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An Interdisciplinary Review: How Rapid Climate Change is Impacting Human Health, Environmental Policy, and Voter Behavior

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AN INTERDISCIPLINARY REVIEW - HOW RAPID CLIMATE CHANGE IS IMPACTING HUMAN HEALTH, ENVIRONMENTAL POLICY, AND VOTER BEHAVIOR

By

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A Dissertation
Submitted in Partial Fulfilment of the
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(in Interdisciplinary Climate Studies)

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Dissertation Advisor: Dr. Paul Andrew Mayewski

An Abstract of the Dissertation Presented
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Preface

As an interdisciplinary Ph.D. student at UMaine's Climate Change Institute, I have an obligation to review a reasonably broad set of applicable climate-related topics, while conducting unique research and tackling specific research questions, problems, and providing substantive conclusions. As such, I have engaged a case study approach where questions specific to the science, policy, and politics of climate change are addressed. Those three case studies are described in more detail below.

Background and Context

As of July 2023, the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) validates and expands on thousands of peer-reviewed publications and author analysis which conclude that climate change is widespread, rapidly advancing, and intensifying and is primarily a consequence of human activity increasing greenhouse as concentrations. The IPCC warns there is a "rapidly closing window of opportunity to secure a livable and sustainable future for all" (IPCC, 2023, pg. 24). Estimates suggest 97% (NASA, 2023) of the scientific

community agree that climate change is a real, existential threat to humanity. While continued research is needed to assess the impact of climate change the science is clear.

In 2015, 196 countries signed the Paris Agreement, a global pact to reduce global warming and mitigate the effects of rapid climate change. These various countries then began offering comprehensive policy proposals designed to meet the goals of the Paris Agreement: to slow global warming to 1.5° Celsius. In 2020, as countries prepared for the global Conference of the Parties (COP26) climate summit, the majority strengthened their original policy proposals in recognition of an ever-shrinking window of opportunity to effectively mitigate global warming and rapid climate change. The new policy goal was to cut carbon emissions to reach net zero by 2050. Policy makers now agree that countries must cut carbon emissions in half by 2030 if we are to keep global warming to 1.5°C. In 2022, the United Nations (UN) published a report suggesting that the combined efforts of the now 193 parties signed on to Paris will result in a 10.6% increase in carbon dioxide emissions by 2030 (UNCC, 2022). An IPCC report released in 2023 (IPCC, 2023) strongly suggests efforts to reduce emissions and meet targets are falling short.

Based upon a 2023 Yale "Climate Change In The American Mind" survey, the number of Americans who think global warming is currently occurring exceeds those who think it is not happening by a 5 to 1 margin (72% versus 15%) (Yale, 2023). Yet a recent Pew (Pew Research Center, 2024) study shows that "dealing with climate change" ranked 18th on a list of the policy priorities, down one spot from 2023. While President Biden's $2 trillion-dollar Bipartisan Infrastructure/Inflation Reduction packages (H.R. 3684. 2021/H.R.5376. 2022) commit an estimated $375 billion to combat climate change, the bills included massive concessions to the fossil fuel industry including billions (CIEL, 2021) in annual subsidies, the opening of new

leases for the extraction of gas and oil on public lands in New Mexico, Wyoming, Utah, Colorado, California, Montana, and North Dakota (BLM, 2023), and an easing of regulations on gas and oil pipeline projects like the Mountain Valley Pipeline in West Virginia, a pet project of US Senate holdout Joe Manchin. Many of these concessions were needed to pass the bill, which passed the US Senate by one vote. While thus far largely unsuccessful, the policies promoted in reports like the UN's 2023 IPCC 6th Assessment on Climate Change reflect the need for immediate and dramatic action. What is missing, according to the 2022 IPCC report (Chapter 5) is the political will of the US public and politicians to prioritize climate change policy. Unfortunately, that will not happen until elected officials' self-preservation instinct (i.e., their desire to be re-elected) become as tied to climate change as it currently is to issues like the economy, health care, education, and immigration, among others. Until political survival hinges on one's position on climate change, meaningful climate change policy will lag behind other, more politically expedient issues.

Literature Review

Each Case Study includes a literature review, including a summary of, comparisons between, and critiques of the most relevant scholarly sources. The literature review focuses on key concepts, theories, and research in order to supplement existing research in each of the three study areas herein.

Contributions to Knowledge

As an interdisciplinary Ph.D. student at UMaine's Climate Change Institute, I have an obligation to cover a reasonably broad set of applicable climate related topics, while conducting research and tackling specific research questions, problems, and conclusions. As such, I have engaged a case study approach where questions specific to the science, policy and politics or

climate change are addressed. That said, it has long been my contention that climate scientists and climate policy makers have done their jobs. Scientists have given us more than adequate scientific proof that climate change is real and advancing rapidly, while those policy makers focused on implementing policy designed to mitigate the impacts of carbon emissions have given us options that, if enacted and codified, would help positively address climate change and global warming. What is missing? Political will. To address this shortcoming, we must convince voters that climate change is at least as great if not a greater priority as important issues like health care, education, and the economy, resulting in the election of more pro-climate friendly candidates. To this end, this research is meant to find ways to effectively communicate climate messaging across partisan lines.

DEDICATIONS

For my father, David W. Hasson, who dreamed of climbing mountains. Thanks Pop.

For Ollie, Maddie, and Aiden. Find love and purpose my beautiful children. You have given me both.

For Ann. The strongest person I know and the love of my life. Thank you…for everything.

"We must live the action and passion of our time, at peril of being judged not to have lived at all." Oliver Wendell Holmes Jr.

"Never give in. Never, never, never, never—in nothing, great or small, large or petty—never give in, except to convictions of honor and good sense." Winston Churchill

ACKNOWLEDGEMENTS

Case study specific acknowledgements will follow each section. That said, my sincere thanks to Dr. Paul Andrew Mayewski, a gentleman, scholar, author, teacher, adventurer, and eminent climate scientist, who saw value in my research and without whom neither my participation in the 2022 Greenland Expedition, nor this iPhD, would have happened. To witness Dr. Mayewski teach at the foot of the Greenland Ice Sheet is to see true passion in action. I'm grateful.

Many thanks to my advisory committee, including lead advisor Dr. Paul Mayewski: University of Maine/Climate Change Institute, Dr. Sean Birkel: UMaine, Dr. Mark Brewer: UMaine, Dr. Alan Gerber: Yale, Dr. Charles Norchi: UMaine Law School, who shared their insights, guidance, encouragement and that most precious of commodities…time. Thank you.

The Greenland research was the result of work done by several individuals. It was conducted as part of the National Science Foundation supported SAUNNA NRT program at the University of Maine, and UMaine's Climate Change Institute. I want to thank my co-authors, Dr. Paul Mayewski, Dr. Mario Potocki, Ligia Naveira, and Kevin Anderson. Additionally, much thanks to the faculty and students affiliated with the University of Maine's SAUNNA NRT 2022 program including Dr. Jasmine Saros (PI), Dr. Kristin Schild, Dr. Kiley Daley, Dr. Robert Northington (Husson University), Dr. Charles Norchi (UMaine Law School), Dr. Amanda Lynch (Brown University) and UMaine graduate students Amanda Gavin and Vaclava Hazukova. I'd also like to thank the crew of the research vessel Arctic/Earth, including Captain Magnus Day, Mate Julia Prinselaar, and Arctic/Earth owner David Conover. Finally, I'm grateful to the staff at Tasermiut Outfitters who provided much needed and appreciated support.

To the entire University of Maine Graduate School staff, particularly Dean Scott Delcourt and Aylah Ireland. Your dedication and support made the process much easier.

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CASE STUDY #1 - PFAS IN SOUTH GREENLAND MELTWATER

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Highlights

- PFAS sampling and analysis of 16 meltwater test sites in southern Greenland.
- PFAS detected at ten of sixteen sample sites.
- The concentrations of PFAS were below EPA advisory levels.
- Both direct and atmospheric transport from North America are likely responsible for detected PFAS.

1.1 Abstract

The Greenland Ice Sheet (GrIS) is a critical water source for residents and agricultural interests that exposes downstream marine and terrestrial ecosystems to both important nutrients as well as harmful pollutants. As climate change pressures, particularly increased temperatures, cause ice sheets and glaciers to melt at an ever-increasing pace, downstream exposure to pollutants, including PFAS (per- and poly-fluoroalkyl substances), is a critical concern. Our research team collected a set of sixteen glacier meltwater samples from locations in Southern Greenland and submitted these samples to Anatek Labs in Moscow, Idaho for solid-phase extraction (SPE) liquid chromatography/tandem mass spectrometry (LC/TMS) analysis to determine concentration levels of detected PFAS. Ten of the sixteen locations showed concentrations of three, out of a possible twenty-five, PFAS compounds tested at Anatek Labs, PFAS subtypes, including PFBA Perfluorobutanoic acid, PFNA Perfluorononanoic acid, and PFPeA Perfluoropentanoic acid. (Table 1.1.) All the detected concentration levels were below EPA and WHO advisory limits. Site #3 showed the highest level of any PFAS type, at.00158 ug/L of PFBA, while PFAS concentrations were not detected at six of the test sample locations.

1.2 Introduction

The Greenland Ice Sheet (GrIS) covers over 650,000 square miles, with an average ice thickness of 1600 meters, and holds 7.7% of global freshwater (McColaugh, 2017). Glaciers play an important role in providing downstream populations with drinking water (Immerzeel et al., 2020) as well as hydration for agricultural needs (Miner et al., 2020; McColaugh, 2017; Potocki et al., 2022; Carey et al., 2017). Meltwater run-off also provides downstream marine and terrestrial ecosystems with important beneficial nutrients like nitrates, ammonium, and a host of dissolved natural matter like amino acids, carbamide, dissolved organic nitrogen, and granulated nitrogen (Kissman et al., 2013; Slemmons et al., 2013; Chu et al., 2014). Ice sheets and glaciers also act as sinks for atmospherically transported chemicals and toxins (Miner et al., 2020; Miner et al., 2018) including fertilizers, industrial and consumer chemicals like PFAS, and microplastics (Miner and Mayewski et al., 2021; Miner et al., 2021; Miner et al., 2017).

PFAS, or per- and polyfluoroalkyl substances, are man-made chemicals that do not naturally degrade and therefore easily accumulate in the environment (Pelch et al., 2022; EPA, 2022). PFAS can be transported over long distances from heavily populated areas where PFAS are in substantial use, to more remote corners of the globe (Kwok et al., 2013; Miner et al., 2021; Wang et al 2019). First devised, produced, and widely used in the 1930s, 40s and 50s, per- and polyfluoroalkyl substances (PFAS) have been used in a variety of industries including fire-retardant substances, aerospace industry technologies and consumer products for decades (Brennan et al., 2021). In 2018, CDC researchers released a statement suggesting that most Americans (97%) have traces of PFAS in their system (CDC, 2022). Environmental pressures related to climate change, specifically rising temperatures (Immerzeel et al., 2019; Miner et al 2020) and impacts on atmospheric weather systems leading to greater rainfall (Simonson et al.,

2022; Auger et al., 2017) in Greenland have resulted in the rapid melting of the Greenland Ice Sheet (Auger et al., 2017) and a corresponding increase in meltwater run-off volume. The chemical composition of this meltwater, and the pollutants it may carry, can have a significant impact on Greenland's human, marine, and terrestrial ecosystem health (Kissman et al., 2013). Moreover, climate projections for Greenland indicate that continued increased temperatures due to global warming will produce greater meltwater flow (Cameron et al., 2017; Simonson et al., 2021) and therefore will potentially exacerbate the delivery of dangerous chemicals, like PFAS, found in glacial runoff (Hanna et al., 2008; Hauptmann et al., 2017). Assessing the toxicity levels of meltwater from the GrIS and adjacent glaciers can provide authorities with critical information specific to chemical composition, potential health concerns, and corresponding policy.

1.3 Research Purpose

The purpose of this research was to collect and analyze a series of glacier meltwater samples in South Greenland for per- and poly-fluoroalkyl substances, assess and compare PFAS concentration levels in our samples with known or recommended health advisory levels, and determine whether PFAS levels are present in such quantities to represent a health risk to both local human populations and surrounding ecosystems. Additionally, enhancing a water quality framework, specifically a baseline assessment, for Greenland and the Arctic region can be useful for several reasons, including, a) Environmental Tracking: Establishing a baseline for water quality provides a reference point against which future changes can be assessed. It allows for ongoing monitoring and evaluation of environmental conditions, including the presence of contaminants like PFAS, changes in pollutant levels, and potential impacts on aquatic and

terrestrial ecosystems. This information could be vital for understanding and managing the health of freshwater resources in the region, b) Identification of Threats and Impacts: A baseline assessment helps identify existing and potential threats to water quality in Greenland and the Arctic. This includes pollution sources such as industrial activities, shipping, mining, agriculture, and fossil fuel extraction efforts. By understanding the current state of water quality, public health officials and stakeholders can develop effective policy to address and prevent further degradation. Also, as efforts to open a rare earth metal mining operation near Narsaq in south Greenland progress, benchmark measurements may provide future litigants with critical evidence, c) Protection of Ecosystems and Biodiversity: Greenland, as well as the entire Arctic region, is home to unique and fragile ecosystems, including freshwater habitats that support a diverse range of species. Establishing a water quality baseline aids in the protection and conservation of these ecosystems. It allows for early detection of changes that may negatively impact aquatic biodiversity and helps identify key areas for conservation efforts, d) Human Health Considerations: Water quality is closely linked to human health, as communities rely on freshwater sources for drinking, sanitation, agriculture, and cooking. A baseline assessment enables the identification of potential threats to human well-being. It allows for the application of measures to protect the well-being of local populations, e) Climate Change Implications: Greenland and the Arctic are up-against widespread environmental changes due to climate change. These changes, including melting ice, increased runoff from glaciers, altered precipitation patterns, and increased human activities including extraction and mining efforts, can impact water quality. Developing a baseline assessment provides a foundation for understanding and distinguishing natural variations from anthropogenic influences, thus facilitating effective adaptation and mitigation strategies in the face of climate change, f)

International Cooperation and Policy Development: A water quality framework serves as a basis for international cooperation and policy development. It provides a common understanding of water quality issues among Arctic nations and helps establish regional agreements and regulations to protect shared water resources. In summary, developing a water quality framework, including a baseline assessment, in Greenland and the Arctic is vital for understanding the current state of water resources, identifying threats and impacts, protecting ecosystems and biodiversity, ensuring human health, addressing climate change, and promoting international cooperation. It provides the necessary foundation for effective management, protection, and sustainable use of freshwater resources in the region (Sondergaard et al., 2020; Sondergaard & Mosbech, 2022).

1.4 PFAS Background

PFAS are a set of man-made substances that have been use in many facets of industry and manufacturing over the past seventy years (EPA, 2022; Miner et at., 2020). Researchers note the PFAS sub-sets include thousands of chemicals (Buck et al., 2021), with recent reports identifying more than 4,500 PFAS in broad worldwide use over the past several decades (OECD, 2018; Sunderland et al., 2019). While certain chemical manufacturing companies responsible for the early production and distribution of specific types of chemicals called “long-chain” PFAS have discontinued production, replacement chemicals called “short-chain” PFAS (Buck et al., 2021) 156 continue to be produced. Specifically, these chemicals are used for their stain, grease, and water- resistant properties in the manufacturing of many industrial products such as cookware, packaging, electronics, garments, carpets, cosmetics, and personal care products (Garcia-Barrios et al., 2021; Pelch et al., 2022; OECD, 2018; EPA, 2022).

1.5 Health Risks & Advisory Limits

Research shows exposure to per- and polyfluoroalkyl substances may be linked to a multitude of serious ailments, including but not limited to modified immune and endocrine use, liver disease, lipid and insulin abnormalities, kidney maladies, reproductive and developmental system complications, and cancer (Jorgensen et al., 2014; Fenton et al., 2021; OECD, 2018, Sunderland et al., 2019). Specific to the health risks of the three types of PFAS found in our samples, PFBA-Perfluorobutanoic acid is a short-chain replacement perfluoroalkyl substance used in many of the same ways and for many of the same purposes as other PFAS. Associated developmental and reproductive concerns include challenges specific to pregnancy, infertility, lower birth weights, liver failure, thyroid disease, decreased red blood cell counts, and lower hemoglobin levels (EWG, 2020).

