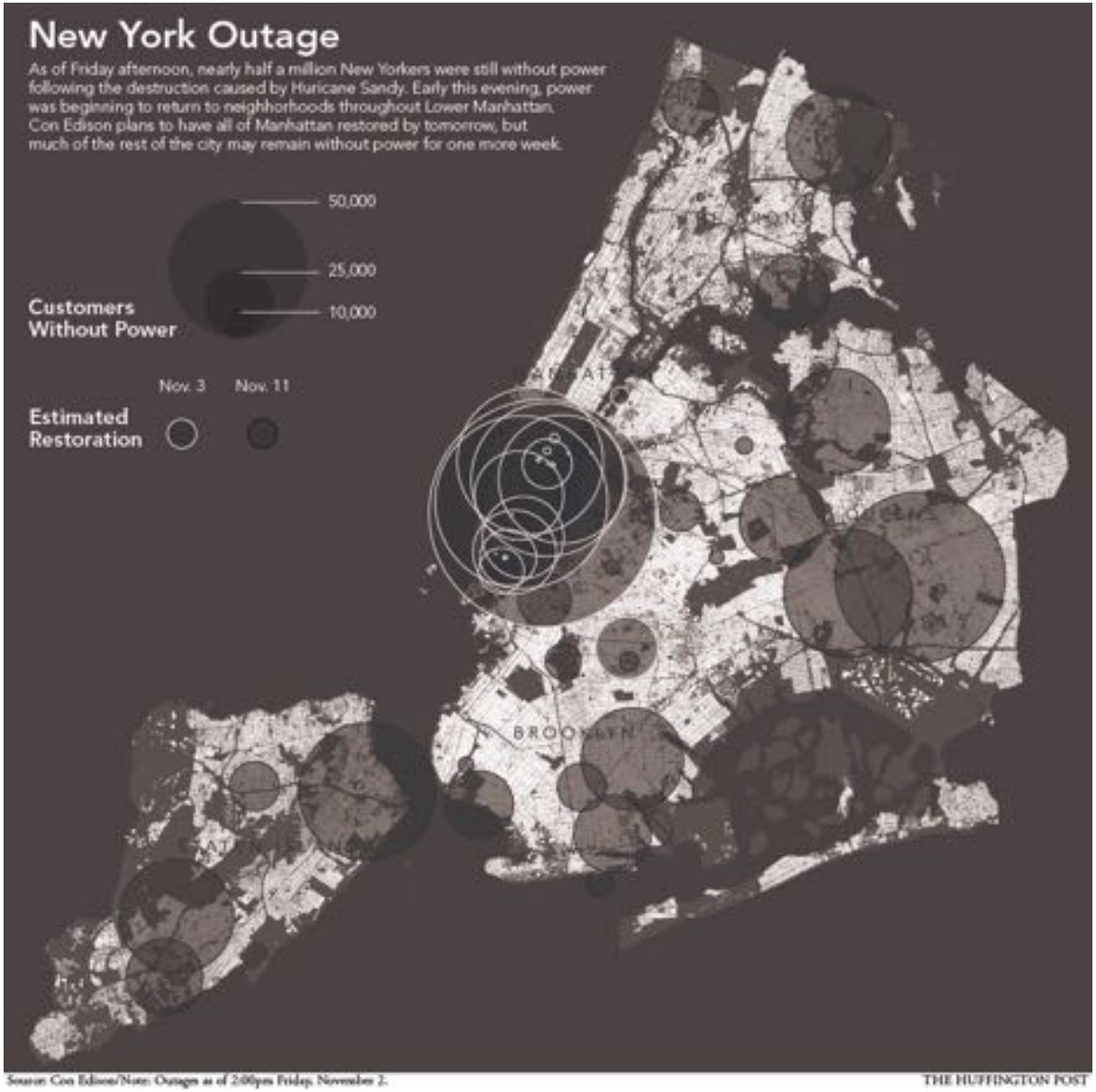
Climate Trends

- Relative sea levels rose more than 8 inches in some regions over the past 50 years
- Hurricanes and tropical storms have become more intense
- A larger fraction of precipitation has fallen during intense precipitation events, which has increased flood magnitudes

Key Energy Sector Impacts

- Increasing intensity of storm events, sea level rise, and storm surge put coastal and offshore facilities at increased risk of damage or disruption
- Increasing intensity of storm events increases risk of damage to electric transmission and distribution lines
- Increasing intensity and frequency of flooding increases the risk to inland thermoelectric facilities, and to rail and barge transport of crude oil, petroleum products, and coal

Example: Regional and Local Impacts in the Northeastern U.S.



