

Gender and Climate Change in the United States: A Reading of Existing Research



PHOTO CREDIT: PHOTO 159243541 © YVONNE STEWART - DREAMSTIME.COM

PUBLISHED MARCH 2020 IN PARTNERSHIP WITH:





PHOTO CREDIT: ANNABELLE AVRIL / WECF

About the Author: Sam Sellers

Trained as a demographer, Sam is interested in issues at the intersection of demography, conservation, human health, and gender. He most recently served as a Senior Fellow at the University of Washington, Seattle, researching issues related to climate change and human health. Sam received his PhD from the University of North Carolina at Chapel Hill in 2017, and his BA from Swarthmore College in 2011.

Acknowledgements

This report would not have been possible without the planning assistance and constructive feedback provided by Mara Dolan and Bridget Burns at WEDO and A. Tianna Scozzaro and Jessica Olson at the Sierra Club's Gender Equity and Environment Program. Additional review and commentary by Frances Roberts-Gregory (PhD Candidate, UC Berkeley) provided important comments on an earlier draft of this report. We appreciate the generous financial support of the Sierra Club in funding the creation of this report. Janet Leydon conducted the report's graphic design.

WEDO



The Women's Environment and Development Organization (WEDO), founded in 1990, is a global women's advocacy organization, working for a just world that promotes and protects human rights, gender equality, and the integrity of the environment. WEDO's headquarters is located in New York. Visit us at www.wedo.org.

Sierra Club



The Sierra Club is a grassroots environmental organization in the United States working to amplify the power of our 3.5+ million members and supporters to defend everyone's right to a healthy world. The Sierra Club's Gender, Equity and Environment Program advocates for gender equity so that these communities can become healthier, stronger, and better prepared to adapt to climate disruption. See more at www.sierraclub.org/gender.

Table of Contents

4	1. Introduction
5	2. Research Methods
6	3. Human Health
6	3.1 Deaths & Injuries Associated with Extreme Weather Events
7	3.2 Heat Mortality and Morbidity
8	3.3 Infectious Disease
8	3.4 Mental Health
9	3.5 Gender-Based Violence
10	3.6 Respiratory Health
11	3.7 Reproductive Health Outcomes
11	3.8 Elderly Health
12	4. Gendered Impacts of Extreme Weather Events
12	4.1 Gendered Disaster Preparation
12	4.2 Gendered Evacuation
13	4.3 Gendered Economic Well-Being
13	4.4 Women Recovering from Disaster
14	5. Employment in Climate-Affected Sectors
14	5.1 Gendered Employment Data
14	5.2 Gendered Employment in Energy-Related Sectors
17	5.3 Gendered Employment in Other Climate-Affected Sectors
19	6. Climate Change Perceptions, Attitudes, Knowledge, and Behaviors
20	6.1 Climate Change and Environment Perceptions, Attitudes, and Knowledge
20	6.2 Gendered Environmental Behaviors
21	6.3 Women's Leadership and Representation
22	7. Knowledge Gaps and Conclusion
23	Resources
24	Appendix 1: Search Terms and Technical Notes
25	Appendix 2: Leading US-focused Gender and Climate Change Academic Researchers
26	Appendix 3: Organizations Related to the Intersection of Gender, Women's Rights and Climate Change Activities in the US
30	References

1. Introduction

Climate change poses a substantial threat to human well-being throughout the United States, and as recent extreme weather and climate events have shown, the effects of climate change are rapidly worsening. However, because of the myriad impacts of climate change on economic well-being as well as on human health, different people will be affected in different ways. This review uses gender as a lens to examine the literature on the effects of climate change in the United States, highlighting how gender shapes experiences of climate change.

In recent years, despite unprecedented protests and increasing concern about climate change among the American public, U.S. policymaking to mitigate and adapt to the effects of climate change has largely stalled.¹ At the international level, the United States continues to lag behind other high-income countries which have engaged in national planning and policymaking in accordance with their international obligations. Most notably, in 2017, President Trump announced the intended withdrawal of the U.S. from the Paris Agreement, a landmark 2015 accord that provides a global framework for tackling climate change. On November 4, 2019, the President initiated the formal withdrawal process from the Paris Agreement, which will go into effect one year following the announcement. However, the election of a new administration in 2020 could reverse this course, allowing the U.S. to quickly rejoin the Agreement. Virtually every other country in the world remains a signatory to the Agreement, and it is a key global standard for climate action. The U.S. has also stopped payments to the Green Climate Fund, the largest global financing mechanism for climate adaptation, resulting in a \$2 billion gap between what the U.S. has pledged and what has been delivered.² The U.S. decision to withhold these funds imperils climate adaptation and mitigation efforts designed to support vulnerable populations in less developed countries.

Moreover, policy choices at the national level are likely to slow emissions declines in future years. The Trump Administration has sought to limit increases in vehicle mileage standards, locking in further vehicle fleet emissions for many years to come. Additionally, the U.S. Environmental Protection Agency is seeking to replace the Clean Power Plan, which imposed stringent emissions limits on new power plants, with an alternative plan with far more permissive requirements.³ U.S. carbon dioxide emissions rose by 2.7% in 2018, a disturbing but not entirely unsurprising development given these recent policy changes.⁴ Without significant policy reversals, U.S. greenhouse gas emissions are unlikely to rapidly decline in future years.

However, more progress has been made at the state and local level. New York State recently announced a landmark target to eliminate greenhouse gas emissions by 2050, while 22 other states and the District of Columbia have adopted targets to drastically cut their emissions by that date.⁵ Moreover, 29 states have adopted renewable portfolio standards designed to increase the proportion of electricity generated from sustainable energy sources.⁶ Additionally, nearly 300 city and county governments across the country have made a firm commitment to continue reducing emissions, despite the announced U.S. withdrawal from the Paris Agreement.⁷

While there are many challenges associated with mitigating and adapting to the effects of climate change in the United States, there are also reasons for hope. There is a robust advocacy movement throughout the United States focused on climate change, including entities that view gender as a key part of their analysis and work. This movement is contributing towards key changes already underway to help Americans mitigate and adapt to the effects of climate change while yielding gender-equitable outcomes. This advocacy is happening concurrent to growing concern and awareness over gender-based harassment and sexual violence as evidenced by the #MeToo movement. Activists have also fought to end the gender pay gap and strengthen access to sexual and reproductive health services, including drawing attention to the particular barriers faced by Black, Hispanic*, and Indigenous women as well as women in low-income communities. We emphasize the importance of synergies and intersections between the two growing activist movements targeting climate action and contemporary gender injustice in the US.

The findings of this review in the U.S. is consistent with a global body of evidence which describes climate change as amplifying existing inequities. Individuals with lower incomes, less social or institutional support, significant care-taking responsibilities, serious health conditions or disabilities, or other socioeconomic and health challenges are likely to be more vulnerable to climate impacts. Such vulnerabilities can result in gendered differences in how people are able to respond to extreme weather events or long-onset climate impacts facing their communities. This story is complex and additional research of key vulnerable populations[†] is critical to more fully understanding how different individuals will experience the impacts of climate change throughout the US.

This review proceeds as follows: Section 2 briefly discusses the methods used in this review; Section 3 explores the gendered health impacts of climate change; Section 4 examines the gendered effects of natural disasters; Section

5 examines gendered employment in sectors likely to be affected by climate change; Section 6 explores gendered perceptions, attitudes, knowledge, and behaviors regarding climate and the environment; Section 7 examines gaps in the literature and concludes. Beyond that, we provide a list of researchers exploring gender and climate change linkages as well as a list of key organizations engaged in gender and climate change activism and advocacy in the United States

2. Research Methods

This review is a reading of existing literature on climate change and gender in the United States; it must be stated from the outset that viewed in totality, this body of work significantly lacks intersectional analysis. Though this will be more thoroughly explored in our discussion, this review reflects the frameworks utilized in the current body of literature, while also highlighting when it leaves critical gaps that must be explored, most notably the lack of engagement with intersectional perspectives.

In general, existing literature distinguishes between sex and gender, with an understanding of gender that refers to the attributes, opportunities and relationships associated with being male and female, which are socially constructed and produced through socialization. As most of the empirical evidence on gender and climate change in the U.S. context uses a binary understanding of gender that is often conflated with sex, this framing is reflected in much of the review below. However, we note that such a framing has important limitations and consequences, explored in additional detail below.

In order to collect the information for this review, we adopted two primary approaches. First, we conducted a literature search using the Web of Science academic database, which searches articles that have been published in academic journals and are peer-reviewed by other scholars prior to publication. Searches were limited to

* In this report, we use “Hispanic” and “Latino/a” in a broad sense to encompass the wide variety of individuals that may identify with one or both of these terms.

† It is imperative to note that these vulnerabilities are not inherent; they are a manifestation of social and institutional structures that disadvantage certain populations. While it is important to understand vulnerability in order to help remedy disparities, an emphasis on vulnerability can also deemphasize the constructed nature of this vulnerability and the reality that “vulnerable” populations are enablers of change. Many of the groups that face additional vulnerability to the effects of climate change are also those that are fighting hardest to generate structural transformations that remedy social disparities, including those related to the effects of climate change, as this review highlights.

English-language publications available as of July 2019. A full set of the search terms used is located in Appendix 1. After we conducted this search, we received additional academic articles not included in the search results from one of our reviewers, which have been incorporated into the text below. Second, we explored a variety of data sources from government or nongovernmental entities relevant to understanding the gendered impacts of climate change, such as databases provided by the U.S. Department of Labor.

Most of the studies identified use quantitative methods, whereby a variety of variables about hundreds or thousands of individuals are incorporated into a statistical model in order to predict a particular outcome. Frequently, one of these variables is gender, usually measured as a binary (women/men). When included in a statistical model, this variable enables researchers to detect the effect of gender on a particular outcome when adjustments have been made for other demographic variables (such as race or age) or socioeconomic variables (such as income or employment status). Though incomplete, a key advantage of such research is the ability to draw generalizable conclusions about large populations, which can be an important first step in creating effective public policies. However, such a methodology has limitations, including that it makes it challenging to discern differences in outcomes among women or among men, despite the fact that there is very often heterogeneity in experiences or preferences within genders. Moreover, such methods are unable to draw conclusions and often even erase the specific experiences of individuals who do not identify within the gender binary and who may identify with other gender identities. As most of the scientific literature on gender and climate change in the U.S. context uses a binary understanding of gender, this review reflects this framing while acknowledging its limitations, consequences, and the gaps we believe future research must address.

Other research cited in this review uses qualitative methods, where a smaller number of individuals were interviewed by scholars to provide an in-depth understanding of personal experiences. A major advantage of such methods is the ability to better understand the complexities and nuances that lead to particular outcomes for individuals, providing deeper insights that can support policymaking and advocacy efforts. A downside is that because relatively few individuals are interviewed in many qualitative studies, it is generally more difficult to make claims about the experiences of large populations.

We acknowledge that there are many perspectives through which to understand climate change experiences, and

gender is but one lens that can be adopted. A variety of other identities, including race/ethnicity, age, socioeconomic status, ability, sexual orientation, and immigration status, among others, affect how individuals are exposed and respond to the effects of climate change. Unfortunately, there is a significant lack of research into gendered climate impacts on a variety of vulnerable populations, making it challenging to conduct an intersectional analysis. While we note the role of identities other than gender in shaping individual experiences where made available and explicit in existing research, we hope that future iterations of this review can adopt a more robust intersectional lens. We more extensively address these knowledge and research gaps in Section 7.

3. Human Health

Climate change has a wide range of impacts on human health, through mechanisms such as extreme heat and infectious disease, as well as through the impacts of natural disasters, such as hurricanes.⁸ While the specific impacts vary by geography, all parts of the U.S. will experience health impacts associated with climate change, many of which are disproportionately encountered by individuals of a particular gender. Individuals who live or work in close proximity to greenhouse gas emitting sites, such as oil refineries or coal-fired power plants, tend to experience a range of negative health impacts because such sites also emit conventional air pollutants. Such sites are disproportionately located in racial/ethnic minority and low-income communities.^{9,10} This section explores the varied evidence of gendered health harms associated with climate change and climate-related natural disasters in the United States.

Key Takeaway Messages:

- Climate change affects the health of all of us, regardless of gender. Policies to adapt to climate change and improve responses to extreme weather events can save lives and prevent health harms.
- Some climate health hazards disproportionately affect men, such as illnesses associated with heat or some infectious diseases, which is likely linked to men's greater exposure to outdoor settings, particularly for work.¹¹
- Other climate health hazards disproportionately affect women, such as experiencing gender-based violence. Increases in GBV have been linked to both natural disasters, associated with emotional stress and loss¹² as well as extractive industry development that can often spur growth in sex trafficking, disproportionately affecting Indigenous women.¹³

- Experiencing extreme weather events is associated with greater risks of low birth weight¹⁴, and preterm births.¹⁵ Air pollutants emitted by industrial sites that also produce greenhouse gases (such as coal power plants or oil refineries) can also increase the risk of low birth weight or preterm births.^{92,93}

3.1 DEATHS & INJURIES ASSOCIATED WITH EXTREME WEATHER EVENTS

Climate-related disasters can pose significant risks to human life. A variety of studies have explored deaths and injuries associated with natural disasters through different means, including examining death records, hospital admissions records, or other data sources. In general, men appear to be at a slightly greater risk than women of dying and being injured in major hurricanes, although the specific magnitude varies by event. This disparity is often linked with greater engagement in risky behavior among men, such as driving in floodwaters, as well as greater representation among men as emergency responders.

- Studies conducted after Hurricane Maria struck Puerto Rico found that men experienced a larger increase in mortality rates following the storm, and that this elevated mortality risk lasted longer after the storm than it did for women.^{16,17}
- A disproportionate risk of death among men has also been found during and immediately following other U.S. hurricanes, including Katrina^{18,19}, Florence²⁰, Harvey²¹, and Sandy.^{22,23} Data following Hurricane Sandy also suggests a far higher nonfatal injury rate among men in the week following the storm.²⁴
- In line with trends from other countries, men in the United States are also more likely to die in flood events.^{25,26} For instance, studies from Texas find that men are about twice as likely to die during floods as women.^{27,28}

One key risk during and following disasters is falling trees, which can strike cars, homes, or pedestrians, leading to serious injury and death. A review of these deaths in the US found that 62% were of men.²⁹ Tree-related injuries, such as falls or injuries sustained during tree removal, significantly increased in New Jersey following Hurricane Sandy, with roughly 90% occurring among men.³⁰

Another key risk associated with disasters is carbon monoxide (CO) poisoning, often occurring when generators or grills are used indoors during electricity outages. A review of cases across the US found that disaster-related CO fatalities disproportionately occur among men (79%), and that these are often associated with the use of generators indoors. However, most CO poisonings are nonfatal, and such poisonings disproportionately occurred among women

(58%).³¹ Similar results were found in a study conducted after Hurricane Sandy, where 60% of individuals poisoned by CO in the aftermath of the storm were women.³²

Disasters can also disrupt lives and health infrastructure in ways that worsen physical health outcomes well after the event, with gendered effects. For instance, the rate of disability went up significantly for women, but not men, following Hurricane Katrina, with roughly 1-in-4 women in New Orleans reporting a disability in the year following the storm.³³

3.2 HEAT MORTALITY AND MORBIDITY

Extreme temperatures pose significant risks to human health due to conditions associated with cardiovascular stress and dehydration.^{34,35} In the U.S., exposure to extremely high temperatures has already resulted in elevated mortality³⁶, and these risks are likely to worsen in future decades due to the effects of climate change.³⁷ However, men and women will experience different levels of exposure to these temperatures, which is affected by gendered differences in work and leisure activities. In general, individuals who remain indoors and well-hydrated are able to avoid occupational heat-related health problems, particularly if air conditioning

is present. However, some individuals work in occupations where they are required to be outdoors, even on the warmest days, placing themselves at heightened risk of heat-related illness. This is particularly true in the agriculture and construction industries, where men are disproportionately represented in the labor force (see Section 5).

In general, because of this disparity, academic studies have identified working-age men as being at a particularly high risk of heat illness. Moreover, there is evidence from the Southeastern U.S. that temperature effects may be stronger for men than for women, that is, as the temperature goes up, the health risks associated with heat appear to increase more for men than for women, likely because of the greater exposure of the former to extreme heat.^{38,39} Researchers measure heat-related illness in different ways; some studies measure hospitalizations associated with severe dehydration or cardiovascular issues, while other studies examine deaths from heat-related illnesses. However, regardless of the outcome measured, most come to similar conclusions about elevated heat health risks faced by men.

