City of Ames
Community Greenhouse Gas Inventory

Agenda

Introduction

Why GHG Emissions Matter

GHG Inventory Findings in Brief

GHG Trends by Sector

Community Comparison

GHG Emissions Forecast

Climate Vulnerability Assessment Review

Citywide Solar PV Energy Potentials Study

Introduction

making change personal
paleBLUEdot LLC

Ted Redmond

Architect
Urban Planner
Renewable Energy Consultant

paleBLUEdot LLC
Services:

- climate planning
- sustainability + resilience consulting
- renewable energy + net zero planning

Climate, and Energy Planning experience in last 5 years:

45+ Projects in 20 states

Introduction

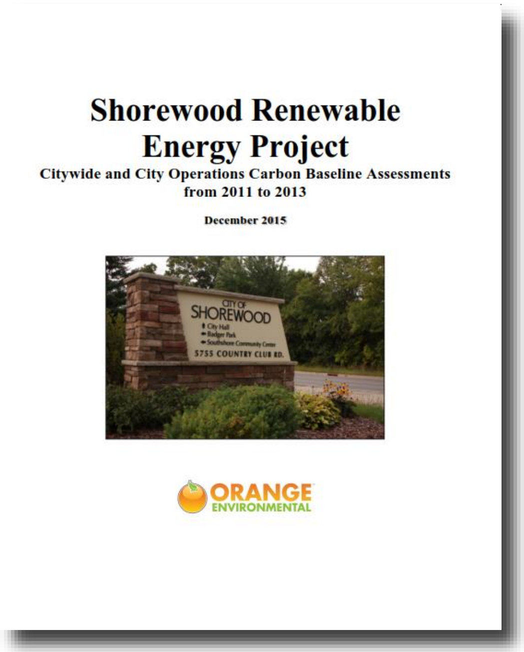
ORANGE ENVIRONMENTAL

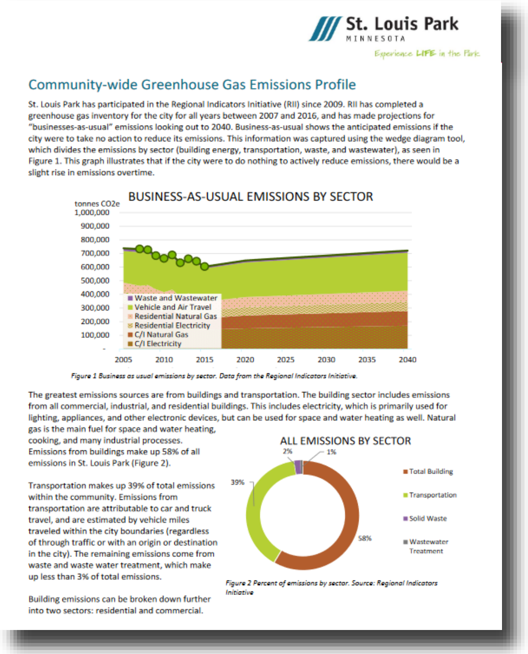
Michael Orange

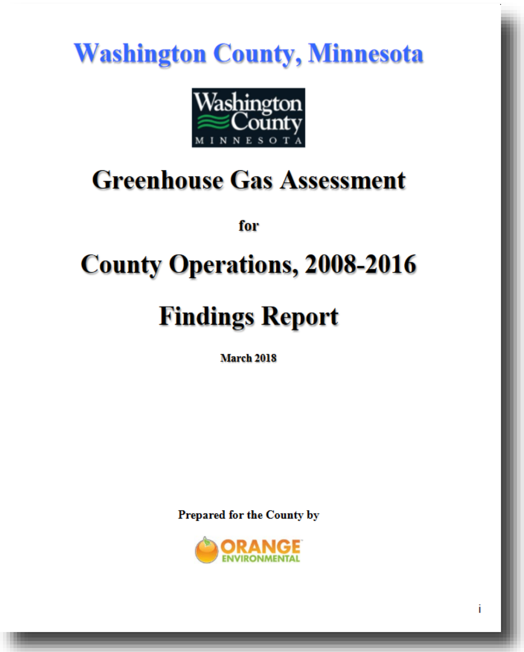
Urban Planner

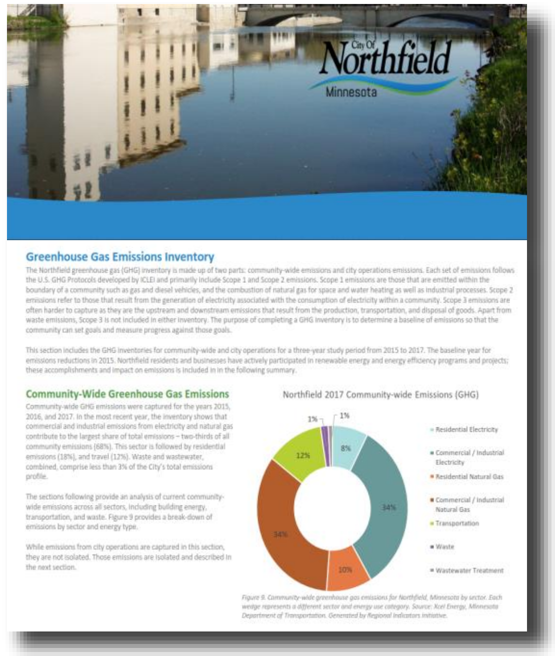
Environmental Consultant

GHG Inventory Specialist









GHG Inventory and Environmental Planning Experience:

58+ analyses for 44 Communities

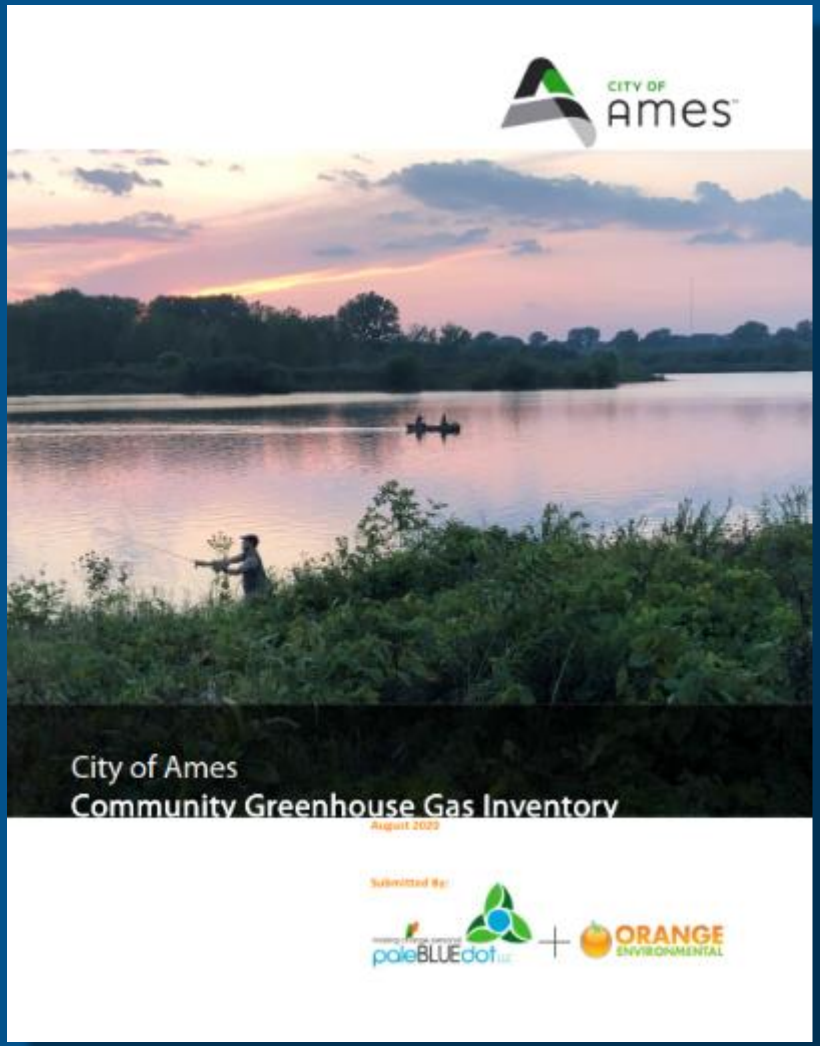
Introduction – Project Overview

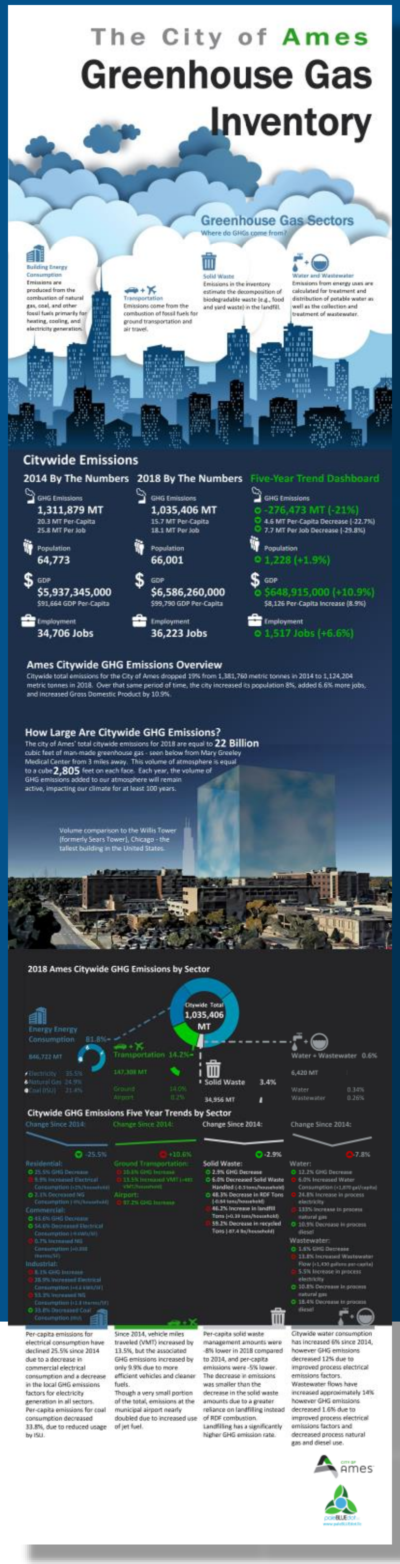
Community GHG Inventory

Citywide Emissions + City Operation Emissions

Deliverables:

- Custom Inventory Tools Enabling Future Efforts:
  - Data Collection Tool
  - GHG Calculator Tool
  - User Manuals
- Report with Supporting Appendices
- Infographic





Introduction – Project Overview

Climate Vulnerability Assessment

Regional Climate Change To-Date

City of Ames Climate Projections

Climate Risks to Population

Vulnerable Populations Mapping

City of Ames Climate Hazards and Risks

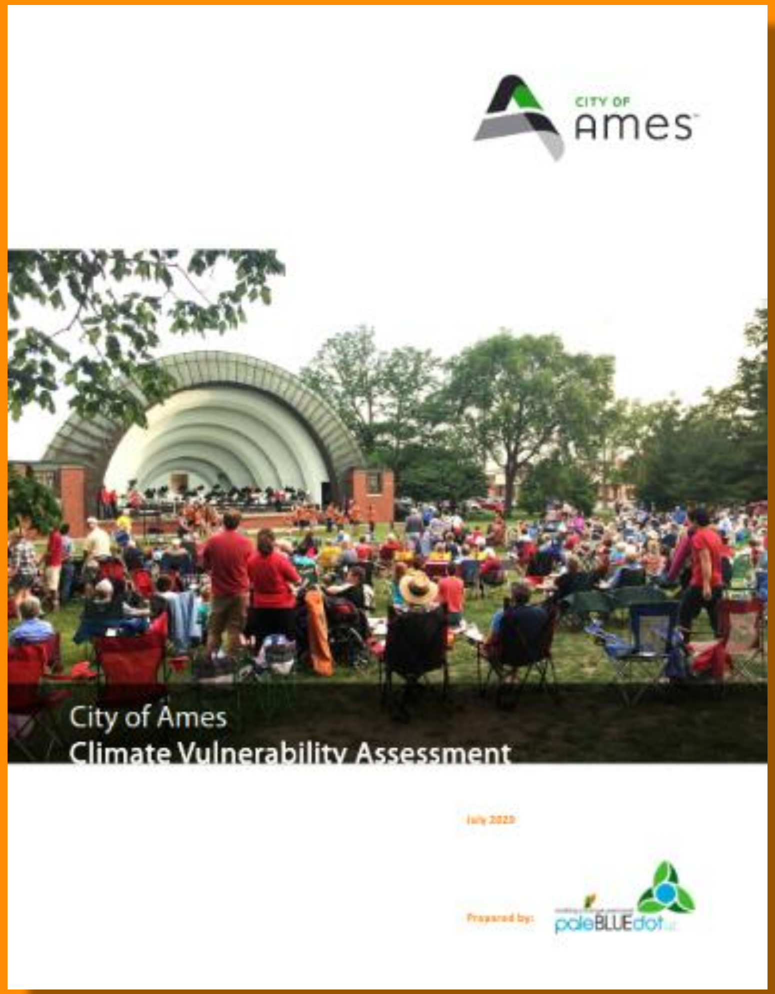
Intent:

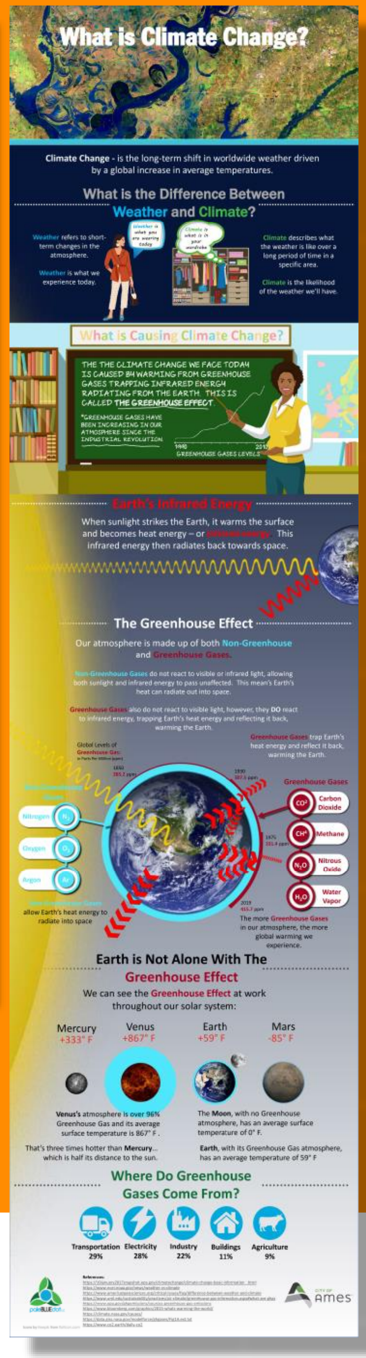
- Supporting Document for Future CAP Planning Effort

Deliverables:

- Report with Recommendations and Supporting Appendices

- Infographics





Introduction – Project Overview

Citywide Solar PV Potentials Study

Overview of Solar Technology

Calculation of Citywide Rooftop Solar Capacity

Market Absorption Scenario Projections

Environmental and Economic Potential

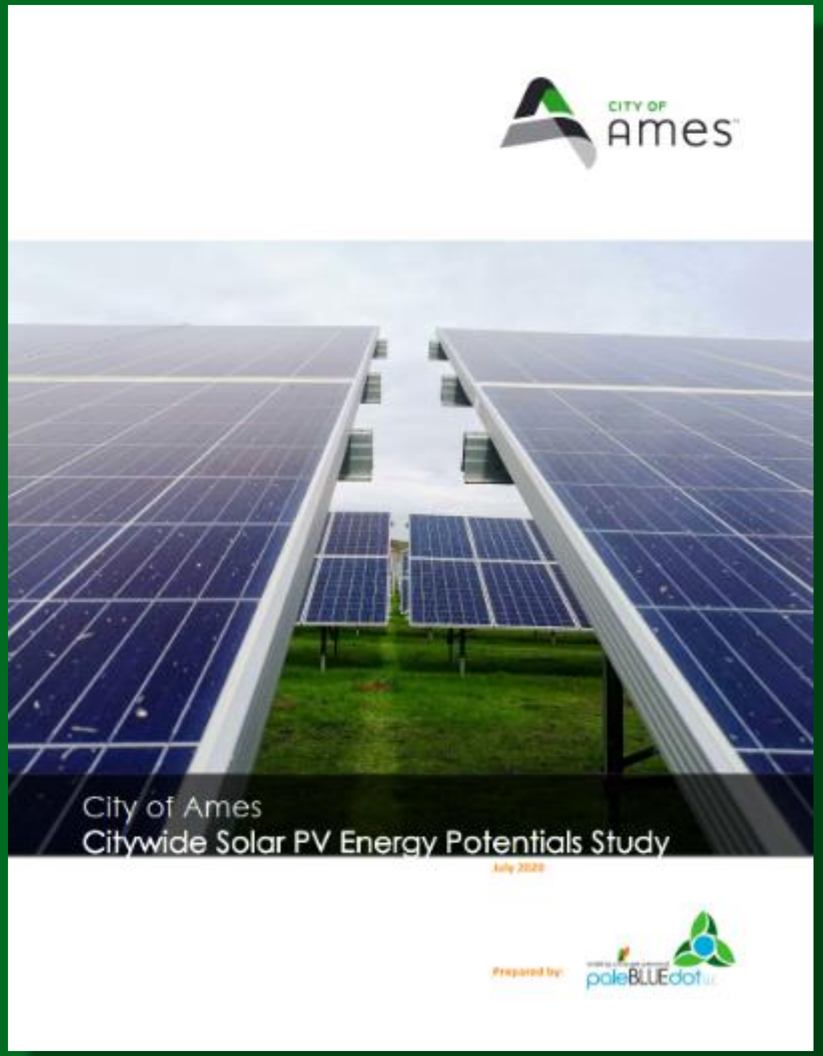
Menu of Potential Actions

Intent:

- Supporting Document for Future CAP Planning Effort

Deliverables:

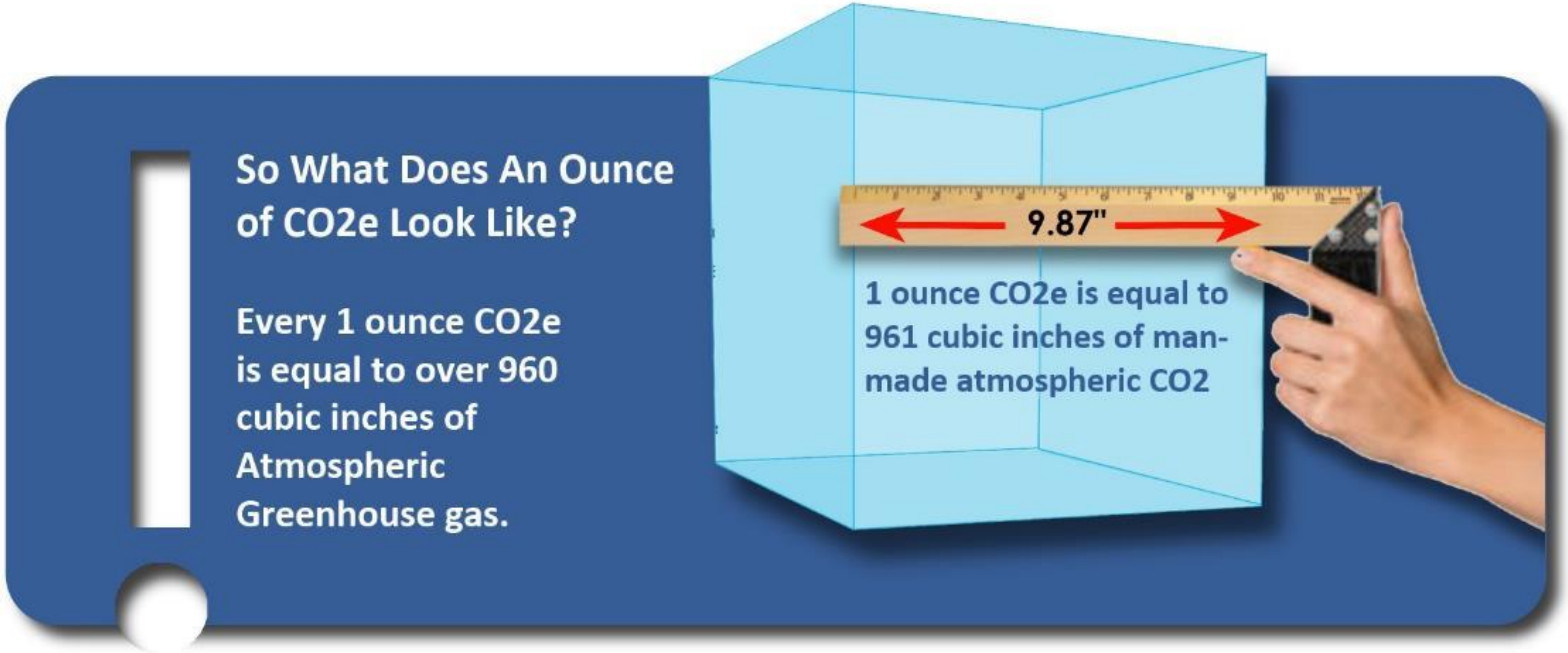
- Report with Recommendations and Supporting Appendices