Our research in south Greenland found concentrations of several PFAS/PFOS, specifically PFBA (perfluorobutanoic acid), that have been linked to health risks like infertility (Jorgensen et al., 2014), immune system deterioration like decreased, heightened asthma risks, higher cholesterol levels, and decreased body weight (EWG, 2020). PFPeA- Perfluoropentanoic Acid is a member of a group of perfluorinated chemicals used in many consumer products as a coating for food wrapping for fast food and chocolate, on lids for fruit preserves and yogurt products, and on pharmaceutical packaging (Zafeiraki, 2013).

Like the other PFAS mentioned, PFPeA are associated with similar serious health effects, like the other chemicals mentioned, and have been found in some of the most remote parts of the planet (EWG, 2020). Industrial usage of PFAS began in the 1940s, but exposure-related illnesses were not identified for several decades and were mostly impacting those who worked in the proximity of manufacturing and production entities using PFAS. In 2016, EPA issued advisory

levels for PFOA and PFOS in drinking water at 70 ppt. In June 2022, advisory limits were updated to 0.004 ppt for PFOA and 0.02 ppt for PFOS, which are more restrictive than the 2016 levels (EPA, 2022). Additionally, in 2022 EPA finalized Lifetime Health Advisory levels for PFBS and GenX chemicals at 2,000 ppt and 10 ppt, respectively, while in 2023, the Biden Administration made $2 billion from the Bipartisan Infrastructure Law available to address a series of newer pollutants found in drinking water, such as PFAS. In January 2021 a European Union drinking water directive limiting all PFAS in drinking water to 0.5 μg/L for all PFAS took effect (EPA, 2024; OECD, 2018). In February 2023, the European Chemicals Agency (ECHA) submitted a restriction proposal for PFAS in firefighting foams (ECHA, 2023). The World Health Organization (WHO) issued draft guidance recommendation limits of 100 parts per trillion (ppt) of either PFOA or PFOS in drinking water, allowing vastly greater quantities of PFAS in drinking water than the limits set by the EPA. The WHO also recommends a total cap of 500 ppt for combinations of up to 30 PFASs. On January 13, 2023, a joint proposal was submitted by Denmark, Germany, the Netherlands, Norway, and Sweden to the European Chemicals Agency (ECHA). The proposal aims to impose restrictions on per- and polyfluoroalkyl substances (PFAS) under the European Union's chemicals regulation, known as REACH. The primary objective of this restriction proposal is to prohibit the use and production of PFAS in order to mitigate the potential risks these substances pose to both human health and the environment. If approved, this restriction would represent the most extensive substance ban ever implemented in Europe. It is worth noting that this ban is expected to be complex due to the existence of over 10,000 different types of PFAS, which are employed in numerous products across various industries. Similarly, the Stockholm Convention has acknowledged the recent advisories issued by the US EPA as a valid standard (POPS, 2023).

1.6 Supporting Research

Due to the wide use of PFAS over the past 60 years (Pelch et al., 2022) their transportability (Miner et al., 2020; Kwok et al., 2013; Muir et al., 2019) and the resistance capacity of these "forever chemicals" to degrading in nature (Pelch et al., 2022; Garcia-Barrios et al., 2021), researchers have detected PFAS in many of the most remote corners of the globe, including on Mount Everest (Miner et al., 2020), in the Arctic (Kwok et al., 2013), and in the Antarctic Ocean (Yamazaki et al., 2021). Moreover, PFAS are found in glacier run-off (Miner et al., 2020; Kwok et al., 2013) affecting a wide range of habitats including all of the world's oceans, the Himalayas, as well the Greenland Ice Sheet (Miner et al., 2020; Kwok et al., 2013). PFAS is also found in a wide range of species, including Arctic species such as Polar Bear, Minke Whale, Ringed Seal, Arctic Cod, Black Guillemot, Narwhal, and a host of plankton and invertebrates (Bossi et al., 2005; Butt et al., 2010). Nearly every United States citizen has some form of PFAS in their blood (Pelch et at., 2022). The delivery of PFAS from more heavily populated areas where PFAS-contaminated products are more widely used to remote regions is attributed to transport in the atmospheric circulation, ocean currents, and by anthropogenic means such as local product use, mining, wastewater treatment, and tourism (Kwok et al., 2021; Herzke 2023; Butt et al., 2009; Miner et al., 2020, Miner & Mayewski et al., 2021; Miner et al., 2021).

Specific to Greenland, researchers have examined surface snow on sea ice in Baffin Bay east of Greenland, northwest of our samples locations, where several PFCs were found, including PFOS (0.0000252 - 0.000137 μg/L), PFOA (0.0000509 - 0.00052 μg/L), PFDA (0.00011-0.000149 μg/L), PFHxS (0.0000082- 0.0000402 μg/L), PFOSA (0.0000242- 0.0000394 μg/L), PFHxA (<0.00001- 0.0000348 μg/L), PFHpA (0.0000121- 0.0000854 μg/L), and PFNA (<

0.00003- 0.0000766 µg/L). (Butt et al., 2010). Only PFNA was common to both our research and the Butt 2009 research, with levels of 0.000750 µg/L and < 0.00003- 0.0000766 µg/L found respectively. In Canada's Northern Territories, blood samples taken from First Nations populations showed concentrations of five PFAS types (PFHxS, PFOS, PFOA, PFNA, and PFDA) found in more than half of the subjects (Barrios et al., 2021). Another study (Jorgenson et al., 2014), also relying on blood samples, showed an infertility rate of 14% among participating Greenlandic women, the highest among the nations studied. As has been previously noted, health studies have shown exposure to PFAS substances is associated with adverse reproductive development (Jorgensen et al., 2014; Fenton et al., 2021; OECD 2018, Sunderland et al., 2019), among other maladies.

In several of the studies reviewed and referenced herein, scientists found a wide variety of PFAS types including PFOS, PFGxA, PFOA, PFNA, PFDA, PFUnA, PFDoA, PFTrA, and PFTeA (Bossi et al., 2015; Kwok et al., 2013). Concentrations measured ranged from "nothing detected," as was the case with 63% of our Greenland samples, to nearly 50 ug/L (Hasson et at., 2024; Kwok et al., 2013; Barrios et al., 2021). Also, the types of PFAS concentrations detected in our research (PFBA, PFNA, & PFPeA) were not particularly unique as they were also found in samples taken for several other Arctic PFAS studies (Barrios et al., 2021; Kwok et al., 2013; Butt et al., 2010; Bossi et al., 2015; Boisvert et al., 2019). As such, variations, disparities, and inconsistencies in the types and concentration levels of PFAS measured in Arctic and sub-Arctic regions were not surprising.

1.7 Methods

Sixteen glacier meltwater samples were collected as part of this study between June 3rd – June 28th, 2022, in southern Greenland (Fig. 1.1.). Samples 1–6 were collected from the research

vessel *Arctic/Earth*. A tender was lowered from the *Arctic/Earth* for access to the shore. Samples were then collected from one glacier source lagoon and five glacier streams. Samples 7-12 were collected by team members hiking into various locations from a basecamp at the Leif Eriksson Hostel in Qassiarsuk Greenland, and samples 13, & 14 were collected near the Tasermiut glacier camp northwest of Narsaq, where a zodiac was used to ferry team members from the camp to desired locations at the foot of nearby glaciers. All samples, except for the first sample taken from a glacial lagoon, were collected from glacier streams. After collection, samples were kept in cool, dry locations either aboard the research vessel *Arctic/Earth*, at the Tasermiut glacier camp, or at the Leif Eriksson Hostel in Qassiarsuk. Samples were then transported by team members to the United States by commercial airline and then overnighted to Anatek Labs in Moscow, ID.

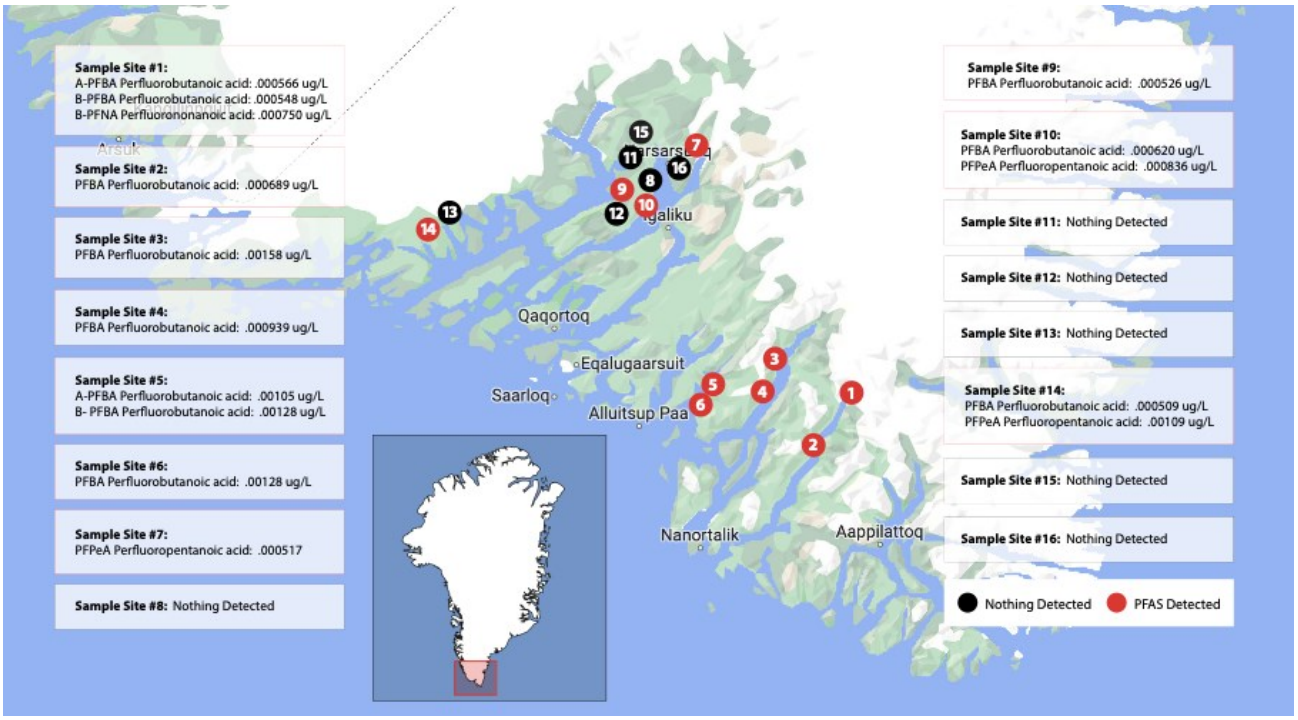

Figure 1.1. A map of sample site locations in southern Greenland. Red dots represent sites where PFAS concentrations were detected, and black dots represent sample sites where there were no PFAS concentrations detected. Within the rectangular boxes on the periphery, as well as in Table 1, are the types of PFAS found and the concentration levels measured in ug/L.

Glacial meltwater samples were collected at each of the sixteen locations (Fig. 1.1.) by team members wearing surgical gloves. Anatek sampling protocol was employed as follows. Two 250 mL polypropylene sample bottles were filled at each site while a third bottle, Field Blank A, was poured into the Field Blank B bottle. Bottles were filled with meltwater samples to the 250 mL mark of the bottle, and capped. Along with the sample bottles, there was one sealed 250 mL plastic bottle containing distilled water (labeled Field Blank A) and one empty bottle, except for a preservative (labeled Field Blank B). At each sampling site, with gloved hands, Field Blank A was poured into empty Field Blank B and sealed. Date, time, and location of the site was included with the samples. All samples were analyzed using LC/MS/MS Solid-Phase Extraction following the Environmental Protection Agency (EPA) Method 533 at Anatek Labs in Moscow, ID, a certified laboratory (EPA, 2019).

PFAS concentration profiles from Southern Greenland samples. Samples without a noted value are concentrations that were not detected using EPA analysis method #533.

Sample Location	Sample ID	Sample Type	Date Collected	Latitude (N)	Longitude (S)	PFBA(A) (ug/L)	PFBA(B) (ug/L)	PFNA (ug/L)	PFPeA (ug/L)
Site 1:	1057-01	Lagune	6/7/22	60.5289	-44.4630	.000566	.000548	.000750	-
Site 2:	1057-02	Stream	6/9/22	60.4177	-44.6400	.000689	-	-	-
Site 3:	1057-03	Stream	6/9/22	60.6734	-44.7992	.00158	-	-	-
Site 4:	1057-04	Stream	6/9/22	60.5579	-44.8802	.000939	-	-	-
Site 5	1057-05	Stream	6/10/22	60.5690	-45.1798	.00105	.00128	-	-
Site 6:	1057-06	Stream	6/10/22	60.5309	-45.2340	.00128	-	-	-
Site 7:	1057-07	Stream	6/15/22	61.2019	-45.3241	-	-	-	.000517
Site 8:	1057-08	Stream	6/16/22	61.1543	-45.5170	-	-	-	-
Site 9:	1057-09	Stream	6/18/22	61.1184	-45.5807	.000526	-	-	-
Site 10:	1057-10	Stream	6/18/22	61.1303	-45.5499	.000620	-	-	.000836
Site 11:	1057-11	Stream	6/18/22	61.1489	-45.6118	-	-	-	-
Site 12:	1057-12	Stream	6/19/22	60.9984	-45.8580*	-	-	-	-
Site 13:	1057-13	Stream	6/20/22	61.0436	-46.7030	-	-	-	-
Site 14:	1057-14	Stream	6/20/22	60.9875	-46.6741	.000509	-	-	.00109
Site 15:	1057-15	Stream	6/22/22	61.2433	-45.5222	-	-	-	-
Site 16:	1057-16	Stream	6/23/22	61.1650	-45.3980	-	-	-	-

Table 1.1. PFAS detection by site location and the type of PFAS found. Not all sample sites (Sites 8, 11, 12, 13, 15, &16) had detectable concentrations. Samples for Site #1 were taken from a glacial lagoon, while all other samples were taken from glacial meltwater streams. PFBA - Perfluorobutanoic acid was the most common type of PFAS, found at nine sites, while PFNA - Perfluorononanoic acid, detected only at Site #1, was the least frequently detected PFAS types found. PFPeA - Perfluoropentanoic acid, was detected at three sites.