Hurricane Sandy

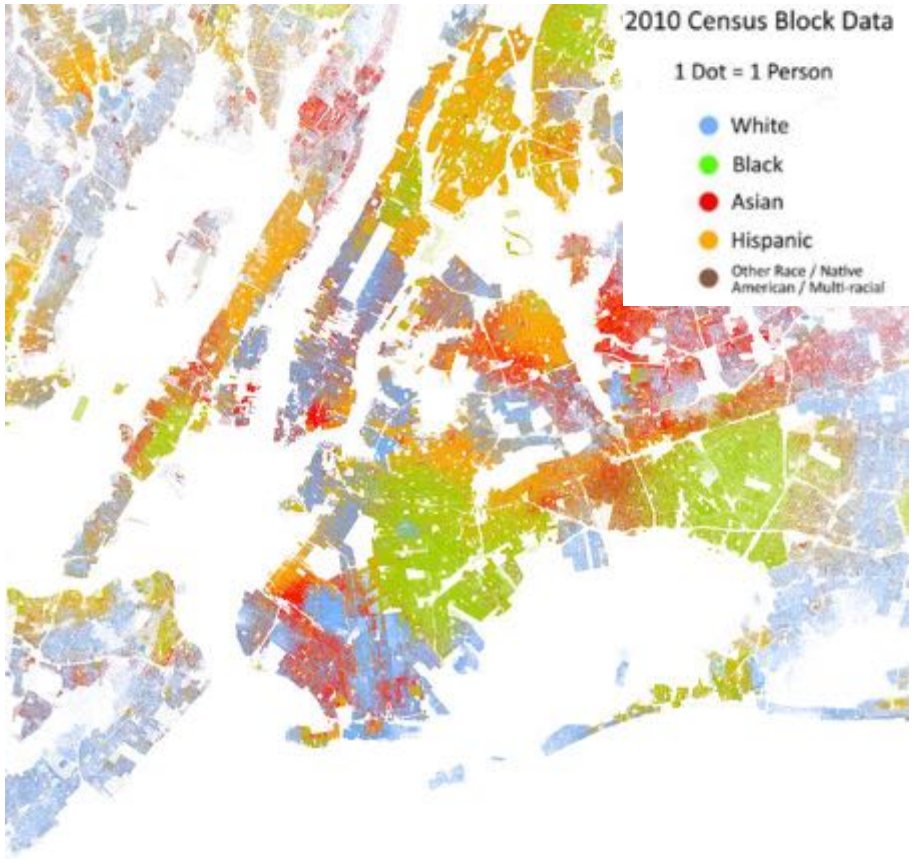
- Hurricane Sandy is the second costliest hurricane in the nation's history: $65B in damages and economic loss
- Approx. 8.5M customers experienced power outages following Sandy (in electricity meters, not individuals effected)
- 650,000 homes damaged or destroyed; 43% of those registered for FEMA assistance were renters with 64% of renter registrants identifying as low-income in NYC and 67% in NJ

Source: HUD

Example: Regional and Local Impacts in the Northeastern U.S.

(*Risky Business*, 2014)