GHG Inventory – Why Emissions Matter

Greenhouse Gas emissions are human made additions to the make up of **Earth's atmosphere.**

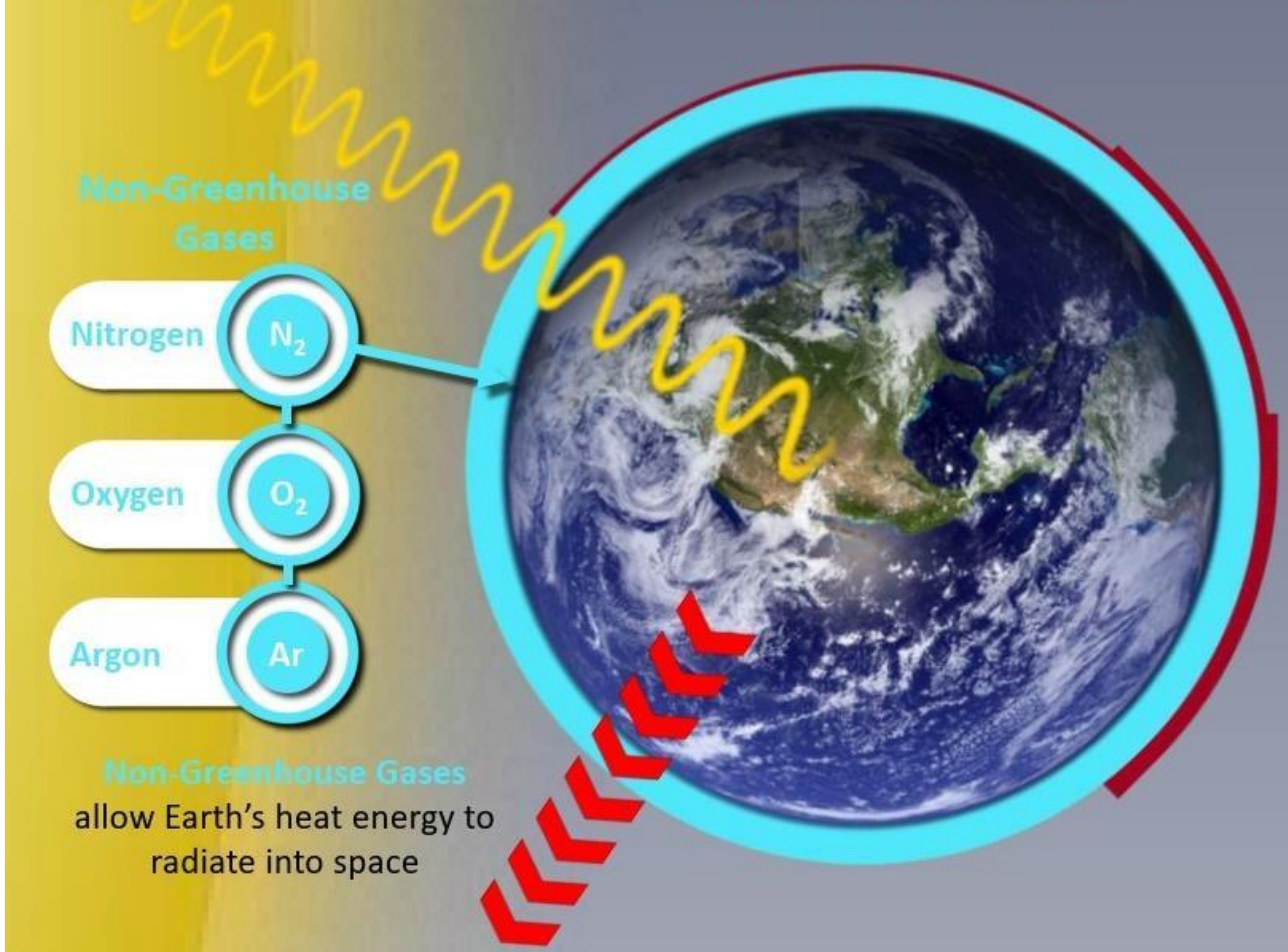
They will occupy a volume of that relatively thin coating for **100+ years.**



So….What?

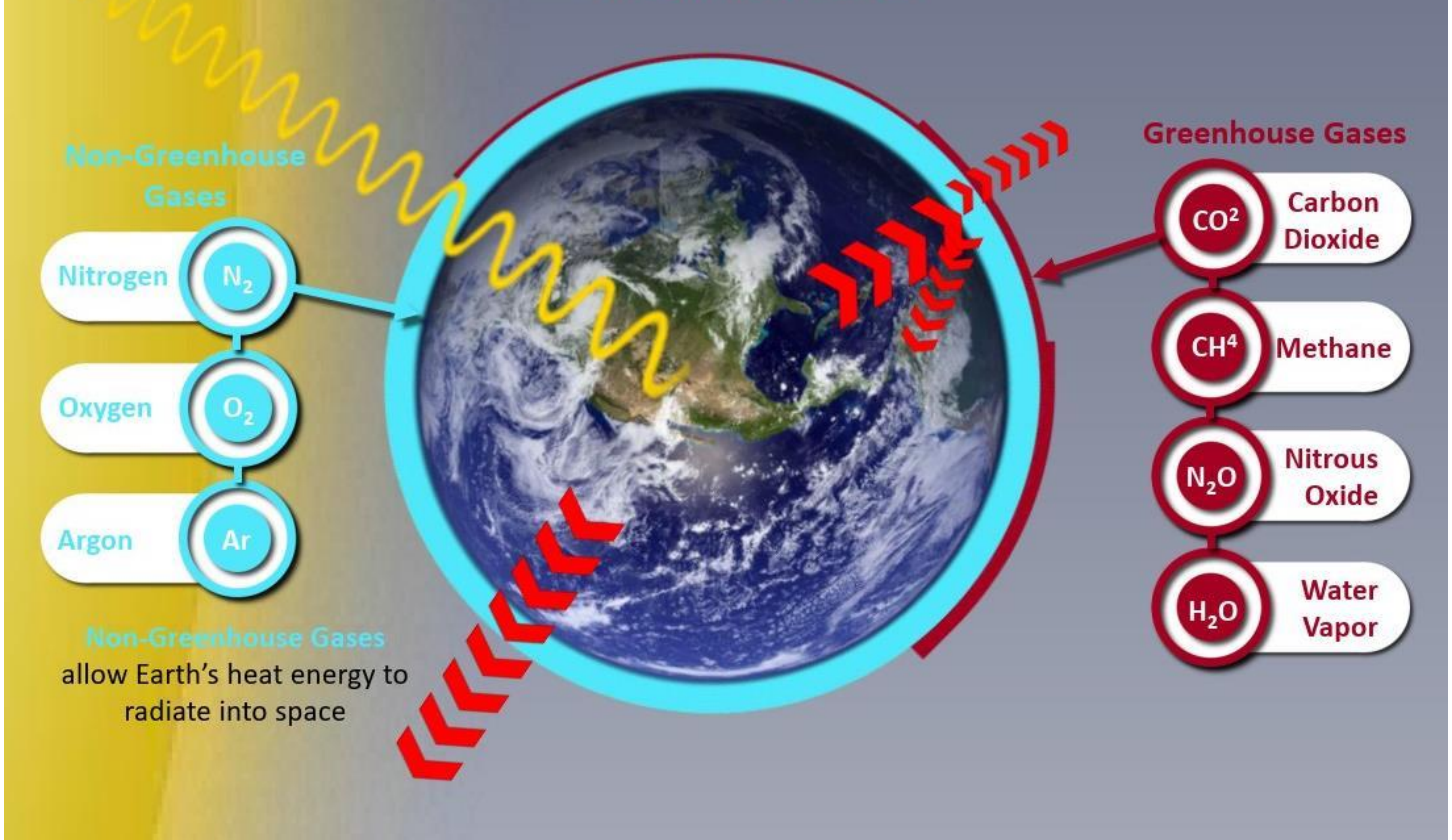
The Greenhouse Effect

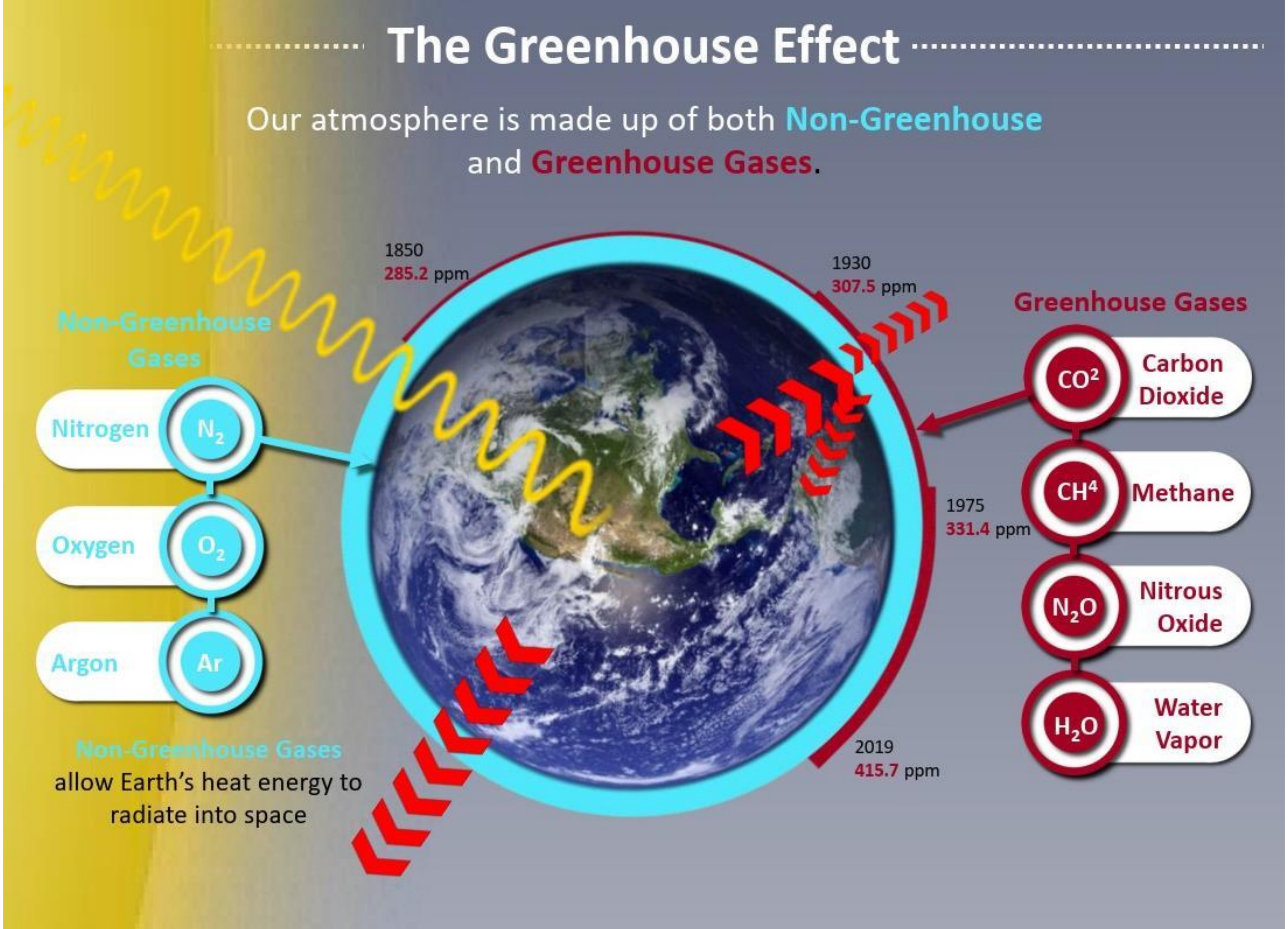
Our atmosphere is made up of both **Non-Greenhouse** and **Greenhouse Gases**.



The Greenhouse Effect

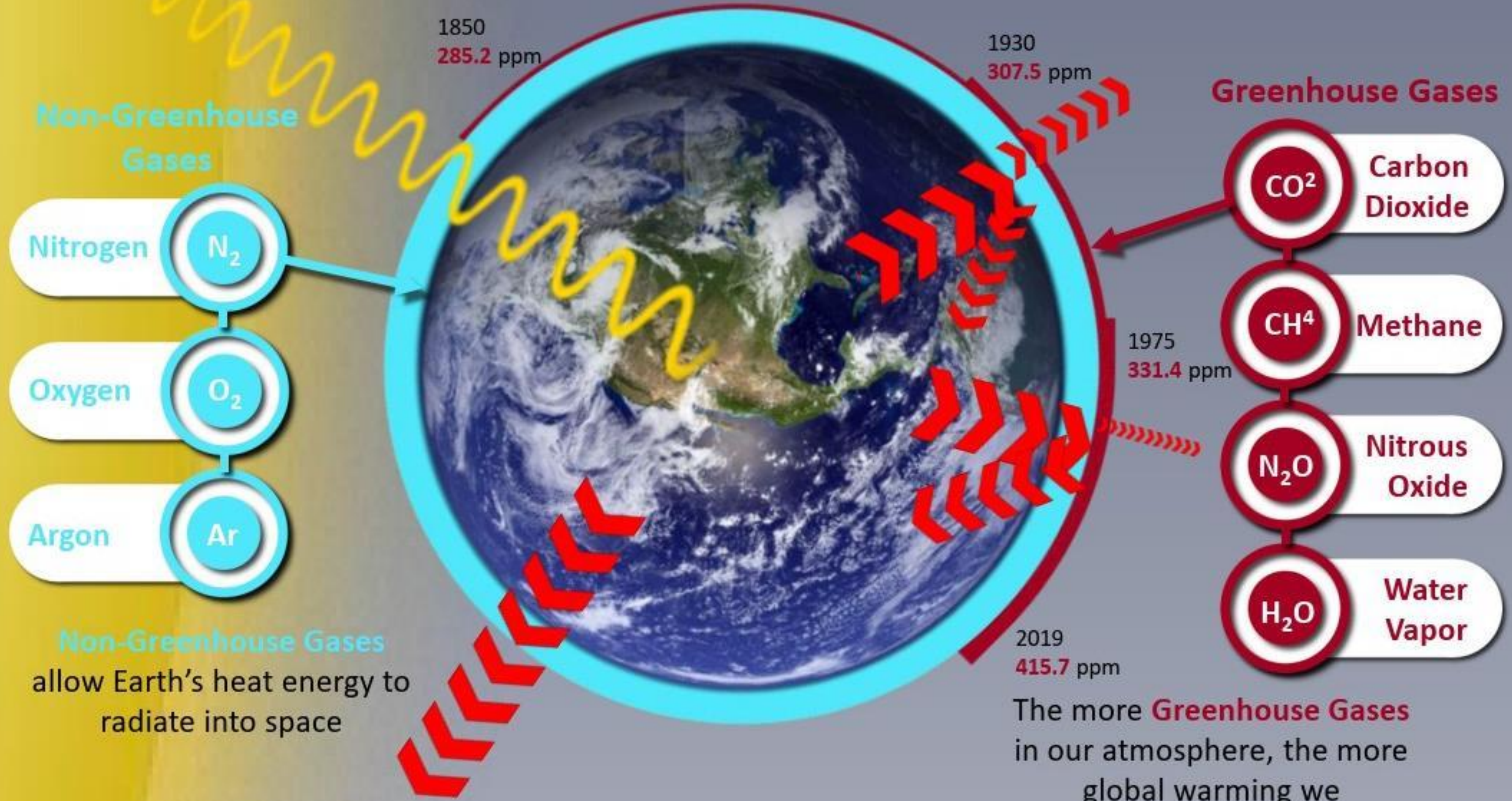
Our atmosphere is made up of both **Non-Greenhouse** and **Greenhouse Gases**.




The Greenhouse Effect
Our atmosphere is made up of both Non-Greenhouse and Greenhouse Gases.
Non-Greenhouse Gases
Nitrogen
N_2
Oxygen
O_2
Argon
Ar
Non-Greenhouse Gases allow Earth's heat energy to radiate into space
1850
285.2 ppm
1930
307.5 ppm
1975
331.4 ppm
2019
415.7 ppm
Greenhouse Gases
CO^2
Carbon Dioxide
CH^4
Methane
N_2O
Nitrous Oxide
H_2O
Water Vapor

The Greenhouse Effect

Our atmosphere is made up of both **Non-Greenhouse** and **Greenhouse Gases**.



Non-Greenhouse Gases allow Earth's heat energy to radiate into space

The more **Greenhouse Gases** in our atmosphere, the more global warming we experience.

GHG Inventory – Why Emissions Matter

The climate impacts from our collective GHG emissions are and will continue to be felt globally **and locally.**

These impacts will become greater in the coming decades.
For Ames, a conservative projection through 2100 anticipates:

Annual % Change to GDP by Category:

Agriculture:	Mortality:	Energy:	Labor Productivity:	Property Crime:	Violent Crime:
-24.2%	+1.0%	+8.8%	-1.3%	+1.8%	+4.0%

= **$61,181,951**
Annual Cost Impact
(in current $)

Source: "Estimating economic damage from climate change in the United States"

We can still reduce future impacts of Climate Change by decreasing our GHG emissions.

GHG Inventory – Why Emissions Matter

The climate impacts from our collective GHG emissions are and will continue to be felt globally **and locally.**

These impacts will become greater in the coming decades. For Ames, a conservative projection through 2100 anticipates:

Annual % Change to GDP by Category:

Agriculture:	+	Mortality:	+	Energy:	+	Labor Productivity:	+	Property Crime:	+	Violent Crime:
-24.2%		+1.0%		+8.8%		-1.3%		+1.8%		+4.0%

= **$61,181,951**
Annual Cost Impact

Source: "Estimating economic damage from climate change in the United States"

GHG Inventory – Findings in Brief

Figure H: Findings In Brief - Citywide

2014 By The Numbers

GHG Emissions
1,311,879 MT
20.3 MT Per-Capita
25.8 MT Per Job

Population
64,773

GDP
$5,937,345,000
$91,664 GDP Per-Capita

Employment
34,706 Jobs

2018 By The Numbers

GHG Emissions
1,089,662 MT
16.5 MT Per-Capita
19.6 MT Per Job

Population
66,001

GDP
$6,586,260,000
$99,790 GDP Per-Capita

Employment
36,223 Jobs

Five-Year Trend Dashboard

GHG Emissions
-222,217 MT (-16.9%)
3.8 MT Per-Capita Decrease (-18.7%)
6.2 MT Per Job Decrease (-24.0%)

Population
1,228 (+1.9%)

GDP
$648,915,000 (+10.9%)
$8,126 Per-Capita Increase (8.9%)

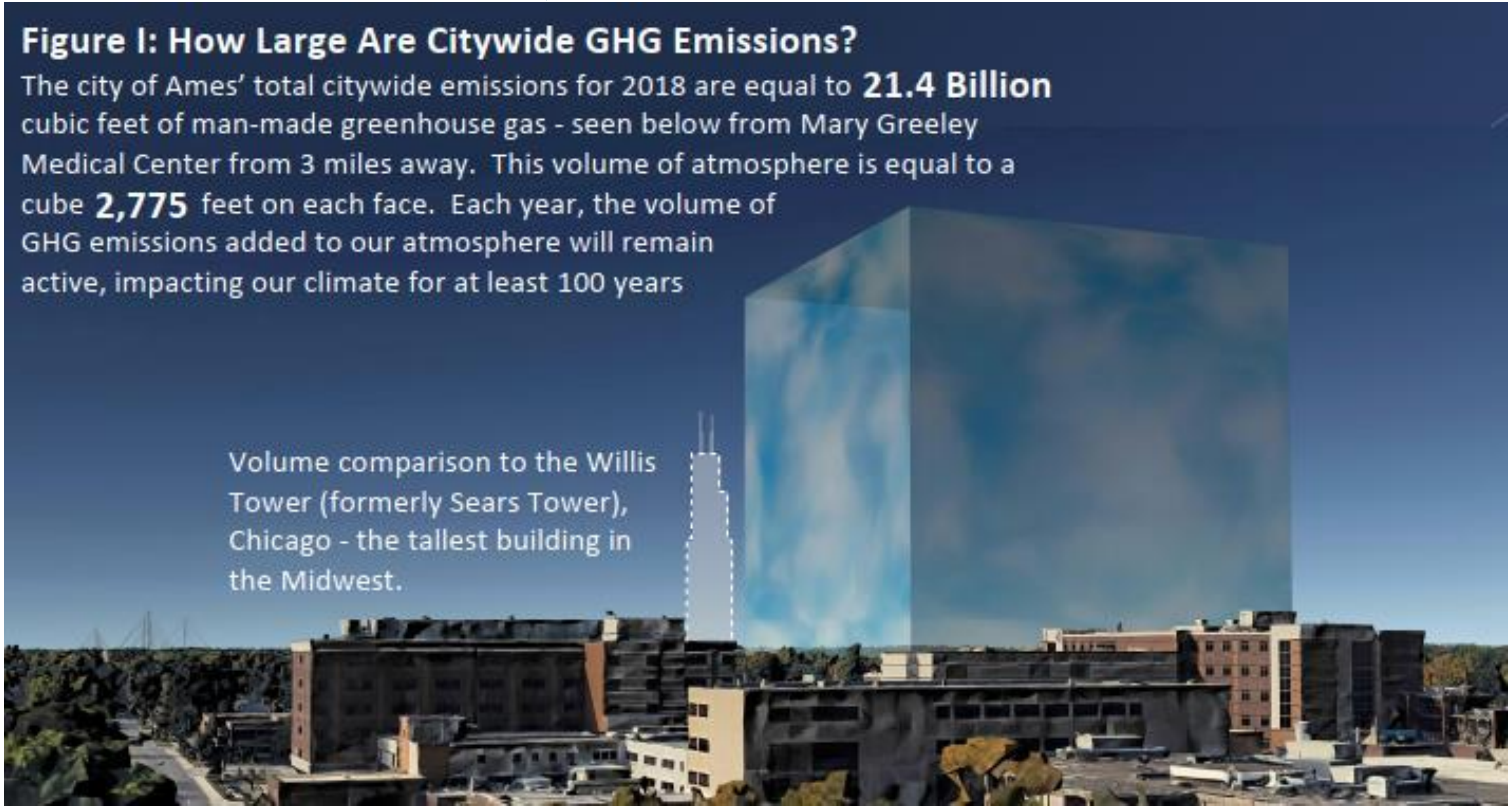
Employment
1,517 Jobs (+6.6%)

GHG Inventory – Findings in Brief

Ames Citywide GHG Emissions Overview

Citywide total emissions for the City of Ames dropped 16.9% from 1,311,879 metric tonnes in 2014 to 1,089,662 metric tonnes in 2018. Over that same period of time, the city increased its population 1.9%, added 6.6% more jobs, and increased Gross Domestic Product by 10.9%.