1.8 Results

PFAS were found in glacial meltwater samples taken at ten of the sixteen test sites (Table 1.1.) - sample sites 1, 2, 3, 4, 5, 6, 7, 9, 10, & 14. Three types of PFAS were found, including PFBA - Perfluorobutanoic acid, PFNA - Perfluorononanoic acid and PFPeA - Perfluoropentanoic acid. Site #3 (1057-03) had the highest concentrations of any PFAS type (Table 1.2.) at .00158

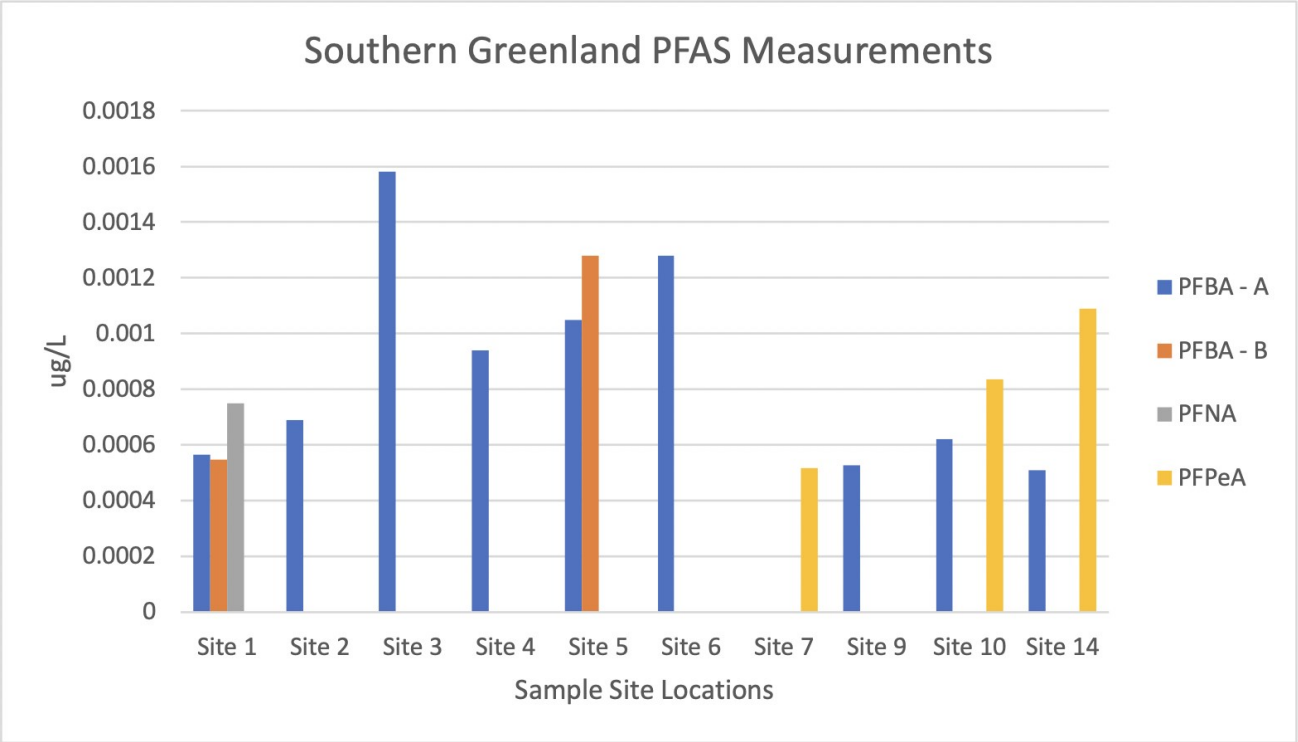

Table 1.2. PFAS detection by site location and the type of PFAS found. Not all sample sites (Sites 8, 11, 12, 13, 15, &16) had detectable concentrations. Samples for Site #1 were taken from a glacial lagoon, while all other samples were taken from glacial meltwater streams. PFBA - Perfluorobutanoic acid was the most common type of PFAS, found at nine sites, while PFNA - Perfluorononanoic acid, detected only at Site #1, was the least frequently detected PFAS types found. PFPeA - Perfluoropentanoic acid, was detected at three sites.

ug/L of PFBA, while site #1 (1057-01) was the only sample location with concentrations of all three types of PFAS. Sites #5, #10 & #14 each had two different types of PFAS with site #5 showing PFBA – A, PFBA – B and Sites #10 and #14 showing PFBA and PFPeA. Sample Sites #2, #3, #6 and Site #9 showed only PFBA, and Site #7 only showed PFPeA (Table 1.2.).

1.9 Discussion: Transport

The delivery of chemicals, including PFAS, from more densely populated regions where chemicals and pollutants are used more heavily to remote areas where these toxins are used to lesser degrees occurs through various methods of transport. Direct transport involves exposure to, or the use of, PFAS-infused products like food packaging, clothing, personal care products, and cookware as well as from activities associated with mining, aviation, and water treatment. Moreover, as tourism and mining activities expand in Greenland, direct transport of PFAS may increase concentration levels and human exposure (Miner et al., 2020; Kwok et al., 2013; Butt et al., 2010). Another pathway for PFAS to reach remote regions, including Greenland and the Arctic, is ocean currents. PFAS has been broadly detected in the Earth's oceans (Muir et al., 2019; Wang et al., 2019). As ocean water containing pollutants travel from heavy-use areas to more remote locales, the evaporation of ocean water delivers contaminants to Arctic areas, including the GrIS (Muir et al., 2019; Wang et al., 2019; Kwok et al., 2013).

PFAS and other pollutants are also carried from industrialized areas to southern Greenland by atmospheric transport via the Westerlies (Fig. 2 & 3). The westerlies are the prevailing mid-latitude winds (blowing west–east) associated with the jet stream. The strength of the westerlies is tied closely to poleward temperature and pressure gradients, where the latter is expressed by the climatological features known as the Icelandic Low and Azores High. The Icelandic Low, typically centered near Iceland, represents the mean sea level pressure field that resultants from the passage of storms. This low-pressure node is counterbalanced by the Azores High, a climatological feature located in the North Atlantic subtropics, often centered near the Azores Islands. These systems control the direction and strength of winds in the North Atlantic and parts of Europe. The peak strength of the Icelandic Low occurs in the winter and early spring

of the Northern Hemisphere, with a central focus over Iceland and southern Greenland. In contrast, during the summer, it experiences diminished intensity and may split into two segments—one positioned west of Iceland and the other spanning the Davis Strait between Greenland and Baffin Island. At this point, the Azores High/Icelandic Low takes on the role of the prevailing weather feature in the North Atlantic.

PFAS and other pollutants are mainly deposited on the Greenland Ice Sheet through precipitation, which in turn carries a strong association with the large-scale atmospheric features described above. Weather patterns are also influenced by a topographical divide along the 44° W longitude, essentially dividing southern Greenland into southeastern and southwestern halves (Auger et al., 2017). This divide is responsible for two distinct weather patterns defined by southeasterly winds across southwestern Greenland and northeasterly winds along southeastern Greenland (Auger et al., 2017). The map of our sample site locations (Fig. 1.2 & 1.3.) shows that sites 1-6, where 100% of the sites tested positive for PFAS, are east of 44° W longitude, making those sample sites subject to both higher annual precipitation levels that would deposit more pollutants like PFAS onto the Greenland Ice Sheet, as well as to winds (Westerlies) and atmospheric pressures (Azores High/Icelandic Low) that combine to carry pollutants like PFAS from North America's industrialized east to southeastern Greenland (Auger et al., 2017). Figure 1.2. shows how the climatological Icelandic Low (purple) and Azores High (orange) pressure systems interact during the winter (DJF) to a) guide the westerlies from the industrialized areas of North America to the North Atlantic, b) produce higher velocity winds across the North Atlantic and c) create a cyclonic effect between Iceland and southern Greenland in the Denmark Straight. This rotation is likely responsible for additional pollution deposits at sample sites 1-6.

Figure 1.3. shows how wind velocity and direction change as the Icelandic Low eases during the summer months (JJA).

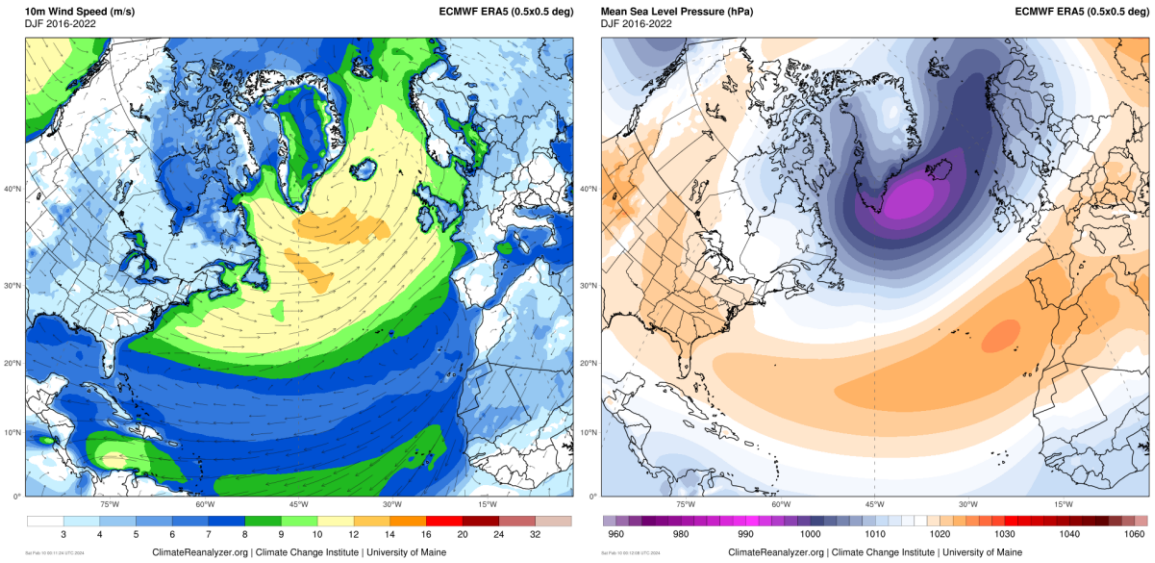

Figure 1.2. North Atlantic winter (DJF) climatology for 10-meter wind speed (left) and mean sea level pressure (right) for the period 2016–2022. Data from ECMWF Reanalysis version 5 (Hersbach et al., 2020); maps generated using Climate Reanalyzer (2024). Climate Reanalyzer (2023). Monthly Reanalysis Maps. Climate Change Institute, University of Maine. Retrieved from https://climatereanalyzer.org/.

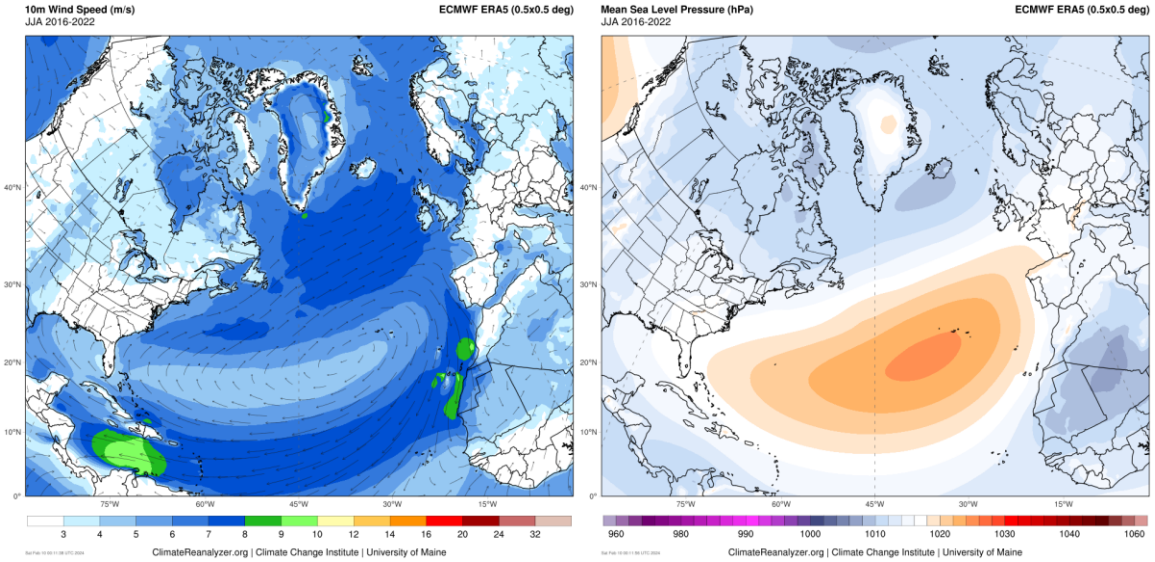

Figure 1.3. North Atlantic summer (JJA) climatology for 10-meter wind speed (left) and mean sea level pressure (right) for the period 2016–2022. Data from ECMWF Reanalysis version 5 (Hersbach et al., 2020); maps generated using Climate Reanalyzer (2024). Climate Reanalyzer (2023). Monthly Reanalysis Maps. Climate Change Institute, University of Maine. Retrieved from https://climatereanalyzer.org/.

Auger's research is supported by the fact that each of our samples taken east of 44° W longitude tested positive for PFAS likely carried by the westerlies from the industrialized eastern US and Canada, while only four of ten sites west of the 44° tested positive for PFAS. Of the sites west of 44° W longitude that tested positive for PFAS, three sites (#7, #9, and #10), are near the Narsarsuag water treatment facilities, the Narsarsuag Airport, local farms, and small villages. Direct transport could explain the presence of PFAS in these samples found closer to human activity. Sample sites #13 & #14 were directly below a set of glaciers. Sample site #14, which tested positive for both PFBA and PFPeA, was closest to the Tasermuit Outfitters Glacier Camp, possibly explaining the detected PFAS via direct deposit. As the sample collected at site #13 was more isolated from human activity, drawn directly from glacier melt, west of 44° W, and tested negative for PFAS, Auger's finding that weather patterns in Greenland's southwest carry less precipitation and therefore would deliver lower levels of pollutants to area glaciers is supported. (Auger et al., 2017).

1.10 Conclusions

The PFAS pollution detected in southern Greenland highlights several key realities of this family of chemicals, including the pervasiveness of these pollutants in remote environments like Greenland and the transportability of PFAS by atmospheric, ocean currents, or more direct means. Specific to transport, given the limited human activity near most of the sample areas as well as the known historic atmospheric and ocean currents, primarily the Westerlies, Icelandic Low & Azores Highs, and the North Atlantic Current, it is likely the detected PFAS contaminants were conveyed to Southern Greenland atmospherically. That said, human activity in the form of mining, agriculture, tourism, fishing, scientific research, shipping, and direct transport may contribute to PFAS exposure in Southern Greenland. While this research is

intended as an early effort to identify the presence and potential health risks due to exposure as well as concentration levels of PFAS in Greenland's glacial meltwater, further sample collection is needed to supplement current analysis and provide health authorities with ongoing data. That said, this research was successful in a variety of significant ways including, a) identifying dominant types of PFAS (PFBA, PFNA & PFPeA) found in meltwater samples (see Tables 1.1. & 1.2.), b) identifying concentration levels of identified PFAS (see Tables 1.1. & 12) in order to compare with existing health advisory limits, c) identifying likely transport sources (see Climate Reanalyzer map/Westerlies), and d) providing scientific and health authorities with baseline measures of existing PFAS as the foundation for future assessments. Importantly, by identifying the types of PFAS found, authorities may be able to isolate the sources and control further proliferation. For instance, PFBA (Perfluorobutanoic acid), the most common PFAS found in our meltwater samples, is a bi-product of other PFAS that are used in stain-resistant fabrics, paper food packaging, and carpets. PFBAs are also used in photographic film production, in a variety of food products, and at water treatment facilities (EPA, 2022). Alternatively, PFNA (Perfluorononanoic acid) are primarily used in the production of non-stick coatings (EWG, 2020), as well as to prevent the deterioration of food packaging, furniture, and carpets (Dery et al., 2019). Helping local authorities identify the types and specific uses of the various PFAS types found can aide in identifying the source, primary transport method and inevitably can help health professionals implement policy designed to mitigate harmful health impacts. Moreover, identifying toxicity levels gives authorities the ability to compare baseline measurements against both future samples to determine fluctuations and against health advisory limits to determine existing threats. As stated, all samples had detected levels of PFAS below both the EPA and WHO advisory levels highlighted in Section 1.5.

While the variables specific to transport, sub-lethal toxicity, associated health impacts, the health impacts of simultaneous exposure to multiple types of PFAS, and the ongoing impacts of rapid climate change, specifically rising temperatures, and glacial run-off volume, require further study, there is enough agreement specific to the wide proliferation and negative health impacts of PFAS to warrant stricter international policing and regulations. As Greenland is an autonomous, self-governing Dutch territory with ties to Europe, North America, and the Arctic, continued work to develop a water quality framework in Greenland may strengthen existing pollution monitoring programs in various regions. Currently, the Arctic Monitoring and Assessment Program (AMAP), established in 1991, is charged with monitoring and assessing Arctic pollution under the Arctic Environmental Protection Strategy. Over the years, AMAP has evolved into a Working Group of the Arctic Council. AMAP's mission is to monitor and assess the Arctic region's status regarding pollution and climate change. This involves coordinating circumpolar monitoring and research, documenting levels and trends, identifying human-induced changes versus natural phenomena, and proposing actions to reduce associated threats. As part of its efforts, AMAP has produced assessments addressing the occurrence and trends of Persistent Organic Pollutants (POPs) and, more recently, chemicals and substances not fitting the classical definition of POPs in the Arctic region. The defined Arctic area by AMAP includes the Arctic Ocean, northern seas of the North Atlantic Ocean, the Bering Sea, and adjacent land masses within pan-arctic countries (de Wit et al., 2022). Combined with European, North American and countries contiguous with the Arctic region, water quality frameworks originating in Greenland may inform much broader international agreements.