A variety of empirical studies have been conducted in the U.S. on gendered heat health impacts. Figure 1 presents a

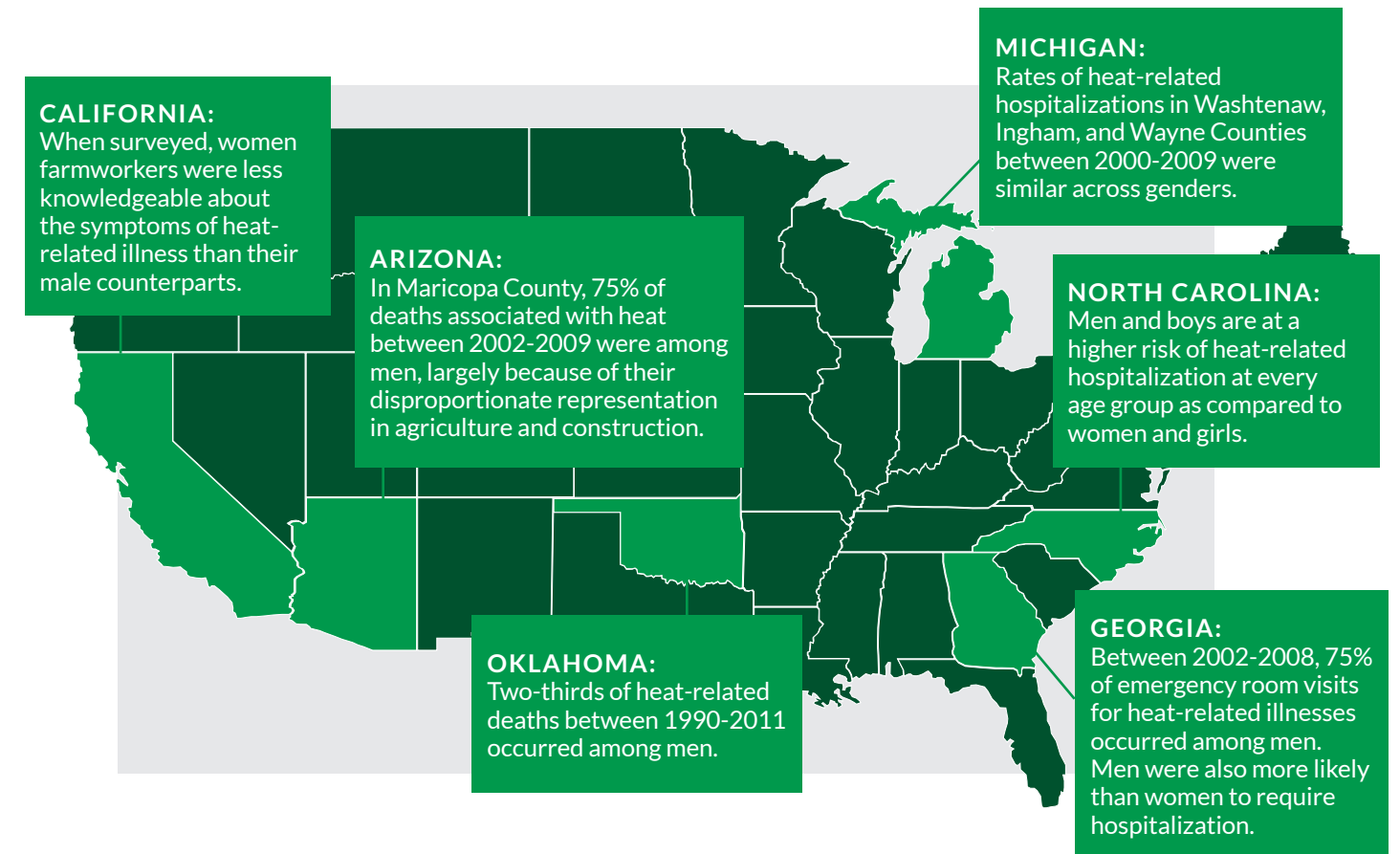


Figure 1: A snapshot of state- or local-level studies on gendered heat health impacts.¹⁶⁷⁻¹⁷²

sampling of evidence from state- and local-level studies. Multi-state or nationwide findings include the following:

- A nationwide study looking at work-related heat deaths identified 359 deaths occurring between 2000 and 2010. Of these, only 10 were of women, resulting in a risk of heat death 32 times higher for men per year worked than for women.¹¹
- When examining all heat illnesses (as opposed to those associated with work), a similar pattern emerges. In a sample of hospitals nationwide, 73% of heat-related emergency department visits, such as for dehydration or heatstroke, occurred among men⁴⁰
- A study examining heat-related hospitalizations in 20 states found that men were more than twice as likely as women to be hospitalized.⁴¹
- Additionally, there is evidence from a nationwide study that extreme heat during pregnancy is associated with pregnancy-related conditions such as hypertension and eclampsia.⁴²
- By contrast, among U.S. Army soldiers, women experienced a higher rate of hospitalization due to heat illness than their male counterparts (although the absolute number of hospitalizations was much greater for men, because of their greater representation in the armed forces).⁴³

3.3 INFECTIOUS DISEASE

Climate change is likely to increase the range and seasonality of various infectious diseases, which can also pose gendered health risks. For instance, the number of reported Lyme disease cases has surged in recent years, with the range of the *Ixodes* ticks that carry the disease also expanding.^{44,45} Lyme disease is often underreported, but the data that are available suggests that men are at a slightly elevated risk of getting the disease in the U.S. Gendered differences in Lyme incidence are likely due to men's increased exposure to grassy or wooded areas for occupational or recreational purposes, as well as their diminished likelihood of engaging in prevention behaviors.⁴⁶

Different data sources yield slightly different estimates as to what the gender gap in Lyme disease risk is. The most recent surveillance data (2018) from the U.S. Centers for Disease Control and Prevention (CDC), shows that there were roughly 36% more probable or confirmed cases of Lyme among men than among women.⁴⁷ Recent multi-year surveillance data suggest similar patterns, with males comprising roughly 57% of Lyme cases nationwide, though with women at a slightly higher risk than men in areas with low incidence.⁴⁸ However, studies focusing on individual states, which use health system records to assess

incidence, find that the gender gap may be narrower than what is reported by CDC. For instance, data from a major Pennsylvania health system found that only 52% of cases were identified in men, with women being more likely than men to experience persistent Lyme symptoms following treatment.⁴⁹ Additionally, a large study of health records in Maryland found no significant difference in Lyme incidence by gender.⁵⁰

Similar gendered differences are found for some mosquito-borne diseases, such as West Nile virus, where cumulative incidence records show males are at greater risk.⁵¹ In 2018, the most recent year for which CDC data are available, 62% of reported cases were among men.⁵² By contrast, more than four out of every five reported Zika infections in 2018 were among females.⁴⁷ This may be because of reporting gaps; due to concerns about Zika and adverse pregnancy outcomes, women may be more likely to be tested for Zika, which is often asymptomatic.

3.4 MENTAL HEALTH

Extreme weather is associated with substantial impacts on mental health, including stress, depression, and increases in substance use disorders. Each disaster is unique, and more severe extreme weather events tend to be associated with more substantial mental health impacts. Much of the evidence in the U.S. context has been collected after Hurricane Katrina (see text box), which resulted in significant mental health impacts in part because of the prolonged effects of the storm on livelihoods. Studies after other U.S. disasters have generally found weaker and less gendered impacts on mental health.

In addition to studies exploring the aftermath of Katrina, other research has found significant mental health impacts associated with extreme weather events, although the gendered impacts vary based on the nature of the particular event. Several studies have explored the aftermath of Hurricane Sandy, finding few, if any significant gendered differences in posttraumatic stress symptoms and depression following the event.⁶⁴⁻⁶⁷ One study following the event noted that while the incidence of mental health challenges following the storm was similar across genders, women were significantly more likely to utilize mental health services, resulting in a treatment gap for men.⁶⁸ However, mental health services may also be disrupted in ways that are gendered during and following disasters. For instance, following wildfires in San Diego, women who were being treated for mental health disorders experienced greater difficulty during evacuation in getting information and taking medicines than similarly situated men.⁶⁹



Gendered Mental Health Effects of Katrina

Much of the evidence on the gendered mental health impacts of climate change in the U.S. centers on the aftermath of Hurricane Katrina, a disaster unique in its scale and effect on lives throughout the Gulf Coast. While the significant adverse impacts of Katrina on mental health are not necessarily representative of all climate-related events, they should serve as a wake-up call to policymakers and health professionals, among others, given the increased potential for similarly destructive events in a world with a changing climate and significant inequalities.

Studies measuring posttraumatic stress disorder following Katrina found elevated levels among women and particularly among Black women. Studies of individuals affected by the storm found that women were more likely to experience symptoms consistent with post-traumatic stress disorder, although specific levels vary across studies due to differences in the post-storm duration measured and sampling strategies.⁵⁴⁻⁵⁶ Studies that explored other psychological metrics, such as psychosocial distress or depression, also found elevated risks for women, with the highest risks for Black women.^{57,58} Young and middle aged Black women were also more likely to experience increases in mental and physical impairments.³³ These differences are likely in part due to the greater vulnerability of Black women to damage caused by the storm. Heightened vulnerability to the effects of climate change among Black women

is a product of structural racism and sexism as well as economic disinvestment, among other factors.

Studies of specific populations that experienced Katrina find important intragroup differences that affect mental health outcomes:

- A study of pregnant women's experiences found that race and lower levels of education were significant predictors of postpartum depression, in part because those characteristics were associated with greater disruption and loss from Katrina.⁵⁹
- Women's experiences before and immediately after Katrina affected long-term psychological outcomes, with women who experienced fewer traumatic events before the storm, as well as who had stronger social networks tending to fare better than those who did not.⁶⁰
- Similarly, a study of mothers following Katrina found strong persistence of posttraumatic stress symptoms four years after the event, particularly among women who experienced housing damage or had lower incomes.⁶¹
- However, mental health problems also occurred in predominantly male groups, such as firefighters. One study reported 27% of firefighters experienced depressive symptoms three months after the storm.⁶² Among adolescents, gender was not predictive of psychological distress following Katrina.⁶³

Studies that explore specific groups exposed to disasters find some gendered effects, although these center more on the protective factors that can modify the risk of developing mental health problems rather than the incidence of such challenges.

- Among women exposed to disasters, those who experienced the event in early adolescence are less susceptible to developing depression and PTSD than older individuals.⁷⁰
- Among women exposed to the Deepwater Horizon oil spill, Black and Hispanic women were more likely than White women to experience depressive symptoms following the event.⁷¹
- Women with greater exposure to a disaster often

experience greater mental health impacts. For instance, pregnant women who were more affected by floods in Iowa experienced greater depressive symptoms.⁷²

3.5 GENDER-BASED VIOLENCE

The stress and disruption associated with natural disasters can also result in an increase in gender-based violence, which disproportionately affects women. Following Hurricane Katrina, scholars documented a substantial increase in gender-based violence, although differences exist between studies regarding the magnitude and significance of findings. Overall, both women and men were more likely to report psychological forms of victimization after the storm, with



PHOTO CREDIT: PICKSTOCK ID:458661503

women also significantly more likely to report physical forms of victimization.¹² A study examining displaced populations in trailer parks found that the rate of violence more than tripled for women surveyed in the year following the storm, and elevated risks persisted two years after the storm.⁷³ Women with greater exposure to Katrina were more likely to be involved in partner conflict after the storm.⁷⁴ By contrast, a study examining female college students in New Orleans found no increases in experiences of sexual violence.⁷⁵ Given the chaotic environment in the affected areas in the weeks after the storm, it is likely that there were significant numbers of cases of gender-based violence that went unreported, and we will never know the true incidence.⁷⁶

Elevated risks of GBV have also been found in the aftermath of other disasters, likely in part due to stress associated with the disaster. For instance, a study of Florida counties and the impacts of the severe 2004 hurricane season found that counties with greater exposure to hurricanes experienced higher rates of simple assault in the following years compared to similar counties that did not experience as significant an impact.⁷⁷ Additionally, greater exposure to the Deepwater Horizon oil spill among women was associated with higher levels of interpersonal violence.⁷¹

The presence of extractive industries in rural areas, particularly oil and gas extraction in Indigenous communities, often correlates with increases in gender-based violence

and sex trafficking.^{13,78,79} For instance, research in the Fort Berthold Indian reservation, home to the Mandan, Hidatsa and Arikara Nation, documented a substantial increase in sex trafficking and sexual violence against Native women as oil and gas development brought predominantly male workers to live in what are colloquially called “man camps.”¹³ Addressing this problem will require numerous strategies, including more accountable governance, stronger law enforcement capacity, as well as greater public pressure on fossil fuel companies to enact and enforce anti-trafficking policies.

3.6 RESPIRATORY HEALTH

Studies conducted following major wildfire events suggest that women’s respiratory function tends to be more affected than that of men. However, changes in aeroallergen concentrations associated with climate change appear to disproportionately affect boys rather than girls.

- After 2008 wildfires in California, women were significantly more likely than men to visit the emergency room for asthma-related conditions. While men’s risk of visiting the ED increased by roughly 2%, women’s risk increased by 7%.⁸⁰
- A study examining the effects of fires in the Western United States found that women were 10% more likely to be admitted to the hospital for respiratory problems during days with heavy smoke, while men were only 4% more likely.⁸¹

- After wildfires in Washington State, hospitalizations for respiratory or cardiovascular ailments increased at roughly the same rate among both genders.⁸²
- Exposure to particulate matter air pollutants increases the risk of children being hospitalized for asthma, with the majority (roughly 61%) of hospitalizations occurring among boys.⁸³
- Among U.S. adults, however, women are almost twice as likely as men to have asthma. Moreover, women tend to experience more severe asthma; women with asthma are more than 1.5 times as likely as men to visit the emergency room because of their condition.⁸⁴
- Gender gaps appear less pronounced with conditions associated with indoor air quality, although more research is needed to better understand these relationships. A study conducted after Hurricane Katrina found that women were at no greater risk than men for experiencing respiratory symptoms due to mold or dust in flooded homes.⁸⁵

Climate change is also associated with changes in pollen and other allergens in the United States.^{86,87} Among children, boys are at an overall greater risk than girls of experiencing allergies.⁸⁸ The prevalence of many allergies, such as hay fever, is mediated by environmental factors such as temperature and precipitation, with a disproportionate effect on boys.⁸⁹

3.7 REPRODUCTIVE HEALTH OUTCOMES

Reproductive health can be adversely affected by climate change. A variety of studies have linked both greenhouse gas production and climate-related events, including natural disasters and persistently high temperatures, with poor infant and maternal health outcomes:

- Higher ambient temperatures in California are linked with significantly higher levels of preterm birth and stillbirth.^{90,91}
- Nationwide studies examining millions of births find a strong association between high temperatures and low birth weight¹⁴, as well as preterm birth.¹⁵
- Exposure to air pollution caused by facilities that emit greenhouse gases can also significantly increase risks of low birth weight⁹² and preterm birth.⁹³

Hurricanes and other climate-related events are also associated with similar adverse pregnancy outcomes:

- Heavy exposure to Hurricane Katrina immediately before or during pregnancy was associated with significantly elevated risks of preterm birth and low birth weight.⁹⁴
- Studies exploring other hurricanes have found heavier hurricane exposure linked to other adverse pregnancy

outcomes, including extremely preterm delivery⁹⁵, fetal distress⁹⁶, and reliance of a newborn on a ventilator.⁹⁷ While more research is needed to more fully understand the mechanisms underlying these relationships, it is likely that stress related to extreme events is a contributor to these adverse outcomes.