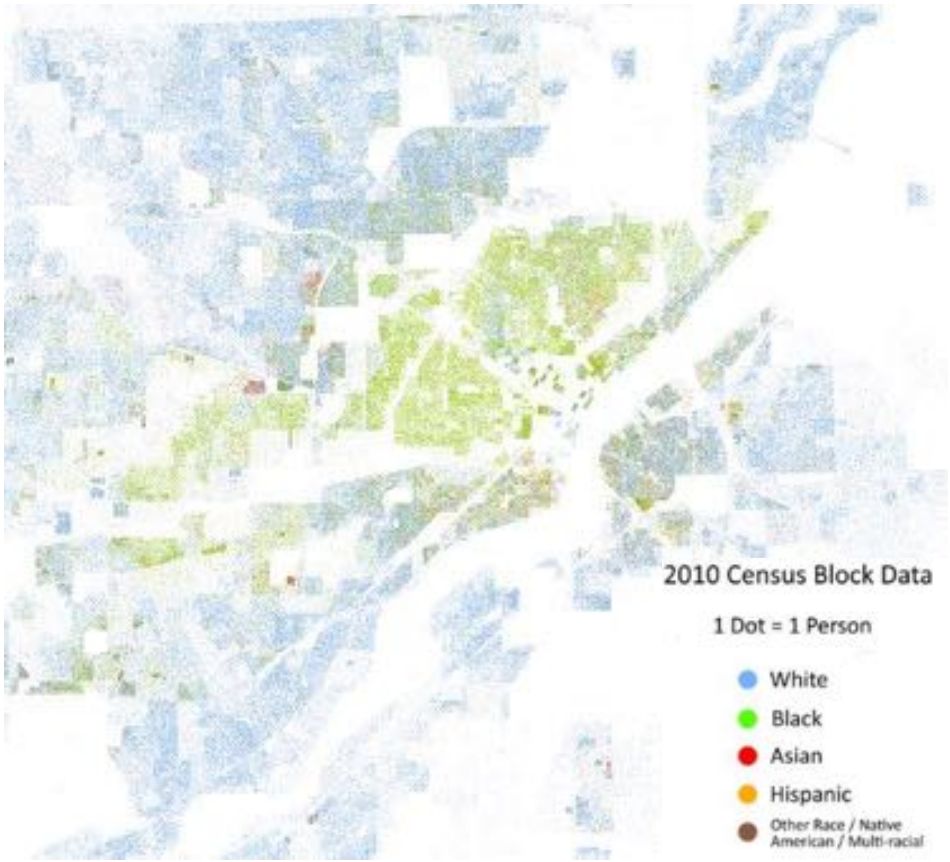
Map of Racial Diversity in New York City, 2010 Census Block Data