This said, there are substantial hurdles specific to enforceability. As of late 2020, the European Commission unveiled their Chemicals Strategy for Sustainability titled “Towards a

Toxic-Free Environment." This report included measures advocating for a zero-tolerance approach to non-compliance aimed directly at EU member countries and entities suspected of low compliance and inconsistent enforcement (Klika, 2021).

The adoption of the REACH (Registration, Evaluation, Authorization, and Restriction of Chemicals) regulation in 2006 signaled a significant shift in EU chemicals policy. REACH introduced tools for regulating chemical substances and established the European Chemicals Agency (ECHA). Interestingly though, REACH then began delegating responsibilities for risk assessment and compliance management to private entities such as manufacturers, importers, producers, and customers, with REACH seemingly providing additional oversight (Klika, 2021).

Recent reviews of chemicals policy, including REACH, brought to light notable instances of non-compliance. For example, REACH mandated the registration of all substances on the market, necessitating manufacturers and users to submit reports to ECHA. However, the compliance check conducted by ECHA and Member States revealed that only one-third of these submissions were fully compliant. Despite ECHA's authority to check compliance, the decision-making process proved cumbersome, and ECHA lacked the legal mandate to revoke registrations (Klika, 2021). In response, the Forum for Exchange of Information on Enforcement (Forum) was established by REACH to foster cooperation and coordination among its members, ECHA, and the Commission. The Forum's common enforcement strategy serves as a guide for EU-wide enforcement activities, including joint projects, training initiatives, and support for reporting. Despite its contributions within legal constraints, enforcement practices still exhibit significant variations across different countries. (Klika, 2021)

Another enforcement challenge pertains to variations in advisory limits. Notably, in January 2021, a European Union drinking water directive set a limit of 0.5 μg/L for all PFAS in

drinking water. Subsequently, in February 2023, ECHA proposed restrictions for PFAS in firefighting foams. The World Health Organization recommended limits of 100 parts per trillion (ppt) for either PFOA or PFOS in drinking water, differing significantly from the EPA's advisory levels set in 2016 at 70 ppt. In June 2022, the EPA updated these advisory limits to 0.004 ppt for PFOA and 0.02 ppt for PFOS, imposing more stringent restrictions than the 2016 levels. Additionally, in 2022, the EPA established Lifetime Health Advisory levels for PFBS and GenX chemicals at 2,000 ppt and 10 ppt, respectively (ECHA, 2023; EPA, 2022) . Until there is consensus specific to uniform health advisory limits, stronger incentives for compliance, and the proper authority given to entities policing the manufacturing, the production of alternatives, and use of pollutants like PFAS, enforcement will remain challenging regardless of the instrument. And while the Stockholm Convention on Persistent Organic Pollutants (POP) is a global treaty to protect human health and the environment from chemicals like PFAS, relying on the chemical industry to self-police, manage chemical hazards and publish safety information on compounds, which POPs currently does, seems counterintuitive (Bilela, et at., 2023).

1.11 Authorship and Contribution Statement

Doug Hasson: Field sample collection, analysis, writing. Dr. Paul Andrew Mayewski: Project administration, funding acquisition, supervision, sample collection, editing. Dr. Mariusz Potocki: Field sample collection, expedition equipment, and technical oversight, methodology advisor. Ligia Naveira: Sample collection. Kevin Anderson: Sample collection, editing. Kristina Grimaldi: Sample collection. Anna Crowley: Sample collection

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CASE STUDY #2 - THE SCIENCE, POLICY, AND POLITICAL IMPLICATIONS OF DROUGHT IN THE AMERICAN SOUTHWEST

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Highlights

- Assessment of science-based drivers of drought in the Colorado River Basin.
- Unique public opinion research specific to Colorado River Basin drought.
- Review of State Referendum & State Legislative Activity as tools to contain carbon emissions.

2.1 Abstract

US political leaders have lacked the will to enact legislation that will meaningfully arrest the catastrophic effects of anthropogenic climate change. While climate researchers and well-meaning policy makers have succeeded in establishing both the core science-based role of climate change as well as proposing the steps required to mitigate CO_2 emissions, until the voting public forces elected officials to see climate change as an issue requiring immediate attention, meaningful action will lag. Long-term drought in the Colorado River Basin is one of many examples of climate change felt by a wide set of residential, economic, cultural, and public health interests. And yet, none of the factors examined for this research—national public opinion research, unique regional public opinion research conducted specifically for this paper, direct democratic action i.e., state ballot initiatives, or proposed/enacted state legislation designed to mitigate the effects of climate change—reflects the worsening science-based indicators. This research finds little evidence that the priorities of voters in the drought-stricken American Southwest are such that elected officials will be motivated to pursue the necessary measures many believe are now required to avert further warming and consequent drought in that region. An assessment of the science-based evidence of drought (increased temperature, heightened evaporation, snowpack, altered weather patterns, snow melt timelines, and the snow-to-rain

precipitation change), public opinion, and state-specific direct democratic activities (state ballot initiatives and state legislative activity) shows that as scientific projections specific to climate-driven drought in the American Southwest worsen, the public's willingness to push for meaningful climate action remains flat.

2.2. Introduction

NASA announced that June 2023 was the hottest June on record, globally (NASA, 2023). In the American Southwest, the city of Phoenix set two summer records; the highest daily air temperature ever recorded (119°F/48.3°C on July 25th) and the longest consecutive period (27 days) of temperatures over 110°F/43.3°C. The city of El Paso, Texas, went 42 days over 100°F/37.7°C (NASA, 2023).

A July 25th, 2023, report from World Weather Attribution states plainly that these temperatures would be all-but impossible without human activity, specifically the burning of fossil fuels (Zachariah et al., 2023). This same report, among many, asserts the direct connection between anthropogenic climate change, fossil fuels emissions, soaring temperatures, and drought.

The Intergovernmental Panel on Climate Change (IPCC) states, there is "high confidence" that anthropogenic climate change will continue to impact the frequency and intensity of weather phenomena, including "hot extremes" and drought (IPCC, 2022). These drought extremes will exacerbate global food shortages, involuntary migration, related health conditions, social upheaval, violence, and human fatalities. As is the case with many of the effects of climate change-induced phenomena, marginalized peoples and the poor are particularly vulnerable (Rikani et al., 2023). Over the next twenty-five years, climate change could compel hundreds of millions of people, mostly the poor, to leave their homes (IPCC, 2022). Ironically,

2022 US relocation data show five of the seven states focused on in this study – California, Colorado, Nevada, Utah, and Wyoming – are not only some of the hottest, driest, and most susceptible to drought in the US, but they each have net population gains over recent years. As the populations of Southwest US cities like Phoenix, Tucson, Provo, Las Cruses, Las Vegas, Salt Lake City, and Cheyenne expand drought (USCB, 2023) is tightening its grip on the main source of water to the American Southwest.

The Colorado River Basin (CRB) (Fig. 2.1.), which includes the Colorado River and several tributaries, provides water for more than 40 million Americans as well as a host of industries and agricultural interests (Kim et al., 2022). The Colorado River Basin is experiencing record low water flow resulting from expanded agricultural and residential use (Xiao et al., 2021, Cohen et al., 2006; Li et al., 2021) as well as a complex set of climate change factors impacting its hydrology, including record-setting temperatures, evaporation, changes in precipitation, decreased snowfall in the Rockies, and changes in snow melt timing (Xiao et al., 2021; Rasmussen et al., 2011).

Figure 2.1. The Colorado River basin region. Image Source: Center for Colorado River Studies, Utah State University (2022).

Increasingly, it has been suggested that a key factor missing in the effort to implement meaningful policy to impact anthropogenic climate change is political will (Hassan et al., 2023, Funfgeld et al., 2023). The other key factors: science, and policy, are well established and if accepted and implemented would likely help mitigate the negative climate impacts that ultimately result from burning fossil fuels. With this as the premise, the purpose of this research is to review the science driving the current drought conditions in the Colorado River Basin (CRB) and to utilize existing climate data products to explore future projected trends in Colorado River Basin hydrology. This chapter also contains a review of trends in national public opinion research Public Opinion Research specific to climate, and unique public opinion research targeting the Colorado River Basin states of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming. This research includes voters' baseline attitudes about climate change and drought in the American Southwest, voter tolerance for sacrifice as mitigation options are proposed, and how voters' issue priorities may influence who they vote for in upcoming elections.

Against this public opinion backdrop, the existing policy framework, climate-related state referendum, and climate-related state legislation are assessed. While these four metrics (public opinion research, state ballot initiatives, state legislation and existing policy) are distinct from each other, they reflect potential patterns indicating how climate change may be growing as a priority compared to other important issues. Included also are possible trends in projections (weather patterns, temperature, evaporation, snowpack, precipitation change, and snowmelt timelines) specific to drought in the Colorado River Basin, trends in public opinion around drought and climate change, and trends in voter behavior as reflected in public opinion data, state ballot initiative activity, and proposed state legislation designed to address CO_2 emissions.

2.3. Study Area: The Colorado River Basin

The Colorado River is the largest river in the U.S. Southwest, and the region's most important surface water source. The area of the entire Colorado River basin is roughly 637,000 km^2 , and more than 90% of its streamflow is generated in the Upper Colorado River Basin (UCRB) above Lees Ferry, AZ (Cohen et al., 2013). Approximately 40 million Americans depend on the Colorado River Basin for water (Kim et al., 2022). However, the persistent drought (Fig. 2.2.) and falling precipitation levels since 2000 has strained water resources, causing critically low water levels in reservoirs like Lake Mead and Powell (Fig. 2.3.).

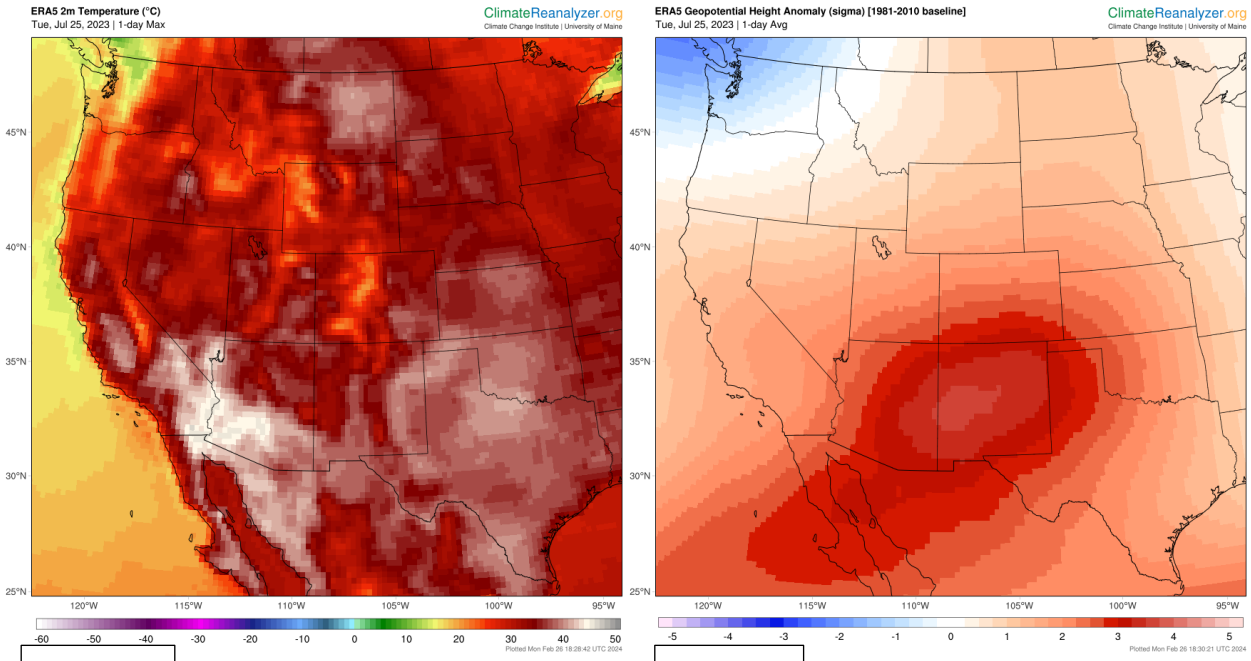

Figure 2.2. Weather maps for Tuesday, July 25, 2023, depicting a record heat wave in the southwestern US: maximum 2-meter air temperature (°C) (Panel A) and 500 hPa geopotential height standardized anomaly (in reference to 1981-2010 climatology), wherein elevated heights represent a "heat dome" with values exceeding 3 standard deviations from mean climatology (Panel B). Maps generated using Climate Reanalyzer (2024) using data from ECMWF Reanalysis version 5 (Hersbach et al., 2020). Climate Reanalyzer (2023). Monthly Reanalysis Maps. Climate Change Institute, University of Maine. https://climatereanalyzer.org/.

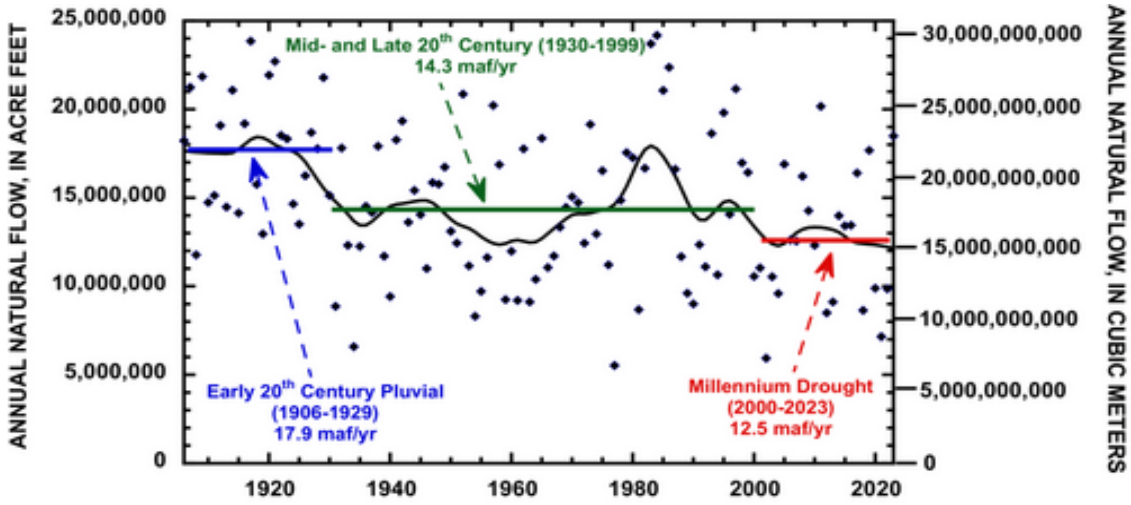

Figure 2.3. Annual flow of the Colorado River at Lees Ferry, as estimated by the USBR. Horizontal lines are the average flow for the indicated time periods. Source: US Bureau of Reclamation (April 2023).

The upper Colorado basin consists of Colorado, Utah, Wyoming, and New Mexico, while the lower basin consists of California, Nevada, and Arizona (Metcalfe et al., 2023). These states are central to the US agricultural economy, generating an estimated $60 billion in crops and livestock per year. Long periods of rain deficiency during the spring and early summer will have serious consequences on the economy in terms of agricultural production as agriculture in and around the Colorado River Basin consume over 70% of the area freshwater resources (Xiao et al., 2021; Cohen et al., 2006; Li et al., 2021). As water becomes scarcer, there will be growing competition for water resources from residential and municipal parties to industry and agricultural interests. This competition has already strained century-old agreements between Colorado River Basin states regarding managing the increasingly limited water supply. The Colorado River has long been governed by a series of agreements dating back to the 1922 Colorado River Compact. This set of federal laws, court decisions and decrees, contracts, and regulatory guidelines are collectively known as the "Law of the River," which allocates and

regulates water from the Colorado River among the seven basin states and Mexico (Singh, 2023; USBR, 2012). For the first time in our history, these agreements are in jeopardy of dissolving under the weight of competing interests (Schmidt et al., 2023).