- A study of Red River flooding in North Dakota found increased that the proportion low birthweight births grew by 20%, while the proportion of preterm births grew by roughly 10% in the most-flood affected counties. Additionally, mothers in these counties were nearly ten times more likely to experience eclampsia in the years following the floods than before.⁹⁸

Family planning use can also be affected by disasters, potentially resulting in greater unprotected sex and higher rates of unintended pregnancy. Following hurricanes Katrina and Ike, many women reported difficulty accessing contraception.^{99,100} Following Hurricane Ike Black women were more than twice as likely as White women to lack access to contraception.¹⁰⁰

3.8 ELDERLY HEALTH

Older individuals often experience more substantial health challenges that can generate obstacles during disasters, including needing specialized medical equipment or requiring regular interactions with healthcare providers. These challenges can be gendered, in part because women’s longer life expectancy tends to result in a disproportionately female elderly population. Some examples include:

- A survey conducted in New Orleans prior to Katrina found that older women were more likely than older men to require equipment such as a wheelchair or special bed, which presents added challenges for evacuation.¹⁰¹
- Women were admitted to hospitals during the 2003 New York City blackout at a higher rate, potentially because of the disproportionate effect of this event on the elderly population, which is disproportionately female and also tends to be susceptible to extreme heat.¹⁰² While this event was not caused by climate change, blackouts may become more frequent as weather becomes more severe.
- Nationally, men are as likely as women to utilize electricity-dependent medical equipment, the use of which can be disrupted during extreme weather events.¹⁰³

Studies following severe weather events illustrate varied impacts on the elderly. For instance, following Hurricane Sandy, elderly women were significantly more likely than elderly men to experience respiratory and cardiovascular diseases, as well as physical injuries¹⁰⁴, although elderly

men were more likely to visit the emergency room in the weeks following the storm.¹⁰⁵ Icy conditions appear to disproportionately reduce the likelihood that older women will leave the home to undertake activities such as exercise, grocery shopping, or volunteering.¹⁰⁶ While staying indoors is not desirable for overall well-being, it may be a sensible short-term choice; researchers have identified men at being at greater risk for sustaining fractures during the winter months, likely due to increased outdoor exposure.¹⁰⁷

4. Gendered Impacts of Extreme Weather Events

Gender factors into differentiated experiences before, during and following natural disasters, effects that are likely to become more pronounced during future severe weather events. Broadly, there is a dearth of evidence, particularly quantitative studies, exploring the gendered impacts of disasters. This section explores several ways in which experiences of disasters vary along gendered lines, including in preparation, evacuation, and recovery experiences following disasters.

Key Takeaway Messages:

- Women and men prepare for, and experience, disasters differently. While studies vary in their findings, in general, men appear to be more prepared for severe weather events.¹⁰⁸
- Women are generally more likely than men to evacuate during major hurricanes.¹⁰⁹
- The socioeconomic effects of major storms last well after the event has passed. There is some evidence to suggest women struggle for longer after these events than do men.¹¹⁰

4.1 GENDERED DISASTER PREPARATION

Across the United States, there is substantial evidence that men are better prepared to deal with natural disasters or other climate and extreme weather events. A 2008 nationwide survey found that men were more likely to have an emergency kit and plan¹⁰⁸, while multistate studies have found men are more likely to be prepared for emergencies by having at least a three day supply of food, water, and prescribed medications, as well as battery-operated radios and flashlights.¹¹¹⁻¹¹⁴ However, other studies have found no significant gender differences in disaster preparedness among general populations in vulnerable locations^{115,116}, as well as among populations with special medical needs^{117,118}, suggesting that more research is needed to better understand under what circumstances gender is associated with disaster preparation.

4.2 GENDERED EVACUATION

While results vary across studies¹⁰⁹, there is substantial evidence that in many major storms, gender is a significant predictor for evacuation behavior. Studies from various major storms, including Sandy¹¹⁹, Katrina¹²⁰, and Gustav¹²¹ find that women are more likely to follow evacuation orders when given, with men being more willing to try and ride out a storm or evacuate during/after a storm. However, this is despite the fact that many women view public hurricane shelters as unsafe places. For instance, a study of women in hurricane-prone parts of North Carolina cites the potential for sexual violence as a key reason for women opting not to evacuate to public shelters¹²², while many women who evacuated after Katrina feared for their safety in FEMA-operated trailer parks.¹²³

During Hurricane Katrina, it was widely reported that many low-income and predominantly Black communities experienced difficulty evacuating due to lack of available vehicles.¹²⁴ It is also possible that women are less likely to have access to vehicles for evacuation, although data to explore this hypothesis are generally scarce, highlighting an important research need. The U.S. Census Bureau annually conducts a survey which asks about available vehicles within the household. In several major U.S. metro areas where evacuation from a major storm event is possible, women workers are less likely than men to be part of a household that owns a car, although the gap is generally small (Table 1).¹²⁷

Further, existing scholarship on LGBTQI experiences during evacuation and recovery to Hurricane Katrina point to differing needs and support based on identity. For instance, given the definition of “family” by both governmental and non-governmental entities same sex couples and their families were separated and resettled in different cities.¹²⁶ An added layer of complexity in evacuation and response efforts disproportionately burdened transgender and intersex people who were often denied access to aid based on having the “wrong” identification information versus their gender expression and subjected to harassment in evacuation shelters where their identities were questioned and gender-appropriate bathroom access was difficult.¹²⁷

Following Katrina, women and men were about equally likely to return to the city. However, White people, with larger wealth on average, were about 40% more likely to return than Black residents.¹²⁸ Moreover, among single Black mothers, homeowners prior to the storm were significantly more likely to return to their pre-Katrina homes than renters or those in subsidized housing.¹²⁹ Many poor, Black women were reticent or unable to return to New Orleans following

METRO-AREA	FEMALE	MALE
Miami-Fort Lauderdale-West Palm Beach	3.4%	3.7%
Orlando-Kissimmee-Sanford	2.3%	2.6%
New Orleans-Metarie	4.6%	4.4%
New York-Newark-Jersey City	31.8%	28.3%
Houston-The Woodlands-Sugar Land	2.5%	2.2%

Table 1: Percentage of workers age 16 or over by sex in major U.S. metro areas with no motor vehicles in their household, for the period 2013-2017. See Appendix 1 for additional details.

the storm because of higher living costs, less accessible public services, and weakened social networks.^{130,131}

4.3 GENDERED ECONOMIC WELL-BEING

Women and men experience different economic impacts of disasters, and are differently prepared economically to respond to disasters. Women’s emergency savings rates are lower than that of men, and women are more likely to be financially fragile, without access to liquid assets equivalent to three months’ income.¹³² In the U.S., post-disaster economic impacts have been primarily studied in the context of Katrina. After Katrina, men were more likely to have recovered in the labor market, namely, they were more likely to be employed in jobs of equal status (measured subjectively) after the storm than before.¹³³ Women were also more likely to request loans from the Small Business Administration after the event, suggesting women-owned businesses had been harder hit and/or had greater difficulty getting capital for repairs from other sources.¹³⁴ Additionally, women-owned businesses were more likely to fail after Katrina.¹³⁵

4.4 WOMEN RECOVERING FROM DISASTER

After disasters, women often face myriad challenges in rebuilding their lives while supporting their families and communities. In the U.S., these challenges have been primarily explored in the aftermath of Katrina. Various

scholars have explored women-led advocacy efforts in the aftermath of this event, noting the key role that women of a variety of backgrounds including low-income women and Black women, played in galvanizing support for more just post-disaster policies. For instance, a group of Louisiana women mobilized in early 2006 to advocate for more resources to support recovery efforts. Approximately 140 women flew to Washington D.C. to lobby congressional representatives and invite them back to Louisiana to view the storm damage first-hand.^{136,137} Other key areas of activism included groups supporting victims of sexual violence as well as public housing residents.¹³⁶ However, many women engaged in front-line recovery work felt marginalized by their experiences, with most key decisions being made by (usually White) men. As a result, many women felt recovery activities all too often reinforced structural inequities rather than ameliorated them.¹³⁸ Additionally, some women felt that activism following the storm was too often framed in gender-neutral terms, and consequently failed to meet the gendered needs of certain marginalized populations.¹³¹

Moreover, women often were saddled with significant parenting responsibilities after Katrina, such as finding new schools for their children or undertaking routine care activities such as feeding or playing with children. Many women found these burdens to be substantial following the storm, given the many other demands on their time and energy following the event.¹¹⁰

Other evidence on gendered disaster recovery in the U.S. comes from the aftermath of Red River flooding. A comprehensive study of this disaster on women notes that many women faced challenges before the storm, and recovering from the disaster added further complexity onto their lives. For instance, many women reported additional caring responsibilities and increased financial challenges during flood recovery.¹³⁹

5. Employment in Climate-Affected Sectors

Climate change presents challenges as well as opportunities for employment, with some sectors likely to experience significant declines due to decarbonization, while others will likely grow substantially. As our country works towards ensuring a just transition away from unsustainable forms of energy and resource use, it is imperative that people of all genders have opportunities to benefit from growth in new industries, while ensuring that workers in adversely affected industries receive support and services to facilitate this transition.

Key Takeaway Messages:

- Men represent approximately 72% of workers in energy and fuels production.¹⁴⁰ This includes workers in fields adversely affected by decarbonization efforts, such as coal, natural gas, and petroleum, as well as sectors benefiting from decarbonization, including wind and solar. Men also represent the vast majority of workers in related fields, including transmission, distribution, and storage, energy efficiency, and motor vehicles and component parts.
- Men are also the majority of the workforce in sectors with significant occupational exposure to the effects of climate change, particularly outdoor workers in the agriculture and construction industries.
- Ensuring a just transition to a sustainable economy requires providing support and opportunities to those displaced by new energy technologies, while doing more to engage renewable energy employers to increase the representation of women in these sectors.
- Improved policies and messaging that account for gender differences in workforce composition are needed to keep workers safe as outdoor labor becomes more hazardous in a changing climate.

5.1 GENDERED EMPLOYMENT DATA

Historically, it has been challenging to get reliable data on gendered employment in sectors most affected by climate

change. While the U.S. Department of Labor Bureau of Labor Statistics (BLS) has published gendered employment data in a variety of sectors for many years, the data are disaggregated into occupational categories that are not especially meaningful for researchers interested in understanding growth in sectors likely to benefit from decarbonization efforts, most notably renewable energy. This is because in existing data collection, workers in renewable energy and related fields are spread across multiple BLS occupational categories, making it difficult to develop meaningful demographic estimates of this workforce.

To overcome such challenges, the U.S. Department of Energy developed a report on U.S. energy employment, which surveys a variety of firms engaged in renewable and nonrenewable energy activities. The first report was released in 2016, and has been released annually since, most recently by the National Association of State Energy Officials and the Energy Futures Initiative.¹⁴⁰ This report is complemented by other data sources, such as the National Solar Jobs Census from the Solar Foundation.¹⁴¹ Using these data, we explore gendered employment in key sectors affected by climate change, including energy, agriculture, and construction.

5.2 GENDERED EMPLOYMENT IN ENERGY-RELATED SECTORS

The energy production and energy efficiency sectors are responsible for roughly 6.7 million jobs nationwide as of 2018, with an additional 2.5 million Americans employed in vehicle manufacturing or supplier jobs.¹⁴² Collectively, these sectors represent roughly 6% of jobs nationwide, forming an integral part of the American economy. However, while roughly 53% of jobs nationwide are held by men, their share in energy subsectors is substantially greater. Many energy subsectors also are below the national average on measures of racial/ethnic diversity as well. As the industry becomes a key source of opportunity in a decarbonized economy, it is imperative that the field work towards fostering a demographic makeup closer to that of the country as a whole.

The 2019 U.S. Energy & Employment report contains a variety of data on the demographic makeup of the energy workforce, including in renewable energy subsectors.¹⁴⁰ Figure 2 shows total employment by gender for jobs in electric power generation and fuels by energy source. This includes jobs in mining and processing/refining, as well as in construction, installation, maintenance, sales, and administrative/support services for power systems, but does not include jobs related to the transport and distribution of energy.

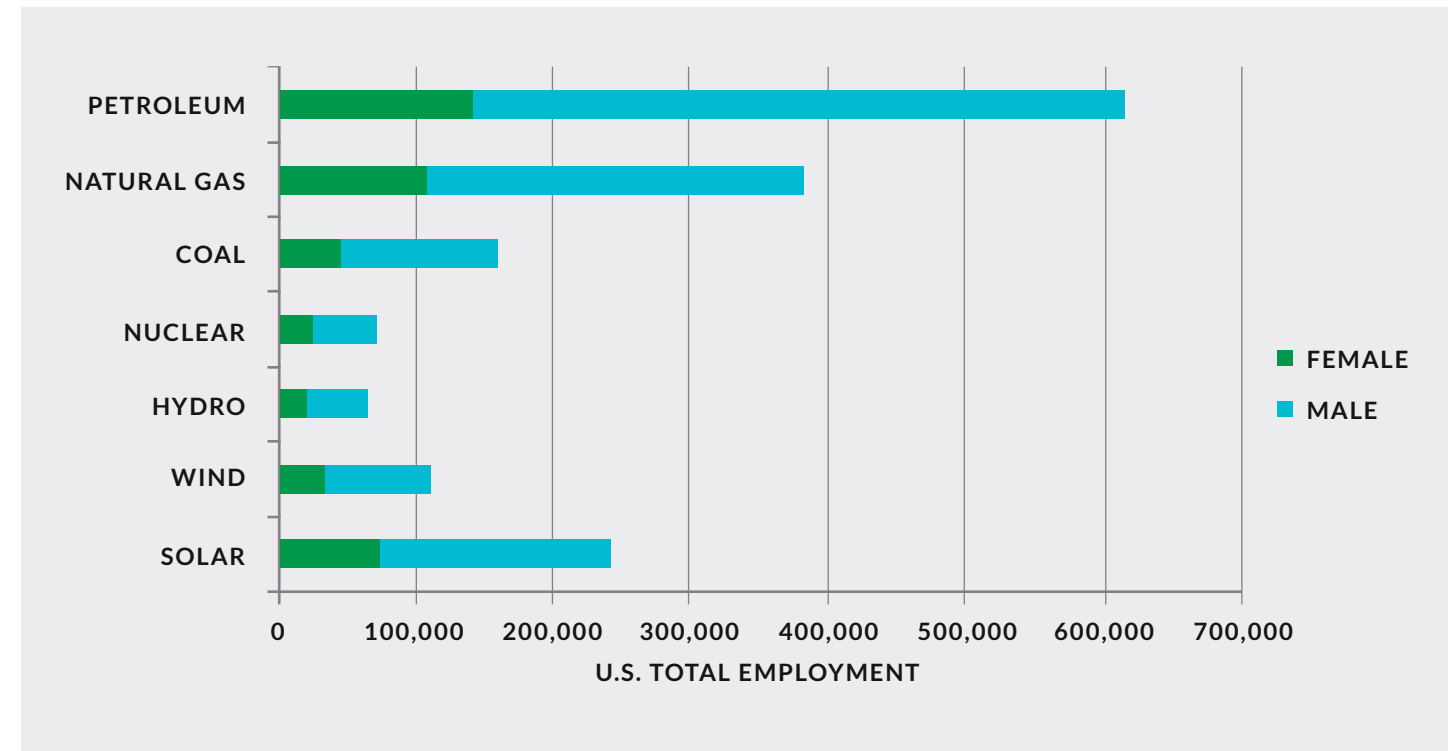


Figure 2: Gendered employment in fuels and power generation sectors as of 2018. Data is taken from the USEER 2019 report; see Technical Notes at end of document for additional information.

Overall, nonrenewable sources make up the bulk of employment in the electric power sector, but this is changing as jobs in renewable fields have experienced rapid growth during the past decade. However, men continue to dominate every subfield, though there is a considerable range in gendered employment between subfields. On one end of the spectrum, only 23.2% of those working in petroleum-related jobs in 2018 were women, while at the other end, 37.2% of those working in nuclear-related jobs were women. The share of women in the wind and solar sectors (32.2% and 31.1% respectively) is above that of most of the nonrenewable sectors, but still well short of gender parity.

Within each of these fields, however, there may be different rates of gendered employment. For instance, coal mining has historically been a very male-dominated field (while other subsectors within the coal sector have a greater proportion of women), and the dramatic fall in total employment, as well as a less substantial fall in the share of female employment suggests that it will be almost exclusively men who will be affected by further adjustments in the subsector. Figure 3 displays coal mining jobs since 2000 (using the BLS occupational classification), along with changes in female employment share over that period.

Men are also disproportionately represented in other energy-related sectors (Figure 4). The transmission, distribution, and storage sector includes jobs related to the construction and maintenance of electrical lines, pipelines, railways engaged in transporting energy commodities, as well as jobs related to energy storage. Energy efficiency jobs include those associated with the manufacture of ENERGY STAR®-labeled products, as well as jobs in heating, ventilation, and air conditioning (HVAC), and positions associated with the manufacture and installation of advanced building materials and lighting systems. Motor vehicles and component parts jobs include positions involved with vehicle manufacturing, including those directly employed by vehicle manufacturers, as well as individuals employed by suppliers.