GHG Inventory – Findings in Brief

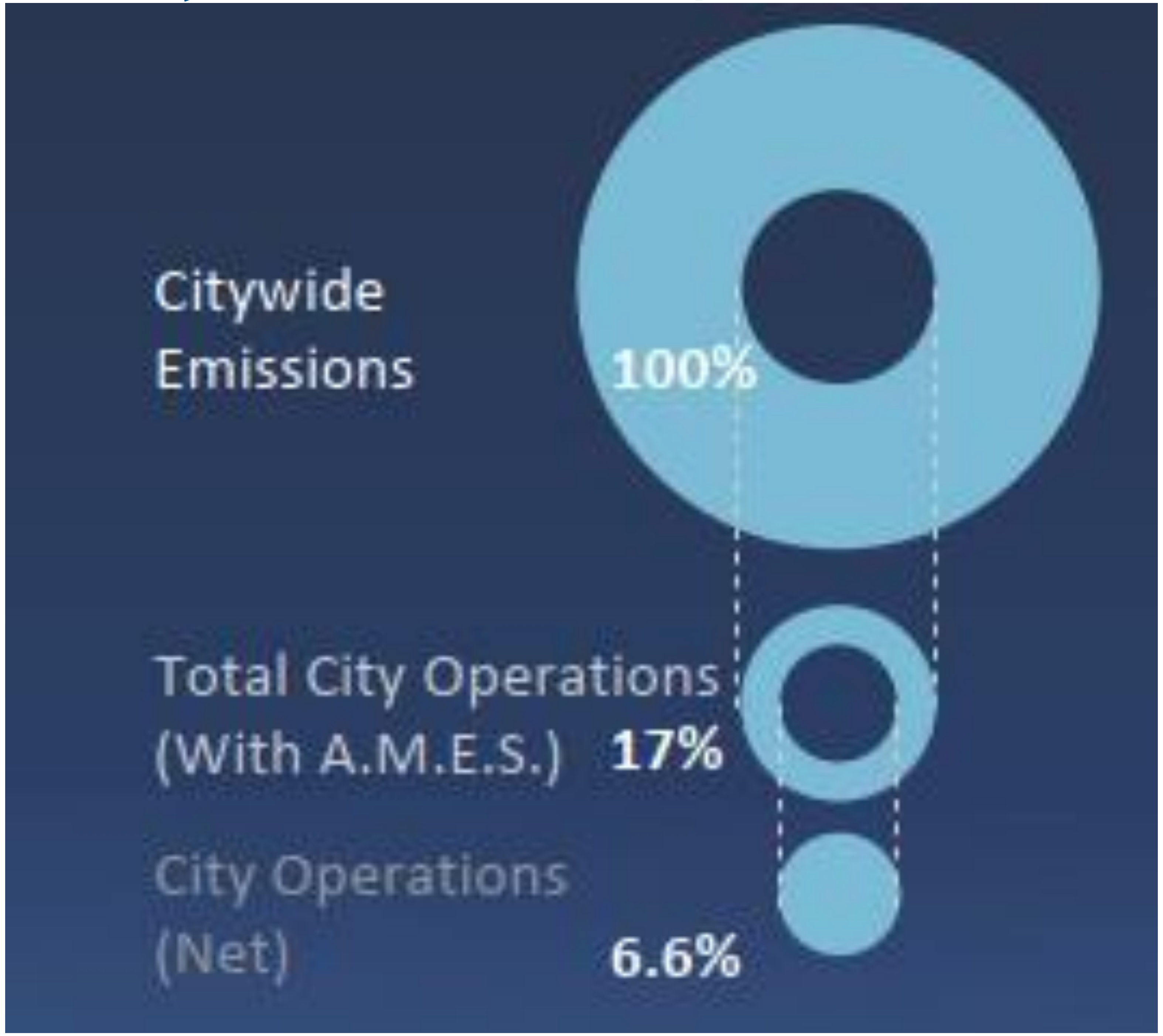


GHG Inventory – Findings in Brief

Figure L: Findings In Brief - City of Ames Operations

2014 By The Numbers	2018 By The Numbers	Five-Year Trend Dashboard
City Operations GHG (net)	City Operations GHG (net)	City Operations GHG (net)
76,018 MT	**72,056 MT**	**-3,962 MT (-5.2%)**
0.144 MT Per Building SF	0.136 MT Per Building SF	0.01 MT Per SF Decrease
127.4 MT Per Staff (FTE)	120.8 MT Per Staff (FTE)	6.6 MT Per Staff Decrease
1.17 MT Per-Capita	1.09 MT Per-Capita	0.01 MT Per-Capita Decrease
3.2 MT Per Household	2.8 MT Per Household	0.4 MT Per House Decrease
Ames Municipal Energy System GHG	Ames Municipal Energy System GHG	Ames Municipal Energy System GHG
313,692 MT	**112,873 MT**	**-200,819 MT (-64.0%)**
City Operations Grand Total	City Operations Grand Total	City Operations Grand Total
389,710 MT	**184,929 MT**	**-204,781 MT (-52.5%)**
0.74 MT Per Building SF	0.35 MT Per Building SF	0.39 MT Per SF Decrease
653.8 MT Per Staff (FTE)	309.9 MT Per Staff (FTE)	343.9 MT Per Staff Decrease
6.0 MT Per-Capita	2.8 MT Per-Capita	3.2 MT Per-Capita Decrease
16.5 MT Per Household	7.3 MT Per Household	9.2 MT Per House Decrease

GHG Inventory – Findings in Brief



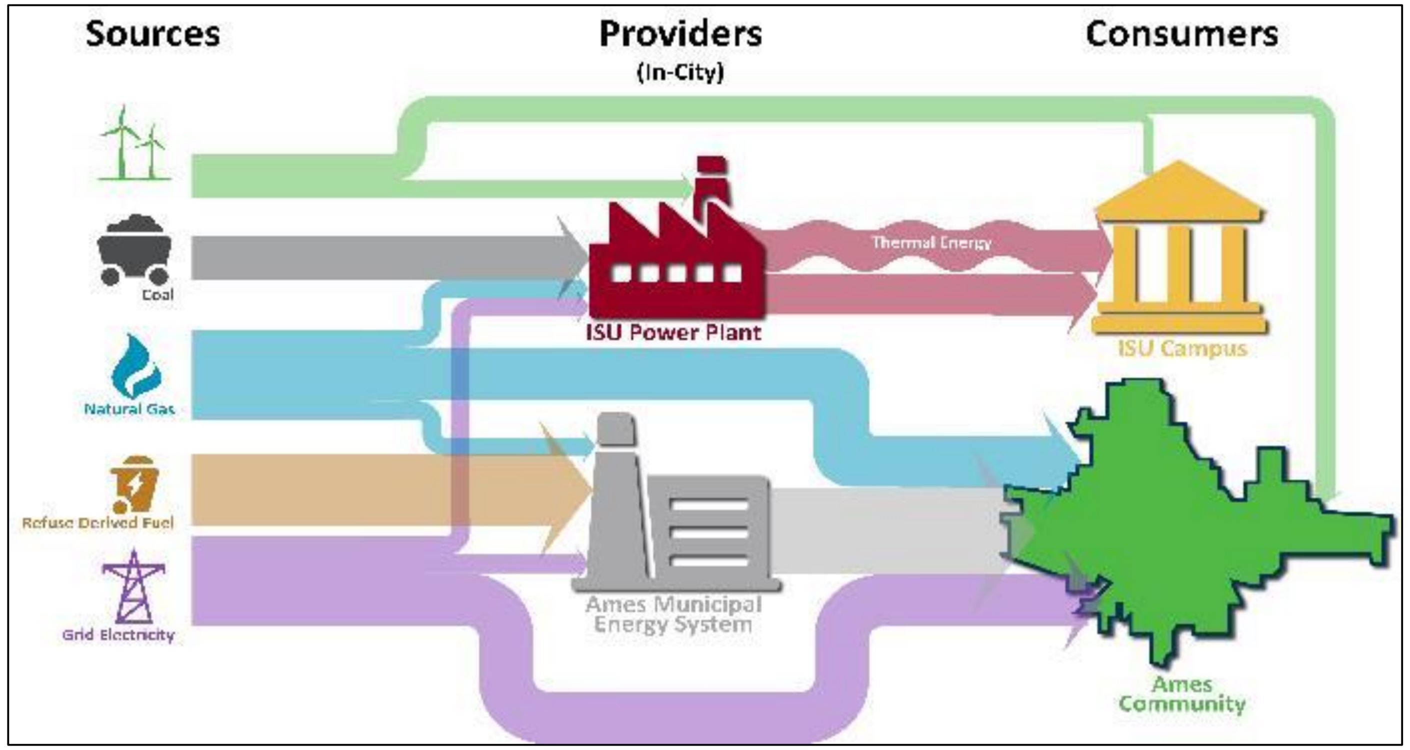
GHG Inventory – Trends By Sector

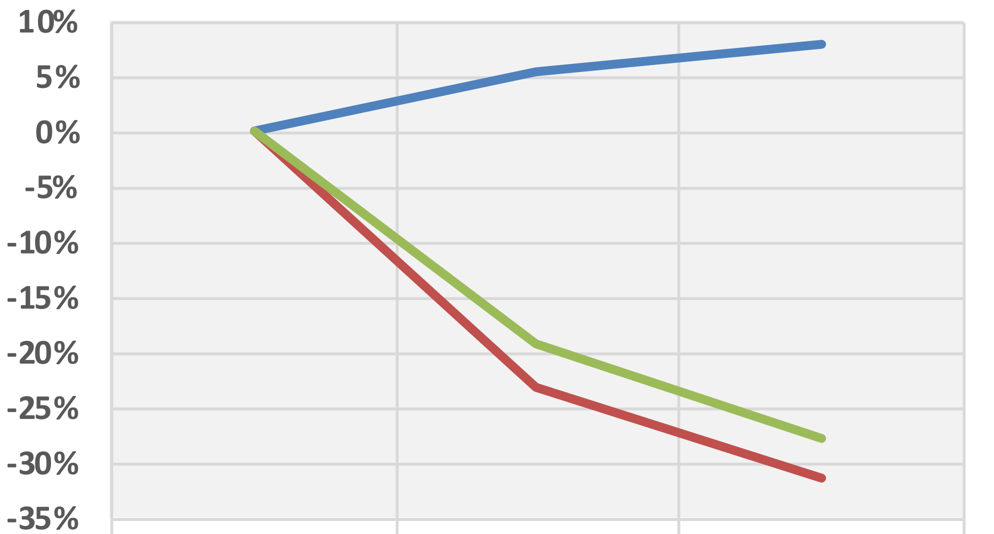
Citywide Inventory

Electricity data:

- Alliant Energy
- Consumers Electric
- Midland Power Cooperative
- Central Iowa Power Cooperative
- Ames Municipal Electric System (AMES)

Emission factors (GHG tonnes per MWh)





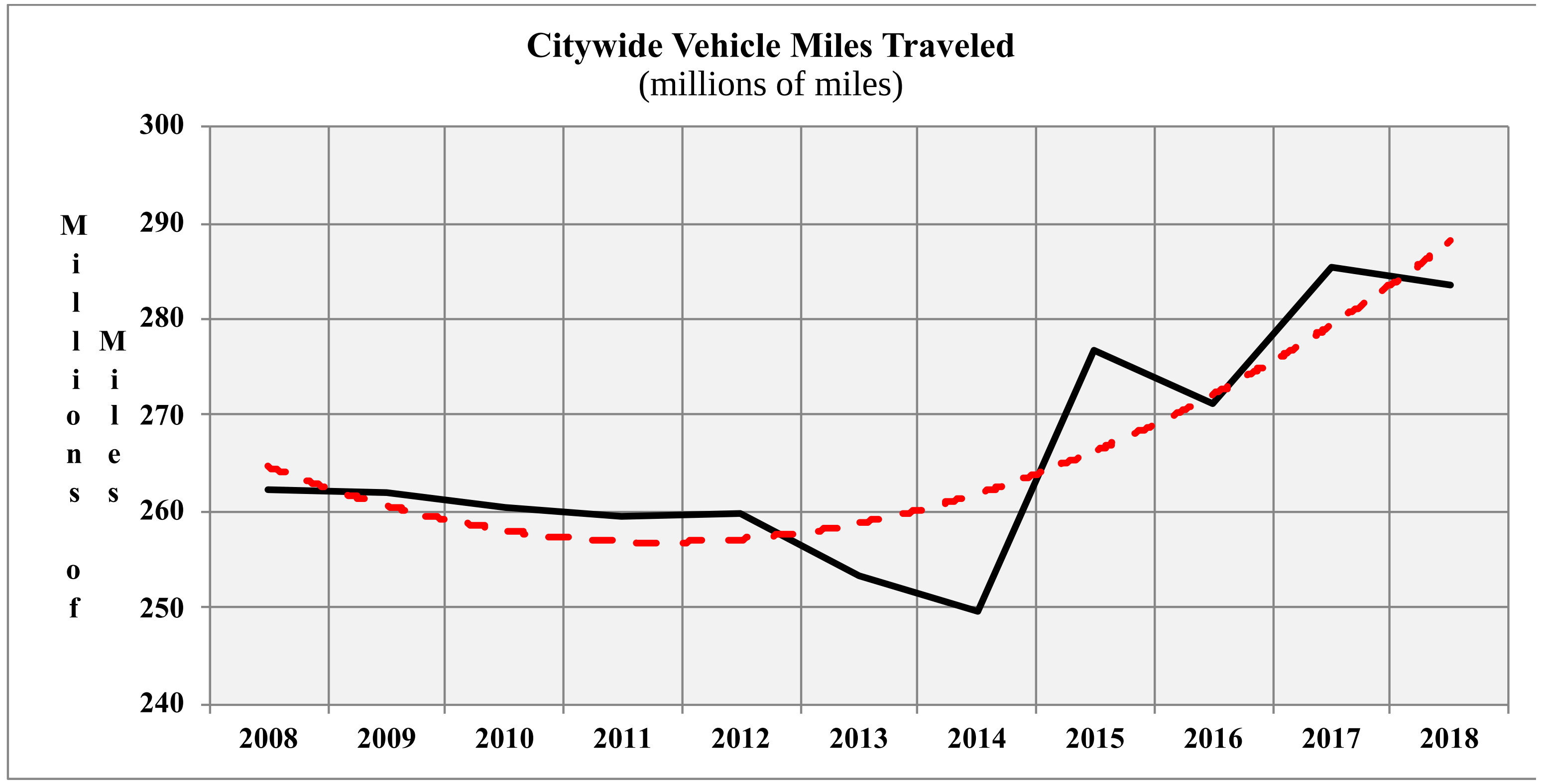
	2014	2016	2018
Electricity consumption	0%	6%	8%
Electricity emission factor	0%	-23%	-31%
Electricity emissions	0%	-19%	-28%

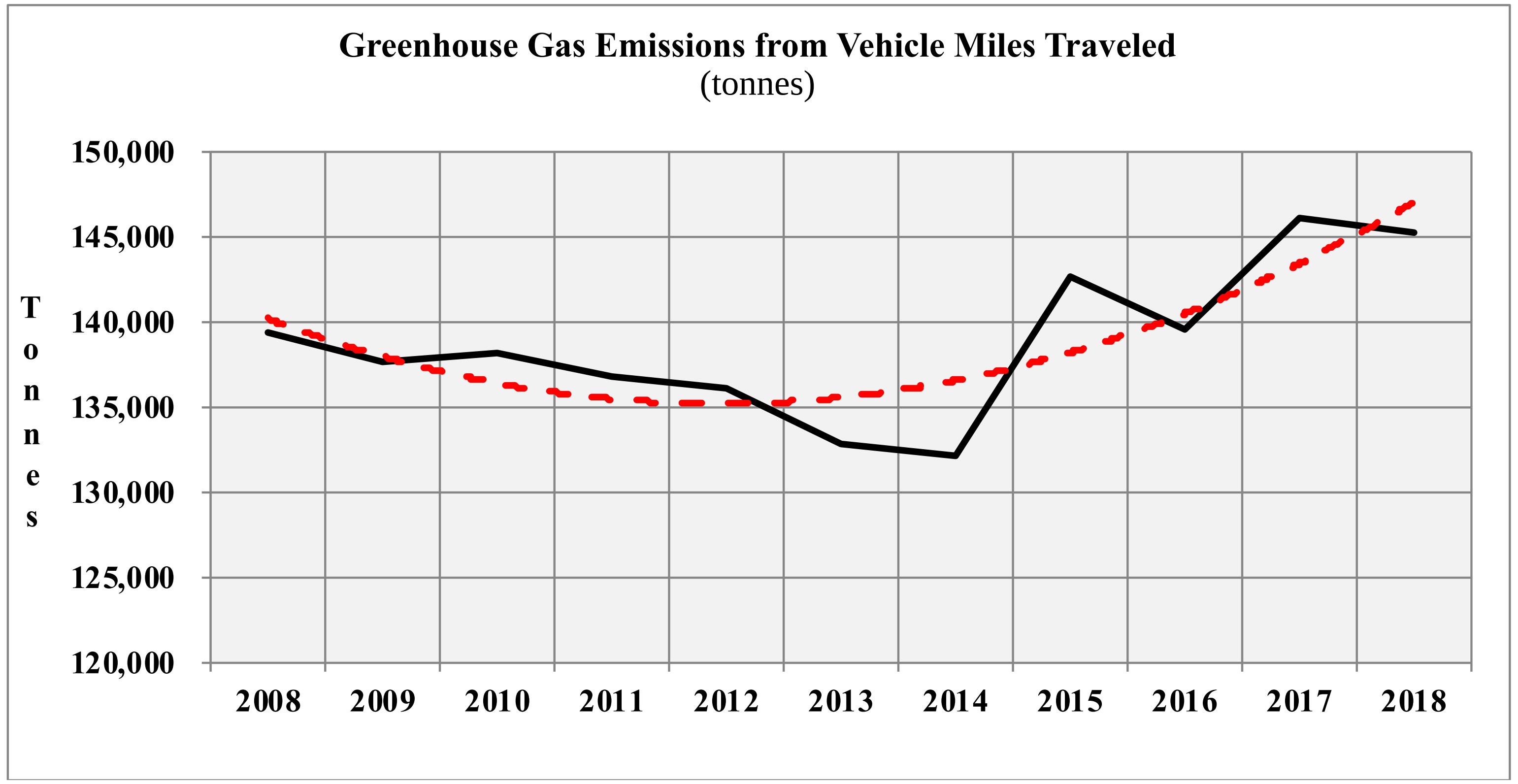
GHG Inventory – Trends By Sector

Citywide Inventory

Transportation:

- Vehicle miles traveled (VMT) data from IADOT
- Fuel consumption data from Federal Highway Administration
- Energy consumed and GHG emitted within City boundaries