The cultural, biological, economic, and recreational significance of this ecosystem cannot be overstated as it supports 22 federally recognized tribes (Austin & Drye, 2011), 7 National Wildlife Refuges, and 4 National Recreation Areas. It also sustains 11 National Parks and generates over 4,200 megawatts of electrical capacity via its many hydropower plants. This hydropower plays a key role in meeting the energy needs of the Western region while also reducing reliance on fossil fuels (Kalra et al., 2017; Christensen et al., 2004).

2.4. Drought, Climate and Hydrology of the Study Area

Drought has historically played a significant role in human migration, the collapse of civilizations, human suffering, and conflict. Drought may have been the driving force behind the earliest human migration out of Africa around 130,000 to 90,000 years ago. Evidence from African lake water volume indicates a drastic decrease of up to 95% during that period (Scholz et al., 2007). Drought has also been linked to major historical events such as the decline of the pharaohs in Egypt 4,500 years ago (Barta et al., 2008), the fall of the Mayan empire 1,200 years ago due to massive crop failures in Mesoamerica (Evans et at., 2018), and the death of millions of people in China between 1928 and 1930 (Zhang et al., 2023). A little closer to home, the infamous “Dust Bowl” drought caused the migration of roughly 2 million people from the American Midwest (Brown et al., 2013; Brown, 2008).

More recently, drought exacerbated by climate change has led to prolonged water shortages, crop failures, economic instability, and mass migration in regions like the Middle East, Latin America, and parts of Asia. Rural families in countries like Syria and Guatemala have

been forced to abandon their farms, often leading to poverty, political tensions, human rights violations, and immigration-related issues (Able et al., 2019). Projections indicate that climate change-induced drought, extreme weather events, and rising sea levels could result in a significant increase in migration, potentially displacing 200 million people by 2050 (IOM, 2008). Furthermore, climate change is expected to intensify drought conditions globally. By the end of the 21st century, large areas of the world, including the American Southwest, are predicted to become drier, with the proportion of land in constant drought estimated to increase from 2% to 10% by 2050 (IOM, 2008; Burke et al., 2006). Rainfall patterns will also change, with some regions experiencing heavier rainfall, leading to soil erosion, and flooding, while other areas will face reduced rainfall, impacting agriculture (Houghton et al., 2009). Recent IPCC reports estimate that yields of some crops could fall by up to 50% in coming years (IPCC "Special Report on Global Warming of 1.5°[C]", 2018). Increased aridity and water-related issues are predicted to worsen a variety of health problems, leading to more widespread malnutrition. As the globe warms, mosquito breeding locations will widen, spreading diseases like malaria, dengue fever, chikungunya, Lyme Disease, and West Nile virus. Exposure to hotter conditions impacts our ability to regulate temperature and can result in a series of illnesses (IPCC, 2007).

Over the past 83 years, the American Southwest, including the Colorado River Basin, has warmed by approximately 1.5°C (Fig. 2.4.) coincident with a change in annual precipitation from 0.008in in 1940 to -0.02in in 2023 (Fig. 2.5.), leading to aridification and a transition towards drier conditions.

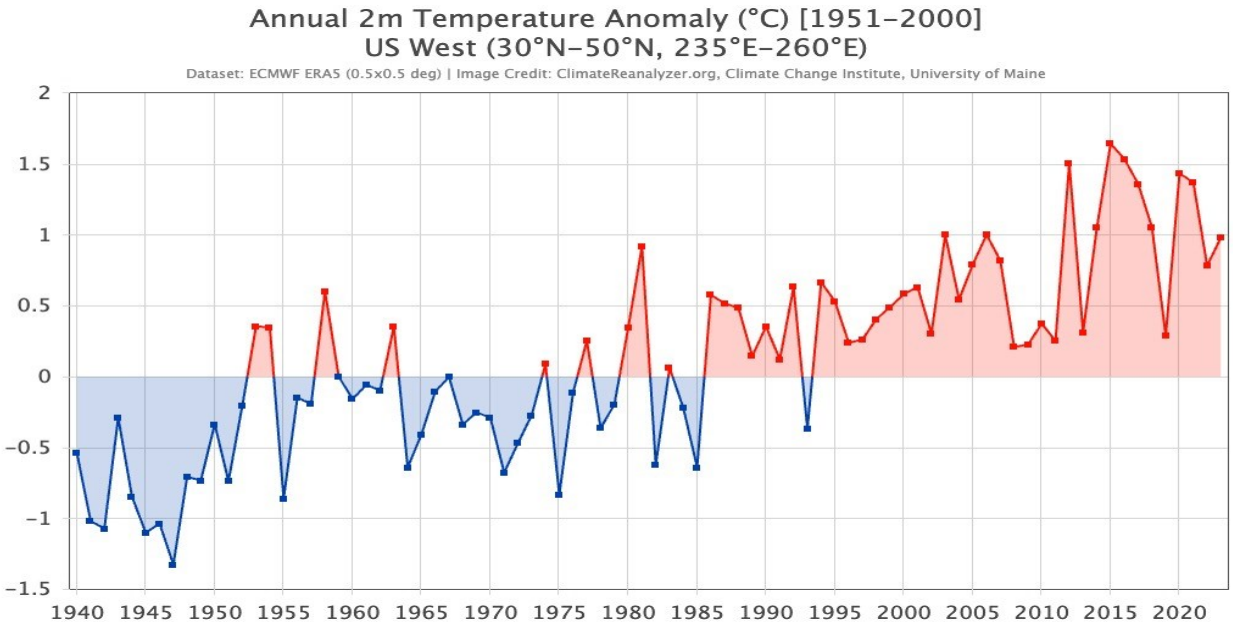

Figure 2.4. Annual 2-meter air temperature anomaly 1940-2023. **M**aps generated using Climate Reanalyzer (2024) using data from ECMWF Reanalysis version 5 (Hersbach et al., 2020).

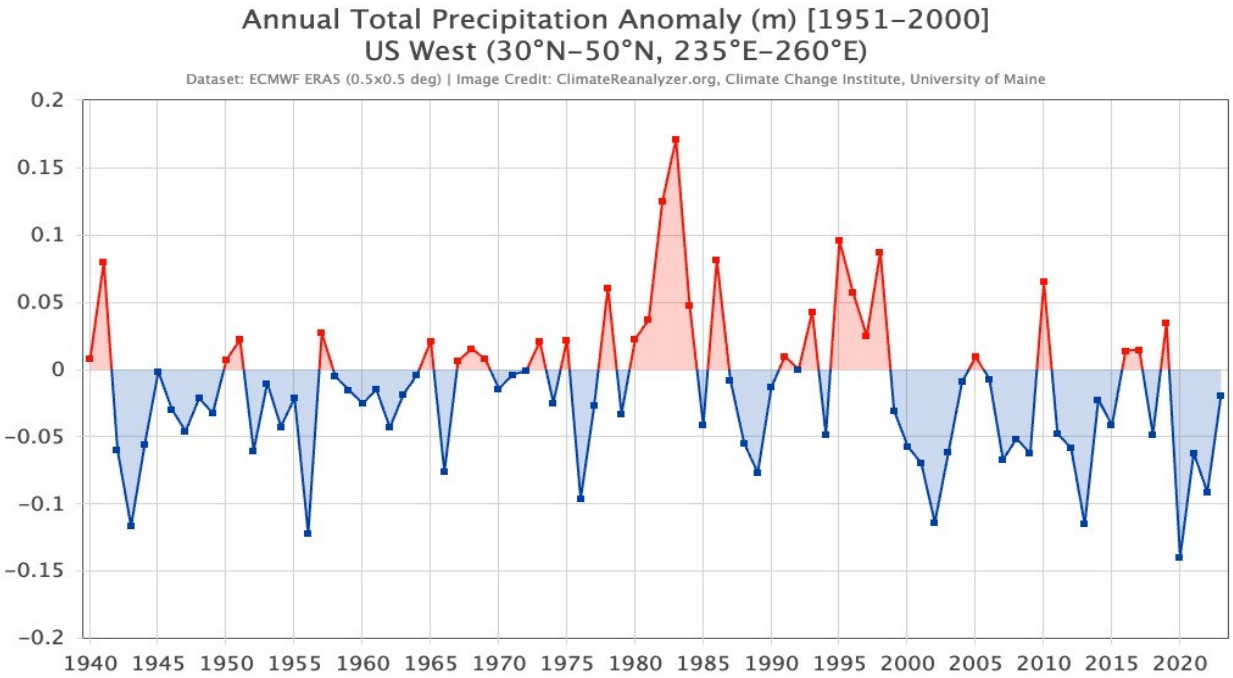

Figure 2.5. Annual total precipitation anomaly 1940-2023. **M**aps generated using Climate Reanalyzer (2024) using data from ECMWF Reanalysis version 5 (Hersbach et al., 2020.

Researchers have studied how climate change has affected the hydrology of the Colorado River Basin. The primary impacts are regional temperature increases and accompanying factors

such as increased evaporation and evapotranspiration, early snowmelt, intensified southwestern monsoon, and diminished snowpack in the Rocky Mountains (Albano et al., 2020; Knowles et al., 2006; Ralph et al., 2019; Xiao and Lettenmaire, 2021; Wallace et al., 2024). These temperature-driven factors play critical roles in hydrological processes in the American Southwest (Dettinger et al., 2020).

Evaporation is the change of state of water from a liquid to a gas, water vapor, which is augmented by rising temperatures. Similarly, evapotranspiration is the evaporation of water from plants through small pores in plant leaves. Both evaporation and evapotranspiration are important factors in the Colorado River Basin's hydraulic cycle (McNabb et al., 2023) and drought. In fact, the level of reservoirs in desert areas like the American Southwest can drop 5 feet in one year from evaporation/evapotranspiration alone. Areas with expanding populations, like Phoenix and Maricopa County, move water through open canals where evaporation causes additional water loss (McNabb et al., 2023). This is happening throughout the Colorado River Basin reservoir, lake, and river systems, including the Salt, Verde, and Gila rivers and includes reservoirs like Lake Mead, Lake Powell, and Lake Pleasant (Trenberth, 2011; USBR, 2012). The evaporation losses at Lake Mead and Lake Powell alone are more than 1.8 million acre-feet, which means that 13% of the water from the reservoirs is lost to evaporation each year (Hannoun et al., 2023; Syed, 2023). Specific to evapotranspiration, research suggests that with each degree Celsius of warming, the annual average flow of water within the Colorado River Basin is diminishing by 9.3% (Hoerling et al., 2019). So, while increased temperatures and summer monsoon activity may support predictions of more cumulative precipitation, it is unlikely that these increases will offset warming induced aridity and evapotranspiration in the Colorado River Basin (Milly et al., 2020).

Mountains are renowned as the globe's reservoirs of freshwater, capturing, stockpiling, and subsequently releasing water for downstream utilization. In the western region of the United States, this natural function predominantly takes place through the accumulation of seasonal snow, or "snowpack," in the Rocky Mountains and several lesser western ranges, amassing a little more than 160 million acre-feet of water each year (Siirila-Woodburn et al., 2021). Notably, in areas like Southern California, within the lower Colorado River Basin, the volume of water stored in the springtime snowpack nearly doubles the capacity of surface water reservoirs (Hale et al., 2023). The thawing of these seasonal snow deposits during the spring and summer months plays a pivotal role in the functioning of water systems, providing a supply of water during periods of lighter rainfall and high demand. Over the course of the past century, both observations and predictive models have unveiled the significant impact of human-induced climate change on water resources in the Western United States (Rhoades et al., 2022). A pronounced effect has been the diminishing snowpack, with a decline in spring snowpack ranging between 15% and 30% (Siirila-Woodburn et al., 2021) since the mid-twentieth century. Projections for the future indicate a further reduction in mountain snow accumulation and corresponding increase in high latitude rain, possibly leading to the eventual disappearance of snowpack, although the precise rate of this decline remains uncertain. While the worst-case scenario involves the complete loss of snow, a more plausible outcome, deduced from historical data on periods of minimal snow cover, entails a decrease in Snow Water Equivalent (SWE) and seasonal snow, alongside a shift from infrequent or short-lived reductions in snowpack to a more persistent trend of "low-to-no snow" conditions (Siirila-Woodburn et al., 2021). Loss of mountain snowpack, earlier spring snowmelt—also known as "snow drought," and precipitation change from snow to rain spurred by higher temperatures reduce the availability of drinking

water downstream (McNabb et al., 2023). Researchers suggest that 70%-80% of the flow within the Colorado River system begins as snowpack (Dettinger et al., 2020; Christensen et al., 2007).

Another factor influenced by climate change is the North American Monsoon. This weather phenomenon contributes significantly to the yearly rainfall in the southern region of the Colorado River Basin throughout the warm season. Research suggests that the intensity of short-term monsoon rainfall has risen in the Southwest U.S. concurrently with potential reductions in the frequency of monsoon occurrences, attributed to alterations in broader hydrology system changes (McCoy et al., 2022). Summer monsoon season brings much needed June-August rains to the Southwestern United States. Monsoon rains generate 6% of annual streamflow, compared to the 70%-80% of flow generated from snowpack. As monsoon season occurs during the dry, warm summer months, most of the moisture generated from monsoons is absorbed by plants and soil rather than adding to Colorado River Basin flow (Carroll et al., 2020; NOAA, 2021).

The final piece of the Colorado River Basin hydrology puzzle to consider is the timing of snowmelt. As anthropogenic climate change continues to cause warming, the timing of the spring thaw will also be impacted, resulting in a wide range of issues, including reservoir management and water availability, flood vulnerability, agricultural needs, water rights, wildfire intensity, forest management and recreation. The onset of earlier snowmelt is likely to advance, potentially leading to an extended runoff period. This prolonged melt timeline could potentially mitigate the risk of flooding during the initial snowmelt phase, though. Conversely, the threat of flooding might escalate if rising temperatures induce more rain-on-snow events in the Colorado River Basin (Clow, 2010; Dettinger et al., 2020; Hamlet et al., 2005).

As a result of climate change, the aggregate natural runoff within the Colorado River Basin has experienced a decline. Concurrently, water consumption has exhibited a relatively

consistent pattern, resulting in historically diminished levels of reservoir storage. Between January 2000 and April 2023, the volume of water held within the largest reservoirs in the United States, namely Lake Mead and Lake Powell, reduced by a substantial 33.5 million acre-feet or 41.3 billion cubic meters (USBR, 2012) (Fig. 2.6.).