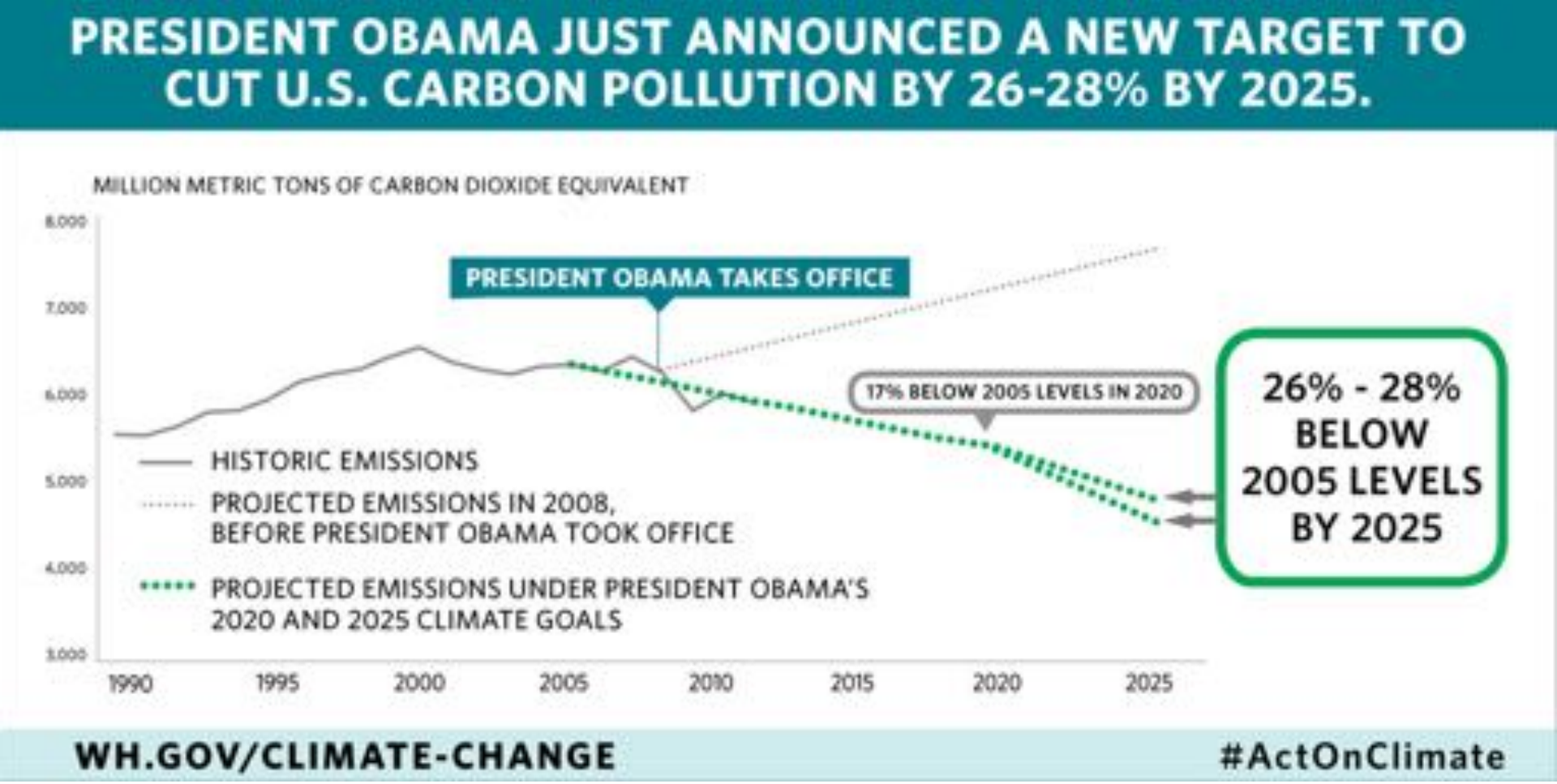


Example: Power Outages in Detroit, MI

- Major power outages: 2010, 2011, 2013, and 2014
- Causes: aging municipal electricity generation and distribution system and “system overload”
- 2010 McKinsey report determined the Department of Public Lighting needed $250 M in repairs
- DOE & Detroit Streetlighting Initiative
  - Public Lighting Authority co-wrote technical specification with DOE for LED technology deployment
  - Upwards of $1.5 M year in savings from streetlighting alone
  - 17,000 metric tons of CO_2 savings
- Detroit is now working on RFP to upgrade 83 municipal buildings with energy efficiency retrofits

Map of Racial Diversity in Detroit, MI
2010 Census Block Data





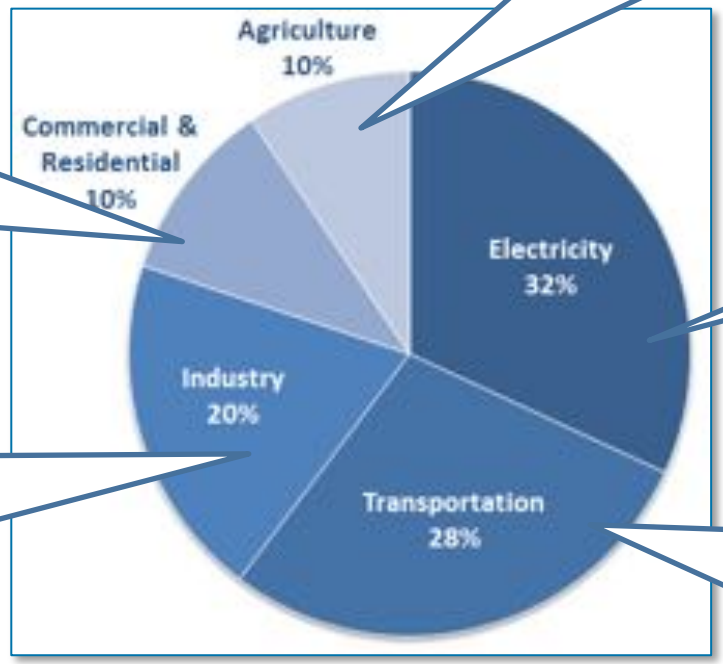
- Robust action will bring us in range of 26-28% below 2005 levels by 2025
- Doubling of decarbonization pace
- Consistent with reductions of >80% by 2050