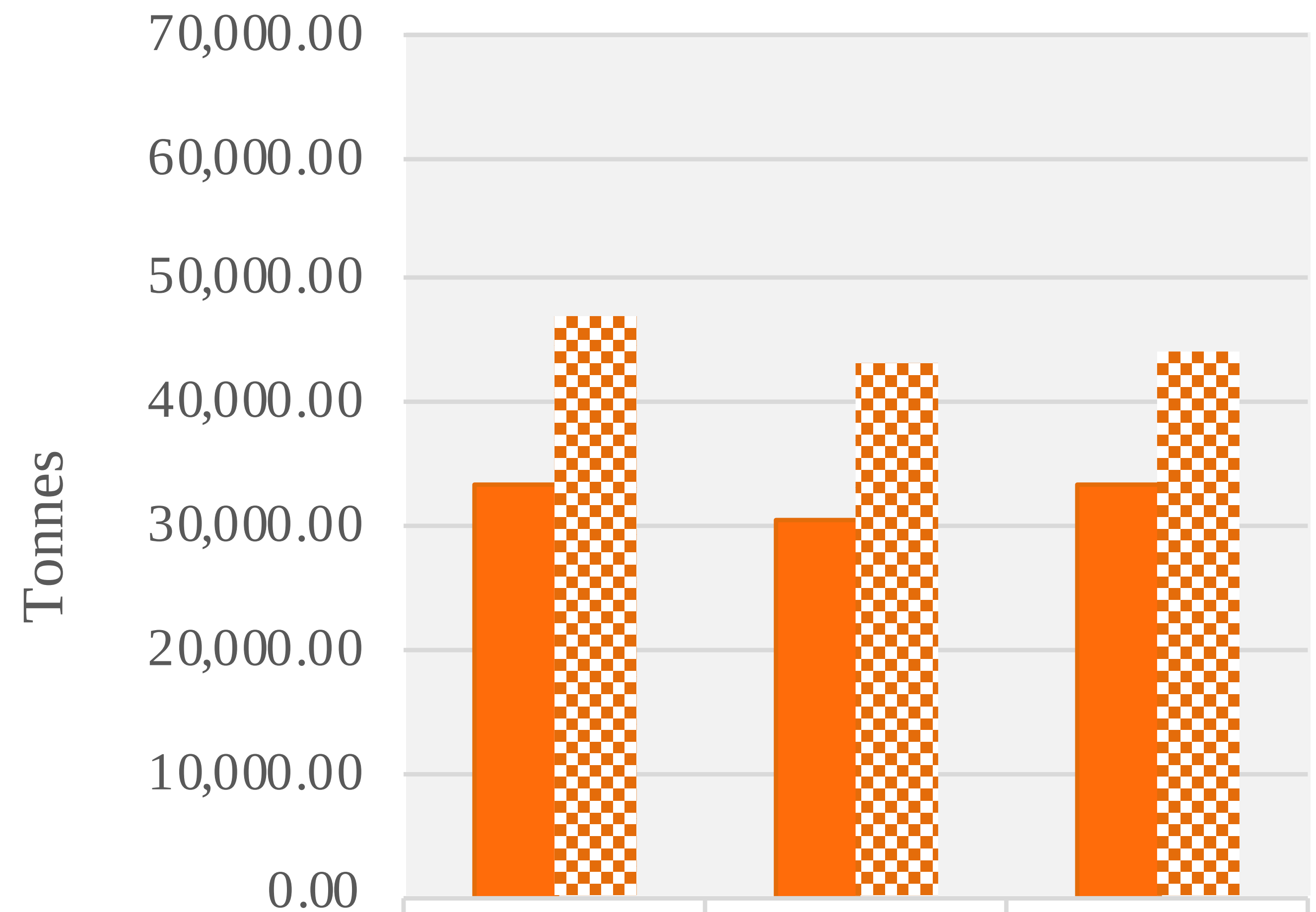


GHG Inventory – Trends By Sector

Citywide Inventory

Solid Waste:

- About half of waste to Chantland refuse derived fuel (RDF) facility
- RDF to electricity at the AMES (0.8 GHG tonnes per ton)
- About half of waste to landfill (fugitive methane emissions, 1.3 GHG tonnes per ton)
- If 100% landfilled, result in average of 38% more tonnes



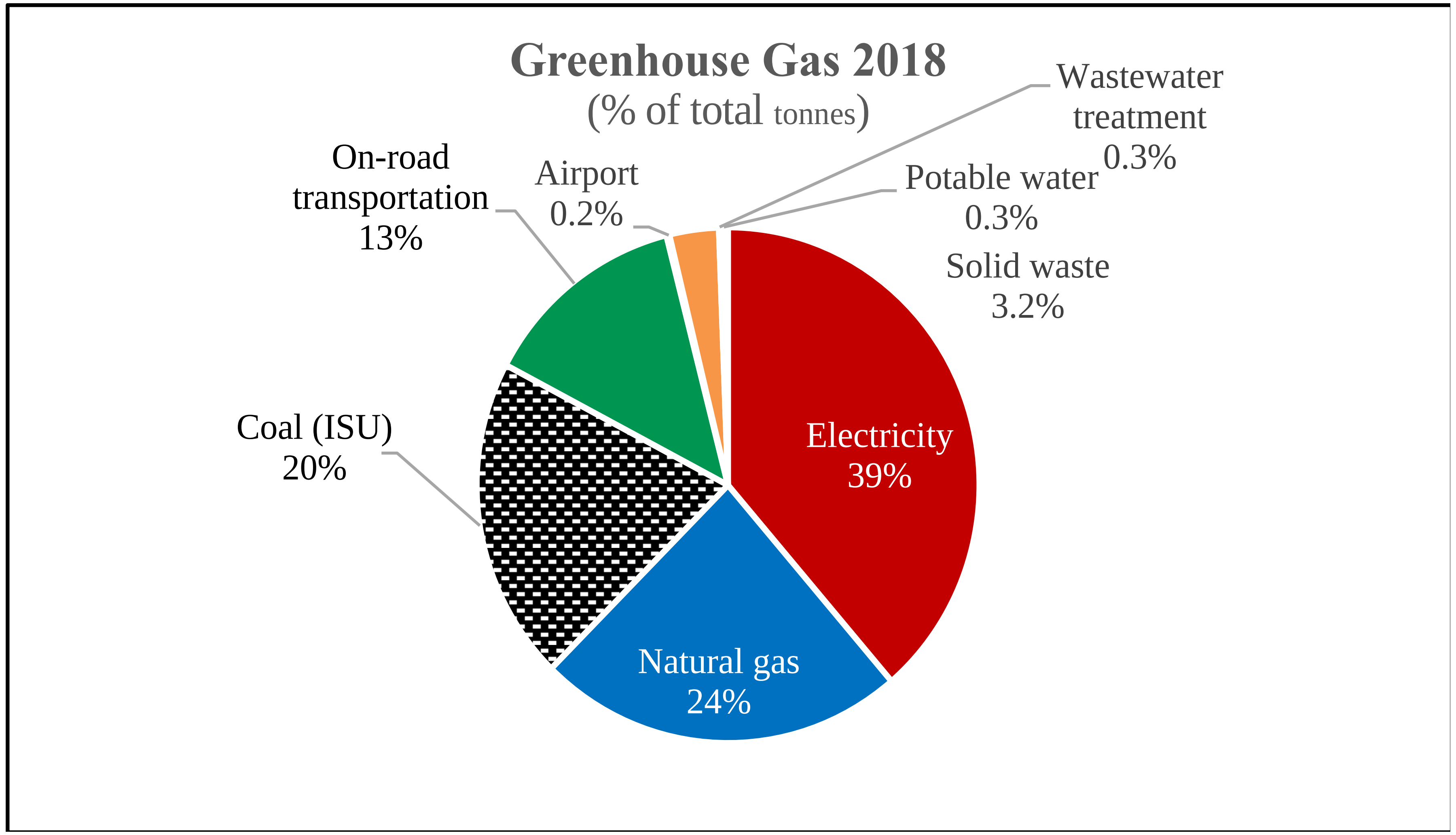
	2014	2016	2018
Actual emissions	33,182	30,499	33,434
Theoretical 100% landfilling	46,865	43,337	44,050

GHG Inventory – Trends By Sector

Citywide Inventory

Results:

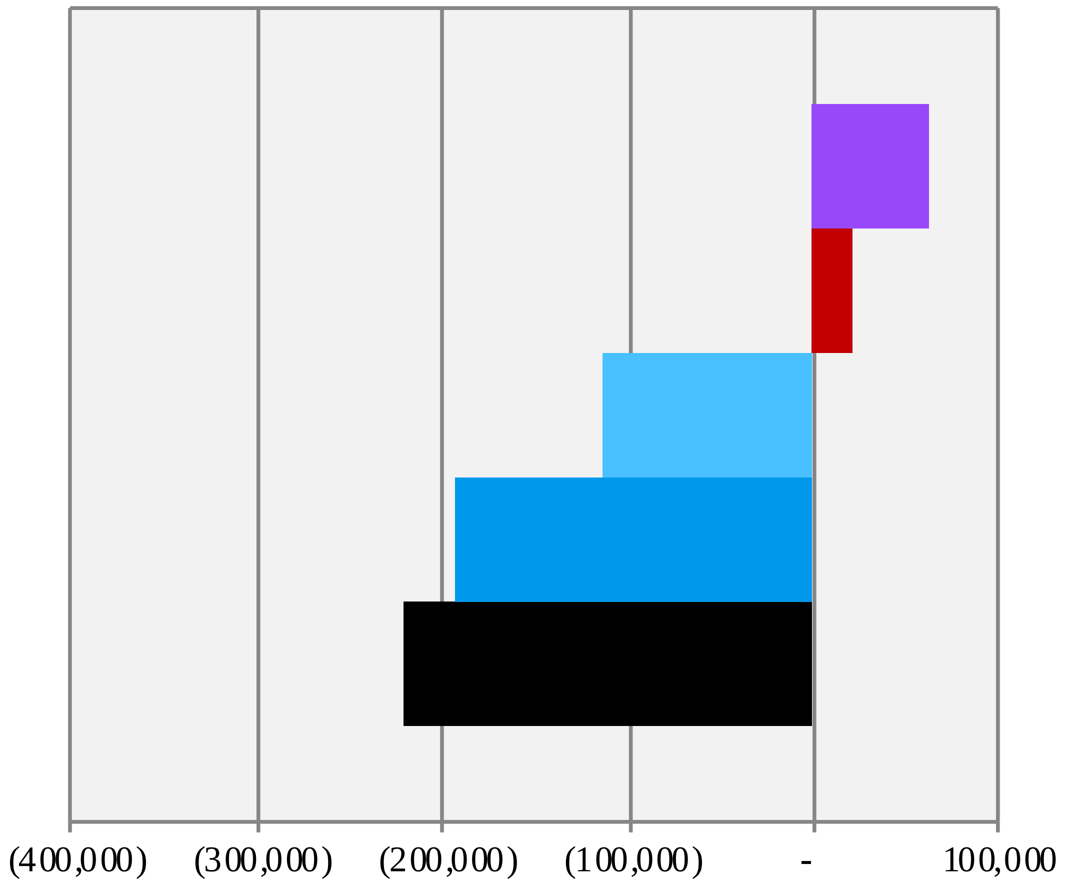
Citywide Inventory, Change in GHG Emissions, 2014-2018	
Category	**Change from 2014**
Electricity	-28%
Natural gas	19%
Coal	-34%
Transportation	11%
Solid waste	-5%
Wastewater treatment	-2%
Potable water	-12%
Total	**-17%**
Normalized total (2014 electricity emission factor)	-2%



GHG Inventory – Trends By Sector

Citywide Inventory

Primary Change Factors:



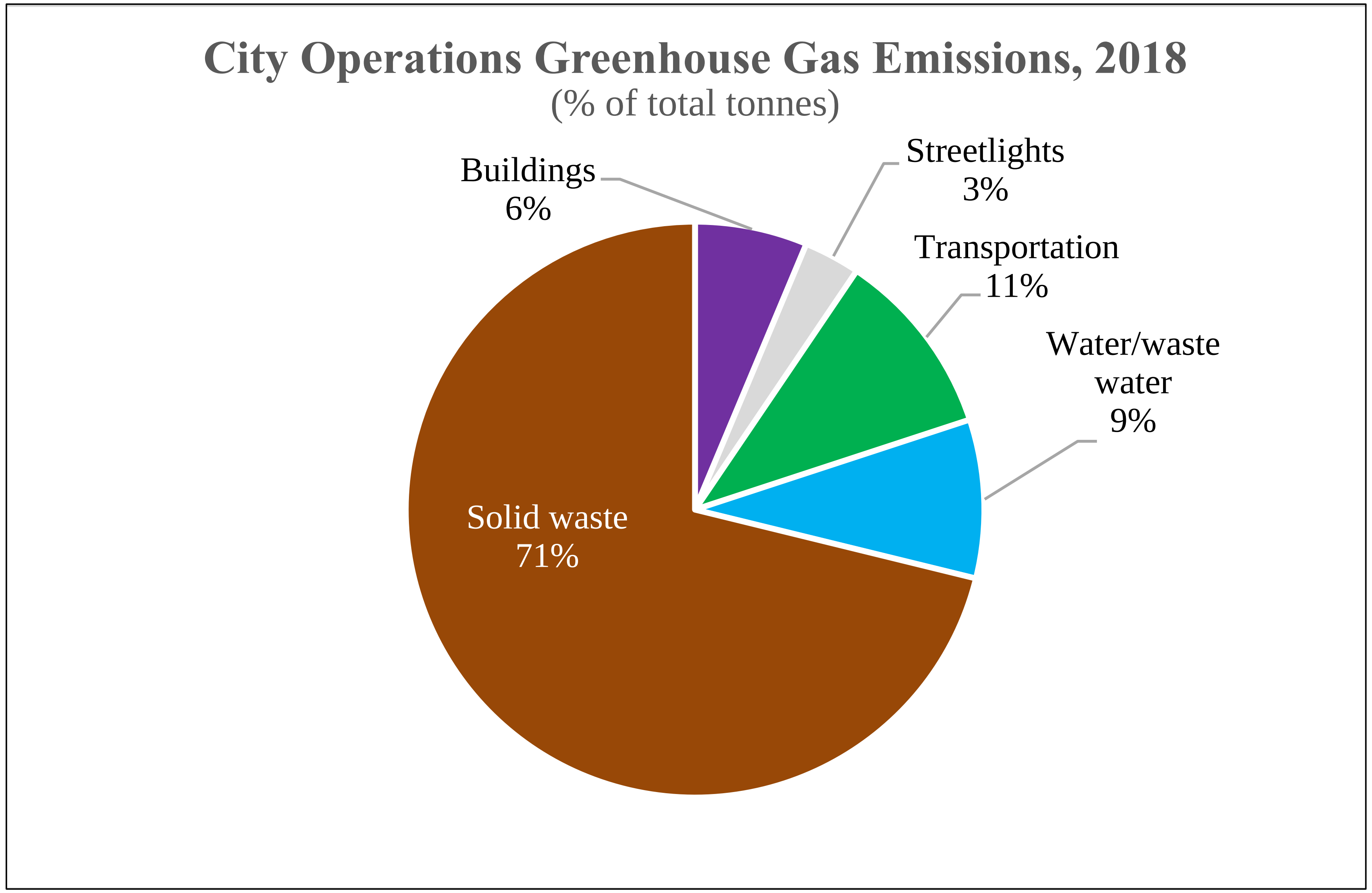
	Tonnes
Net increased emissions in other categories	61,944
Increased electricity consumption	20,931
Reduced coal at ISU CHP plant	(112,791)
Gas replaced coal at AMES	(192,302)
Total	(222,218)

GHG Inventory – Trends By Sector

City Operations Assessment

Results:

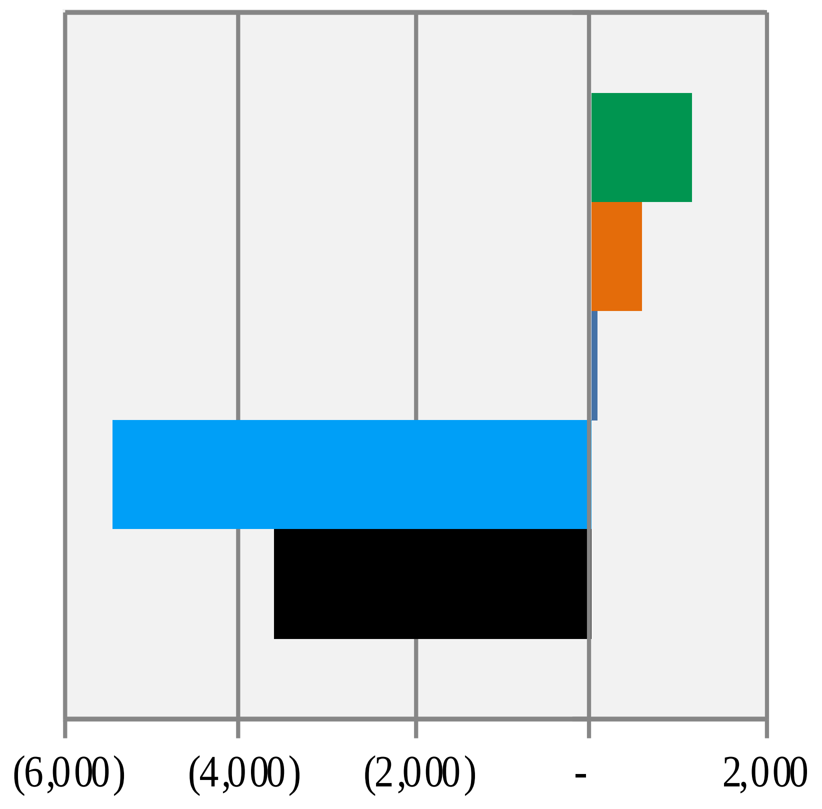
City Operations Assessmwnt, Change in GHG Emissions, 2014-2018	
Category	**Change from 2014**
Buildings and facilities	-27%
Streetlights and signals	-43%
Transportation	18%
Water	-12%
Wastewater	-2%
Solid waste	-2%
Subtotal	**-5%**
Ames Municipal Electric System	-43%
Grand total	**-53%**



GHG Inventory – Trends By Sector

City Operations Assessment

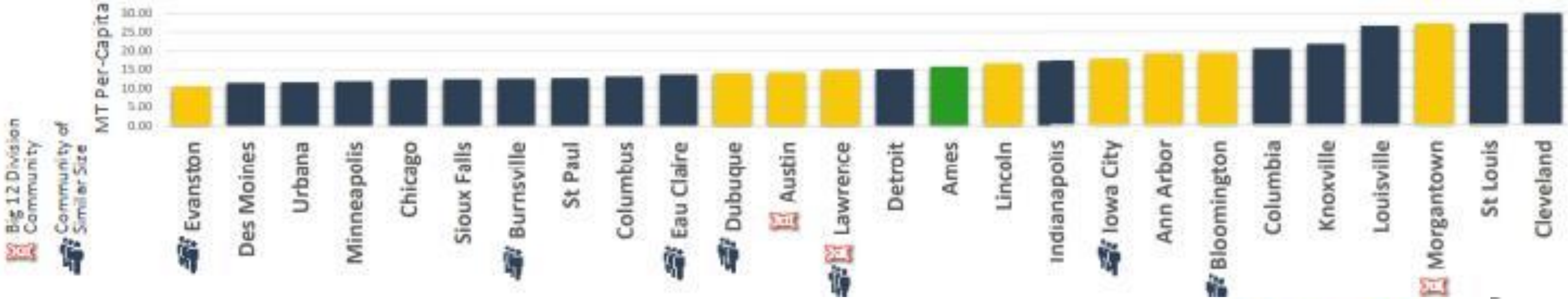
Primary Change Factors:



	Tonnes
Transportation	1,169
Solid waste	587
Natural gas	123
Gas replaced coal at AMES	(5,451)
Total	(3,571)