In all three of these sectors, men are disproportionately represented at similar levels, with slightly less than one in four jobs in all of these sectors occupied by women. In transmission, distribution and storage, 24.5% of workers are female; in energy efficiency, this share is 24%, while in motor vehicles and component parts, it is 22.6%. While more specific data are not publicly available, it is likely that certain subfields within these industries are closer to reaching gender parity. For instance, within the energy efficiency sector, slightly less than half of jobs are in manufacturing

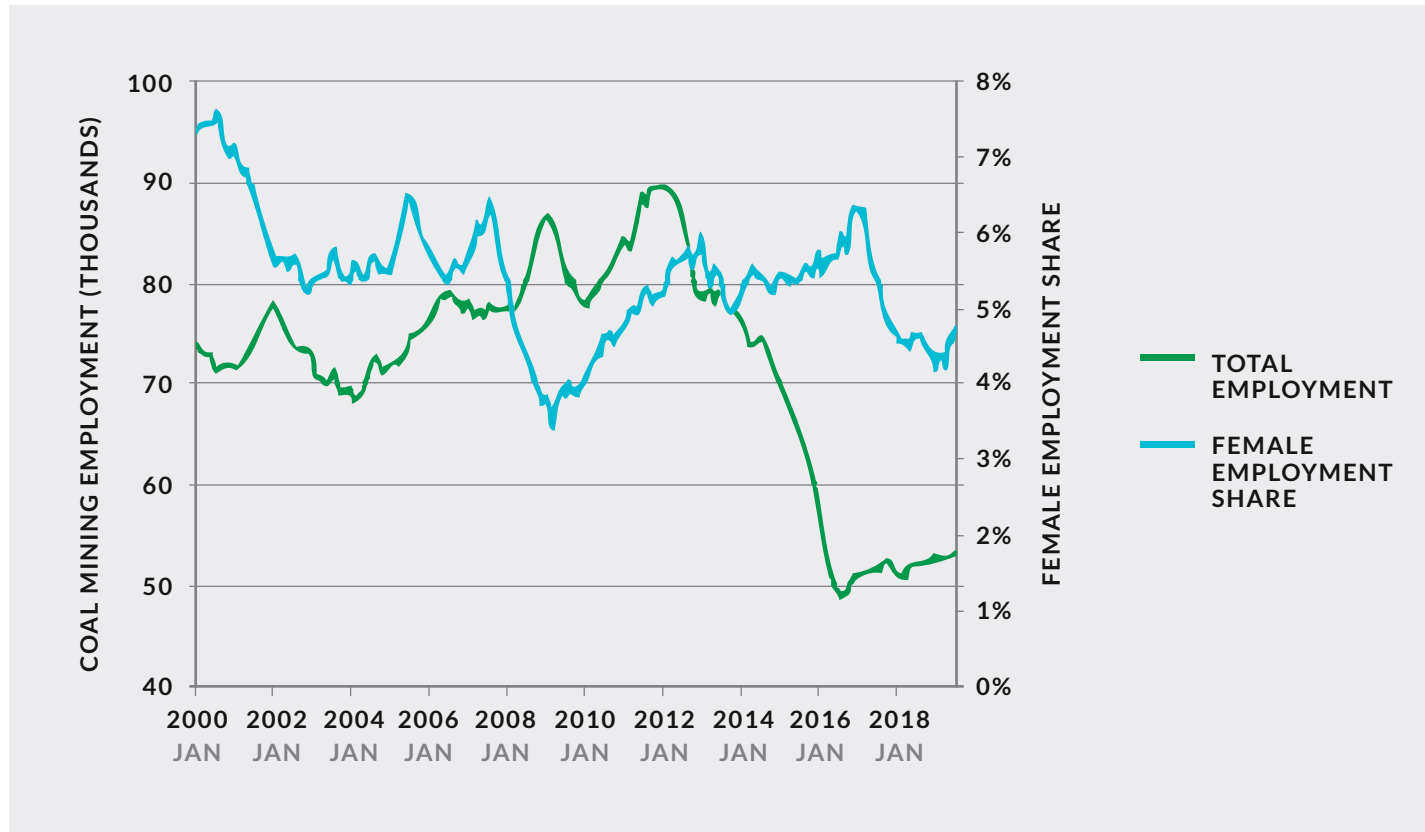


Figure 3: Coal mining employment and female employment share in the U.S., by month January 2000-June 2019. Data was calculated using seasonally unadjusted BLS CES; see Technical Notes at end of document for additional details.

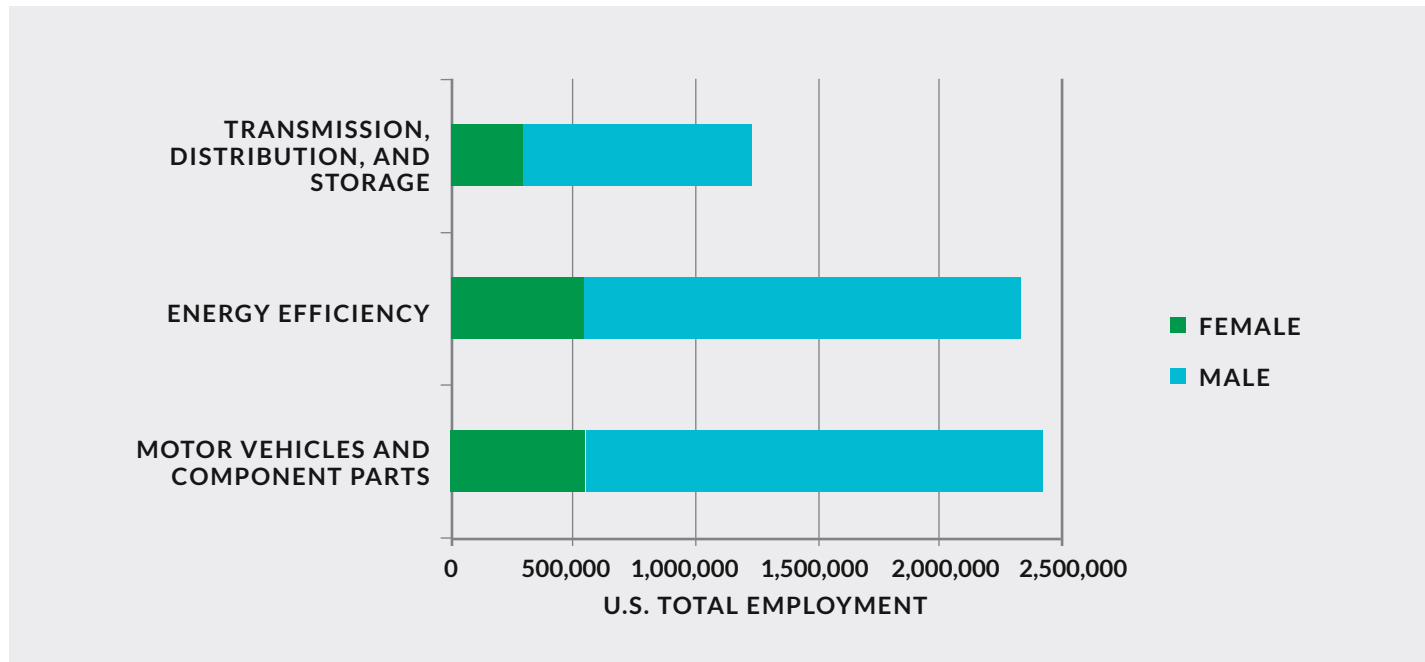


Figure 4: Gendered employment in additional energy sectors as of 2018. Data is taken from the USEER 2019 report; see Technical Notes at end of document for additional information.

or installation/repair, fields that tend to be heavily male-dominated. By contrast, the other half of jobs in the sector are in positions such as administration or sales, fields that have generally employed more women.

It is also likely that there are gender disparities in terms of pay and seniority within energy-related sectors, although specific figures are difficult to come by. According to the 2019 Solar Industry Diversity Study, there is currently a 26% gender wage gap in the industry. Women in the solar field are also less likely to hold senior-level roles, such as managers, directors, or president-level jobs.¹⁴³ Comparable figures are not publicly available for the wind sector or other renewable fields.

5.3 GENDERED EMPLOYMENT IN OTHER CLIMATE-AFFECTED SECTORS

Construction and agriculture are two areas of employment where workers are likely to experience significant effects because of climate change. As noted in Section 3, workers in both sectors are at disproportionate risk for occupational exposure to heat and poor air quality, which can adversely affect health outcomes. As is true in energy-related sectors,

these fields are predominantly male, which helps explain the elevated risk of men to heat-related illnesses and mortality.

Figure 5 displays total employment and female employment share in the construction sector. The share of women in construction has held fairly steady since 2000, fluctuating between 12-13.5% of the industry for most of this period. It should be noted that while many of the individuals represented by these data are associated with building construction, there is overlap between some of the individuals represented in these figures and those discussed above with regard to specific energy sectors, as many workers in energy are involved in construction-related activities.

Figure 6 displays total employment and female employment share for crop agriculture workers, based on annual Current Population Survey (CPS) data. Men make up a disproportionate share of workers in crop agriculture, roughly three out of every four workers in the field, although the industry is increasingly trending towards gender parity.

A different measure of gender in the agricultural workforce comes from the National Agricultural Workers survey, which provides data on the crop workforce using face-to-face interviews at work and has a longer history.¹⁴⁴ By contrast,

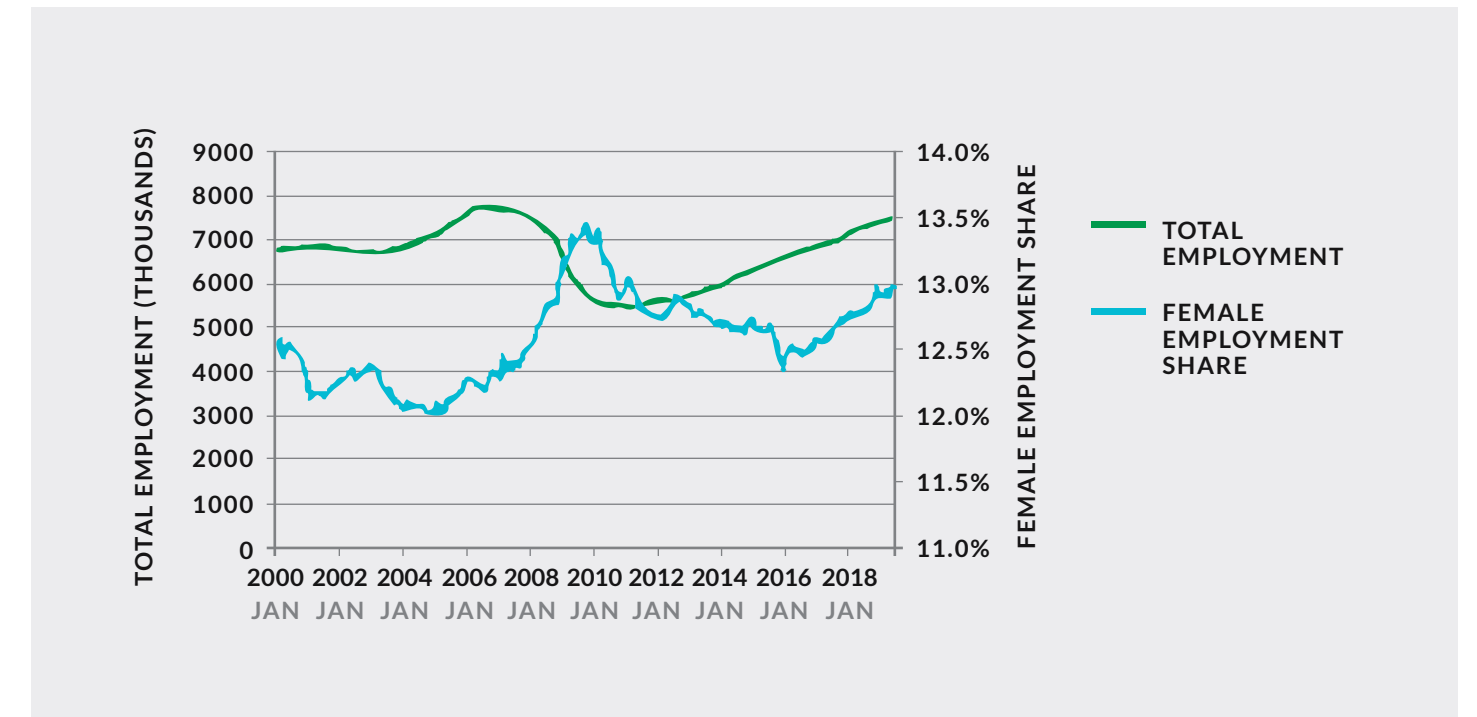


Figure 5: Construction employment and female employment share in the U.S., by month January 2000-June 2019. Data was calculated using seasonally adjusted BLS CES; see Technical Notes at end of document for additional details..

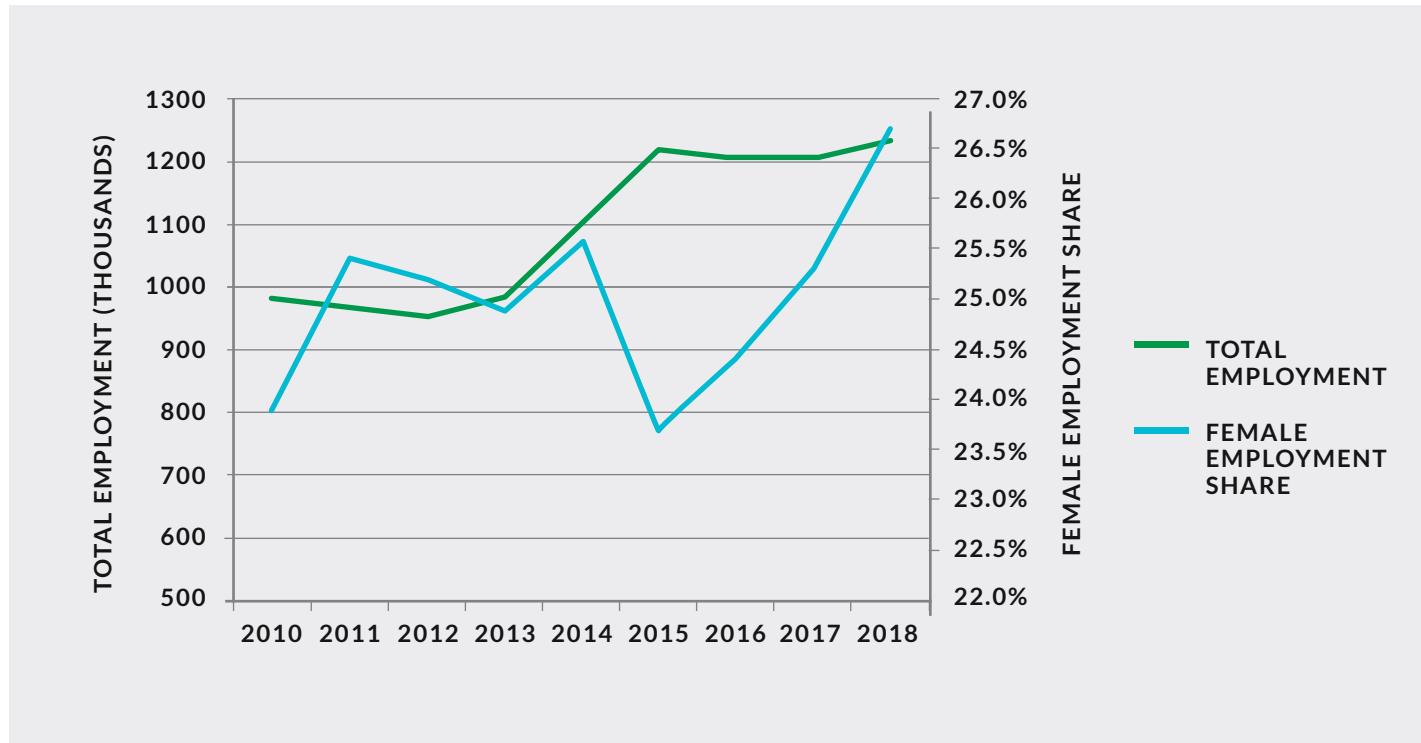


Figure 6: Crop agriculture employment and female employment share in the U.S., by year 2010-2018. Data calculated using annual CPS data; see Technical Notes at end of document for additional details.