Policies Address All Sectors and Gases

- Interagency Methane Strategy
- Agricultural programs

- Appliance & Equipment standards
- Building codes
- Green Mortgages
- Other measures

- Clean Power Plan
- Building codes
- Appliance & equipment standards
- Other measures



Sector Breakdown of 2012 Emissions

- HFCs including SNAP
- Oil & Gas Methane
- Efficiency standards and programs
- Other measures

- Fuel economy standards
- Biofuels
- Reduced VMT
- Other measures

- The U.S. is driving substantial reductions in all sectors and gases through existing and new policies.
- Enhanced policies to bolster sinks through reforestation and conservation will further contribute to reaching our 2025 goal

Cutting emissions: Power plant rule

- Climate plan directs the Environmental Protection Administration (EPA) to complete standards for both new and existing power plants
- Revised draft rules for new plants were released on September 20, 2013
- Existing plant rule—EPA's Clean Power Plan—was proposed on June 2, 2014
  - Proposed rule will, by 2030, cut carbon pollution from the power sector by 30% from 2005 levels
  - Gives states the flexibility to choose how to meet their goals

Cutting emissions: Long term investment in clean energy innovation

- December 2013: DOE issued an $8bn solicitation in loan guarantee authority for advanced fossil energy projects
- July 2014: DOE issued a solicitation for as much as $4bn in loan guarantees for renewable energy and efficient energy projects
- Accelerating Clean Energy Permitting (on Federal lands)
- Expanding and Modernizing the Electric Grid
- Supporting Expanded Production and Use of Natural Gas

Cutting emissions: Building a 21st-Century Transportation Sector

- Increasing Vehicle Fuel Economy Standards: Minimum standards have been set that will nearly double new car fuel economy by 2025 and will reduce emissions by at least 6bn metric tons cumulatively. The development of rules that will require further gains for heavy duty vehicles has been initiated.
- Developing and Deploying Advanced Transportation Technologies: Support continues for development and deployment of a broad range of new automotive fuels and batteries, as well as advanced engine and drivetrain technologies.

Cutting emissions: Energy Efficiency

- Climate plan set a goal for DOE's combined first and second term appliance efficiency standards to reduce emissions by at least 3bn metric tons cumulatively by 2030
- Recent final rules: distribution transformers, microwave oven stand-by power, external power supplies, metal halide light fixtures, commercial refrigeration equipment, walk-in coolers/freezers, residential through-the-wall central air conditioners and heat pumps, electric motors and furnace fans

Environmental Justice Implications (1)

- Marginalized communities likely to be impacted more severely by climate change
  - Location
  - Ability to withstand and recover from shocks
- Impacts to marginalized communities include those caused by mitigation and adaptation responses. For example:
  - Increased electricity rates
  - Rental vs ownership of property often shapes resource allocation
  - Reduced attention to other priorities

Environmental Justice Implications (2)

- Federal policies must continue to follow existing guidelines regarding environmental justice, including E.O. 12898
  - "*By effectively implementing environmental laws, we can improve quality of life and expand economic opportunity in overburdened communities. And recognizing these same communities may suffer disproportionately due to climate change, we must cut carbon emissions, develop more homegrown clean energy, and prepare for the impacts of a changing climate that we are already feeling across our country*." - Presidential Proclamation on the 20th Anniversary of Executive Order 12898 on Environmental Justice
- Many climate actions have additional benefits, including public health benefits, that will aid marginalized communities
  - Power plant rule will reduce emissions of NOx, SOx, mercury and particulates
  - Efficiency standards will reduce operating expenses

DOE Actions on Environmental Justice

- Investing in Science and Workforce Training at Historically Black Colleges and Universities and Minority and/or Hispanic Serving Institutions
  - National Nuclear Security Administration (NNSA): Internships for minority undergraduate, graduate, doctoral and postdoctoral students
- Public Involvement in Site Activities:
  - NNSA and Environmental Management (EM): work with tribal governments to develop and maintain environmental monitoring programs
  - EM and the Site Specific Advisory Boards (SSABs) – created to involve stakeholders more directly in DOE EM cleanup decisions.