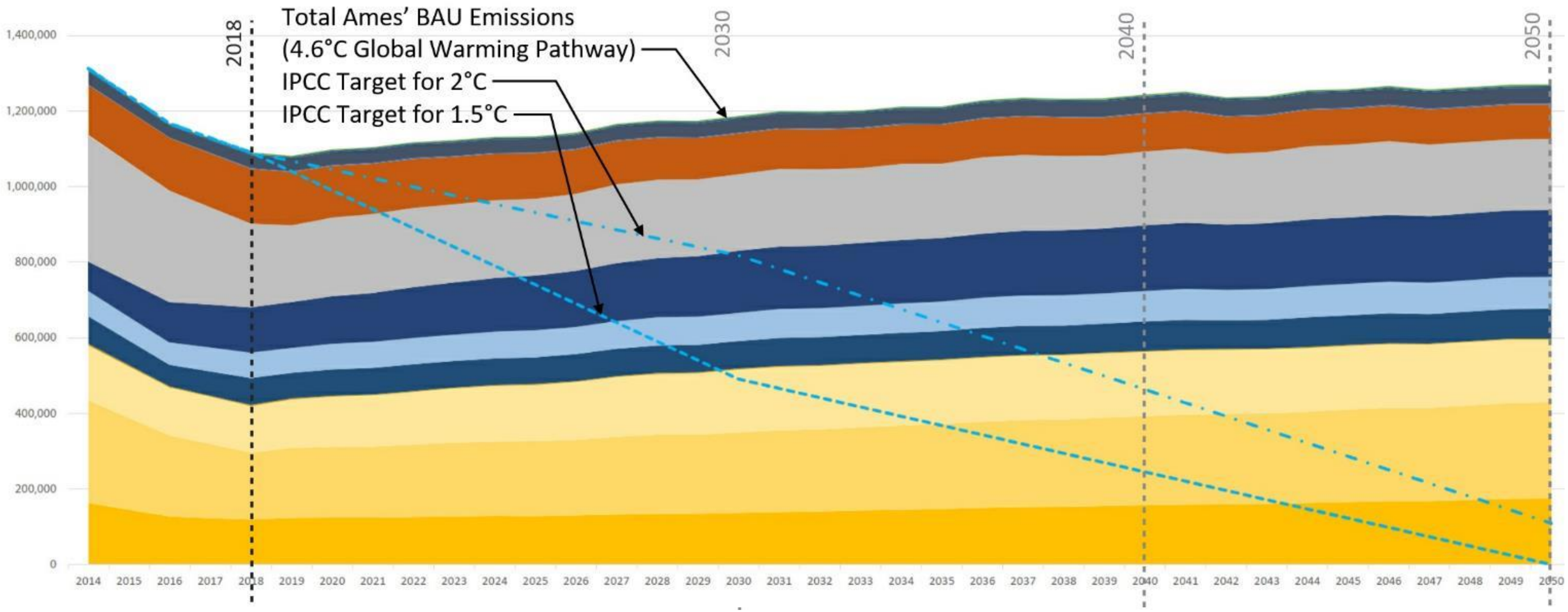
GHG Inventory – Community Comparison

GHG Inventory – Community Comparison

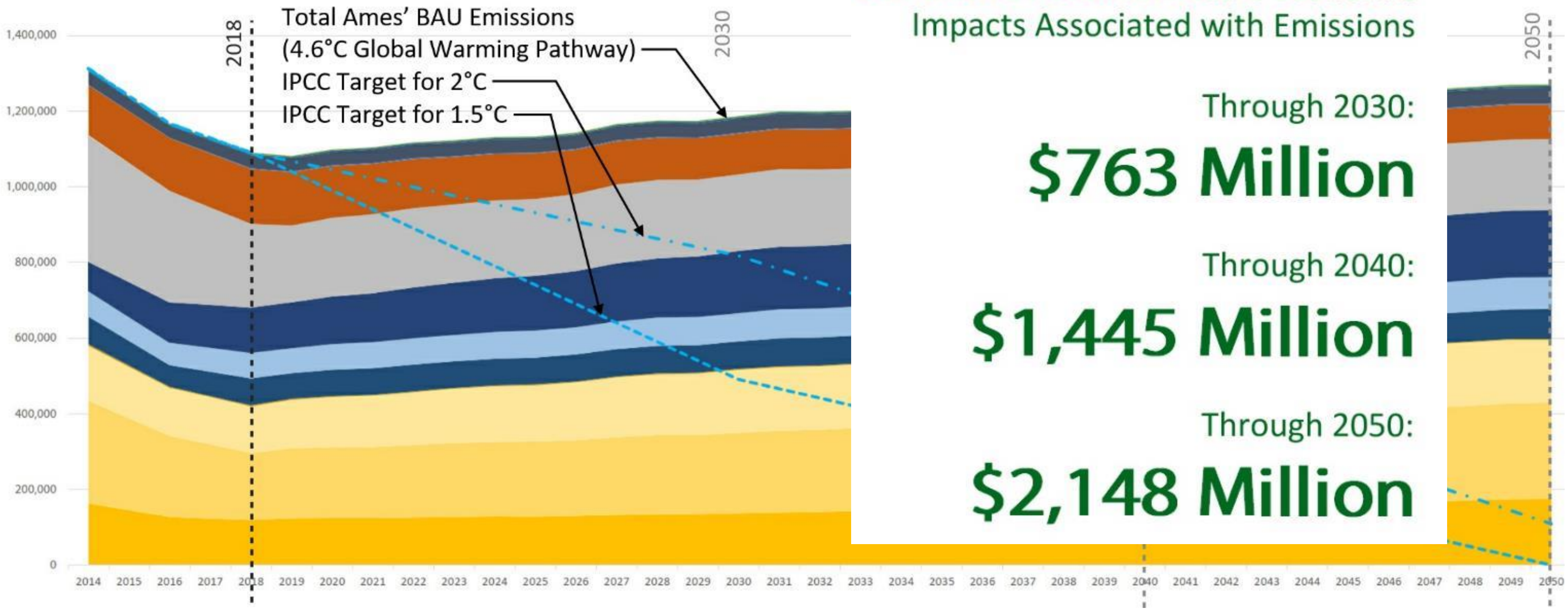


City of Ames: **16.5**

GHG Inventory – GHG Emissions Forecast



GHG Inventory – GHG Emissions Forecast



Cumulative Potential Future Economic Impacts Associated with Emissions

Through 2030:

$763 Million

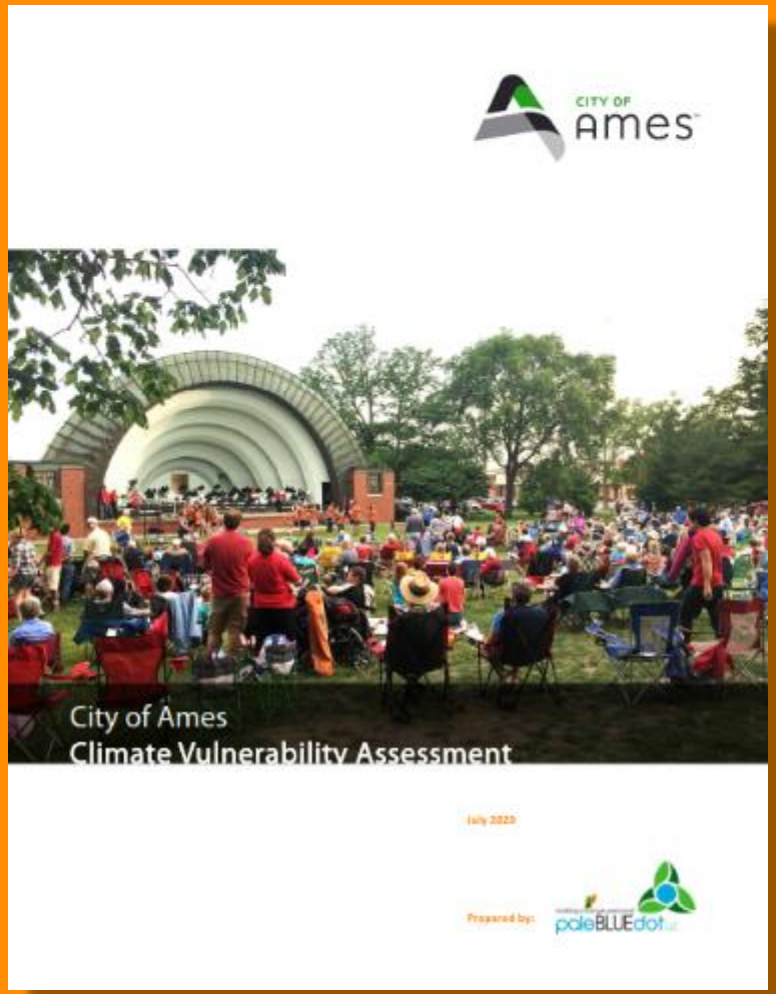
Through 2040:

$1,445 Million

Through 2050:

$2,148 Million

Climate Vulnerability Assessment



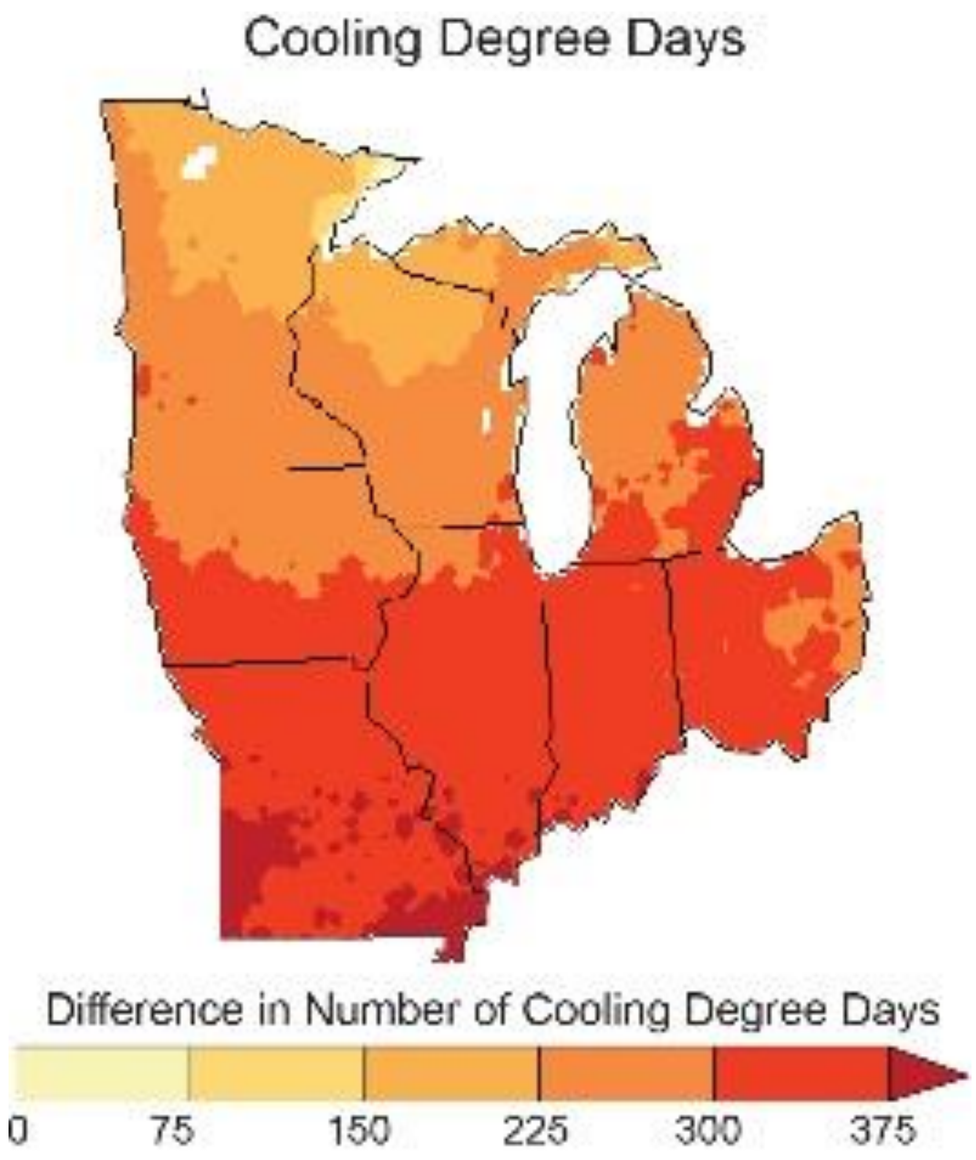
Climate Vulnerability Assessment

What is Climate Change Vulnerability?

According to the Intergovernmental Panel on Climate Change (IPCC):
Vulnerability is “the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes”

Climate Change in Midwest

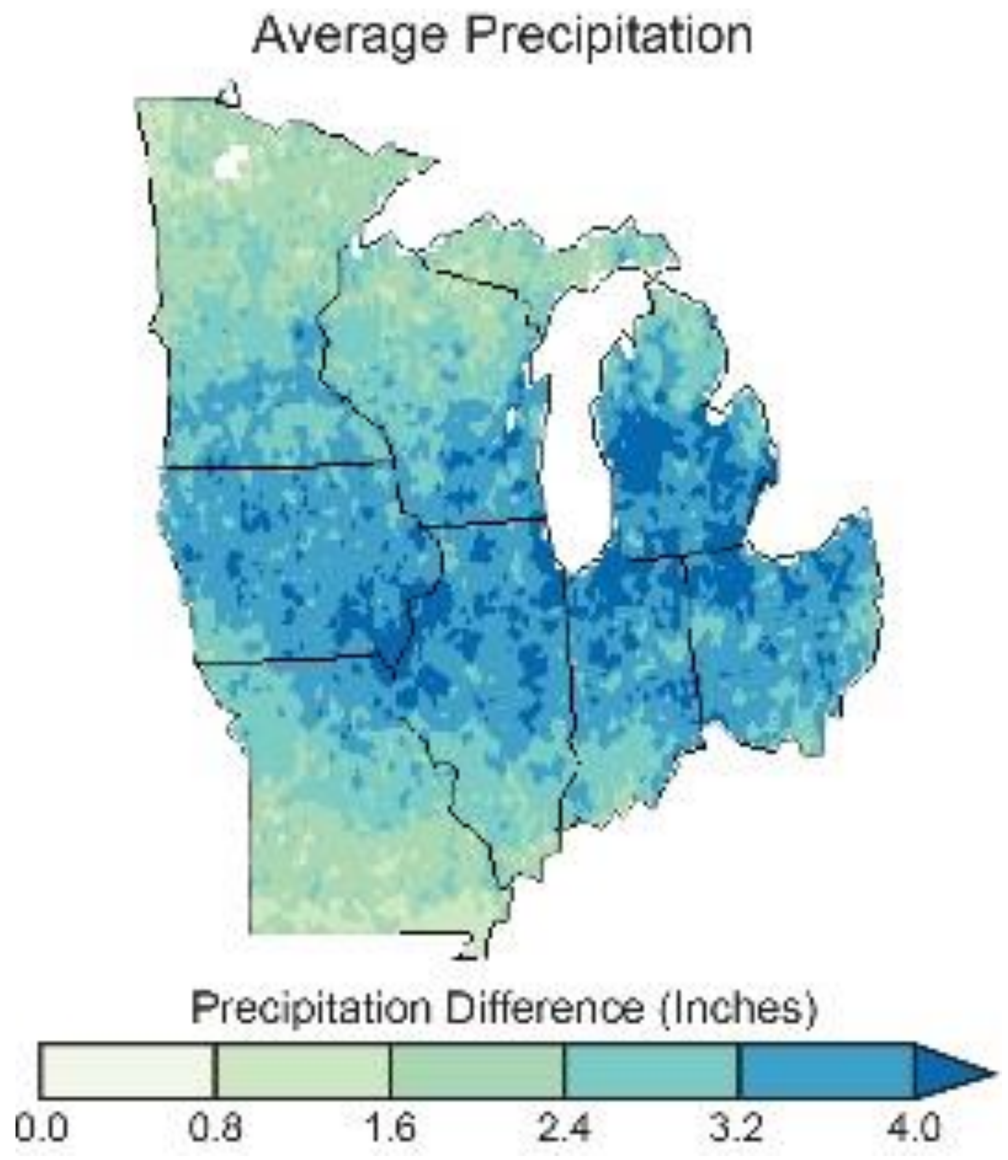
the Midwest region is projected to experience a climate that is hotter