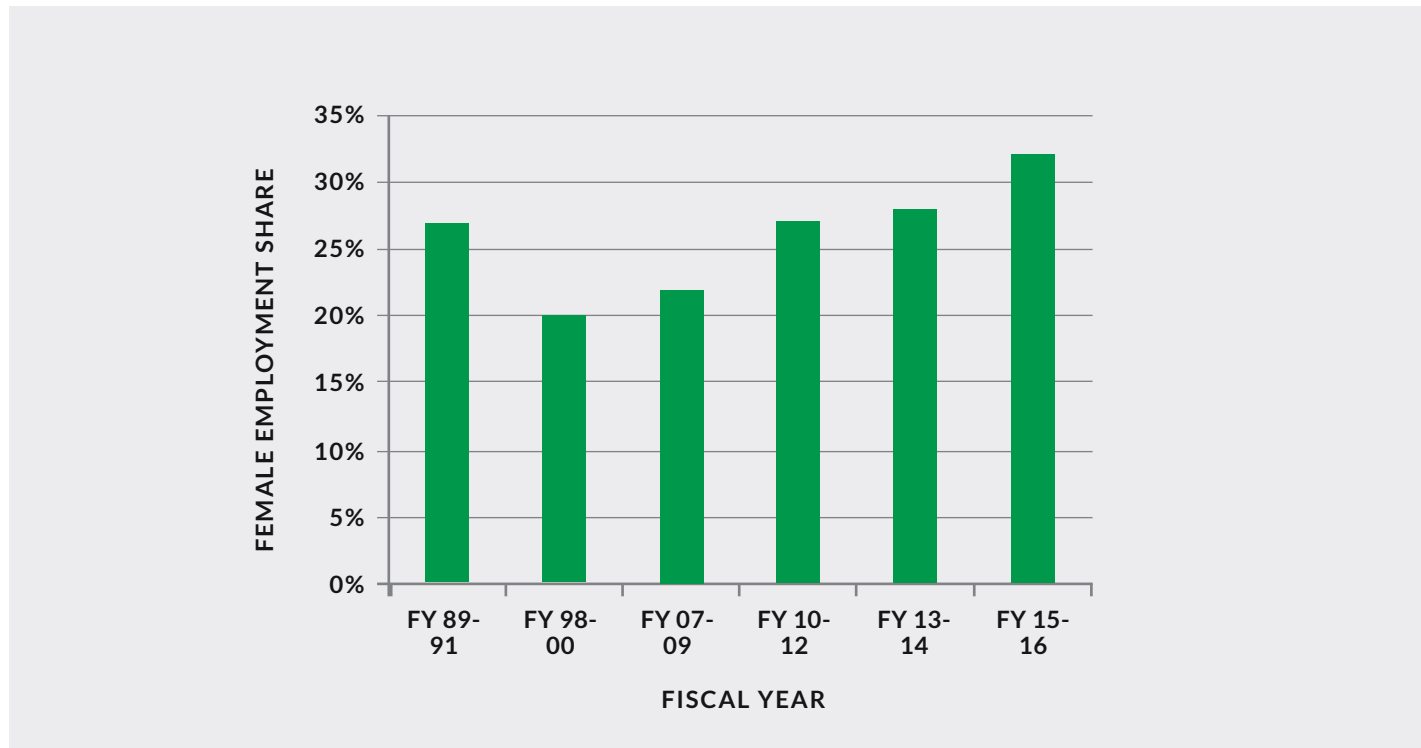


Figure 7: Crop agriculture female employment share in the U.S. Data generated using National Agriculture Workers Survey summary tables; see Technical Notes at end of document for additional details. FY=Fiscal Year.

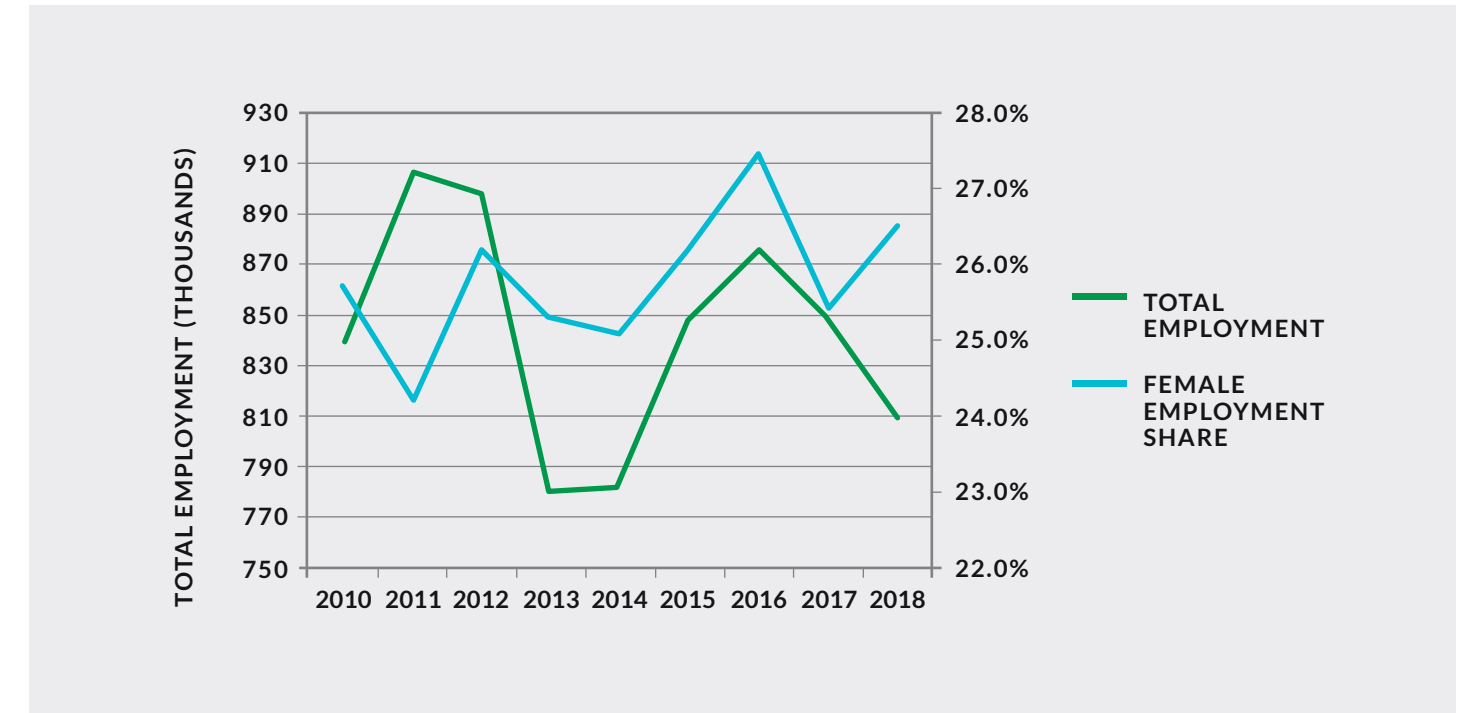


Figure 8: Animal production and aquaculture employment and female employment share in the U.S., by year 2010-2018. Data calculated using annual CPS data; see Technical Notes at end of document for additional details.

CPS is a household-based survey and may be less likely to capture migratory or seasonal workers. However, despite different methodologies, the results broadly mirror those of the CPS data, showing that roughly seven-in-ten crop agriculture workers are male, although the representation of women in the sector continues to grow (Figure 7).

Similar patterns exist for workers in animal agriculture, where roughly one quarter of the workforce is female, according to CPS data (Figure 8).

In sum, these data illustrate that men are both more exposed to potential job transitions associated with decarbonization efforts as well as occupational hazards associated with environmental exposures. Women are also underrepresented in growth sectors, such as wind and solar; a key challenge that must be addressed to ensure a more equitable economy.

6. Climate Change Perceptions, Attitudes, Knowledge, and Behaviors

Gender can shape knowledge and perceptions on a range of environmental issues, resulting in different levels of

support for environmentally-related public policies. These attitudes also influence environmentally-related behaviors, including those related to climate adaptation, as well as regarding diet and transport. This section briefly examines studies on knowledge, perceptions, and opinions regarding environmental topics that relate to climate change. The section concludes by analyzing gender representation in environmental organizations, decision-making processes, and media coverage of climate change.

Key Takeaway Messages:

- Women tend to be more concerned than men about the effects of climate change, and are more likely to support mitigation actions.^{145,146}
- A variety of state- and local-studies support gendered theories of environmental preferences.
- There are gendered differences in certain environmentally-related behaviors. For instance, women eat less meat than men¹⁴⁷, but are also less likely to bike to work.¹²⁵
- Women are significantly underrepresented in environmental organizations' leadership positions¹⁴⁸ as well as in media coverage of climate change.¹⁴⁹

6.1 CLIMATE CHANGE AND ENVIRONMENT PERCEPTIONS, ATTITUDES, AND KNOWLEDGE

The academic literature generally shows women expressing greater concern about environmental issues than men. Nationally-representative polling on climate change suggests that women are slightly more likely to believe climate change is occurring, as well as take actions to ameliorate it.^{146,150} As of 2017:

- Strong majorities of women (72%) and men (69%) believe climate change is happening. When analyzing the data by race/ethnicity, African-Americans are most likely to believe climate change is happening; 81% of Black men and women share this belief.
- Around half of Americans believe climate change is currently harming the U.S., including 53% of women and 45% of men. Hispanic (67%) and Black (63%) women are the most likely to agree with this statement.



PHOTO CREDIT: ANNABELLE AVRIL / WECF

- Most Americans believe CO₂ should be regulated as a pollutant, including 79% of women and 72% of men. While the gender gap on this question is small among Blacks and Hispanics, it is much greater among Whites with 79% of White women, but only 69% of White men, affirming this statement.

Other national surveys also find a gender gap in concern about climate change, even when accounting for other sociodemographic factors.^{151,152} Women are also less likely to support continued fossil fuel exploration, including the use of offshore drilling¹⁵³ or hydraulic fracturing.¹⁵⁴

Additionally, a variety of state- and local-level studies of gendered climate change perceptions, attitudes, and knowledge broadly support these findings, a handful of which are summarized in Figure 9.

6.2 GENDERED ENVIRONMENTAL BEHAVIORS

In general, women are less likely than men to engage in behaviors that can have detrimental environmental impacts. For instance, nationwide health surveys show that women consume significantly lower levels of meat than do men. As of 2015-16, men in the U.S. consume roughly 50% more processed meat and unprocessed red meat, and approximately 16% more poultry than do women. Men and women consume roughly equal amounts of fish.¹⁴⁷ Women are also more likely than men to use public transport, though the differences are not particularly large; according to the U.S. Census Bureau, roughly 5.4% of women use public transport to commute to work, while 4.8% of men do. By contrast, men are more than twice as likely as women to bike to work.¹²⁵

There are a handful of studies exploring gendered differences in climate change adaptation practices in the U.S., though this continues to be an area of ongoing study among scholars. Much of the current literature centers on factors affecting loss aversion preferences and insurance purchases:

- A study of landowners in the Southeast found that women forest owners were significantly more likely to purchase insurance against wildfires.¹⁵⁶
- Women homeowners on the Gulf Coast are no more likely than men to purchase flood insurance.^{157,158}
- Single women, but not single men, are significantly less likely than married couples on the Gulf Coast to purchase insurance for wind damage.¹⁵⁹

Moreover, there is growing scholarship exploring the growth of women in the agricultural sector, particularly in locally-oriented and sustainable forms of agriculture.^{160,161} According to the USDA, women make up roughly 29% of farmers who are responsible for day-to-day decision making on their land as of 2017, a sharp increase from earlier surveys.¹⁶² As evidenced by robust local farm networks in Pennsylvania, women are helping to invigorate rural communities with new models of civically-oriented farming, helping to build community and stronger, more sustainable food systems resilient to the effects of climate change.¹⁶³

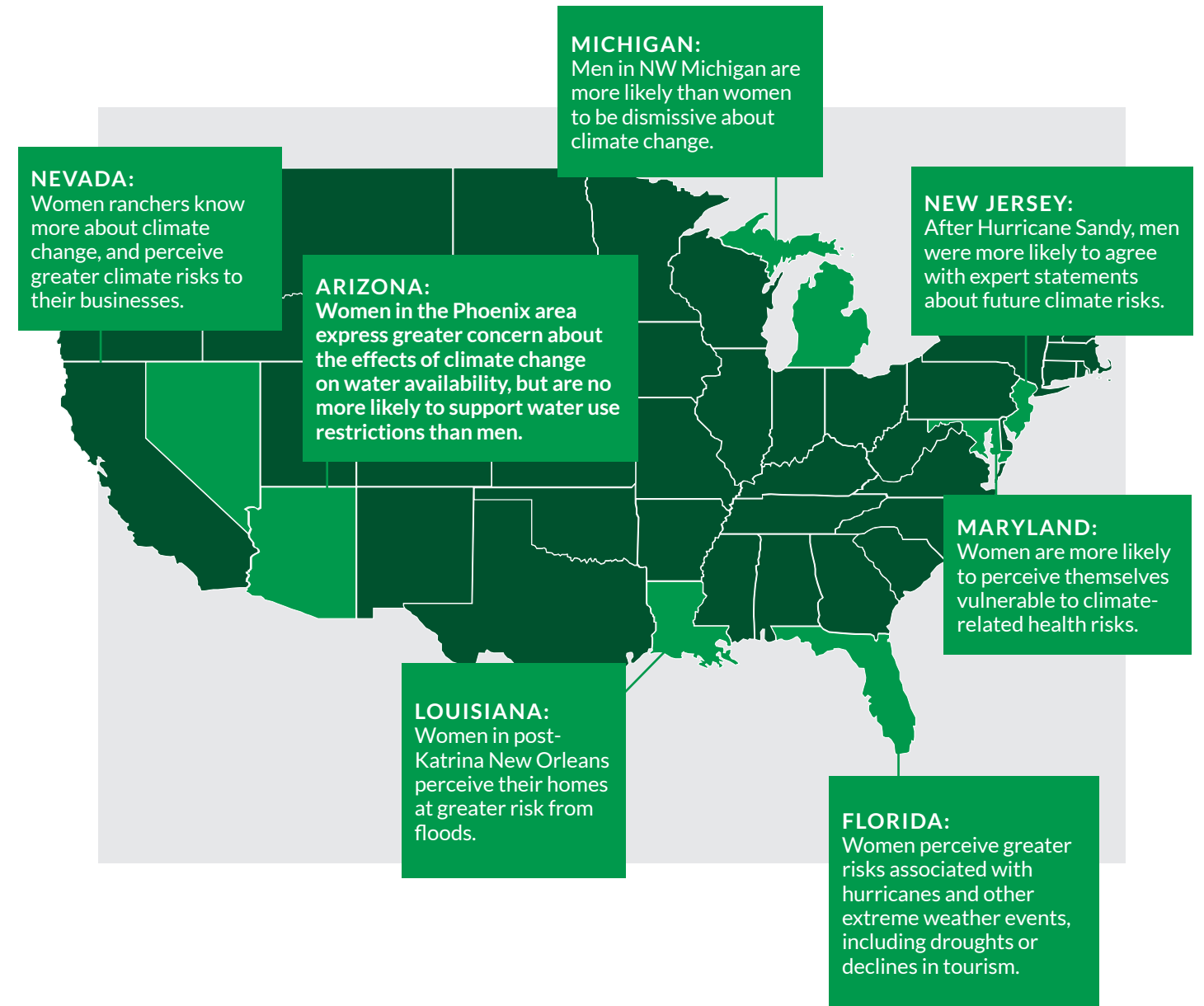


Figure 9: A snapshot of state- or local-level studies on gendered climate change attitudes and perceptions.¹⁷³⁻¹⁸¹

6.3 WOMEN'S LEADERSHIP AND REPRESENTATION

Women remain underrepresented in both the media coverage of climate change and the workforce in environmental organizations. Even when women are employed within environmental organizations, they are rarely promoted to senior leadership roles, which are disproportionately occupied by White males.

- In a survey of conservation and preservation organizations (environmental nonprofits that are not grantmaking

institutions) as of 2014, men occupied 63% of board positions but only 45% of the staff.¹⁴⁸

- Within conservation and preservation organizations, board seats are also overwhelmingly occupied by White individuals; roughly 95% of board members within these groups identify as White. Given that women are underrepresented on environmental nonprofit boards, this suggests that non-White women are especially underrepresented, making it difficult for decision-making within these organizations to account for the needs of all populations.¹⁴⁸



PHOTO CREDIT: ANNABELLE AVRIL / WECF

- A *Media Matters* study from 2018 found that 19% of the people interviewed, featured, or quoted in climate change broadcast television news coverage were women. With a rate even worse for non-White individuals, 9%, it is likely the percentage of non-White women is even lower.¹⁴⁹
- At CBS, the worst of the largest broadcast television networks for this measurement, only one of 36 people featured in climate change coverage was a woman.¹⁴⁹

Women-led grassroots advocacy has played a key role in shaping environmental discourse, although it has often not received significant attention from large media outlets. For instance:

- Women-led groups are playing a key role in catalyzing the transition to renewable forms of energy and more just forms of energy governance.¹⁶⁴
- Following Hurricane Katrina, community-led recovery efforts and grassroots advocacy efforts were often led by and mostly composed of women.¹⁶⁵
- Women- and Two-Spirit-led Indigenous movements, such as #NoDAPL, have played a critical role in galvanizing public attention to the harmful effects of fossil fuel development on native lands.¹⁶⁶

While these studies provide important insights, there are substantial knowledge gaps in our understanding of how gender influences environmental leadership and advocacy, something we explore further in the next section.