DOE Actions on Environmental Justice

- Capacity Building: Helping communities navigate government programs
  - Community Leaders Institute – recent conference in Atlanta at Morehouse College
- Weatherization and Intergovernmental Programs
  - Enabling low-income families to permanently reduce their energy bills by making their homes efficient through insulation, more efficient appliances, and other methods.
- Minorities in Energy Initiative
  - A public-private collaboration aimed at increasing minority and tribal participation in the energy sector through engagement in STEM education, workforce development, energy economic development, and climate change
- Collaborating with National Environmental Justice Conference to host Youth & Emerging Leaders Summit

Environmental Justice & the U.S. *Quadrennial Energy Review*

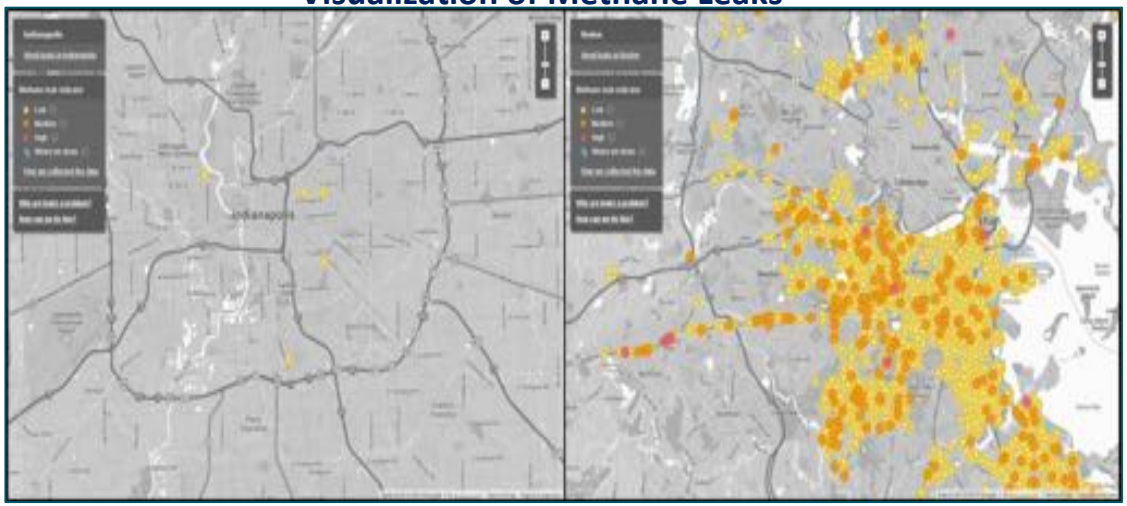
Quadrennial Energy Review: Research, analysis and policy recommendations on U.S. energy transmission, storage and distribution infrastructure with goals of economic competitiveness, energy security, and environmental responsibility.

Siting Energy Infrastructure:

- National Environmental Policy Act requires assessment of proposed transmission routes and impact on EJ communities
- Robust public engagement is critical for siting, permitting and review process