Climate Change in Midwest

the Midwest region is projected to experience a climate that is hotter

… with more rain

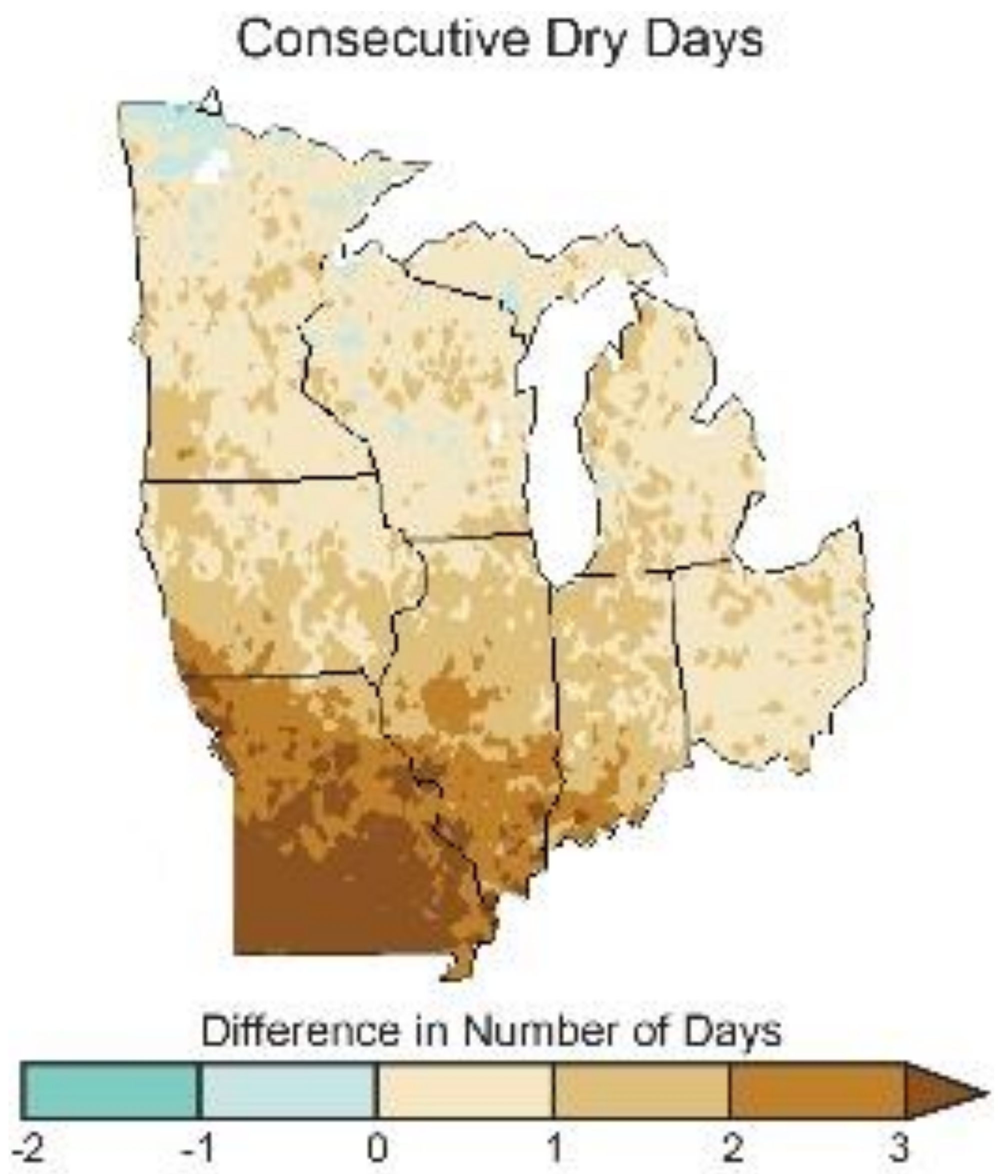


Climate Change in Midwest

the Midwest region is projected to experience a climate that is hotter

… with more rain

…and drought potential



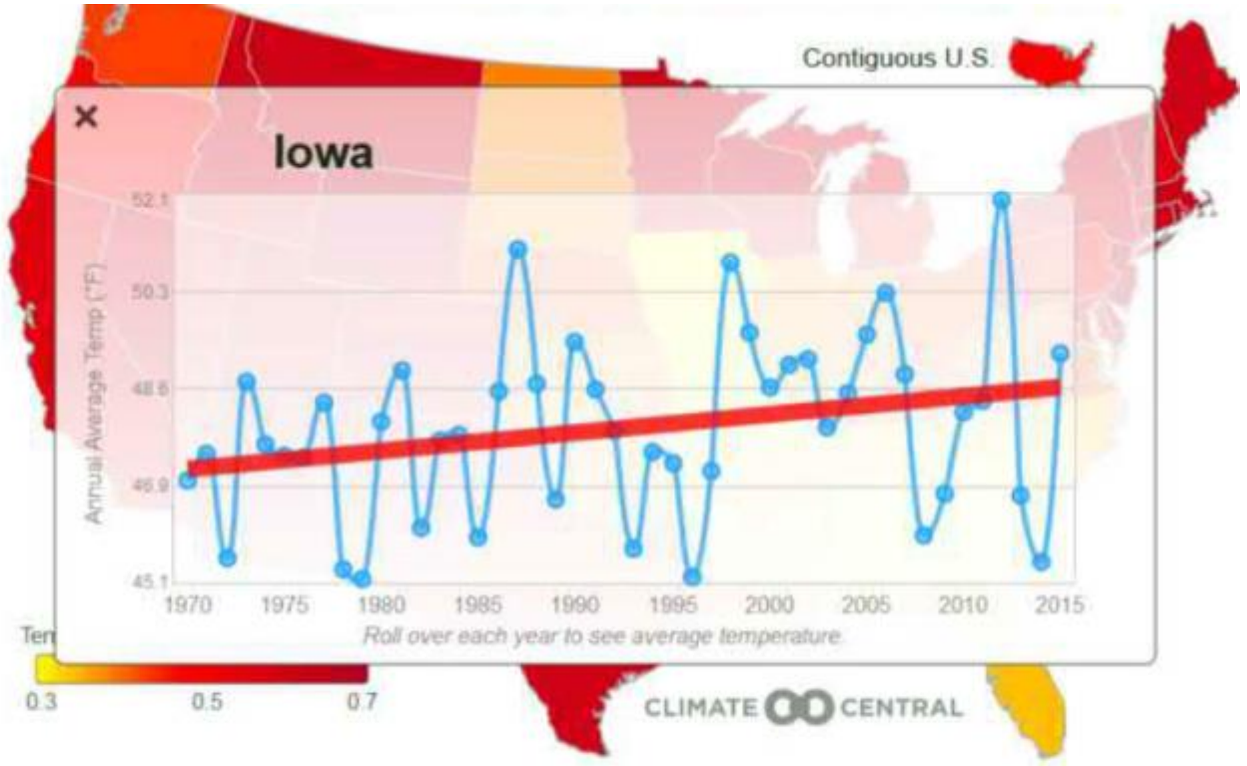
Climate Change in Iowa

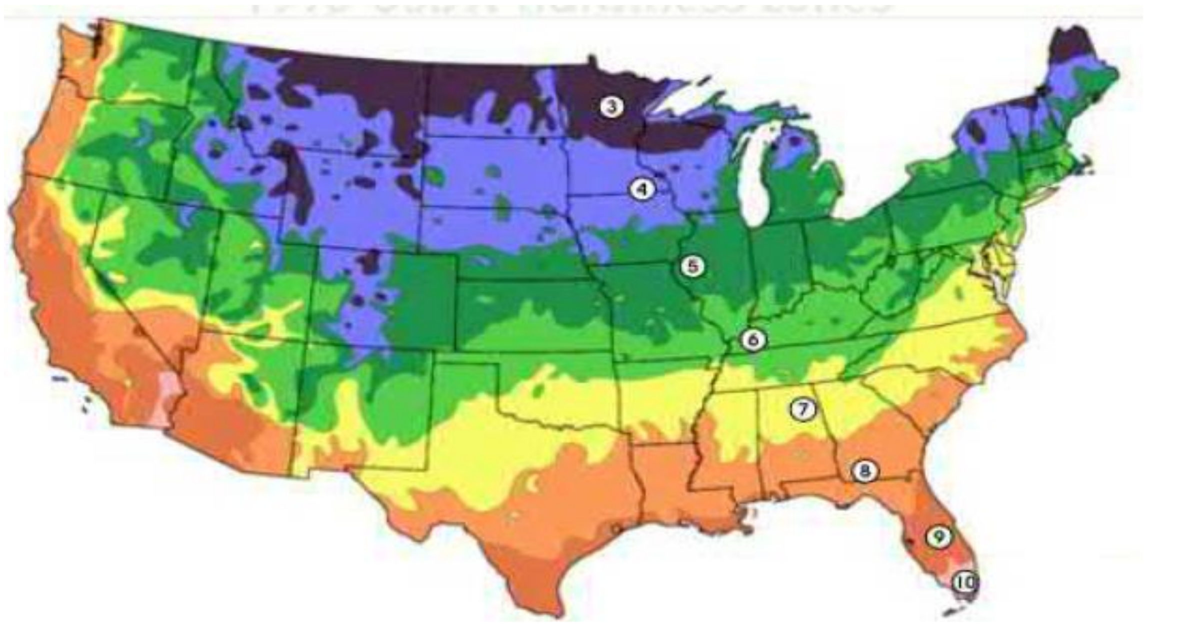
Iowa has already experienced

Increase in temperature

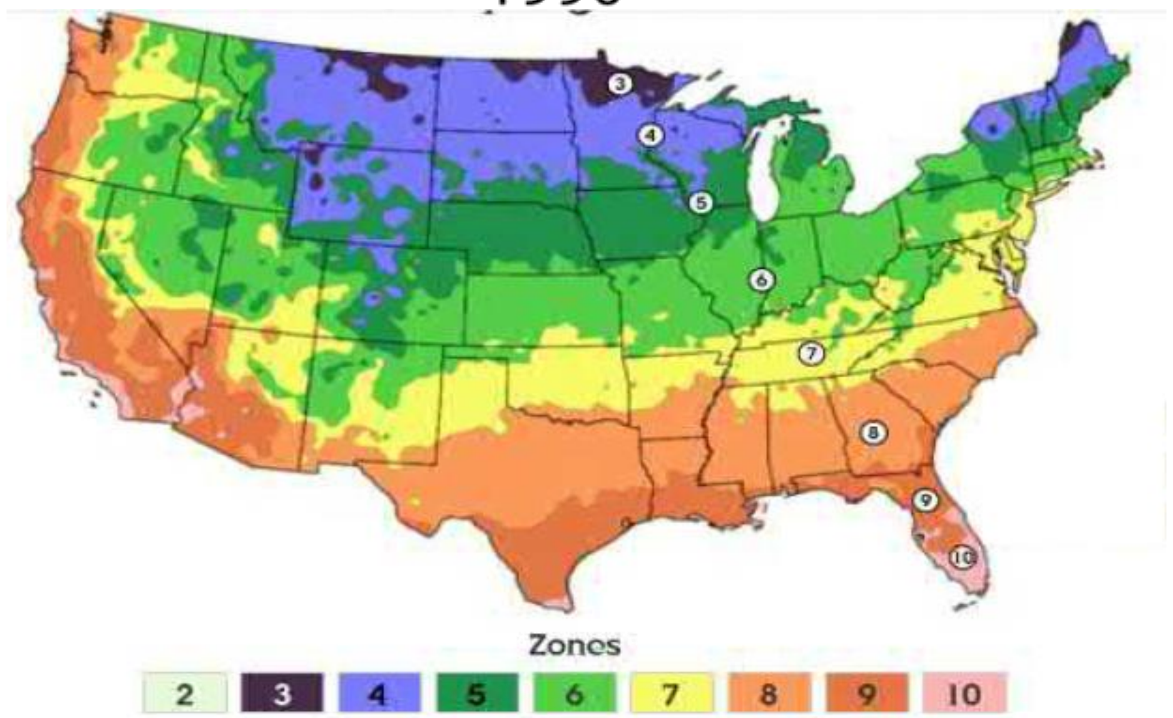
Decrease in spring snow cover

Change in USDA hardiness zones





1990

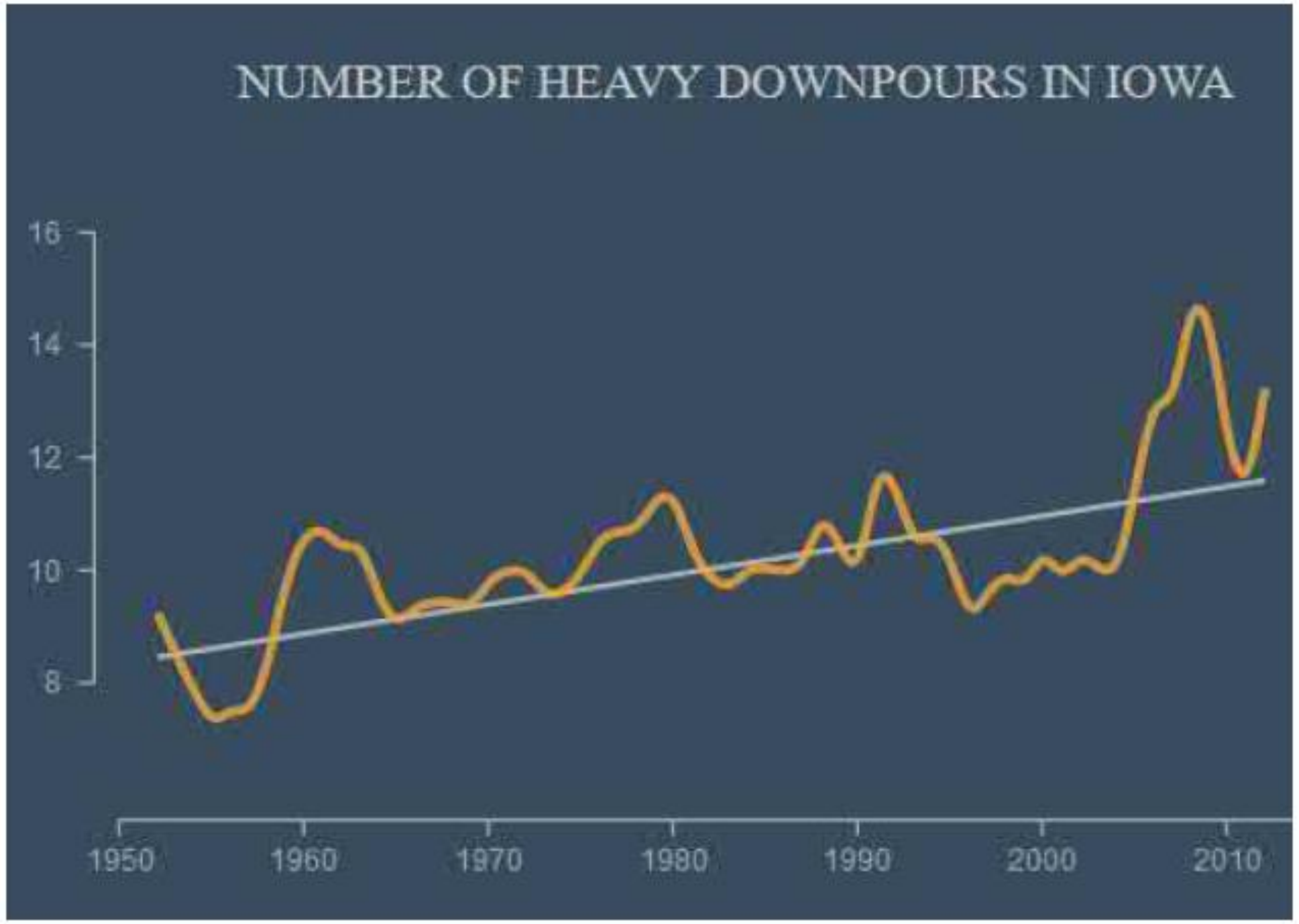


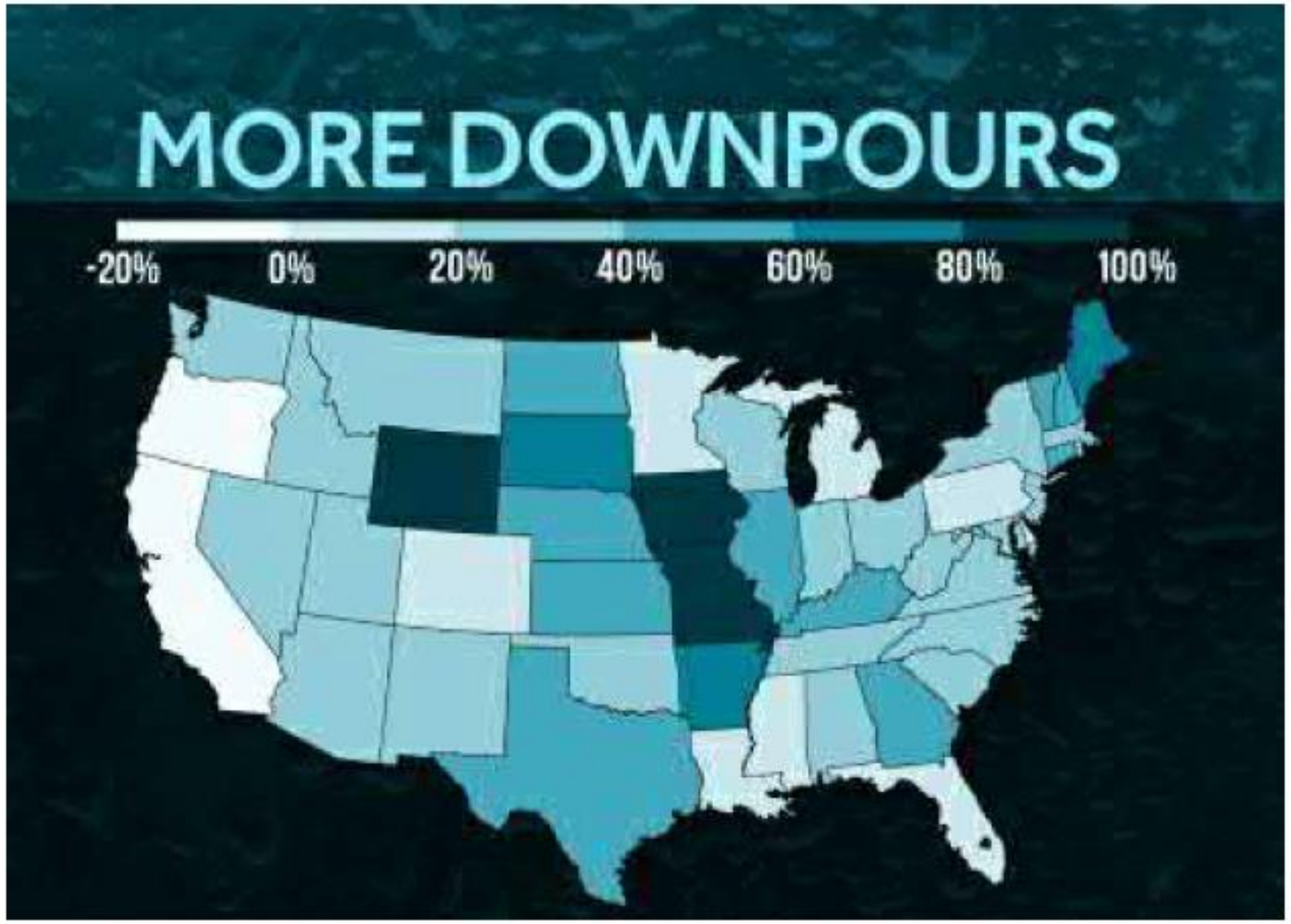
2015

Climate Change in Iowa

Iowa has already experienced

Increase in rainfall

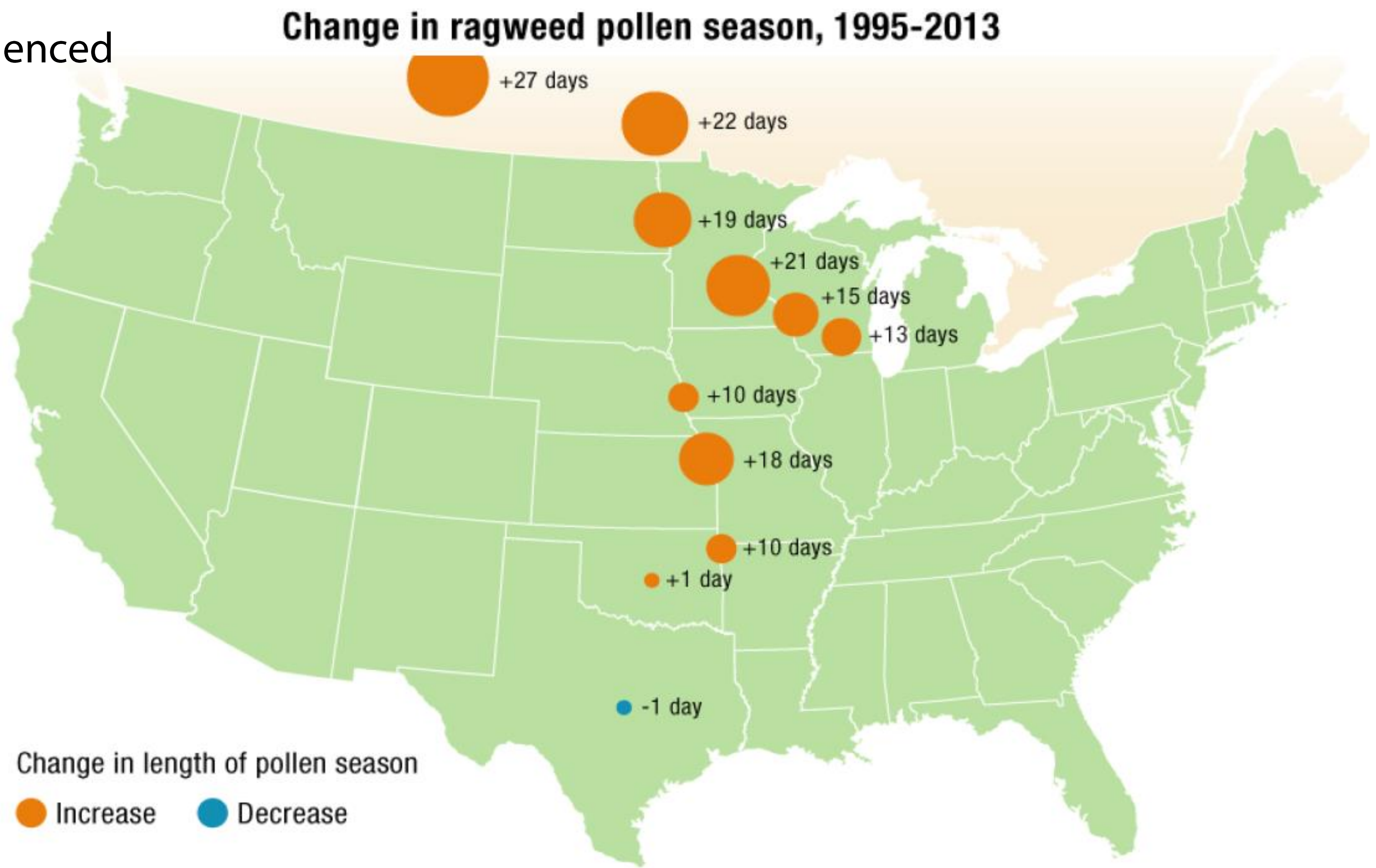




Climate Change in Iowa

Iowa has already experienced

Increase in allergy an
insect vector seasons



Climate Change in Ames

Looking Back

From 1980 through 2018, Ames has experienced:

Increase in annual average temperature:	1.7°
Increase in annual precipitation:	15%
Increase in heavy precipitation	42%
Increase in Days above 95:	2 days
Decrease in Days below 32:	-9 days
Increase in growing season:	10 days

Climate Change in Ames

Looking Back

From 1980 through 2018, Ames has experienced:

Storm Weather Events

Number of Events Reported In Story County:

From March 1999 to March 2009: 370 events

From March 2009 to March 2019: 502 events - an increase of 36%

Average Annual Storm Weather Economic Damage 1999-2019: $4,908,700

(source: NOAA National Centers for Environmental Information)

Increase in growing season: 10 days

Climate Change in Ames

Looking Back

From 1980 through 2018, Ames has experienced:

Storm Weather Events

Number of Events Reported In Story C

From March 1999 to March 2009: 37

From March 2009 to March 2019: 50

Average Annual Storm Weather Econom
(source: NOAA National Centers for Environmental

Increase in growing season:

Looking Forward

By 2100, Ames Can Expect:

Increase in annual average temperature:	6-11°F
Increase in annual precipitation:	-9 to 15% With Significant Seasonal Variation
Increase in heavy precipitation events:	30%
Increase in Days above 95:	+55 days
Decrease in Days below 32:	-45 days
Increase in growing season:	48 days
Increase in Air Conditioning Demand:	245%

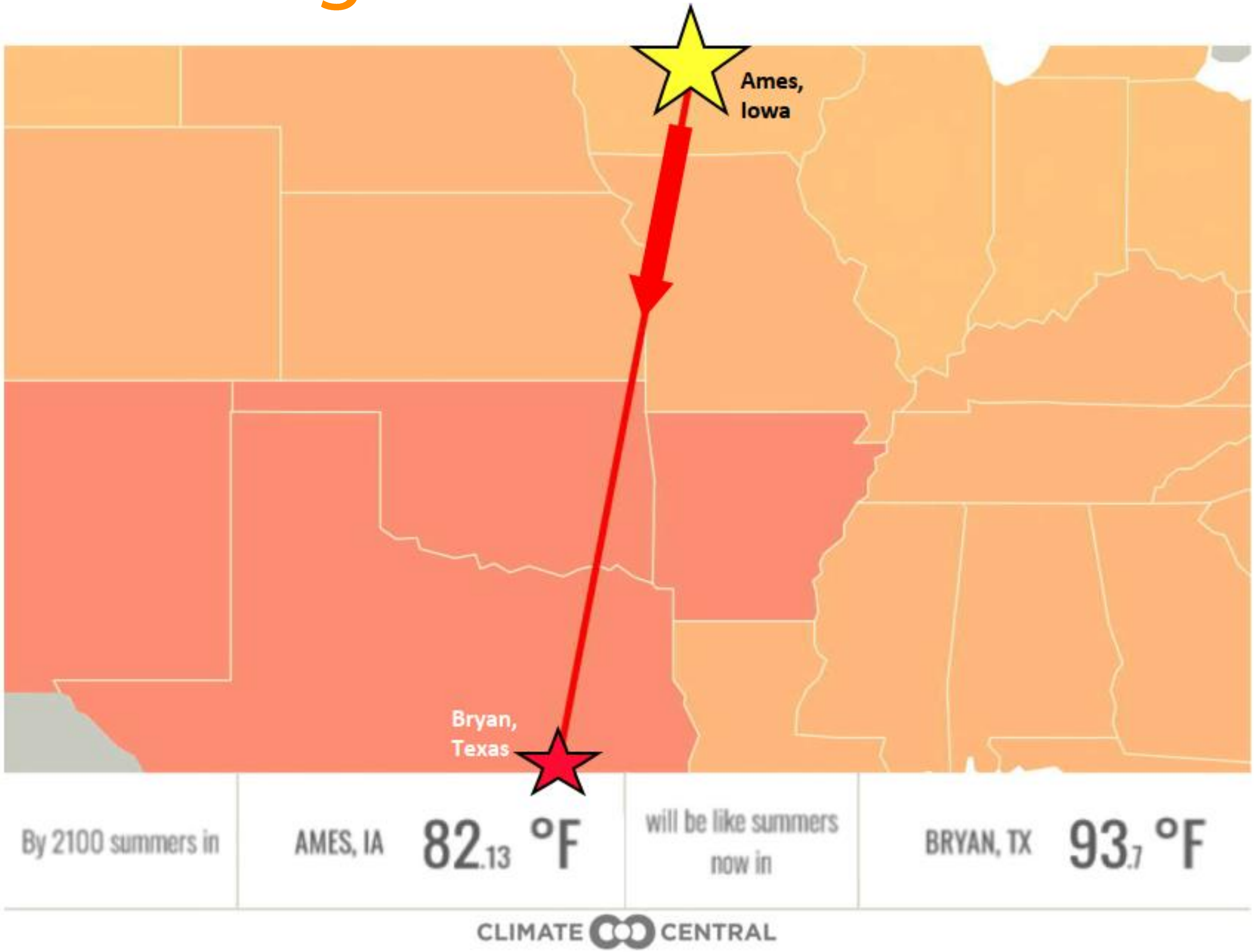
Climate Change in Ames

City on The Move

11 miles Distance southward the City of Ames' climate experience moves every year.