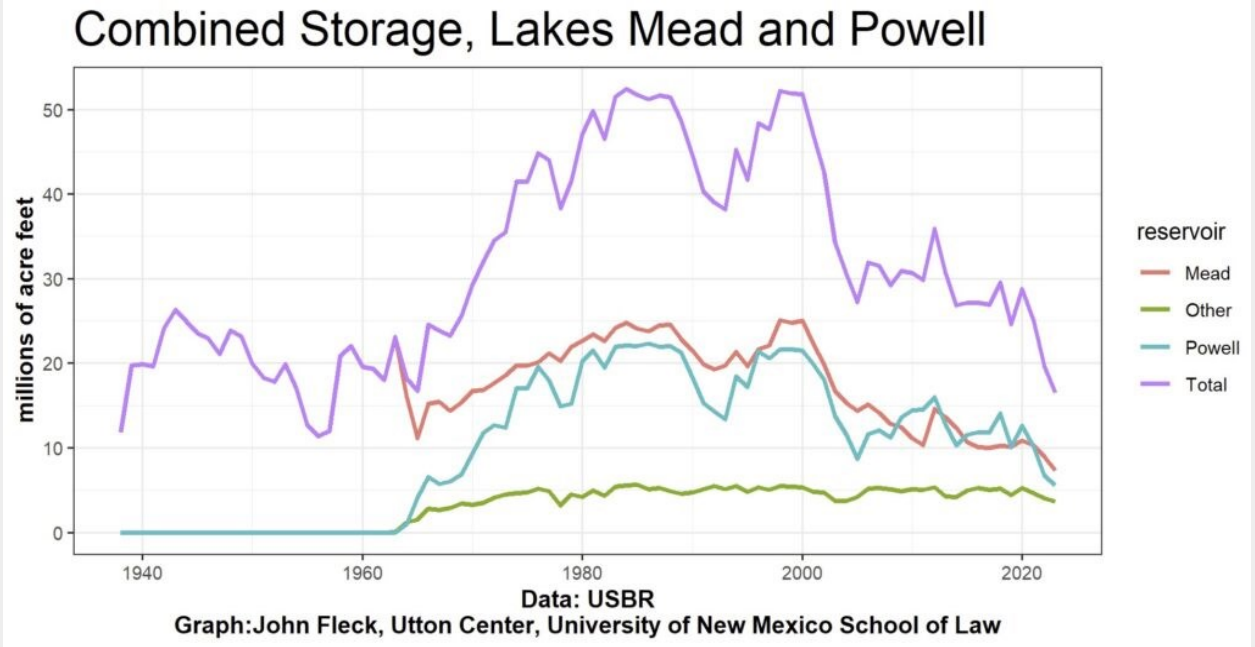

Figure 2.6. Total storage in Lake Mead at the end of September (the end of the western "water year") was lower than it's been since they first filled it in the 1940s. Source: USBR - US Bureau of Reclamation (2012), "Colorado River Basin Water Supply and Demand Study."

As of April 2023, the aggregate storage capacity across the entire Colorado River Basin was only enough to sustain the average basin-wide consumption rate for a little over a year. Although there's a prediction of abundant runoff in the spring of 2023, a sustained remedy would require 100 months of above average rainfall to refill Lake Powell and Lake Mead, assuming no changes in basin-wide water usage. Unfortunately, the prospect of such a scenario is unlikely due to the exacerbating effects of global climate change. Each of these developments is driven by anthropogenic climate change, the release of CO_2 primarily from the burning of fossil fuels, and the resulting increase in atmospheric temperatures (Schmidt et al., 2023).

Most future climate model projections strongly suggest that global temperatures, as well as temperatures in the American Southwest, will increase by 5°F Fahrenheit (intermediate SSP2-4.5), 7.25°F (high SSP3-7.0), to 10°F (very high SSP5-8.5) over the next 70 years, while average annual total precipitation levels in the American Southwest are likely to decrease (NOAA, 2021). Changes in the other factors mentioned above (evapotranspiration, monsoon intensity, the snow vs. rain ratio, and snowmelt timing) paint a discouraging picture of future Colorado River Basin aggregate stream flow volume.

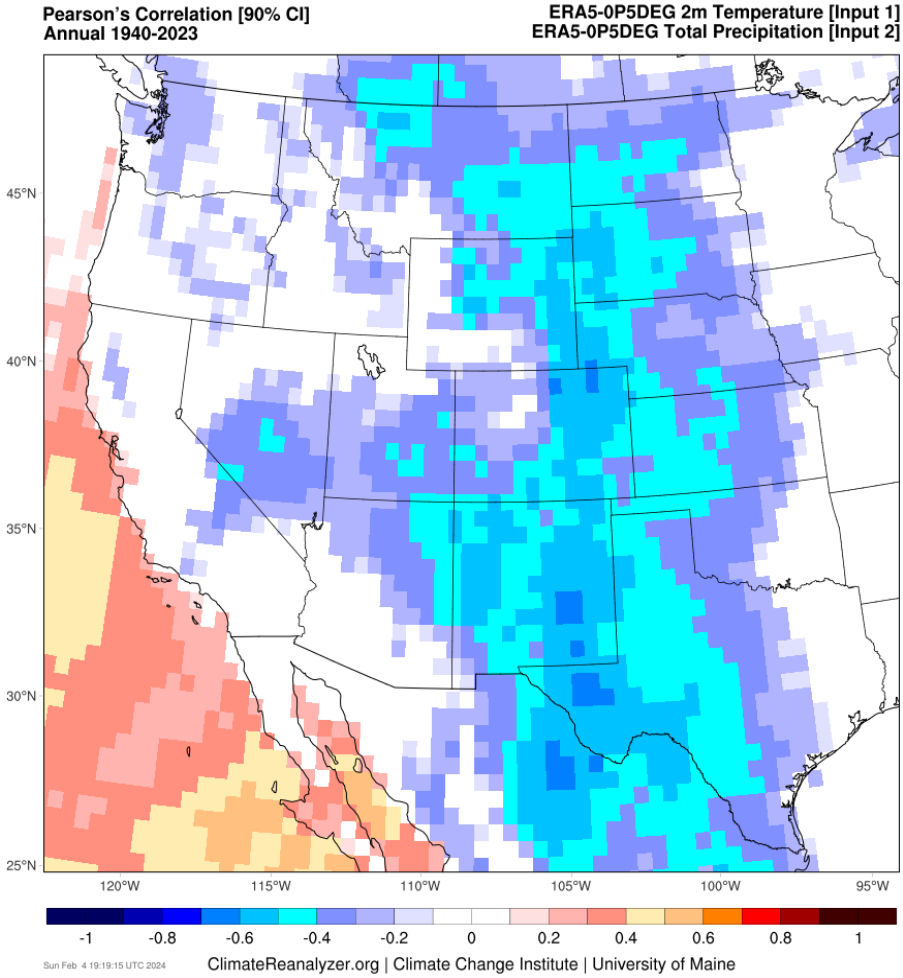

Figure 2.7. Monthly Reanalysis Correlation Map. Annual 2m Temperature vs. Total Precipitation in the US West. Source: UMaine/Climate Change Inst. www.climatereanalyzer.com.

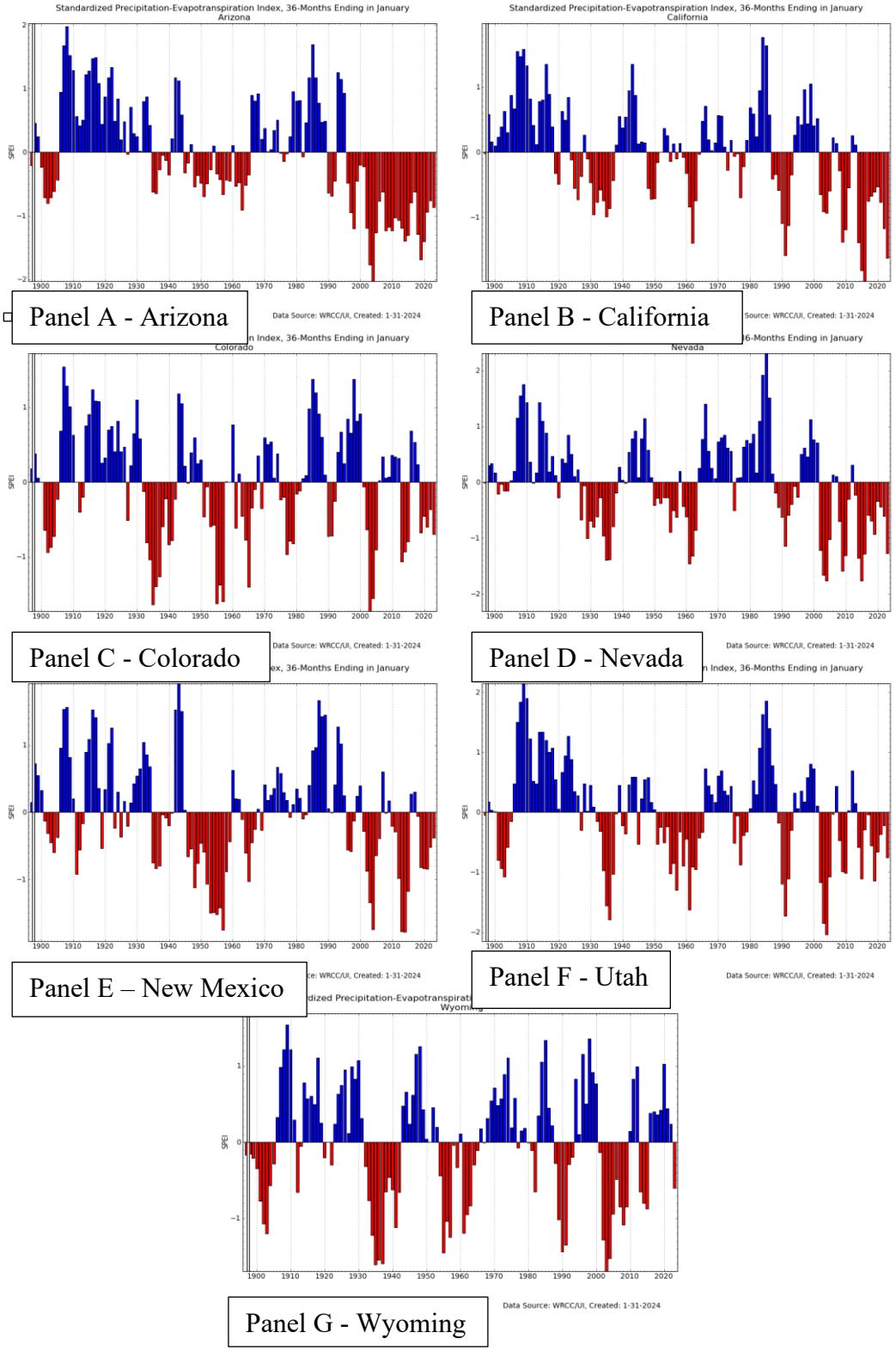

Figure 2.8. Standardized Precipitation-Evapotranspiration Index, 36-Month Intervals Ending in January. Arizona, California, Colorado, Nevada, New Mexico, Utah & Wyoming. Source: West Wide Drought Tracker at https://wrcc.dri.edu/wwdt/time/.

The factors mentioned (temperature, evaporation, and precipitation levels, including snow-to rai- changes, changes to weather patterns, snowpack, and snowmelt timing) have a dramatic impact on flow volume within the Colorado River Basin, and storage levels at critical Colorado River Basin reservoirs like lake Mead and Lake Powell (Tables 2.1. & 2.2.).

Comparison of Current (April 2023) and Last Published (January 2023) CRMMS-ESP 5-Year Projections

Chance of Lake Powell Falling Below Critical Reservoir Elevations in any Month of the Water Year (WY)

	Run	WY 2023[1]	WY 2024	WY 2025	WY 2026	WY 2027[2]
Lake Powell less than 3,525 feet	January 2023	100%	37%	30%	23%	17%
	April 2023	**100%**	**0%**	**0%**	**3%**	**3%**
	Difference	0%	-37%	-30%	-20%	-14%
Lake Powell less than 3,490 feet (minimum power pool)	January 2023	N	10%	10%	20%	13%
	April 2023	**0%**	**0%**	**0%**	**0%**	**0%**
	Difference	0%	-10%	-10%	-20%	-13%
Lake Powell less than 3,375 feet (dead pool = 3,370 feet)	January 2023	0%	0%	0%	0%	0%
	April 2023	**0%**	**0%**	**0%**	**0%**	**0%**
	Difference	0%	0%	0%	0%	0%

All results are computed based on projected physical elevations for Lake Powell.
[1] In January 2023, there was a negligible chance that Lake Powell will fall below 3,490 feet in WY 2023.
[2] For modeling purposes, simulated years beyond 2026 assume a continuation of the 2007 Interim Guidelines, the 2019 Colorado River Basin Drought Contingency Plans, and Minute 323, including the Binational Water Scarcity Contingency Plan. Except for certain provisions related to ICS recovery and Upper Basin demand management, operations under these agreements are in effect through 2026. Reclamation anticipates beginning a process in 2023 to develop operations for post-2026, and the modeling assumptions described here are subject to change for the analysis to be used in that process.

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Table 2.1. Projected 5-year chance of Lake Mead/Lake Powell falling below critical levels 2023-2027 by month. Source: US Bureau of Reclamation/www.usbr/coloradoriverbasin.

Comparison of Current (April 2023) and Last Published (January 2023) CRMMS-ESP 5-Year Projections

Chance of Lake Mead Falling Below Critical Reservoir Elevations in any Month of the Calendar Year

	Run	2023[1]	2024	2025	2026	2027[2]
Lake Mead less than 1,020 feet	January 2023	17%	33%	40%	40%	50%
	April 2023	**0%**	**0%**	**0%**	**3%**	**7%**
	Difference	-17%	-33%	-40%	-37%	-43%
Lake Mead less than 1,000 feet	January 2023	N	13%	13%	13%	13%
	April 2023	**0%**	**0%**	**0%**	**0%**	**0%**
	Difference	0%	-13%	-13%	-13%	-13%
Lake Mead less than 950 feet (minimum power pool)	January 2023	0%	0%	0%	0%	0%
	April 2023	**0%**	**0%**	**0%**	**0%**	**0%**
	Difference	0%	0%	0%	0%	0%
Lake Mead less than 900 feet (dead pool = 895 feet)	January 2023	0%	0%	0%	0%	0%
	April 2023	**0%**	**0%**	**0%**	**0%**	**0%**
	Difference	0%	0%	0%	0%	0%

All results are computed based on projected physical elevations for Lake Mead.

[1] In January 2023, there was a negligible chance that Lake Mead will fall below 1,000 feet in 2023.

[2] For modeling purposes, simulated years beyond 2026 assume a continuation of the 2007 Interim Guidelines, the 2019 Colorado River Basin Drought Contingency Plans, and Minute 323, including the Binational Water Scarcity Contingency Plan. Except for certain provisions related to ICS recovery and Upper Basin demand management, operations under these agreements are in effect through 2026. Reclamation anticipates beginning a process in 2023 to develop operations for post-2026, and the modeling assumptions described here are subject to change for the analysis to be used in that process.

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Table 2.2. Projected 5-year annual chance of Lake Mead/Lake Powell falling below critical levels 2023-2027. Source: US Bureau of Reclamation/www.usbr/coloradoriverbasin.

Tables 2.1. and 2.2. show the US Bureau of Reclamation's Colorado River Mid-term Modeling System (CRMMS) Ensemble Streamflow Prediction (ESP) projections – which combines temperature and precipitation forecasts – for Lakes Mead and Powell. For Lake Powell, there is a 10% chance the water level will fall below 3490 ft in 2024 and 2025, a 20% chance in 2026, and a 13% chance the water level in Lake Powell will fall below 3490 feet in 2027. If Lake Powell falls below 3490 feet, it cannot generate hydroelectric power, which would impact people across the West. The model suggests that Lake Powell has a 37% chance of falling below 3525 feet in 2024, a 20% chance in 2025 & 2026 and a 14% chance of falling below this level in 2027. When Lake Powell reaches its buffer elevation of 3525 feet, it triggers a series of actions to try to stop the lake from reaching its minimum power pool elevation. For Lake Mead,

there is a 13% chance water levels will fall below 1000 feet in each year from 2024-2027, and a 17%, 33%, 40%, 37%, and 43% chance water levels will drop below the 1020 feet level in 2023, 2024, 2025, 2026, and 2027, respectively. When Lake Mead levels drop below 1050 feet, the intake pump used to generate drinking water for Las Vegas is eliminated. The second intake pump works until levels drop to 1000 feet above sea level. If that were to happen, it is possible there could be new water restrictions (USBR, 2012).