7. Knowledge Gaps and Conclusion

Gender has a significant impact on experiences related to climate change in the United States and around the world. While all of us are affected by climate change, men and women are each disproportionately vulnerable to certain impacts of climate change and related decarbonization activities. This includes effects on health, employment, and the ability to be resilient in the face of severe weather events. As many Americans push for a Green New Deal to more rapidly transition to a sustainable economy, it is imperative that gender be considered as part of this framework, particularly as it relates to people who will need to transition to new jobs (predominantly men), as well as for people who seek opportunities in a more sustainable economy, but who have historically faced challenges entering and succeeding in fields that are likely to grow (predominantly women).

Additionally, while the research highlighted above represents an important start in understanding how gender and climate change are linked in the United States, much more remains to be understood in order to construct gender-responsive climate policies. The biggest gap we found was a lack of engagement with intersectional perspectives, which are imperative to developing inclusive climate policy measures. Climate change places an added burden on communities that are already marginalized in other ways, including communities with large Black, Hispanic, Indigenous, undocumented, disabled, nonbinary, and low-income populations. Many of these communities are already grappling with the effects of fossil fuel infrastructure in their communities and with rebuilding following disasters, alongside historical legacies of economic disinvestment and structural racism and sexism. While scholars have increasingly emphasized the particular burdens faced by non-White women during and following extreme weather events like Hurricane Katrina, there has been less research on how historically marginalized communities experience longer onset impacts of climate change. The vast majority of the research reviewed has room to grow in its intersectional analysis, which is crucial to improving climate resilience policies for all people.

In addition to stronger intersectional analyses, additional knowledge gaps include:

- *Long-term gendered impacts of disasters.* As severe weather events are likely to become more frequent and disruptive throughout the United States, relatively little is known about the long-term impacts of these events on people with different gender identities, particularly as it relates to socioeconomic and health outcomes.
- *Greater geographic diversity of research activities.* Much of the research reviewed above that was conducted at a state or local level centers on the southern United States, due to the frequency of disasters encountered, as well as the extant effects of temperature increases on human health in the region. However, other areas of the country are experiencing or will soon experience substantial impacts related to climate change, yet little has been explored regarding gendered vulnerability in these locales. Such places include New England, the Pacific Northwest, the Intermountain West, Alaska, Hawaii, and U.S. Territories.
- *Gendered employment data in key economic sectors.* While efforts have been made in recent years to improve upon BLS occupational categories to provide more robust estimates regarding gender in key energy-related sectors, more needs to be done to improve the quality

and coverage of these data. In particular, where sectors are large enough to provide a sufficient sample size, developing state- or local-level estimates of gendered employment and disparities in specific renewable energy sectors is an important next step towards better understanding how state- and local-level policymakers can support a just transition.

Resources

There are 3 appendices to this review. Appendix 1 contains a full list of search terms used in this review and technical notes. Appendix 2 provides a list of key gender and climate change researchers working in the United States. Appendix 3 provides a list of major nongovernmental organizations in the United States working on gender and climate change issues. Neither of the lists in Appendices 2 and 3 should be read as exhaustive. For Appendix 3, it is important to note that there are groups that have gender justice in their objectives or who have programs focused on the environment, which are not listed. The programs listed include a sampling of organizations that work specifically on the intersection of gender and climate.

Appendix 1: Search Terms and Technical Notes

The full list of search terms included in our literature search is listed below. Articles were required to include at least one term from each category in order to be located in our initial search. The reference lists of selected articles were reviewed to locate additional articles.

Category 1:

Gender OR sex OR woman OR women OR female OR girl OR man OR men OR male OR boy

Category 2:

“Climate change” OR “global warming” OR disaster OR temperature OR heat OR drought OR flood OR blizzard OR storm OR weather

Category 3:

“United States” OR “Alabama” OR “Alaska” OR “Arizona” OR “Arkansas” OR “California” OR “Colorado” OR “Connecticut” OR “Delaware” OR “Florida” OR “Georgia” OR “Hawaii” OR “Idaho” OR “Illinois” OR “Indiana” OR “Iowa” OR “Kansas” OR “Kentucky” OR “Louisiana” OR “Maine” OR “Maryland” OR “Massachusetts” OR “Michigan” OR “Minnesota” OR “Mississippi” OR “Missouri” OR “Montana” OR “Nebraska” OR “Nevada” OR “New Hampshire” OR “New Jersey” OR “New Mexico” OR “New York” OR “North Carolina” OR “North Dakota” OR “Ohio” OR “Oklahoma” OR “Oregon” OR “Pennsylvania” OR “Rhode Island” OR “South Carolina” OR “South Dakota” OR “Tennessee” OR “Texas” OR “Utah” OR “Vermont” OR “Virginia” OR “Washington” OR “West Virginia” OR “Wisconsin” OR “Wyoming” OR “Los Angeles” OR “New York City” OR “Chicago” OR “Detroit” OR “Miami” OR “Houston” OR “New Orleans” OR “Seattle” OR “Portland” OR “Providence” OR “Boston” OR “District of Columbia” OR “Puerto Rico” OR “San Antonio” OR “San Diego” OR “Philadelphia” OR “Dallas” OR “Phoenix” OR “Santa Fe”

Data on employment are captured from several sources, including the USEER surveys, BLS Current Employment Statistics, the Current Population Survey, and the National Agricultural Worker survey. Data on gendered employment

in specific energy sectors and sub-sectors (Figures 2 and 4) is taken from the USEER 2019 report. Figure 2 combines gendered data from the Fuels and Electric Power Generation sectors.

Gendered solar employment data is combined for PV and concentrated solar power. A weighted gendered solar employment value is provided in Figure 2, calculated using the percentages of solar jobs in each of these subsectors (92.4% PV, 7.6% CSP) provided in the USEER report. Only solar employment where employees spend at least 50% of their time on solar-related work is included in the presented totals. We note that while the USEER report relies on Solar Foundation data for total solar employment, they employ a different methodology to yield gendered employment data. The Solar Foundation reports that 26.3% of the solar workforce in 2018 is female.¹⁴³

Gendered coal mining employment (Figure 3) is calculated using seasonally unadjusted BLS CES data on coal mining total employment and female employees (BLS Series ID CEU1021210001 and CEU1021210010). Gendered construction employment (Figure 5) is calculated using seasonally adjusted BLS CES data on construction total employment and female employees (BLS Series ID CEU2000000001 and CEU2000000010). Gendered crop and animal agriculture employment (Figures 6 and 8) are calculated using annual CPS data (BLS Series ID LNU02072096, LNU02072097, LNU02042918, LNU02042919). The alternative gendered crop agriculture employment total (Figure 7) was generated using National Agriculture Workers Survey summary tables.

Gendered vehicle ownership data was gathered using American Community Survey 5-Year estimates for 2013-2017 by taking the point estimates for the number of workers in each of the selected metro areas by sex reporting no vehicles available and dividing by the total number of workers for each sex. Series IDs 320M300US1233100, 320M300US1236740, 320M300US2235380, 320M300US3635620, and 320M300US4826420 were used. All data were retrieved August 9, 2019.

Appendix 2: Leading US-focused Gender and Climate Change Academic Researchers

NAME	INSTITUTION	RESEARCH SPECIALTIES
Susan L. Cutter	University of South Carolina	Disaster vulnerability and resilience
Elaine Enarson	University of Oregon (retired), Independent Scholar	Sociology of gender, disaster, masculinity, and forestry
Alice Fothergill	University of Vermont	Sociology of gender, inequality, and climate disasters
Emily Harville	Tulane University	Environmental risk factors on reproductive-aged women
Aaron M. McCright	Michigan State University	Climate change denial, gender and environmental decision making
Jacqui Patterson	NAACP Environmental and Climate Justice Program	Racial justice, gender justice, violence against women, environmental justice
Frances Roberts-Gregory	University of California Berkeley	Feminism and philosophy of science, environmental and climate justice, ecowomanism
Jade Sasser	University of California Riverside	Reproductive justice and climate change
Chenyang Xiao	American University	Gender and environmental attitudes, beliefs, and behaviors

Appendix 3: Organizations Related to the Intersection of Gender, Women’s Rights and Climate Change Activities in the US

ORGANIZATION NAME	WEB ADDRESS	DESCRIPTION
Another Gulf is Possible	https://anothergulf.com/	Collaborative for a just transition in the Gulf region.
Association of Women in Water, Energy and Environment (AWWEE)	https://awwee.org/	A member organization of 2,000 people, dedicated to supporting professional development and leadership of women in water, energy, and environmental fields throughout California.
Climate Justice Alliance	https://climatejusticealliance.org/	A growing member alliance of 70 urban and rural frontline communities, organizations and supporting networks in the climate justice movement to unite toward a Just Transition.
Ecowomen, with five chapters in Baltimore, Colorado, New York City, Seattle, and Washington DC	https://www.ecowomen.org/	National network of chapters committed to creating a just and equal world by empowering women to be leaders in their professions and stewards of the environment.
Gender & Climate Justice Fund	https://climateandgenderjustice.org/	The Fund will elevate investment in climate justice leadership – primarily Black women, Indigenous women, women of color, youth, and others engaged on the frontlines – to move equitable solutions at the speed and scale needed to attain a just and habitable world.
Grassroots Global Justice Alliance	http://ggjalliance.org/	Grassroots Global Justice is a national alliance of US-based grassroots organizing groups organizing to build an agenda for power for working and poor people and communities of color.
Gulf Coast Center for Law and Policy	https://www.gcclp.org/	GCCLP advances structural shifts toward ecological equity and climate justice in Gulf Coast communities of color on the frontline of climate change.

Indigenous Environmental Network	https://www.ienearth.org/	IEN was formed by grassroots Indigenous peoples and individuals to address environmental and economic justice issues (EJ). IEN’s activities include building the capacity of Indigenous communities and tribal governments to develop mechanisms to protect our sacred sites, land, water, air, natural resources, health of both our people and all living things, and to build economically sustainable communities.
League of Women Voters	https://www.lwv.org/other-issues/environment	The League’s environmental goals aim to mobilize women voters to prevent ecological degradation, and to reduce and control pollutants.
MADRE	https://www.madre.org	MADRE partners with local women’s organizations to take action against climate change by helping advance grassroots solutions and bringing grassroots women’s voices to influence national and international climate policy discussions.
NAACP Environmental and Climate Justice Program	https://www.naacp.org/issues/environmental-justice/	The Environmental and Climate Justice Program works at addressing the many practices that are harming communities nationwide and worldwide and the policies needed to rectify these impacts and advance a society that fosters sustainable, cooperative, regenerative communities that uphold all rights for all people in harmony with the earth.
New England Women in Energy and Environment (NEWIEE)	https://newiee.org/	NEWIEE is a group of professional women in New England devoted to enhancing women’s leadership within the energy and environment sectors.
Sierra Club’s Gender, Equity and Climate Program	https://www.sierraclub.org/gender	The Sierra Club’s Gender, Equity and Environment Program advocates for gender equity so that communities can become healthier, stronger, and better prepared to adapt to climate disruption.
Tewa Women United	http://tewawomenunited.org/	Tewa Women United was incorporated for educational, social and benevolent purposes, specifically for the ending of all forms of violence against Native Women and girls, Mother Earth and to promote peace in New Mexico.
Women in Cleantech and Sustainability (WCS)	https://www.womenincleantechsustainability.org/	WCS fosters a network of engaged professionals to further the role of women in the green economy.

Women in Solar Energy (WISE)	https://www.solwomen.org/	WISE is devoted to creating a more diverse solar industry through activities such as education, capacity building, advocacy, strategic partnerships, networking and events.
Women of Cancer Alley via Louisiana Bucket Brigade	http://labucketbrigade.org/content/women-cancer-alley	The Women of Cancer Alley is a first-ever collection of films made by a group of women who live adjacent to chemical plants, tank farms and refineries along the Mississippi River in south Louisiana. The films depict the lives, concerns and activism of eight women.
Women of Color Speak Out	https://wocspeakout.com/	Women of Color Speak Out is a collective of four climate justice, racial justice, gender justice and intersectional movement activists that work to fight climate change in the Pacific Northwest while addressing oppressive systems.
Women of Renewable Energy and Sustainable Industries (WRISE)	http://wrisenergy.org/	WRISE is devoted to building a diverse workforce for the renewable energy economy throughout the U.S. and around the world.
Women's Earth and Climate Action Network (WECAN)	http://www.wecaninternational.org	WECAN International engages global women's organizations, women leaders, and all manner of gender-focused and feminist groups and individuals to grow an action base and movement of women for climate justice.
Women's Environmental Network, with active local chapters in California and Minnesota, among others	https://www.wencal.org/ , https://wenmn.org/	The WEN mission is to foster professional networks for women working or studying in any aspect of protecting the environment. They build personal and professional networks, encourage and support women and genders underrepresented in the environmental sector; and promote a better understanding of an individual's role in preserving and improving the environment.

Women's Environment and Development Organization (WEDO)	http://www.wedo.org	WEDO is a global advocacy organization, working to ensure that women are empowered to claim their rights as decision-makers and leaders, especially on issues related to environment and sustainable development. Via a focus on advocacy, leadership development and intersectional knowledge generation, WEDO builds power by linking and amplifying grassroots and frontline feminist experiences of environmental impacts into global movements and policy spaces.
Women's Earth Alliance	https://womensearthalliance.org/	WEA designs capacity-building trainings where women from all over the world access skills and tools in appropriate technology, entrepreneurship, and advocacy. Participants go on to launch and scale their environmental projects and teach others to do the same.
Women's Voices for the Earth	https://www.womensvoices.org/	The mission of Women's Voices for the Earth (WVE) is to amplify women's voices to eliminate toxic chemicals that harm our health and communities.