Which is equal to moving **159 feet** every day.

Climate Change in Ames



Climate Risks to Ames' Population

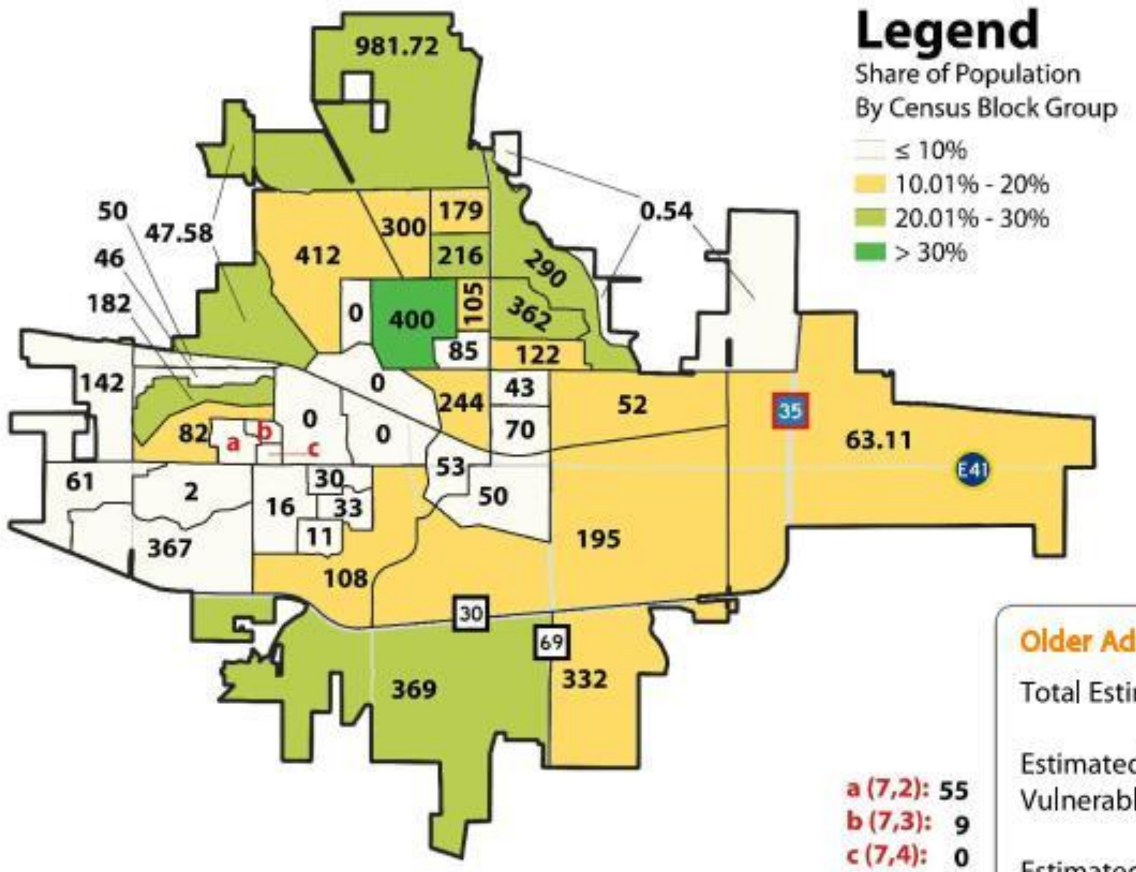
- Extreme Weather / Temperature
- Flood Vulnerability
- Air Quality Impacts
- Vector-Borne Diseases
- Food Insecurity and Foodborne Diseases
- Water Quality/Quantity
- Waterborne Illness
- Power Outage

Climate Risks to Ames' Population

Climate Risks to Ames' Population

Older Adults are particularly sensitive to the following Climate Risks (see Section 6 for Climate Risk information):

Map of Vulnerable Population Distribution Within Community



Adults 65 And Over

Estimated Population Count

Source: Census 2013-2017 American Community Survey 5-Year Estimates

Older Adults Summary

Total Estimated Population: 6,664

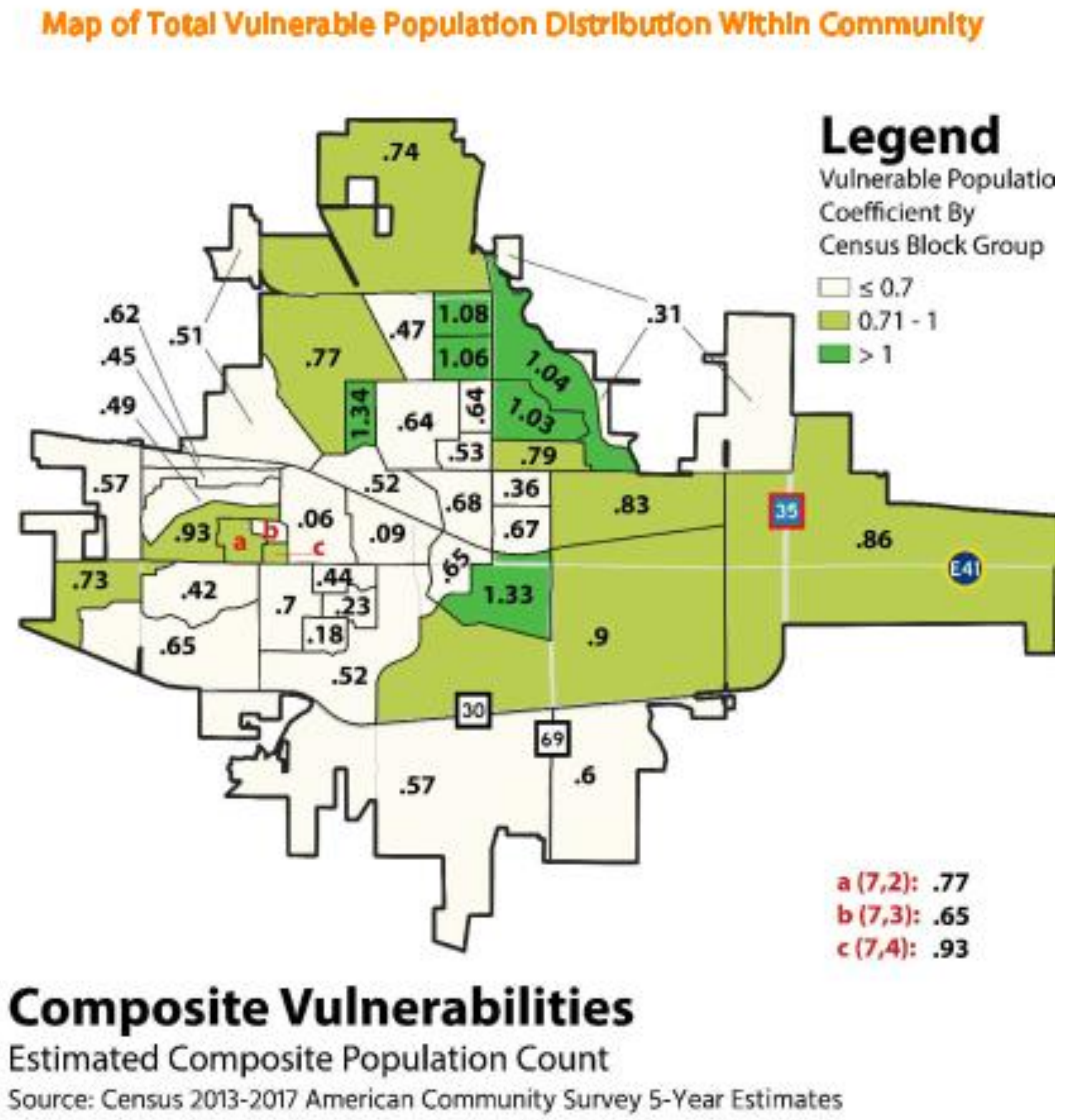
Estimated Share of Total Vulnerable Population: 16-22%

Estimated Share of Total City Population: 9.5%

Observations for Ames

The estimated total older adult population for Ames is 6,664. This vulnerable population makes up 9.5% of the City's total population. Older adults make up at least 16% of the climate vulnerable individuals in Ames. Older adults are most concentrated in the North Central and South Central sections of the City. These sections represent the highest share of the total population of these tracts - making up 20% or more of the total population of those neighborhoods.

Climate Risks to Ames' Population



Prioritizing Climate Risks and Hazards

Climate Hazards

Climate Hazard Type	Current hazard risk level	Expected change in intensity	Expected change in frequency	Timeframe	Number of Events 1999-2009 vs 2009-2019 (NOAA)	% Change	Statewide Annualized Property Loss Value (NOAA)
Extreme Heat	Low	Increase	Increase	Medium-term	0 events to 3 events	N/A	$300K
Extreme Cold	Moderate	Increase	Decrease	Medium-term	0 events to 8 events	N/A	$23,100K
Extreme Precipitation	Not Known	Increase	Increase	Short-term	20 events to 152 events	760%	See Flood
Floods	High	Increase	Increase	Short-term	43 events to 76 events	176%	$125,300K
Droughts	Low	Increase	Increase	Medium-term	4 events to 5 events	125%	$302,900K
Storms	High	Increase	Increase	Short-term	210 events to 303 events	144%	$55,700K
Forest/Wild Fires	Low	Not known	Not known	Not known	0 events to 0 events	N/A	N/A
Air Quality Impacts	Low	Increase	Increase	Long-term	N/A	N/A	N/A

Prioritizing Climate Risks and Hazards

Climate Risks to Population

Health Impacts	Expected Impact(s)	Likelihood of Occurrence	Impact Level (Population Vulnerability)	Timeframe	Risk (Likelihood x Impact)	Impact-related indicators
Extreme Heat	Increased demand for cooling; heat stress and emergency visits, heat related health	Possible	High	Medium-term	High	Cooling Degree Days, days above 95
Flooding	damage to property; flood related health impacts; infrastructure impacts	Likely	High	Short-term	Very High	Flood events, flash flood occurances, wettest 5-day periods, number of heavy rain events, disaster declarations, change in NOAA storm
Drought	Damage to crop/tree/ecosystem, reduced drinking water source, increased flash flood potential due to decreased soil permeability	Possible	Moderate	Medium-term	Moderate	Consecutive days without rain, acquafer level, surface water condition, river flow
Air Quality Impacts	Increased particulate matter, increased ozone impacts, increased instances of asthma	Possible	High	Medium-term	High	Air quality index
Vector-Borne Diseases	Increased instances of lyme disease, encephalitis, heart worm, malaria, zika virus,	Likely	Moderate	Long-term	Moderate	Disease records
Nutrition Insecurity	Food price volitility/change, fluctuation in availability	Possible	Moderate	Medium-term	Moderate	Food price index, Foodshelf demand, % of school children qualifying for free and reduced lunch
Water Quanity/Quality Impacts	Water shortage, surface water quality impacts due to heat and stormwater runoff	Possible	Low	Long-term	Low	Acquafer health; Water quality test results
Water Borne Disease	Bacteria exposusure at infected surface water locations, contamination of drinking water due to flood	Unlikely	High	Medium-term	Low	flood events; algea blooms

Prioritizing Climate Risks and Hazards

Climate Risks to Infrastructure and Institutions

Impacted Policy Sector	Expected Impact(s)	Likelihood of Occurrence	Potential Impact Level	Timeframe	Risk (Likelihood x Impact)	Impact-related Indicators
Buildings	Increased demand for cooling, need for weatherization	Likely	Moderate	Short-term	High	Low income housing units, % of residents with housing burden, housing stock age, % of units without weatherization improvements
Transport / Roads	Increased freeze/thaw damage, increased salt/sand use and maintenance budgets	Likely	High	Short-term	Very High	% of flooded or flood damaged roads and bridges, City road maintenance budget
Energy	Increased power outages, increased demand and cost expediture	Likely	High	Medium-term	High	Energy outage occurances, number of customers without power, cooling degree day increases
Water	Increased scarcity, water quality impacts	Possible	High	Long-term	Moderate	Water infrastructure damage, acquafer health, flood contamination
Waste	Damage to waste infrastructure and processing, particularly wastewater	Unlikely	Moderate	Long-term	Low	Flood impacts at wastewater facilities, sewage release, flooding at landfill/RDF sites
Land Use Planning	Stormwater management impacts, heat island impacts, flood management,	Likely	High	Short-term	Very High	Heat Island co-efficient; stormwater runoff projections, citywide tree canopy coverage, citywide impervious surface coverage, % of complete streets
Agriculture & Forestry	Reduction in crop yield, forest + tree species loss due to changes in hardiness zone and pests	Likely	Moderate	Medium-term	High	% change in crop yeild, impacts to crop planting and harvesting; tree canopy loss to pests, tree canopy loss to hardiness zone changes
Environment & Biodiversity	Insect infestation, increased disease vectors, ecosystem degradation	Likely	Moderate	Medium-term	Moderate	% of habitat loss, invasive species
Law Enforcement and Emergency Response	Increased property and violent crime, increased emergency response demand and mortality rate	Likely	Moderate	Long-term	Low	Property and violent crime statistics (particularly durring extreme heat), instances of mental health need, calls for emergency response (particularly during extreme heat and weather)
Tourism	Decline in tourism demand	Not known	Not Known	Not known	Not Known	Tourism statistics, hotel occupancy levels
Economic Impact	Impacts on regional Ag business, energy expenditures, labor impacts	Likely	Moderate	Medium-term	Moderate	Disaster declarations, economic indicators, employment rates

Menu of Climate Adaptation Strategies

The following are potential Climate Adaptation Goals for the City of Ames provided for consideration. The goals are organized based on the primary anticipated climate change impacts they address.

C Goals To Build Capacity For Preparing For And Responding To Population Risks Of Climate Change Impacts

- Goal C1 - Incorporate climate change preparedness activities into existing local government plans and programs as a means to increase resilience while minimizing costs.
- Goal C2 - Improve effectiveness of on-going adaptation measures.
- Goal C3 - Strengthen emergency management capacity to respond to weather-related emergencies.
- Goal C4 - Improve the capacity of the community, especially populations most vulnerable to climate change risks, to understand, prepare for and respond to climate impacts.
- Goal C5 - Enhance resilience of critical city operations.
- Goal C6 - Enhance city's capacity for adaptation implementation.
- Goal C7 - Secure funding to support City's adaptation efforts.

H Goals Responding to Heat Stress And Extreme Weather

- Goal H1 - Strengthen emergency management capacity to respond to heat stress and extreme weather.
- Goal H2 - Minimize health issues caused by extreme heat days, especially for populations most vulnerable to heat.
- Goal H3 - Improve the capacity of the community, especially populations most vulnerable to climate change risks, to understand, prepare for and respond to high heat and extreme weather.
- Goal H4 - Decrease the urban heat island effect, especially in areas with populations most vulnerable to heat.
- Goal H5 - Enhance resilience of community tree canopy and park/forest land (strategies may include planting climate adaptive trees and native prairie grasses, wild flowers, and landscaping).
- Goal H6 - Enhance the resilience of buildings within the community to extreme heat, weather, and energy and fuel disruptions.
- Goal H7 - Improve the energy efficiency and weatherization of homes and businesses to reduce energy costs and carbon pollution.
- Goal H8 - Expand access to distributed solar energy in low-income communities in order to lower energy bills, increase access to air conditioning, and decrease carbon pollution levels.
- Goal H9 - Enhance resilience of local businesses to extreme weather.
- Goal H10 - Strengthen social cohesion and networks to increase support during extreme weather events.
- Goal H11 - Increase the resilience of natural and built systems to adapt to increased timeframes between precipitation and increased drought conditions.
- Goal H12 - Enhance the reliability of the grid during high heat events to minimize fires, brownouts and blackouts.

A Goals Responding to Air Quality Impacts

- Goal A1 - Reduce auto-generated particulate matter, tailpipe pollutants, waste heat, and ozone formation.
- Goal A2 - Increase and maintain air quality for residents and businesses.

F Goals Responding To Flood Vulnerability

- Goal F1 - Strengthen emergency management capacity to respond to flood-related emergencies.
- Goal F2 - Increase the resilience of the natural and built environment to more intense rain events and associated flooding.
- Goal F3 - Enhance resilience to fuel disruptions in transportation and mobility.

V Goals Responding To Vector-Borne Disease Risks

- Goal V1 - Manage the increased risk of disease due to changes in vector populations.

FI Goals Responding To Food Insecurity And Food-borne Disease Risks

- Goal FI-1 - Increase food security for residents, especially those most vulnerable to food environment.
- (Rural communities) Goal A3 - Increase resilience of croplands, farms, and farmers within community.

W Goals Responding To Water Quality and Quantity Risks

- Goal W1 - Increase the resilience of City's water supply in drier summers.

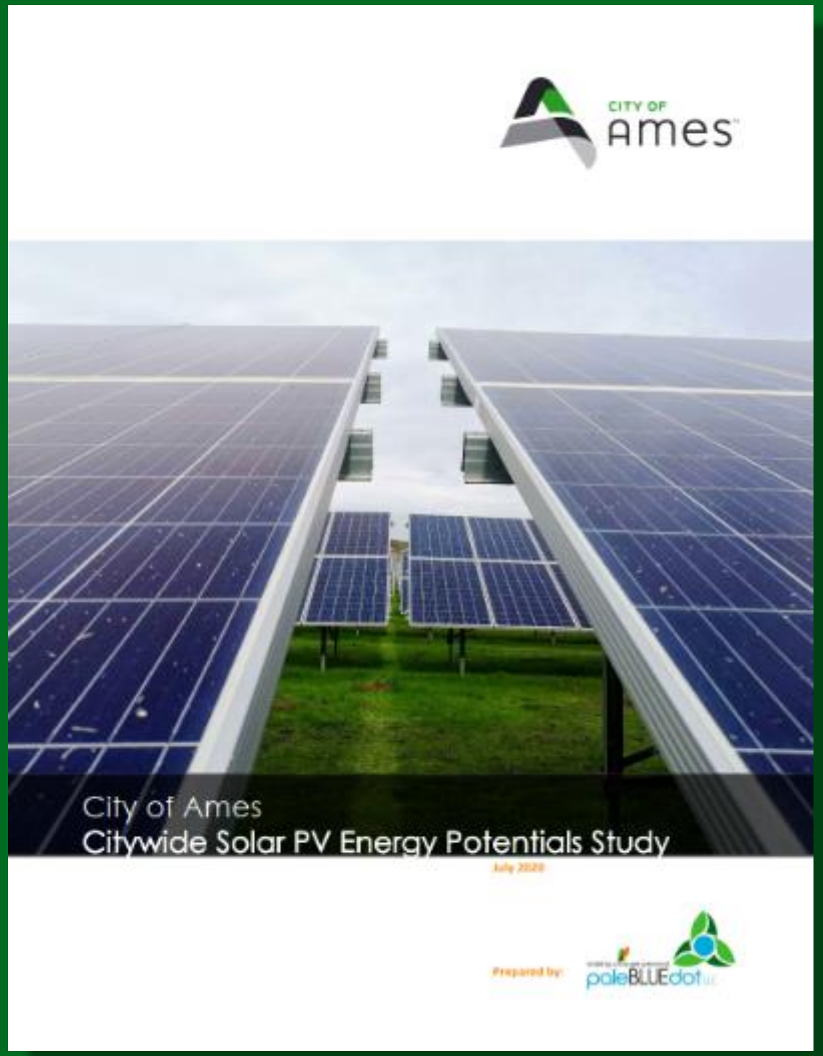
WB Goals Responding To Waterborne Illness Risks

- Goal WB1 - Enhance protection of surface water quality damage from severe storms
- Goal WB2 - Enhance public protection from exposure to surface water pathogen contamination

E Goals Enhancing Economic Resilience in Support of Climate Resilience

- Goal E1 - Leverage the economic development opportunities of the Green Economy
- Goal E2 - Enhance community resilience through economic resilience
- Goal E3 - Including Economic Resilience in Emergency Response Planning

Citywide Solar PV Potentials Study



Citywide Solar PV Potentials Study

Solar In Iowa

As of March, 2020, Iowa has a total of 139.6 megawatts (139,600,000 watts) of solar capacity installed statewide. There are a total of 5,462 solar installations in the State. The State of Iowa ranks 39th nationally for total solar energy production capacity.