Enhance Safety, Reduce Emissions from Local Natural Gas Distribution Systems

Visualization of Methane Leaks



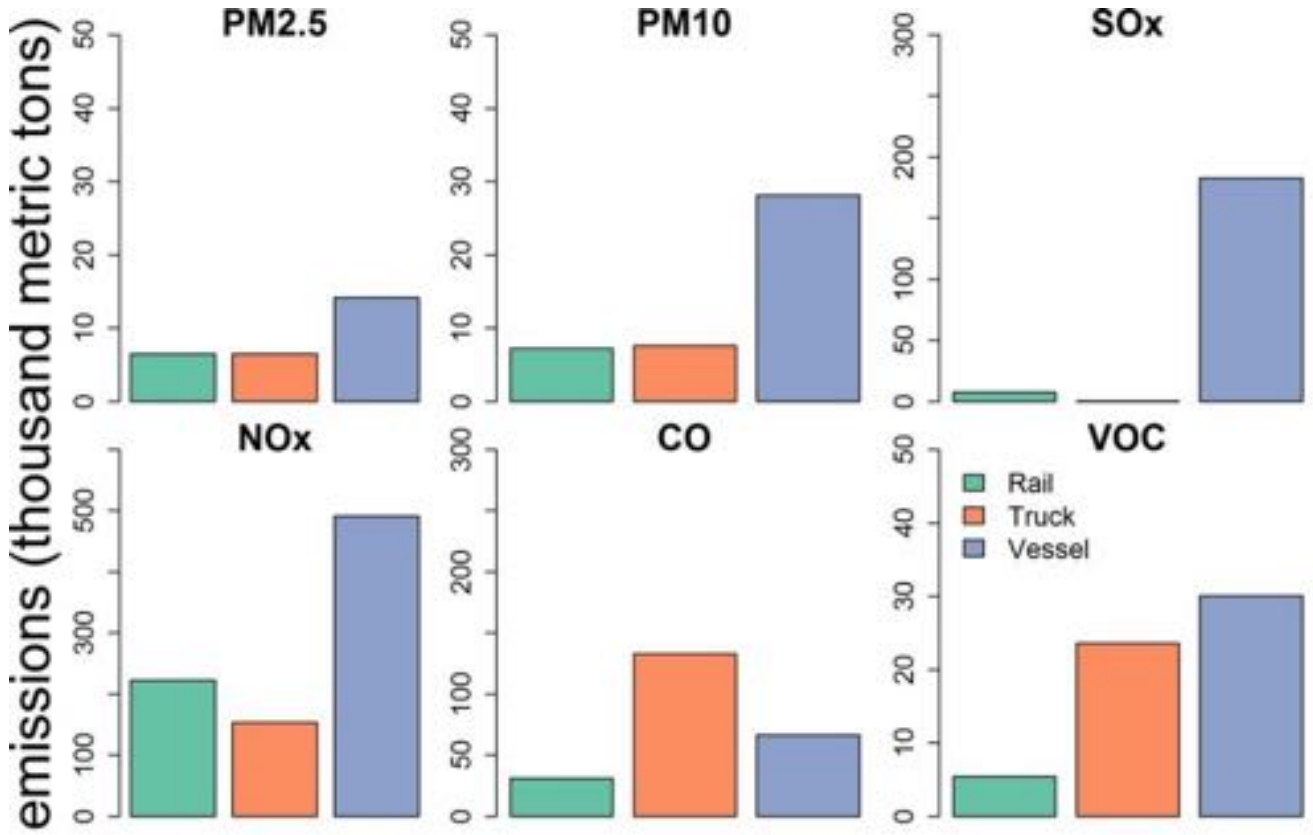
Indianapolis **Boston**

Rank	State	Miles of Cast Iron Mains	Miles of Bare Steel Mains	Total At-Risk Mains	Accelerated Investment	Miles Per Million Persons
1	NY	7246	4541	11787	y	1403
2	PA	8091	3453	11544	y	888
3	OH	7951	693	8644	y	720
4	NJ	1821	5168	6989	y	785
5	TX	5376	967	6343	y	244
6	CA	5801	116	5917	y	156
7	MA	1902	3903	5805	y	866
8	MI	1400	3156	4556	y	460
9	KS	3568	117	3685	y	1271
10	WV	3470	14	3484	n	1936

Natural gas local distribution systems are a large source of methane leaks. Old pipes are cast iron or uncoated steel. **Replacement costs nationally are estimated to be $270 billion**

- **Public Safety Issues. The** Harlem gas main explosion (March 2014) was from a 127 year-old pipeline and 8 lives were lost.
- **Greenhouse Gas Emissions.** Methane is a potent greenhouse gas but short-lived in the atmosphere. Early action has significant benefits in bending the GHG emissions curves.
- **Jobs and Workforce Training.** Blue Green Alliance estimates there are as many as 300,000 permanent jobs to replace all pipes

EJ & the *QER*: Air Pollution and Energy Transport



- The criteria air pollutant emissions depicted above originate from rail, trucking and marine vessel sources and account for a small portion of total U.S. emissions of each pollutant.
- Diesel exhaust from these mobile sources are significant contributors to local and regional air quality problems.

"…[T]he question is not whether we need to act. The overwhelming judgment of science -- of chemistry and physics and millions of measurements -- has put all that to rest…. [T]he question now is whether we will have the courage to act before it's too late. And how we answer will have a profound impact on the world that we leave behind not just to you, but to your children and to your grandchildren."

- President Obama, Georgetown University, June 2013