References

- Americans increasingly see climate change as a crisis, poll shows - *The Washington Post*. <https://www.washingtonpost.com/>. (Sept. 13, 2019).
- Green Climate Fund. Status of Pledges and Contributions made to the Green Climate Fund. (2019).
- Environmental Protection Agency. Electric Utility Generating Units: Repealing the Clean Power Plan. (2019).
- Rhodium Group. Final US Emissions Estimates for 2018. (2019).
- Center for Climate and Energy Solutions. U.S. State Greenhouse Gas Emissions Targets. <https://www.c2es.org/document/greenhouse-gas-emissions-targets/> (2019).
- Barbose, G. U.S. Renewables Portfolio Standards 2019 Annual Status Update. (2019).
- We Are Still In Coalition. <https://www.wearestillin.com/> (2019).
- Smith, K. R. et al. Human health: Impacts, adaptation, and co-benefits. In *climate change 2014: Impacts, adaptation, and vulnerability. Part A: Global and sectoral aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change* (eds. Field, C. B. et al.) 709–754 (Cambridge University Press, 2014).
- NAACP | Coal Blooded. <https://www.naacp.org/climate-justice-resources/coal-blooded/>.
- NAACP | Fumes Across the Fence-Line. NAACP <https://www.naacp.org/climate-justice-resources/fumes-across-fence-line/>.
- Gubernot, D. M., Anderson, G. B. & Hunting, K. L. Characterizing occupational heat-related mortality in the United States, 2000–2010: An analysis using the census of fatal occupational injuries database. *American Journal of Industrial Medicine* 58, 203–211 (2015).
- Schumacher, J. A. et al. Intimate partner violence and Hurricane Katrina: Predictors and associated mental health outcomes. *Violence and Victims* 25, 588–603 (2010).
- Finn, K., Gajda, E., Perrin, T. & Fredericks, C. Responsible resource development and prevention of sex trafficking: safeguarding native women and children on the Fort Berthold Reservation. *Harvard Journal of Law and Gender*, 40, 1-51 (2017).
- Deschenes, O., Greenstone, M. & Guryan, J. Climate change and birth weight. *American Economic Review* 99, 211–17 (2009).
- Sun, S. et al. Ambient temperature and preterm birth: A retrospective study of 32 million US singleton births. *Environment International* 126, 7–13 (2019).
- Cruz-Cano, R. & Mead, E. L. Causes of excess deaths in Puerto Rico after Hurricane Maria: A time-series estimation. *American Journal of Public Health* 109, 1050–1052 (2019).
- Santos-Burgoa, C. et al. Differential and persistent risk of excess mortality from Hurricane Maria in Puerto Rico: a time-series analysis. *The Lancet Planetary Health* 2, e478–e488 (2018).
- Brunkard, J., Namulanda, G. & Ratard, R. Hurricane Katrina Deaths, Louisiana, 2005. *Disaster Medicine and Public Health Preparedness* 2, 215–223 (2008).
- Jonkman, S. N., Maaskant, B., Boyd, E. & Levitan, M. L. Loss of life caused by the flooding of New Orleans after Hurricane Katrina: analysis of the relationship between flood characteristics and mortality. *Risk Analysis* 29, 676–698 (2009).
- Paul, S., Ghebreyesus, D. & Sharif, H. O. Analysis of the fatalities and socio-economic impacts caused by Hurricane Florence. *Geosciences* 9, 58 (2019).
- Jonkman, S. N., Godfroy, M., Sebastian, A. & Kolen, B. Loss of life due to Hurricane Harvey. *Natural Hazards and Earth System Sciences* 18, 1073–1078 (2018).
- Diakakis, M., Deligiannakis, G., Katsesiadou, K. & Lekkas, E. Hurricane Sandy mortality in the Caribbean and continental North America. *Disaster Prevention and Management* 24, 132–148 (2015).
- Seil, K., Spira-Cohen, A. & Marcum, J. Injury deaths related to Hurricane Sandy, New York City, 2012. *Disaster Medicine and Public Health Preparedness* 10, 378–385 (2016).
- Brackbill, R. M. et al. Nonfatal injuries 1 week after hurricane sandy—New York city metropolitan area, October 2012. *Morbidity and Mortality Weekly Report* 63, 950 (2014).
- Ashley, S. T. & Ashley, W. S. Flood fatalities in the United States. *Journal of Applied Meteorology and Climatology* 47, 805–818 (2008).
- Kellar, D. & Schmidlin, T. Vehicle-related flood deaths in the United States, 1995–2005. *Journal of Flood Risk Management* 5, 153–163 (2012).
- Paul, S., Sharif, H. & Crawford, A. Fatalities caused by hydrometeorological disasters in Texas. *Geosciences* 8, 186 (2018).
- Sharif, H. O., Jackson, T. L., Hossain, M. M. & Zane, D. Analysis of flood fatalities in Texas. *Natural Hazards Review* 16, 04014016 (2015).
- Schmidlin, T. W. Human fatalities from wind-related tree failures in the United States, 1995–2007. *Natural Hazards* 50, 13–25 (2009).
- Marshall, E. G., Lu, S.-E., Williams, A. O., Lefkowitz, D. & Borjan, M. Tree-related injuries associated with response and recovery from Hurricane Sandy, New Jersey, 2011–2014. *Public Health Reports* 133, 266–273 (2018).
- Iqbal, S., Clower, J. H., Hernandez, S. A., Damon, S. A. & Yip, F. Y. A review of disaster-related carbon monoxide poisoning: surveillance, epidemiology, and opportunities for prevention. *American Journal of Public Health* 102, 1957–1963 (2012).
- Schnall, A. et al. Characterization of carbon monoxide exposure during Hurricane Sandy and subsequent nor'easter. *Disaster Medicine and Public Health Preparedness* 11, 562–567 (2017).
- Sastry, N. & Gregory, J. The effect of Hurricane Katrina on the prevalence of health impairments and disability among adults in New Orleans: differences by age, race, and sex. *Social Science & Medicine* 80, 121–129 (2013).
- Khan, A., Mojumder, S. K., Kovats, S. & Vineis, P. Saline contamination of drinking water in Bangladesh. *The Lancet* 371, 385 (2008).
- Kjellstrom, T. et al. Heat, human performance, and occupational health: a key issue for the assessment of global climate change impacts. *Annual Review of Public Health* 37, 97–112 (2016).
- Anderson, G. B. & Bell, M. L. Heat waves in the United States: mortality risk during heat waves and effect modification by heat wave characteristics in 43 U.S. communities. *Environmental Health Perspectives* 119, 210–218 (2011).
- Lo, Y. E. et al. Increasing mitigation ambition to meet the Paris Agreement's temperature goal avoids substantial heat-related mortality in US cities. *Science Advances* 5, eaau4373 (2019).
- Lippmann, S. J., Fuhrmann, C. M., Waller, A. E. & Richardson, D. B. Ambient temperature and emergency department visits for heat-related illness in North Carolina, 2007–2008. *Environmental Research* 124, 35–42 (2013).
- Lee, M., Shi, L., Zanobetti, A. & Schwartz, J. D. Study on the association between ambient temperature and mortality using spatially resolved exposure data. *Environmental Research* 151, 610–617 (2016).
- Sanchez, C. A., Thomas, K. E., Malilay, J. & Annet, J. L. Nonfatal natural and environmental injuries treated in emergency departments, United States, 2001–2004. *Family & Community Health* 33, 3–10 (2010).
- Choudhary, E. & Vaidyanathan, A. Heat stress illness hospitalizations—Environmental public health tracking program, 20 states, 2001–2010. *Morbidity and Mortality Weekly Report: Surveillance Summaries* 63, 1–10 (2014).
- Cil, G. & Cameron, T. A. Potential climate change health risks from increases in heat waves: abnormal birth outcomes and adverse maternal health conditions. *Risk Analysis* 37, 2066–2079 (2017).
- Carter, R. I. et al. Epidemiology of hospitalizations and deaths from heat illness in soldiers. *Medicine & Science in Sports & Exercise* 37, (2005).
- Eisen, R. J., Eisen, L., Ogden, N. H. & Beard, C. B. Linkages of weather and climate with *Ixodes scapularis* and *Ixodes pacificus* (Acari: Ixodidae), enzootic transmission of *Borrelia burgdorferi*, and Lyme disease in North America. *Journal of Medical Entomology* 53, 250–261 (2016).
- Kugeler, K. J., Farley, G. M., Forrester, J. D. & Mead, P. S. Geographic distribution and expansion of human Lyme Disease, United States. *Emerging Infectious Diseases* 21, 1455–1457 (2015).
- Gupta, S. et al. Knowledge and preventive behaviors towards tick-borne diseases in Delaware. *Ticks and Tick-Borne Diseases* 9, 615–622 (2018).
- Centers for Disease Control and Prevention. 2018 Annual Tables of Infectious Disease Data. (2019).
- Schwartz, A. M., Hinckley, A. F., Mead, P. S., Hook, S. A. & Kugeler, K. J. Surveillance for lyme disease—United States, 2008–2015. *Morbidity and Mortality Weekly Report Surveillance Summaries* 66, 1 (2017).
- Moon, K. A. et al. Epidemiology of Lyme disease in Pennsylvania 2006–2014 using electronic health records. *Ticks and Tick-Borne Diseases* 10, 241–250 (2019).
- Rebman, A. W. et al. Incidence of Lyme disease diagnosis in a Maryland Medicaid population, 2004–2011. *American Journal of Epidemiology* 187, 2202–2209 (2018).
- Ronca, S. E., Murray, K. O. & Nolan, M. S. Cumulative incidence of West Nile virus infection, continental United States, 1999–2016. *Emerging Infectious Diseases* 25, 325–327 (2019).
- McDonald, E., et al. West Nile Virus and Other Nationally Notifiable Arboviral Diseases—United States, 2018. *MMWR. Morbidity and Mortality Weekly Report* 68, 673–687 (2019).
- Annual statistics from the National Notifiable Diseases Surveillance System (NNDSS). https://wonder.cdc.gov/nndss/nndss_annual_tables_menu.asp?mmwr_year=2019.
- DeSalvo, K. B. et al. Symptoms of posttraumatic stress disorder in a New Orleans workforce following Hurricane Katrina. *Journal of Urban Health* 84, 142–152 (2007).
- Galea, S. et al. Exposure to hurricane-related stressors and mental illness after Hurricane Katrina. *Archives of General Psychiatry* 64, 1427–1434 (2007).
- Mills, L. D. et al. Post-traumatic stress disorder in an emergency department population one year after Hurricane Katrina. *The Journal of Emergency Medicine* 43, 76–82 (2012).
- Adeola, F. O. Mental health & psychosocial distress sequelae of Katrina: an empirical study of survivors. *Human Ecology Review* 16, 195–210 (2009).
- Picou, J. S. & Hudson, K. Hurricane Katrina and mental health: A research note on Mississippi Gulf Coast residents. *Sociological Inquiry* 80, 513–524 (2010).
- Harville, E. W., Xiong, X., Pridjian, G., Elkind-Hirsch, K. & Buekens, P. Postpartum mental health after Hurricane Katrina: A cohort study. *BMC Pregnancy and Childbirth* 9, 1 (2009).
- Lowe, S. R., Rhodes, J. E. & Waters, M. C. Understanding resilience and other trajectories of psychological distress: a mixed-methods study of low-income mothers who survived Hurricane Katrina. *Current Psychology* 34, 537–550 (2015).
- Paxson, C., Fussell, E., Rhodes, J. & Waters, M. Five years later: Recovery from post traumatic stress and psychological distress among low-income mothers affected by Hurricane Katrina. *Social Science & Medicine* 74, 150–157 (2012).
- Tak, S., Driscoll, R., Bernard, B. & West, C. Depressive symptoms among firefighters and related factors after the response to Hurricane Katrina. *Journal of Urban Health* 84, 153–161 (2007).
- Blaze, J. T. & Shwalb, D. W. Resource loss and relocation: A follow-up study of adolescents two years after Hurricane Katrina. *Psychological Trauma: Theory, Research, Practice, and Policy* 1, 312–322 (2009).
- Boscarino, J. A., Hoffman, S. N., Adams, R. E., Figley, C. R. & Solhkhah, R. Mental health outcomes among vulnerable residents after Hurricane Sandy: implications for disaster research and planning. *American Journal of Disaster Medicine* 9, 97–106 (2014).
- Gruebner, O., Lowe, S. R., Sampson, L. & Galea, S. The geography of post-disaster mental health: spatial patterning of psychological vulnerability and resilience factors in New York City after Hurricane Sandy. *International Journal of Health Geographics* 14, 16 (2015).
- Lowe, S. R., Sampson, L., Gruebner, O. & Galea, S. Psychological resilience after Hurricane Sandy: the influence of individual- and community-level factors on mental health after a large-scale natural disaster. *PLoS ONE* 10, e0125761 (2015).
- Hamama-Raz, Y. et al. Gender differences in psychological reactions to Hurricane Sandy among New York metropolitan area residents. *Psychiatric Quarterly* 86, 285–296 (2015).
- Lowe, S. R., Sampson, L., Gruebner, O. & Galea, S. Mental health service need and use in the aftermath of Hurricane Sandy: findings in a population-based sample of New York City residents. *Community Mental Health Journal* 52, 25–31 (2016).
- Tally, S., Levack, A., Sarkin, A. J., Gilmer, T. & Groessler, E. J. The impact of the San Diego wildfires on a general mental health population residing in evacuation areas. *Administration and Policy in Mental Health and Mental Health Services Research* 40, 348–354 (2013).
- Jacobs, M. B. & Harville, E. W. Long-term mental health among low-income, minority women following exposure to multiple natural disasters in early and late adolescence compared to adulthood. *Child & Youth Care Forum* 44, 511–525 (2015).