The State's solar installation total is enough to power 17,300 homes. The share of the State's total electricity use that comes from solar power, however, is less than 0.3%. This indicates great potential for growth throughout the State. Current solar growth projections for the State equal an additional 374 MW over the next 5 years - a growth rate that ranks 38th nationally.

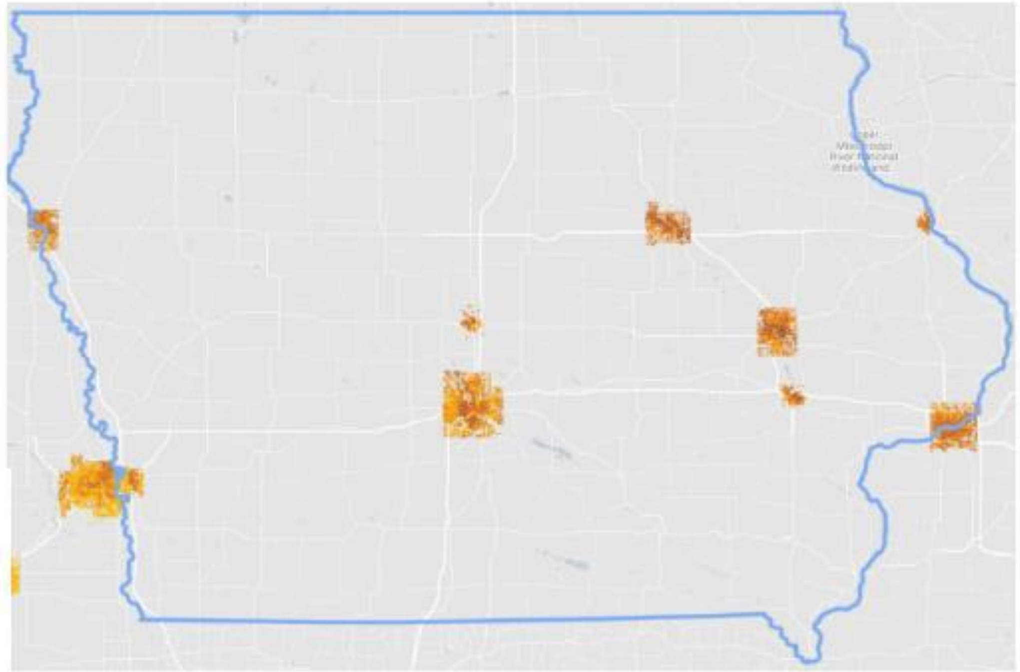
Costs for Solar PV installation in the State have declined 36% since 2015. Price declines have been accompanied with increasing rate of investment in solar energy. A total of $223,860,000 has been invested in Solar PV installations. The industry currently employs 844 people in 72 companies Statewide.

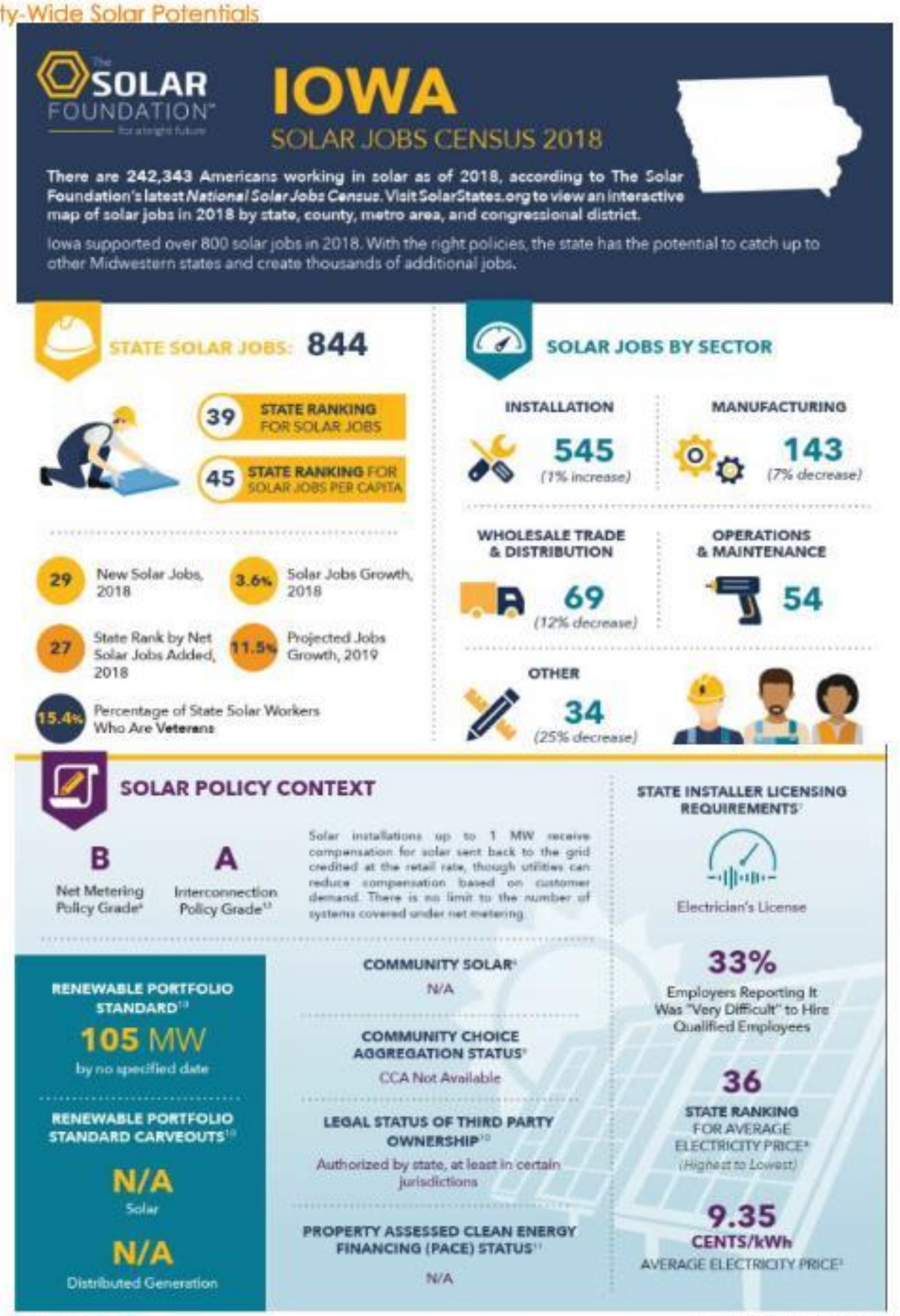
(source: Solar Energy Industries Association SEIA)

Buildings	Roof space	Roofs
74% solar-viable	528M sq ft	350K
4,015 existing solar installations	Capacity 7.5K MW DC	Electricity 8.8M MWh AC per yr

Based on 35% data coverage over buildings in this geographic area. All estimates are based on buildings viable for solar panels. Included panels receive at least 75% of the maximum annual sun in the county. For Iowa, the average value of the threshold is 1,012 kWh/kW

(source: Project Sunroof, SEIA)





(source: Solar Foundation)

Determining Citywide Potentials

Methodology:

1) Input Data:

Roof plane survey (NREL)
lidar data obtained from U.S. (DHS)

2) Roof plan classification by orientation and tilt

Flat (0° - 9.5°)
Low (9.5°- 21.5°)
Mid-Low (21.5° – 34.5°)
Mid-High (34.5° – 47.5°)
High (47.5° and higher)

3) Calculated solar PV energy generation potential Based on Roof Classifications

350 watt panels
Estimated installed capacity based on roof plane type
Calculated system losses based on orientation, tilt
Included average general system losses (22%)

Determining Citywide Potentials

Total Potential

101,217,582 KWh Annually

14% of Citywide Consumption

Generation Capacity In Ames By Roof Slope and Orientation

Breakdown by Roof Orientation (Azimuth)

Breakdown by Roof Tilt			Flat		Low Tilt		Mid-Low Tilt		Mid-High Tilt		High Tilt	
Flat												
Suitable Buildings	2,111	20.98%	2,111									
Suitable Roof Planes	3,884	20.98%	3,884									
Square Footage	1,227,774	21.01%	1,227,774									
Capacity (KW dc)	19,582	21.01%	19,582									
Generation (KWH)	24,438,600	24.14%	24,438,600									
Subtotal South Facing												
Suitable Buildings	2,624	26.08%	0		5		[illegible]		[illegible]		[illegible]	
Suitable Roof Planes	4,829	26.08%	0		1,0		[illegible]		[illegible]		[illegible]	
Square Footage	1,526,668	26.12%	0		326,5		[illegible]		[illegible]		[illegible]	
Capacity (KW dc)	24,349	26.12%	0		5,208		15,615		3,515		12	
Generation (KWH)	27,087,904	26.76%	0		5,595,235		17,329,902		4,149,610		13,157	
West + Southwest												
Suitable Buildings	2,640	26.24%	0		480		1,711		447		2	
Suitable Roof Planes	4,858	26.24%	0		883		3,149		822		4	
Square Footage	1,536,070	26.28%	0		279,158		995,568		259,889		1,456	
Capacity (KW dc)	24,499	26.28%	0		4,452		15,879		4,145		23	
Generation (KWH)	24,960,281	24.66%	0		4,369,453		16,096,615		4,470,177		24,037	
East + Southeast												
Suitable Buildings	2,687	26.71%	0		490		1,749		447		2	
Suitable Roof Planes	4,945	26.71%	0		901		3,218		822		4	
Square Footage	1,554,611	26.60%	0		284,766		1,017,328		251,060		1,456	
Capacity (KW dc)	24,795	26.60%	0		4,542		16,226		4,004		23	
Generation (KWH)	24,730,796	24.43%	0		4,365,925		16,111,479		4,229,848		23,544	
Grand Total			Subtotal: Flat Roof		Subtotal: Low Tilt		Subtotal: Mid-Low Tilt		Subtotal: Mid-High Tilt		Subtotal: High Tilt	
Suitable Buildings	10,061		2,111	20.98%	1,531	15.21%	5,143	51.11%	1,272	12.64%	5	0.05%
Suitable Roof Planes	18,516		3,884	20.98%	2,817	15.21%	9,464	51.11%	2,341	12.64%	10	0.05%
Square Footage	5,845,123		1,227,774	21.01%	890,447	15.23%	2,991,947	51.19%	731,316	12.51%	3,639	0.06%
Capacity (KW dc)	93,226		19,582	21.01%	14,202	15.23%	47,720	51.19%	11,664	12.51%	58	0.06%
Generation (KWH)	101,217,582		24,438,600	24.14%	14,330,612	14.16%	49,537,996	48.94%	12,849,634	12.70%	60,739	0.06%

Determining Citywide Potentials

Optimized Generation Capacity In Ames By Roof Slope and Orientation

Breakdown by Roof Orientation (Azimuth)

Breakdown by Roof Tilt			Flat	Low Tilt	Mid-Low Tilt	Mid-High Tilt	High Tilt
Flat							
Suitable Buildings	2,111	28.46%	2,111				
Suitable Roof Planes	3,884	28.46%	3,884				
Square Footage	1,227,774	28.46%	1,227,774				
Capacity (KW dc)	19,582	28.46%	19,582				
Generation (KWH)	24,438,600	32.01%	24,438,600				
Subtotal South Facing							
Suitable Buildings	2,624	35.39%	0	5[illegible]			
Suitable Roof Planes	4,829	35.39%	0	1,0[illegible]			
Square Footage	1,526,668	35.39%	0	326,5[illegible]			
Capacity (KW dc)	24,349	35.39%	0	5,208	15,615	3,515	12
Generation (KWH)	27,087,904	35.47%	0	5,595,235	17,329,902	4,149,610	13,157
West + Southwest							
Suitable Buildings	2,191	29.55%	0	480	1,711	0	0
Suitable Roof Planes	4,032	29.55%	0	883	3,149	0	0
Square Footage	1,274,725	29.55%	0	279,158	995,568	0	0
Capacity (KW dc)	20,331	29.55%	0	4,452	15,879	0	0
Generation (KWH)	20,466,067	26.80%	0	4,369,453	16,096,615	0	0
East + Southeast							
Suitable Buildings	490	6.60%	0	490	0	0	0
Suitable Roof Planes	901	6.60%	0	901	0	0	0
Square Footage	284,766	6.60%	0	284,766	0	0	0
Capacity (KW dc)	4,542	6.60%	0	4,542	0	0	0
Generation (KWH)	4,365,925	5.72%	0	4,365,925	0	0	0

Grand Total		Subtotal: Flat Roof		Subtotal: Low Tilt		Subtotal: Mid-Low Tilt		Subtotal: Mid-High Tilt		Subtotal: High Tilt	
Suitable Buildings	7,415	2,111	28.46%	1,531	20.64%	3,394	45.77%	379	5.11%	1	0.01%
Suitable Roof Planes	13,646	3,884	28.46%	2,817	20.64%	6,246	45.77%	697	5.11%	2	0.01%
Square Footage	4,313,933	1,227,774	28.46%	890,447	20.64%	1,974,619	45.77%	220,366	5.11%	728	0.02%
Capacity (KW dc)	68,805	19,582	28.46%	14,202	20.64%	31,494	45.77%	3,515	5.11%	12	0.02%
Generation (KWH)	76,358,497	24,438,600	32.01%	14,330,612	18.77%	33,426,517	43.78%	4,149,610	5.43%	13,157	0.02%

Total Potential

76,358,497 KWh Annually

10% of Citywide Consumption

Projecting Market Absorption

Methodology:

5) Using 5 and 10 year Statewide solar install projections for State of Minnesota, Project "Market Absorption" Scenarios to Determine ***likely*** solar array installs in city:

Scenario A: Based on current city share of Statewide install trends (higher than average number of arrays, lower than average KW installed per-capita)
For Climate Action Planning, this could be seen as the baseline condition

Scenario B: Increasing city share in terms of KW installed to match Statewide install trends per-capita

Projecting Market Absorption

Scenario A: Maintaining Current City Adoption Rate and Average Array Size (7.3 KW)

Ames Solar PV Projection

Based Maintaining Existing Share of Installed Capacity x Potential Market Absorption

Year	Cumulative Installed (KW)	Annual Generation (KWH)	% of City Electric Consumption
2025	3,793	4,118,292	0.67%
2030	6,685	7,257,837	1.19%
2040	9,857	10,702,123	1.75%

Scenario B: Based on Potential Market Absorption and Increasing City Adoption Rate to Population Share

Ames Solar PV Projection

Based Population Share of Potential Market Absorption

Year	Cumulative Installed (KW)	Annual Generation (KWH)	% of City Electric Consumption
2025	8,911	9,675,208	1.58%
2030	15,705	17,051,022	2.78%
2040	23,158	25,142,769	4.11%

NOTE: This projection does not include distributed ground-mounted solar pv potentials nor utility scale solar pv installation potential.

Projecting Potential Economic Impact

Ames Local Economic Impacts - Summary Results

Based Scenario B Projection

	Jobs	Earnings Million$ 2020	Output Million$ 2020	Value Added Million$ 2020
During construction period				
Project Development and Onsite Labor Impacts	24	$3.38	$4.61	$3.76
Construction and Interconnection Labor	16	$2.91		
Construction Related Services	9	$0.47		
Equipment and Supply Chain Impacts	24	$1.59	$6.50	$3.20
Induced Impacts	21	$1.26	$3.50	$1.91
Total Impacts	**69**	**$6.24**	**$14.60**	**$8.87**

	Annual Jobs	Annual Earnings Million$ 2020	Annual Output Million$ 2020	Annual Value Added Million$ 2020
During operating years (annual)				
Onsite Labor Impacts	10	$0.68	$0.68	$0.68
Local Revenue and Supply Chain Impacts	2	$0.12	$0.35	$0.24
Induced Impacts	2	$0.14	$0.38	$0.20
Total Impacts	**14**	**$0.94**	**$1.41**	**$1.12**

Projecting Potential Environmental Impact

Carbon and Water Footprint Reduction Potential - Scneario A

Year	Annual Generation (GWH)	GHG Emission Reduction (mTons)	GHG Emission Reduction (Cubic Feet of Atmosphere)	Water Footprint Reduction (Mgallons)
2025	4.12	2,578	51,152,133	21.85
2030	7.26	4,543	90,147,536	38.50
2040	10.70	6,700	132,928,030	56.77

Carbon and Water Footprint Reduction Potential - Scenario B

Year	Annual Generation (GWH)	GHG Emission Reduction (mTons)	GHG Emission Reduction (Cubic Feet of Atmosphere)	Water Footprint Reduction (Mgallons)
2025	9.68	6,057	120,173,009	51.32
2030	17.05	10,674	211,785,904	90.45
2040	25.14	15,739	312,291,209	133.37

Menu of Renewable Energy Strategies

Community-Wide Solar Menu of Potential Actions

In support of the City's interest in Greenhouse Gas emissions reductions and increase in renewable energy generation, the following are a menu of potential actions for the City's consideration and exploration. Note, final actions should be established through a detailed Climate Action Planning effort):

1) Maximize new installations in years 2020 and 2021 for both Residential and Commercial scale projects in order to leverage the greatest potential for local cost savings from the Federal Solar Investment Tax Credit. Actions to support this include:

    a) Develop and distribute information on the advantages of solar with a particular focus on the current tax incentive savings available for both homeowners and businesses. Information should also include detailed information on incentives and opportunities for financing.

    b) Develop and provide a solar benefits educational seminar for residents and businesses, content to include information on the tax incentive savings potential as well as tools and resources for solar procurement and financing.

    c) Conduct a "Solar Top 50" study to identify the top 50 commercial and industrial properties for on-site solar generation. Develop feasibility assessments for each property illustrating energy generation potential and estimated return on investment. Combine feasibility information with information developed in item a above and provide to each subject property owner.

    d) Organize and lead a Commercial Group Purchasing campaign in 2020 and 2021 to competitively bid contractors to offer maximum cost savings based on power of quantity buying. This program could focus on the Solar Top 50 sites identified in item c above as well as combined with City facilities. Program should explore the inclusion of cash purchase as well as third party purchase options.

    e) Organize and lead a Residential Group Purchasing campaign in 2020 and 2021 to competitively bid contractors to offer maximum cost savings based on power of quantity buying.

    f) Develop and distribute a "Solar Ready Guide" outlining steps building owners can take for new construction and renovation projects to make buildings solar ready and decrease the cost of future installations.

    g) Establish a requirement that all City owned new construction projects and significant renovation projects as well as any projects which receive City funding are to be Solar Ready.

    h) Establish a requirement that all City owned new construction projects and significant renovation projects as well as any projects which receive City funding are to include a detailed solar feasibility assessment with projected financial payback (cash purchase and 3rd party ownership options) to be included at time of building permit application. (Strategy encourages awareness of solar potential and potential long-term economic savings)

City-Wide Solar Potentials

Community-Wide Solar Menu of Potential Actions (continued)

2) Maximize new installations in years 2022 and beyond. Actions to support this include:

    i) Continue the City's SolSmart designation efforts and advance to Gold level

    j) Establish an incentive for all privately owned new construction projects and significant renovation projects that are designed to City's Solar Ready Guidelines developed in item f above (incentive may include credit on building permit application and/or expedited permit processing)

    k) Establish a requirement that all new construction projects requiring a Conditional Use Permit or Planned Unit Development be designed to the City's Solar Ready Guidelines developed in item f above.

    l) Establish a requirement that new construction projects and significant renovation projects within the City (private and publicly owned) are to include a detailed solar feasibility assessment with projected financial payback (cash purchase and 3rd party ownership options) to be included at time of building permit application. (Strategy encourages awareness of solar potential and potential long-term economic savings)

    m) Establish a requirement that all private or public projects receiving City of Ames funding be constructed as fully solar ready and include an on-site solar pv array.

    n) Coordinate with other Iowa municipalities and advocate for the establishment of Property Assisted Clean Energy (PACE) financing legislation. Coordinate with Story County to establish a Countywide PACE program.

    o) Coordinate with County to explore the development of new incentive programs, particularly those aimed at low and moderate income residents. Program opportunities may include development of LIHEAP based funding sources.

    p) Conduct a Green Economy Business and Economic Development Potentials study to identify strategies in leveraging economic opportunities in the Green Economy and emerging renewable energy field. Study should focus not only on national, state, and metro area trends, but should identify strengths, weaknesses, opportunities, and threats unique to Ames. The goal of establishing a robust business atmosphere capable not only of serving Ames renewable energy and green economy needs but fulfilling a unique economic niche within the region.

Municipal Refuse Derived Fuel (RDF)

3) Explore implementation of options which result from the pending the completion of the City's Refuse Derived Fuel (RDF) study identifying opportunities to maximize energy production and reduce rejects sent to the landfill.

Thank You!