2.5. The Law of the River

The "Law of the River" (LOR) refers broadly to the general legal and policy framework timeline associated with the Colorado River Basin. Loosely, the LOR is a web of federal, state, local, and tribal laws, court decisions, decrees, contracts, and regulatory guidelines established to manage water rights among the seven Colorado River Basin states and Mexico. This is a brief review of the major Law of the River elements. The LOR was initiated over 100 years ago with the Colorado River Compact of 1922, which established a legal framework between the upper basin states, the source of the river's water supply, and the lower basin states, where water population driven demands were on the rise. The Compact split the Colorado River Basin into upper and lower halves, with each basin entitled to develop and utilize 7.5 million acre-feet of river water a year (Robison et al., 2014). The Boulder Canyon Project Act of 1928 ratified the Colorado River Compact and authorized the construction of the Hoover Dam, while providing allocation quotas for the lower states of Arizona, California, and Nevada. The Boulder Act also established the Secretary of the Interior as the primary authority for Colorado River water use (Robison et al., 2014). The California Seven Party Agreement of 1931 settled intrastate conflicts between California's agricultural and municipal interests over Colorado River water priorities (LaBianca, 1998). The Mexican Water Treaty of 1944 committed 1.5 million acre-feet of the

river's annual flow to Mexico (Umoff, 2008), while the Upper Colorado River Basin Compact of 1948 created the Upper Colorado River Commission and divided the Upper Basin's 7.5 million acre-feet among Colorado, New Mexico, Utah, and Wyoming, with a portion also allocated to the Arizona region within the Upper Colorado Basin (Tiefenthaler, 2012). The Colorado River Storage Project of 1956 provided a water resource development plan for upper-basin states and authorized the construction of dams such as Glen Canyon, Flaming Gorge, Navajo, and Curecanti for river regulation and power generation, along with other irrigation and usage projects (Hobbs, 2008). The Colorado River Basin Project Act of 1968 authorized various water development projects in both the upper and lower basins, including the Central Arizona Project, which established the priority of the CAP water supply as subordinate to California's apportionment during times of shortage (Lochhead, 2000). This prioritization of California over Arizona has become a prime area of conflict. The Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs of 1970 outlined the coordinated operation of reservoirs in both the upper and lower basins and set conditions for water releases from Lake Powell and Lake Mead (Mann, 1975). As mentioned, in addition to these provisions, the "Law of the River" also includes the federal Endangered Species Act, and various Native American water claim settlements (O'Neill et al., 2016). These efforts to manage Colorado River Basin water resources are ongoing and includes recent agreements to slash usage amid ongoing drought conditions.

While there have been legal challenges between LOR states and interests along the way, most notably the previously referenced Arizona v. California (1952) where Arizona objected to the amount of water California was entitled under the Law of the River, the agreement has shown remarkable staying power, until recently. As the Colorado River Basin states and various

business, government, tribal, and energy interests begin to grasp the implications of a dwindling Colorado River Basin water supply, the contract may be unravelling. At the heart of the recent disputes is drought, and the fact that several basin states believe water allocations from the Colorado River Basin are unsustainable. One discrepancy, and a nod to the 1952 case, stems from original Law of the River provision that grants California preference over states like Arizona, as the Colorado River and its tributaries dry up (Schmidt et al., 2023). Recently, in addition to all seven basin states agreeing to, but in many cases not adhering to, water conservation efforts, the federal government passed the Inflation Reduction Act which allocates $4 billion for water conservation efforts in the Colorado River Basin (Singh, 2023).

2.6. National Public Opinion

The purpose of this brief review of national public opinion research is simply to provide context for our regional survey. Based on Pew, Yale/George Mason, Gallup, and Brookings national survey results, roughly 72% of Americans believe global warming is occurring (Fig. 2.9.), but only 56% believe global warming is the result of human activity and less than half of the respondents (46%) say they have personally experienced the effects of global warming.

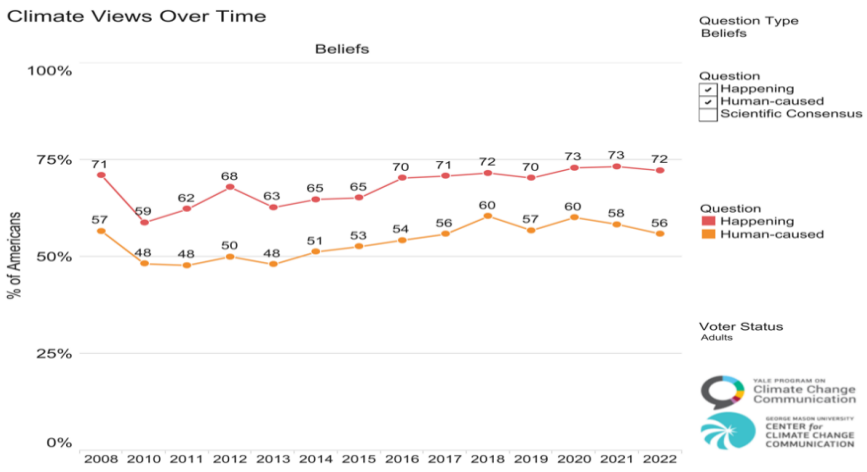

Figure 2.9. Results from polling questions: Is climate change happening? Is climate change caused by humans? Source: Yale Center for Climate Change Communications (2022).

Amid escalating drought in the American Southwest and the ongoing struggles policymakers face to enact substantial reforms, the American public finds itself divided. A significant majority, nearly seven in ten Americans (69%), support the United States' efforts to achieve carbon neutrality by 2050, a target highlighted by President Joe Biden in 2020. At the same time, an equal proportion of Americans (69%) advocate for prioritizing the development of renewable energy sources like wind and solar over the expansion of traditional fossil fuels such as oil, coal, and natural gas. Even so, partisan and age disparities guide most views on climate-related issues.

While 90% of Democrats and Democratic-leaning individuals endorse the notion of the U.S. striving for carbon neutrality by 2050, only 44% of Republicans and Republican-leaning individuals feel the same way, with 53% opposing it. Among Democrats, especially younger Ds aged 18 to 29, a majority (62%) advocate for a complete phasing out of fossil fuels, a stance shared by fewer older Democrats. Conversely, Republicans across all age groups endorse a diverse energy portfolio including oil, coal, and natural gas, although some (22%) younger Republicans aged 18 to 29 advocates for the total abandonment of fossil fuels.

As we might expect, the ideological rift between Democrats and Republicans has widened over the past decade regarding opinions specific to the threat climate change represents. While a majority of U.S. adults (54%) believe climate change is a real threat to the nation's well-being, the gap across party lines is vast. Nearly eight in ten Democrats (78%) regard climate change as a major threat, marking a substantial increase from about six in ten (58%) a decade ago. In contrast, about one in four Republicans (23%) view climate change as a significant threat, a figure largely unchanged from a decade prior.

Despite acknowledging climate change as a major threat, the American public ranks it as a lesser concern compared to other national issues such as immigration, economic strength, crime, healthcare costs, and inflation. Approximately 37% of Americans considered addressing climate change a top priority for the president and Congress in 2023, with an additional 34% regarding it as an important, but a lesser concern. This places climate change 18th out of 21 national issues in terms of priority, according to a Pew survey conducted in January 2023.

Reflecting broader national trends, residents of states within the Colorado River Basin express concerns regarding the potential impacts of climate change, both on the broader U.S. populace and on themselves personally. For example, in Arizona, 65% of residents worry about climate change's adverse effects on the nation, while 48% express concerns about its personal ramifications. Similarly, varying degrees of apprehension are observed in other Colorado River Basin states, including California, Colorado, Nevada, New Mexico, Utah, and Wyoming. Furthermore, partisan disparities extend to the prioritization of climate change as an issue. Democrats predominantly rank it among their top priority concerns, with 59% considering it a top priority. In contrast, among Republicans, it ranks near the bottom of priority issues, with only 13% identifying it as a top concern.

In summary, Pew Research Center survey highlights significant differences in attitudes toward climate change between Democrats and Republicans. While nearly all Democrats perceive climate change as a somewhat serious problem and are willing to point their finger at human activity as the primary cause, Republicans exhibit a lower propensity to hold such beliefs, with notable variations by age and ideological orientation. Younger and more moderate or liberal Republicans are more likely to acknowledge climate change as a pressing issue and to recognize human involvement. Additionally, Democrats report a higher incidence of extreme weather

events in their localities over the past year and are more inclined to connect these events with climate change compared to Republicans.

Regarding remedies for mitigating carbon emissions, there are vast differences of opinion on how the federal government should handle the task of reducing carbon emissions. Generally, more Americans lean towards the use of EVs and nuclear power production. That said, large subsets of the population believe that the government should not get involved. Views on oil and gas extraction are fairly evenly split with 34% of Americans in support of government sponsored extraction, 30% saying they would rather see the government enact policies opposing drilling, and 35% somewhere in the middle. Coal mining, however, stands out as the only extraction activity where public sentiment is mostly negative. A larger percentage feel that the federal government should discourage coal mining (39% vs. 21%), while 39% express neutrality.

Perceptions of local climate impacts, such as drought in the Colorado River Basin, vary depending on individuals' political affiliations and their beliefs regarding the seriousness of climate change. Most Americans (61%) acknowledge that global climate change is affecting their local communities, while about four in ten (39%) perceive little to no impact in their own areas. The view that climate change has an impact on local areas and populations is a potential catalyst for public concern and demands for action. However, these perceptions are more strongly linked to people's beliefs about climate change and their political affiliations rather than the actual conditions in their localities.

(Sources for the national public opinion research section include the Yale/George Mason University "Climate Change in the American Mind" surveys 2020-2023, Pew Research Center surveys 2020, 2021 & 2022, Gallop 2020, 2022, 2023 & The Brookings Institution survey 2022.)

2.7. Unique Public Opinion in the Colorado River Basin

The public opinion research conducted for this chapter sought insights into aspects of public opinion not found in some of the national research sources referenced. One key difference

is we surveyed registered voters in Colorado River Basin states rather than residents. Additionally, other than basic demographic questions, our research looked at: a) voter's baseline knowledge about global warming and climate change, b) the degree to which voters would make sacrifices in order to reduce the impacts of climate change and global warming, c) how voters in Colorado River Basin states prioritize climate change compared to other critical issues as well as how voters would prioritize candidates running for office who themselves prioritized implementing climate change policy versus candidates who prioritized other important issues, and finally d) how voters in Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming feel about the drought that is currently gripping their states, as well as water allocation policies. Only aggregate response data for all Colorado River Basin states and significant findings are highlighted in this text. Readers are welcome to review both aggregate combined data and individual state data in Indexes 1-8.

Unlike the national research referenced earlier, our survey of Colorado River Basin states showed that a minority (47.3%) voters agree that climate change and/or global warming is currently occurring (Table 2.3.), with only 13.5% of aggregate Colorado River Basin voters believing CC/GW is the "direct result of human activity."

Would you agree, Climate Change and/or Global Warming is currently happening?

	Total	STATE						
		California	Colorado	Nevada	New Mex.	Utah	Wyoming	Arizona
Total	431.0	61.0	59.0	65.0	63.0	60.0	62.0	61.0
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total Answering	413.0	56.0	57.0	64.0	61.0	58.0	57.0	60.0
	95.8%	91.8%	96.6%	98.5%	96.8%	96.7%	91.9%	98.4%
Strongly agree	109.0	5.0	18.0	17.0	16.0	27.0	10.0	16.0
	25.3%	8.2%	30.5%	26.2%	25.4%	45.0%	16.1%	26.2%
Agree	95.0	12.0	11.0	13.0	16.0	13.0	14.0	16.0
	22.0%	19.7%	18.6%	20.0%	25.4%	21.7%	22.6%	26.2%
Neither agree nor disagree	83.0	14.0	11.0	18.0	13.0	7.0	10.0	10.0
	19.3%	23.0%	18.6%	27.7%	20.6%	11.7%	16.1%	16.4%
Disagree	51.0	10.0	4.0	4.0	5.0	7.0	11.0	10.0
	11.8%	16.4%	6.8%	6.2%	7.9%	11.7%	17.7%	16.4%
Strongly disagree	69.0	14.0	13.0	9.0	10.0	4.0	11.0	8.0
	16.0%	23.0%	22.0%	13.8%	15.9%	6.7%	17.7%	13.1%
Not Sure/Don't Know	6.0	1.0	-	3.0	1.0	-	1.0	-
	1.4%	1.6%		4.6%	1.6%		1.6%	

Table 2.3. Response to Question #6. Orion Research.

Only 28.7% of Colorado River Basin voters definitively state that CC/GW is the result of C02 and GHG emissions. Moreover, nearly half (47.1% and 48.3% respectively) of aggregate respondents disagreed that recent "record-setting temperatures" and/or "droughts, wildfires, flooding, and increased storm severity," are the result of CC/GW The second battery produced little evidence that Colorado River Basin state voters were willing to make substantial individual sacrifices to reduce the impacts of CC/GW. For instance, voters were asked if they would be willing to replace their current home energy source with 100% renewable energy sources if the government paid all costs. Only 35.3% of Colorado River Basin voters (Table 2.4.) said "Yes."

<u>If the government paid for 100% of the costs, would you be willing to replace your current home energy source with 100% renewable sources like wind or solar within the next five years?</u>

	Total	STATE						
		California	Colorado	Nevada	New Mex.	Utah	Wyoming	Arizona
Total	431.0	61.0	59.0	65.0	63.0	60.0	62.0	61.0
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total Answering	429.0	59.0	59.0	65.0	63.0	60.0	62.0	61.0
	99.5%	96.7%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Yes	152.0	16.0	19.0	25.0	24.0	28.0	14.0	26.0
	35.3%	26.2%	32.2%	38.5%	38.1%	46.7%	22.6%	42.6%
No	234.0	43.0	33.0	28.0	36.0	21.0	43.0	30.0
	54.3%	70.5%	55.9%	43.1%	57.1%	35.0%	69.4%	49.2%
Not Sure/Don't Know	43.0	-	7.0	12.0	3.0	11.0	5.0	5.0
	10.0%		11.9%	18.5%	4.8%	18.3%	8.1%	8.2%

Table 2.4. Response to Question 14. Orion Research.

Colorado River Basin voters were asked if they'd be willing to trade their internal combustion engine automobile in for an electric vehicle if the government covered $5000 of the costs. Only 12.3% of voters said they would switch. We then asked Colorado River Basin voters if they'd be willing to use public transportation for 50% of their "local" transportation needs. 18.6% said yes. When asked if they'd be willing to pay "their fair share" of the costs to transition

from a fossil-fuel based economy and society to renewables, 19.5% of Colorado River Basin voters said they would. And when we quantified this question asking Colorado River Basin voters would be willing to pay $100, $50 or $10 a month to fund a national transition from fossil-fuel based energy to renewables, only 15.1% ($100), 16.5% ($50) and 26.5% ($10), respectively, said they would be willing to fund the transition. When voters were asked whether industrialized countries like the US, China, Great Britain, Russia, and Germany, i.e., countries that have contributed more CO2 and greenhouse gases to the atmosphere than other less developed countries, should pay more toward the cost of transitioning away from fossil-fuels, 35.6% over voters said those countries should pay more. The final question in the second battery asked voters if they believed there was anything we could do at this point to reverse the effects of CO2 and GHG emissions, 35% said "yes," 39.4% said "no," and 24.4% were undecided.

In the third battery, we looked at Colorado River Basin voter's issue priorities. In an open-ended issue question, where voters were asked to rank the issues they want their chosen candidate in the upcoming election to focus on, 45.2% chose the economy, another 5.3% specifically chose inflation, 19.2% chose "protecting our democracy," 7.7% said immigration, 5.8% chose healthcare and 5.6% selected climate as their #1 issue. Then, we asked voters to choose between candidate "A" who prioritized "climate change remedies," vs. candidate "B" who prioritized other important issues including (in order), a) inflation, b) economic development and job creation, c) assuring clean elections, d) education, e) race relations, f) health care, and g) protecting reproductive health care rights.

Now, if Candidate A, running for local, state, or federal office, publicly stated that they prioritized climate change remedies and Candidate B prioritized a fiscally conservative agenda including lower taxes, less government spending, lowering gasoline prices, addressing inflation, and bringing the cost of living under control, would you support Candidate A or Candidate B?