71. Rung, A. L. et al. Depression, mental distress, and domestic conflict among Louisiana women exposed to the Deepwater Horizon oil spill in the WaTCH study. *Environmental Health Perspectives* 124, 1429–1435 (2016).
72. Brock, R. L. et al. Peritraumatic distress mediates the effect of severity of disaster exposure on perinatal depression: The Iowa Flood Study. *Journal of Traumatic Stress* 28, 515–522 (2015).
73. Anastario, M., Shehab, N. & Lawry, L. Increased gender-based violence among women internally displaced in Mississippi 2 years post-Hurricane Katrina. *Disaster Medicine and Public Health Preparedness* 3, 18–26 (2009).
74. Harville, E. W., Taylor, C. A., Tesfai, H., Xu Xiong & Buekens, P. Experience of Hurricane Katrina and reported intimate partner violence. *Journal of Interpersonal Violence* 26, 833–845 (2011).
75. Fagen, J. L., Sorensen, W. & Anderson, P. B. Why not the University of New Orleans? Social disorganization and sexual violence among internally displaced women of Hurricane Katrina. *Journal of Community Health* 36, 721–727 (2011).
76. Thornton, W. E. & Voigt, L. Disaster rape: vulnerability of women to sexual assaults during Hurricane Katrina. *Journal of Public Management and Social Policy* 13, 23–49 (2007).
77. Gearhart, S. et al. The impact of natural disasters on domestic violence: an analysis of reports of simple assault in Florida (1999–2007). *Violence and Gender* 5, 87–92 (2018).
78. Shanley, E. & Jordan, R. Sex Trafficking in Indian Country. in *Human Trafficking Is a Public Health Issue: A Paradigm Expansion in the United States* (eds. Chisolm-Straker, M. & Stoklosa, H.) 123–140 (Springer International Publishing, 2017).
79. Sweet, V. Rising waters, rising threats: The human trafficking of Indigenous women in the circumpolar region of the United States and Canada. *The Yearbook of Polar Law Online* 6, 162–188 (2014).
80. Reid, C. E. et al. Differential respiratory health effects from the 2008 northern California wildfires: A spatiotemporal approach. *Environmental Research* 150, 227–235 (2016).
81. Liu, J. C. et al. Who among the elderly is most vulnerable to exposure to and health risks of fine particulate matter from wildfire smoke? *American Journal of Epidemiology* 186, 730–735 (2017).
82. Washington State Department of Health. Surveillance Investigation of the Cardiopulmonary Health Effects of the 2012 Wildfires in North Central Washington State. (2015).
83. Roy, A., Sheffield, P., Wong, K. & Trasande, L. The effects of outdoor air pollutants on the costs of pediatric asthma hospitalizations in the United States, 1999 to 2007. *Med Care* 49, 810–817 (2011).
84. Mazurek, J. M. & Syamlal, G. Prevalence of asthma, asthma attacks, and emergency department visits for asthma among working adults—National Health Interview Survey, 2011–2016. *Morbidity and Mortality Weekly Report* 67, 377 (2018).
85. Rath, B. et al. Adverse respiratory symptoms and environmental exposures among children and adolescents following Hurricane Katrina. *Public Health Reports* 126, 853–860 (2011).
86. Ziska, L. et al. Recent warming by latitude associated with increased length of ragweed pollen season in central North America. *Proc Natl Acad Sci USA* 108, 4248 (2011).
87. Zhang, Y. et al. Allergenic pollen season variations in the past two decades under changing climate in the United States. *Global Change Biology* 21, 1581–1589 (2015).
88. Salo, P. M. et al. Prevalence of allergic sensitization in the United States: results from the National Health and Nutrition Examination Survey (NHANES) 2005–2006. *Journal of Allergy and Clinical Immunology* 134, 350–359 (2014).
89. Silverberg, J. I., Braunstein, M. & Lee-Wong, M. Association between climate factors, pollen counts, and childhood hay fever prevalence in the United States. *Journal of Allergy and Clinical Immunology* 135, 463–469 (2015).
90. Basu, R., Malig, B. & Ostro, B. High ambient temperature and the risk of preterm delivery. *American Journal of Epidemiology* 172, 1108–1117 (2010).
91. Basu, R., Sarovar, V. & Malig, B. J. Association between high ambient temperature and risk of stillbirth in California. *American Journal of Epidemiology* 183, 894–901 (2016).
92. Bell, M., Ebisu, K. & Belanger, K. Ambient Air Pollution and Low Birth Weight in Connecticut and Massachusetts. *Environmental Health Perspectives* 115, 1118–24 (2007).
93. Le, H. Q. et al. Air pollutant exposure and preterm and term small-for-gestational-age births in Detroit, Michigan: long-term trends and associations. *Environment International*. *Environment International* 44, 7–17.
94. Xiong, X. et al. Exposure to Hurricane Katrina, post-traumatic stress disorder and birth outcomes. *The American Journal of the Medical Sciences* 336, 111–115 (2008).
95. Grabich, S. C. et al. Hurricane Charley exposure and hazard of preterm delivery, Florida 2004. *Maternal and Child Health Journal* 20, 2474–2482 (2016).
96. Zahran, S., Snodgrass, J. G., Peek, L. & Weiler, S. Maternal hurricane exposure and fetal distress risk. *Risk Analysis* 30, 1590–1601 (2010).
97. Currie, J. & Rossin-Slater, M. Weathering the storm: hurricanes and birth outcomes. *Journal of Health Economics* 32, 487–503 (2013).
98. Tong, V. T., Zotti, M. E. & Hsia, J. Impact of the Red River catastrophic flood on women giving birth in North Dakota, 1994–2000. *Maternal and Child Health Journal* 15, 281–288 (2011).
99. Kissinger, P., Schmidt, N., Sanders, C. & Liddon, N. The effect of the Hurricane Katrina disaster on sexual behavior and access to reproductive care for young women in New Orleans. *Sexually Transmitted Diseases* 34, (2007).
100. Leyser-Whalen, O., Rahman, M. & Berenson, A. B. Natural and social disasters: racial inequality in access to contraceptives after Hurricane Ike. *J. Womens Health* 20, 1861–1866 (2011).
101. McGuire, L. C., Ford, E. S. & Okoro, C. A. Natural disasters and older US adults with disabilities: implications for evacuation. *Disasters* 31, 49–56 (2007).
102. Lin, S., Fletcher, B. A., Luo, M., Chinery, R. & Hwang, S.-A. Health impact in New York City during the Northeastern blackout of 2003. *Public Health Reports* 126, 384–393 (2011).
103. Molinari, N. A. M., Chen, B., Krishna, N. & Morris, T. Who's at risk when the power goes out? The at-home electricity-dependent population in the United States, 2012. *Journal of Public Health Management and Practice* 23, 152–159 (2017).
104. Lawrence, W. R. et al. After the storm: short-term and long-term health effects following Superstorm Sandy among the elderly. *Disaster Medicine and Public Health Preparedness* 13, 28–32 (2019).
105. Malik, S. et al. Vulnerability of older adults in disasters: emergency department utilization by geriatric patients after Hurricane Sandy. *Disaster Medicine and Public Health Preparedness* 12, 184–193(2018).
106. Clarke, P. J., Yan, T., Keusch, F. & Gallagher, N. A. The impact of weather on mobility and participation in older US adults. *American Journal of Public Health* 105, 1489–1494 (2015).
107. Bischoff-Ferrari, H. A., Orav, J. E., Barrett, J. & Baron, J. Effect of seasonality and weather on fracture risk in individuals 65 years and older. *Osteoporosis International* 18, 1225–1233 (2007).
108. Semenza, J. C., Ploubidis, G. B. & George, L. A. Climate change and climate variability: personal motivation for adaptation and mitigation. *Environmental Health* 10, 46 (2011).
109. Huang, S.-K., Lindell, M. K. & Prater, C. S. Who leaves and who stays? A review and statistical meta-analysis of hurricane evacuation studies. *Environment and Behavior* 48, 991–1029 (2015).
110. Peek, L. & Fothergill, A. Displacement, gender, and the challenges of parenting after Hurricane Katrina. *NWSA Journal* 20, 69–105 (2008).
111. Gazibara, T., Jia, H. & Lubetkin, E. I. Disaster preparedness: a comparative study of North Carolina and Montana. *Disaster Medicine and Public Health Preparedness* 8, 239–242 (2014).
112. Ekeganga, C. C. & Ziyu, L. Gender and public health emergency preparedness among United States adults. *Journal of Community Health* 1–5 (2019).
113. Ablah, E., Konda, K. & Kelley, C. L. Factors predicting individual emergency preparedness: a multi-state analysis of 2006 BRFSS data. *Biosecurity and Bioterrorism* 7, 317–330 (2009).
114. DeBastiani, S. D., Strine, T. W., Vagi, S. J., Barnett, D. J. & Kahn, E. B. Preparedness perceptions, sociodemographic characteristics, and level of household preparedness for public health emergencies: Behavioral Risk Factor Surveillance System, 2006–2010. *Health Security* 13, 317–326 (2015).
115. Baker, E. J. Household preparedness for the aftermath of hurricanes in Florida. *Applied Geography* 31, 46–52 (2011).
116. Reininger, B. M. et al. Social capital and disaster preparedness among low income Mexican Americans in a disaster prone area. *Social Science & Medicine* 83, 50–60 (2013).
117. Foster, M. et al. Personal disaster preparedness of dialysis patients in North Carolina. *Clinical Journal of the American Society of Nephrology* 6, 2478–2484 (2011).
118. Renukuntla, V. S., Hassan, K., Wheat, S. & Heptulla, R. A. Disaster preparedness in pediatric type 1 diabetes mellitus. *Pediatrics* 124, e973–e977 (2009).
119. Kulkarni, P. A. et al. Evacuations as a result of Hurricane Sandy: analysis of the 2014 New Jersey Behavioral Risk Factor Survey. *Disaster Medicine and Public Health Preparedness* 11, 720–728 (2017).
120. Elliott, J. R. & Pais, J. Race, class, and Hurricane Katrina: social differences in human responses to disaster. *Social Science Research* 35, 295–321 (2006).
121. Meyer, M. A., Mitchell, B., Purdum, J. C., Breen, K. & Iles, R. L. Previous hurricane evacuation decisions and future evacuation intentions among residents of southeast Louisiana. *International Journal of Disaster Risk Reduction* 31, 1231–1244 (2018).
122. Farmer, A. K., Zelewicz, L., Wachtendorf, T. & DeYoung, S. E. Scared of the shelter from the storm: fear of crime and hurricane shelter decision making. *Sociological Inquiry* 88, 193–215 (2018).
123. Fothergill, A. & Peek, L. *Children of Katrina*. (University of Texas Press, 2015).
124. Bullard, R. D. & Wright, B. *Race, Place, and Environmental Justice after Hurricane Katrina: Struggles to Reclaim, Rebuild, and Revitalize New Orleans and the Gulf Coast*. (Westview Press, 2009).
125. U.S. Census Bureau. *American Community Survey 5-Year Estimates 2017*. (2018).
126. Dominey-Howes, D., Gorman-Murray, A. & McKinnon, S. Queering disasters: On the need to account for LGBTI experiences in natural disaster contexts. *Gender, Place & Culture* 21, 905–918 (2014).
127. D'ooge, C. *Queer Katrina: Gender and sexual orientation matters in the aftermath of the disaster*. in *Katrina and the Women of New Orleans* (ed. Willinger, B.) 22–24 (2008).
128. Fussell, E., Sastry, N. & VanLandingham, M. Race, socioeconomic status, and return migration to New Orleans after Hurricane Katrina. *Population and Environment* 31, 20–42 (2010).
129. Fussell, E. & Harris, E. Homeownership and housing displacement after Hurricane Katrina among low-income African-American mothers in New Orleans. *Social Science Quarterly* 95, 1086–1100 (2014).
130. *Get to the Bricks: The Experiences of Black Women from New Orleans Public Housing After Hurricane Katrina*. Institute for Women's Policy Research <https://iwpr.org/publications/get-to-the-bricks-the-experiences-of-black-women-from-new-orleans-public-housing-after-hurricane-katrina/>.
131. Luft, R. Racialized disaster patriarchy: An intersectional model for understanding disaster ten years after Hurricane Katrina. *Feminist Formations* 28, 1–26 (2016).
132. West, S. & Mottola, G. A population on the brink: American renters, emergency savings, and financial fragility. *Poverty & Public Policy* 8, 56–71 (2016).
133. Zottarelli, L. K. Post-Hurricane Katrina employment recovery: the interaction of race and place. *Social Science Quarterly* 89, 592–607 (2008).
134. Josephson, A. & Marshall, M. I. The demand for post-Katrina disaster aid: SBA disaster loans and small businesses in Mississippi. *Journal of Contingencies and Crisis Management* 24, 264–274 (2016).
135. Marshall, M. I., Niehm, L. S., Sydnor, S. B. & Schrank, H. L. Predicting small business demise after a natural disaster: an analysis of pre-existing conditions. *Natural Hazards* 79, 331–354 (2015).
136. Pyles, L. & Lewis, J. S. Women of the storm: Advocacy and organizing in post-Katrina New Orleans. *Affilia* 22, 385–389 (2007).
137. David, E. Cultural trauma, memory, and gendered collective action: The case of women of the storm following Hurricane Katrina. *NWSA Journal* 20, 138–162 (2008).
138. Weber, L. & Messias, D. K. H. Mississippi front-line recovery work after Hurricane Katrina: An analysis of the intersections of gender, race, and class in advocacy, power relations, and health. *Social Science & Medicine* 74, 1833–1841 (2012).
139. Fothergill, A. *Heads above Water: Gender, Class, and Family in the Grand Forks Flood*. (State University of New York Press, 2004).
140. National Association of State Energy Officials & Energy Futures Initiative. *U.S. Energy & Employment Report 2019*. (2019).

141. Solar Foundation. National Solar Jobs Census 2018. (2019).
142. National Association of State Energy Officials & Energy Futures Initiative. U.S. Energy & Employment Report 2019. (2019).
143. The Solar Foundation & Solar Energy Industries Association. U.S. Solar Industry Diversity Study 2019. (2019).
144. U.S. Department of Labor Employment and Training Administration. National Agricultural Workers Survey. (2018).
145. Ballew, M. T. et al. Climate change in the American mind: Data, tools, and trends. *Environment: Science and Policy for Sustainable Development* 61, 4–18 (2019).
146. Yale Program on Climate Change Communication (YPCCC) & George Mason University Center for Climate Change Communication (Mason 4C). Climate Change in the American Mind: National survey data on public opinion (2008-2017).
147. Zeng, L. et al. Trends in processed meat, unprocessed red meat, poultry, and fish consumption in the United States, 1999-2016. *Journal of the Academy of Nutrition and Dietetics* 119, 1085-1098. e12 (2019).
148. Taylor, D. The State of Diversity in Environmental Organizations Mainstream NGOs Foundations Government Agencies. (2018).
149. MacDonald, T. & Hymas, L. How broadcast TV networks covered climate change in 2018. *Media Matters for America* <https://www.mediamatters.org/donald-trump/how-broadcast-tv-networks-covered-climate-change-2018>.
150. Ballew, M. T. et al. Climate change in the American mind: Data, tools, and trends. *Environment: Science and Policy for Sustainable Development* 61, 4–18 (2019).
151. Liu, X., Vedlitz, A. & Shi, L. Examining the determinants of public environmental concern: Evidence from national public surveys. *Environmental Science & Policy* 39, 77–94 (2014).
152. McCright, A. M. The effects of gender on climate change knowledge and concern in the American public. *Population and Environment* 32, 66–87 (2010).
153. Mukherjee, D. & Rahman, M. A. To drill or not to drill? An econometric analysis of US public opinion. *Energy Policy* 91, 341–351 (2016).
154. Davis, C. & Fisk, J. M. Energy abundance or environmental worries? Analyzing public support for fracking in the United States. *Review of Policy Research* 31, 1–16 (2014).
155. Selm, K. R., Peterson, M. N., Hess, G. R., Beck, S. M. & McHale, M. R. Educational attainment predicts negative perceptions women have of their own climate change knowledge. *PLoS one* 14, e0210149 (2019).
156. Gan, J., Jarrett, A. & Gaither, C. J. Wildfire risk adaptation: propensity of forestland owners to purchase wildfire insurance in the southern United States. *Canadian Journal of Forest Research-Revue Canadienne De Recherche Forestiere* 44, 1376–1382 (2014).
157. Shao, W. et al. Understanding the effects of past flood events and perceived and estimated flood risks on individuals' voluntary flood insurance purchase behavior. *Water Research* 108, 391–400 (2017).
158. Petrolia, D. R., Landry, C. E. & Coble, K. H. Risk preferences, risk perceptions, and flood insurance. *Land Economics* 89, 227–245 (2013).
159. Petrolia, D. R., Hwang, J., Landry, C. E. & Coble, K. H. Wind insurance and mitigation in the coastal zone. *Land Economics* 91, 272–295 (2015).
160. Pilgeram, R. & Amos, B. Beyond “inherit it or marry it”: exploring how women engaged in sustainable agriculture access farmland. *Rural Sociology* 80, 16–38 (2015).
161. Ball, J. A. She works hard for the money: women in Kansas agriculture. *Agriculture and Human Values* 31, 593–605 (2014).
162. National Agricultural Statistics Service. 2017 Census of Agriculture. (2019).
163. Trauger, A., Sachs, C., Barbercheck, M., Brasier, K. & Kiernan, N. E. “Our market is our community”: women farmers and civic agriculture in Pennsylvania, USA. *Agriculture and Human Values* 27, 43–55 (2010).
164. Allen, E., Lyons, H. & Stephens, J. C. Women's leadership in renewable transformation, energy justice and energy democracy: Redistributing power. *Energy Research & Social Science* 57, 101233 (2019).
165. Pyles, L. & Lewis, J. S. Women of the storm: Advocacy and organizing in post-Katrina New Orleans. *Affilia* 22, 385–389 (2007).
166. TallBear, K. Badass (Indigenous) Women Caretake Relations: #NoDAPL, #IdleNoMore, #BlackLivesMatter. *Society for Cultural Anthropology* <https://culanth.org/fieldsights/badass-indigenous-women-caretake-relations-no-dapl-idle-no-more-black-lives-matter>.
167. Ogbomo, A. S. et al. Vulnerability to extreme-heat-associated hospitalization in three counties in Michigan, USA, 2000–2009. *International Journal of Biometeorology* 61, 833–843 (2017).
168. Petitti, D. B., Harlan, S. L., Chowell-Puente, G. & Ruddell, D. Occupation and environmental heat-associated deaths in Maricopa County, Arizona: A case-control study. *PLoS one* 8, e62596 (2013).
169. Stoecklin-Marois, M., Hennessy-Burt, T., Mitchell, D. & Schenker, M. Heat-related illness knowledge and practices among California hired farm workers in the MICASA study. *Industrial Health* 51, 47–55 (2013).
170. Sugg, M. M., Konrad, C. E. & Fuhrmann, C. M. Relationships between maximum temperature and heat-related illness across North Carolina, USA. *International Journal of Biometeorology* 60, 663–675 (2016).
171. Johnson, M. G. et al. Identifying heat-related deaths by using medical examiner and vital statistics data: surveillance analysis and descriptive epidemiology—Oklahoma, 1990–2011. *Environmental Research* 150, 30–37 (2016).
172. Pillai, S. K. et al. Heat illness: Predictors of hospital admissions among emergency department visits—Georgia, 2002–2008. *Journal of Community Health* 39, 90–98 (2014).
173. Akerlof, K., Delamater, P., Boules, C., Upperman, C. & Mitchell, C. Vulnerable populations perceive their health as at risk from climate change. *International Journal of Environmental Research and Public Health* 12, 15419–15433 (2015).
174. Feltman, B. C., Norris, P. E. & Batanian, J. L. Gauging concerns about climate change in Great Lakes coastal communities. *Journal of Great Lakes Research* 43, 670–677 (2017).
175. Larson, K. L., Ibes, D. C. & White, D. D. Gendered perspectives about water risks and policy strategies: A tripartite conceptual approach. *Environment and Behavior* 43, 415–438 (2011).
176. Burger, J. & Gochfeld, M. Perceptions of severe storms, climate change, ecological structures and resiliency three years post-hurricane Sandy in New Jersey. *Urban Ecosystems* 20, 1261–1275 (2017).
177. Liu, Z., Smith, W. J. & Safi, A. S. Rancher and farmer perceptions of climate change in Nevada, USA. *Climatic Change* 122, 313–327 (2014).
178. Safi, A. S., Smith Jr, W. J. & Liu, Z. Rural Nevada and climate change: vulnerability, beliefs, and risk perception. *Risk Analysis* 32, 1041–1059 (2012).
179. Peacock, W. G., Brody, S. D. & Highfield, W. Hurricane risk perceptions among Florida's single family homeowners. *Landscape and Urban Planning* 73, 120–135 (2005).
180. Carlton, S. J. & Jacobson, S. K. Climate change and coastal environmental risk perceptions in Florida. *Journal of Environmental Management* 130, 32–39 (2013).
181. Gotham, K. F., Lauve-Moon, K. & Powers, B. Risk and recovery: Understanding flood risk perceptions in a postdisaster city—The case of New Orleans. *Sociological Spectrum* 37, 335–352 (2017).