	Total	STATE						
		California	Colorado	Nevada	New Mex.	Utah	Wyoming	Arizona
Total	431.0 100.0%	61.0 100.0%	59.0 100.0%	65.0 100.0%	63.0 100.0%	60.0 100.0%	62.0 100.0%	61.0 100.0%
Total Answering	424.0 98.4%	57.0 93.4%	59.0 100.0%	65.0 100.0%	63.0 100.0%	60.0 100.0%	60.0 96.8%	60.0 98.4%
Other (please specify)	-	-	-	-	-	-	-	-
Candidate A	74.0 17.2%	7.0 11.5%	12.0 20.3%	10.0 15.4%	14.0 22.2%	13.0 21.7%	8.0 12.9%	10.0 16.4%
Lean Candidate A	23.0 5.3%	-	3.0 5.1%	4.0 6.2%	3.0 4.8%	11.0 18.3%	1.0 1.6%	1.0 1.6%
Candidate B	284.0 65.9%	46.0 75.4%	40.0 67.8%	43.0 66.2%	40.0 63.5%	25.0 41.7%	46.0 74.2%	44.0 72.1%
Lean Candidate B	26.0 6.0%	2.0 3.3%	2.0 3.4%	6.0 9.2%	3.0 4.8%	8.0 13.3%	2.0 3.2%	3.0 4.9%
Not Sure/Don't Know	17.0 3.9%	2.0 3.3%	2.0 3.4%	2.0 3.1%	3.0 4.8%	3.0 5.0%	3.0 4.8%	2.0 3.3%

Table 2.5. Response to Question 27. Orion Research.

Candidate "B" won six of seven matchups with the candidate prioritizing health care garnering the most support at 86.6%, clean elections – 71.7%, education – 66.3%, inflation – 57.7% (Table 2.5.), economic development – 53.5% and the candidate advocating for reproductive health rights got 52.5%. Only the candidate championing race relations (39.4%) lost to our climate change policy candidate.

In the fourth and final battery, DRB voters were asked specifically about drought. When Colorado River Basin voters were asked if they agreed that temperatures in Southwestern US had increased in recent years, 36.4% said yes. When asked if they believed there was a connection between CC/GW and increased temperatures and longer more severe droughts, 36% said there was a connection. Yet, when asked how concerned they were that the Colorado River Basin, a main water source of 40 million Americans, was at record low levels, 76.5% (Table 2.6.) said

they were either “strongly concerned” or “concerned,” with 84.6% of Nevada voters answering similarly.

How concerned are you that the Colorado River Basin, the main water source for the Southwestern US states, the main source of water for over 40 million Americans, for critical economic interests like farming, mining, and fossil fuel extraction, and the main source of water to Lake Meade and Lake Powell, is currently near the lowest level on record?

	Total	STATE						
		California	Colorado	Nevada	New Mex.	Utah	Wyoming	Arizona
Total	431.0	61.0	59.0	65.0	63.0	60.0	62.0	61.0
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Total Answering	422.0	56.0	59.0	65.0	63.0	58.0	61.0	60.0
	97.9%	91.8%	100.0%	100.0%	100.0%	96.7%	98.4%	98.4%
Strongly concerned	160.0	11.0	24.0	27.0	21.0	32.0	14.0	31.0
	37.1%	18.0%	40.7%	41.5%	33.3%	53.3%	22.6%	50.8%
Concerned	170.0	28.0	20.0	28.0	28.0	14.0	30.0	22.0
	39.4%	45.9%	33.9%	43.1%	44.4%	23.3%	48.4%	36.1%
Unconcerned	58.0	9.0	10.0	5.0	10.0	9.0	10.0	5.0
	13.5%	14.8%	16.9%	7.7%	15.9%	15.0%	16.1%	8.2%
Very Unconcerned	20.0	5.0	3.0	1.0	4.0	3.0	3.0	1.0
	4.6%	8.2%	5.1%	1.5%	6.3%	5.0%	4.8%	1.6%
Not Sure/Don't Know	14.0	3.0	2.0	4.0	-	-	4.0	1.0
	3.2%	4.9%	3.4%	6.2%			6.5%	1.6%

Table 2.6. Response to Question 36. Orion Research.

And when Colorado River Basin voters were asked who should be prioritized if severe rationing policies were implemented, 47.6% small family farms received the greatest support, followed by residential users (20.4%), large corporate farms (10.7%), energy producers like hydro-electric dams (6.5%), large cities (3.9%), and industrial economic interests like mining and drilling (.2%). It should be noted here that agri-business accounts for 79% of Colorado River Basin water allocations, with residential use (12%), industrials economic interests (4%), and hydropower (4%) rounding things out (Shoa, 2023).

Religion plays an important role in voters' views on climate change. For instance, when those who believe that changes in climate conditions "are in God's hands" were asked whether climate change is occurring, 30.6% said that climate change was in fact occurring as compared to 47.3% of the aggregate respondent group. Of note, of this same subset, only 6.6% of those who believe changes to climate conditions are "in God's hands" strongly agreed that climate change was occurring compared to 25.3% of the aggregate response group. Similarly, when it was suggested that climate change was a result of "naturally occurring trends and cycles" (as opposed to being human induced) 86.9% of those who believe climate change is "in God's hands" said it was, compared to 42.7%, less than half, of the aggregate response group. Finally, when the "in God's hands" group was asked if climate change and global warming were primarily caused by the burning of fossil fuels, only 8.2% believed it was, compared with 28.7% of the aggregate response group.

2.8. States – The Laboratories of Democracy

Next, we sought to determine whether the public's concerns regarding climate change and drought were reflected in state-level direct democracy efforts like ballot initiatives and state legislative activity. It's been said that states are our laboratories of our democracy. This phrase, penned by U.S. Supreme Court Justice Louis Brandeis, describes how individual states often push social norms and societal limits without imposing untested issues on the nation. This concept highlights the level of state autonomy that exists in the United States where state governments act as social laboratories and laws and policies are created and tested at the state level. Some examples of this are the Affordable Care Act (Massachusetts), the legalization of marijuana (Colorado), and the phasing out of internal combustion car engines (California) (Tyler et al., 2023). The concept of states acting as laboratories for democracy is rooted in the 10th

Amendment to the US Constitution that prescribes that “all powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people." Different legislative agendas can be enacted and tested at the state level without impacting the entire country. With this concept in mind, we assess three areas of relevance: a) national- and state-level public opinion research with a supplemental focus on unique survey research conducted in each Colorado River Basin state for this paper, b) state-level legislative activity specific to climate change, c) and state-level ballot initiatives specific to climate change to determine if there are correlations between these metrics and worsening climate change -related conditions in Colorado River basin states.

2.9. Ballot Measures

Since Oregon introduced the first state-level initiatives to voters in 1904, a total of 2,653 have appeared on the ballot up to the end of 2022. Among these, 1,110 (or 42 percent) have received approval. The modern initiative movement traces back to the late 1970s, sparked by California's tax-cutting Proposition 13. This movement experienced rapid growth in subsequent decades, peaking in the 1990s with 382 initiatives, of which 177 were successful. The following decade witnessed 375 initiatives, with 158 gaining approval. While there has been a slight slowdown in initiative activity in the most recent decade, the trend remains significant.

Twenty-four states have had at least one initiative during the period of 1904- 2021. California has the most, with 393, followed closely by Oregon with 379, and they have an identical 35 percent approval rate. Colorado (257), North Dakota (199), and Washington (190) round out the top five. The degree to which voters approve ballot measures meant to effect

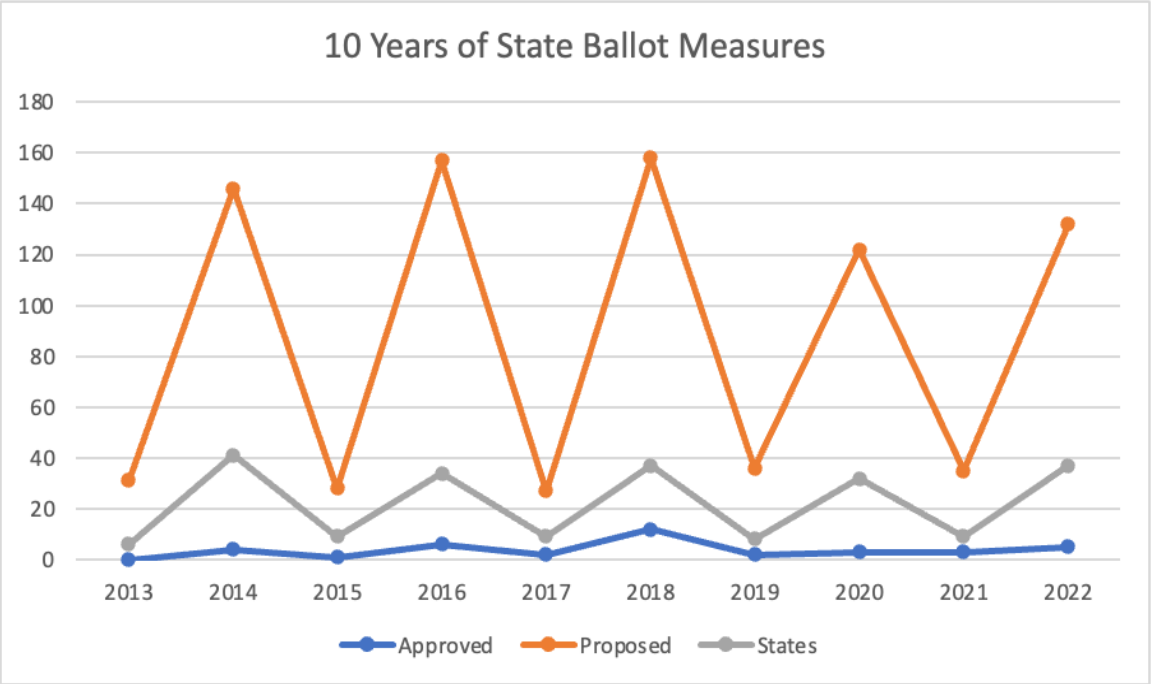

Figure 2.10. State ballot measures proposed (orange line), approved (blue line), and the number of states engaged (grey line) 2013-2022. Hasson (2024).

carbon emissions and warming though is discouraging. For instance, of the 132-climate related ballot measure that were proposed nationally in 2022, only 5 (4%) were approved by voters (Fig. 2.10.). And while 2018 was banner year for ballot initiative success with a record 158 climate related measures on the ballots across 37 different states, only 12 measures (+/- 8%) were passed (USC, 2023).

2.10. State Legislative Activity

Over the past five years, during the 2019, 2020, 2021, 2022, and 2023 state legislative sessions, individual state legislatures have proposed, passed, and adopted a wide range of measures designed to curb the impacts of climate change. The assessment covers several significant areas, along with those that are not included. The addressed issue areas encompass a) Climate Justice: It emphasizes the need for an equitable and accessible approach to addressing climate change. Prioritizing communities affected by climate change, particularly historically

marginalized ones like low-income and BIPOC communities, is vital. Climate justice recognizes their disproportionate vulnerability to climate impacts. A fair transition from fossil fuels to clean energy requires supporting those transitioning out of the fossil fuel industry, granting them self-determination and equitable policy frameworks; b) Emissions Reduction: The foremost strategy to combat climate change involves reducing greenhouse gas emissions. States play a crucial role in achieving this goal and transitioning to fully clean energy economies; c) Transportation: States hold a key role in decarbonizing US transportation. They can implement policies that promote the widespread use of electric vehicles and allocate funding for public transit options in urban and rural areas; d) Grid Modernization: Enhancing energy efficiency and transmission through modernized grid and utility systems is a priority for states. This ensures sustainable and resilient energy grids for the future, e) Oceans: Coastal states are particularly impacted by climate change, facing challenges like rising sea levels and extreme weather events. Legislation that supports renewable offshore wind energy, restricts offshore drilling, and establishes flood plans in response to sea-level rise takes center stage. However, this assessment does not encompass legislation concerning pollution, such as plastics and PFAS, nor does it include efforts related to land conservation, biodiversity protection, wildlife preservation, or state-level initiatives promoting outdoor activities. While some of these omitted issues are influenced or exacerbated by climate change, the research predominantly concentrates on legislation specifically geared towards mitigating carbon emissions.

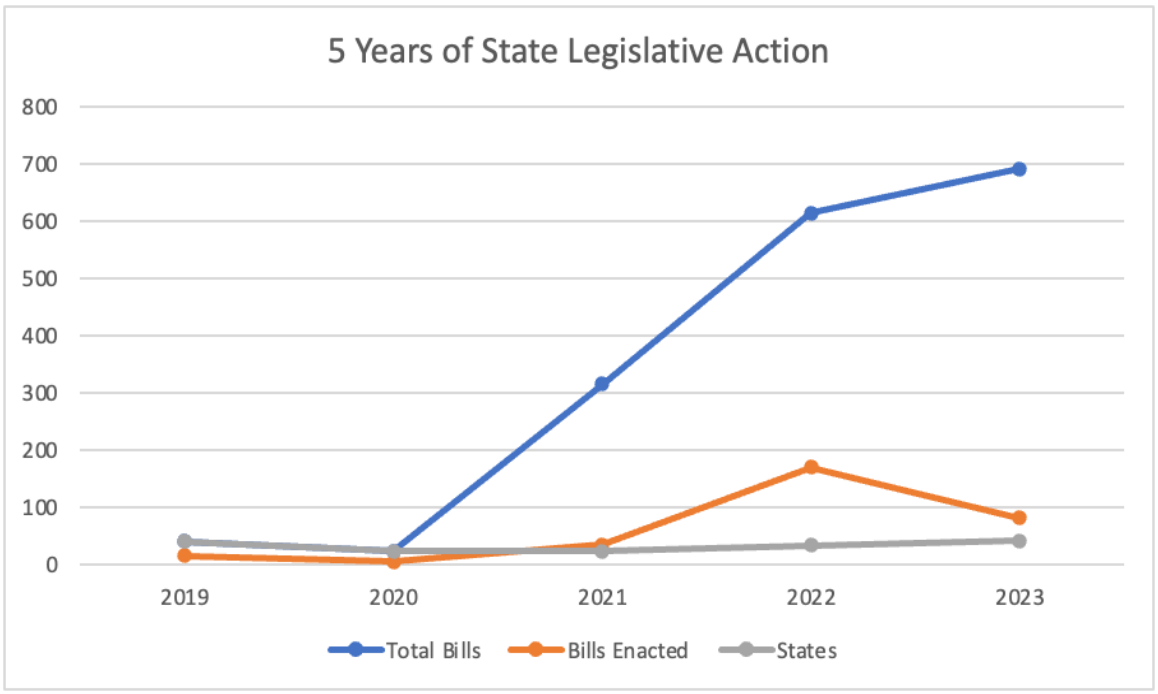

Figure 2.11. Total climate bills proposed (blue) and enacted (orange) at the state level from 2019-2023, and the number of states involved (grey). Hasson (2024).

In 2019, there were 40 total bills proposed in 17 states that met our criteria. In 2020, there was a drop in state legislative activity specific to climate change, with 23 bills put forward in 23 states (Fig. 2.11.). There was a dramatic uptick in state legislative activity in 2021 with 316 pieces of legislation offered, again in 23 states. 2022 saw a doubling of the number of bills (615) advanced from 2021 in 34 states and in 2023, there were a total of 692 bills presented for consideration in 42 states. It should be noted, despite the seemingly low bill-to-law enactment rate highlighted herein, according to National Caucus of Environmental Legislator honoree New Hampshire State Senator David Watters, many proposed bills are incorporated into larger omnibus efforts. While there is no set tracking method to determine the number of bills that are absorbed into broader legislative efforts, both Senator Watters and NCEL staff suggest the number is significant. It should be noted that while the Biden Administrations' 2022 Inflation Reduction Act invests nearly $400 million in climate mitigation efforts, many critics point to

concessions the administration made to the fossil fuel industry, like an easier permitting process for natural gas pipelines, expanded lease auctions to drill for fossil fuels on public lands, and continued federal subsidies to the hugely profitable gas and oil industry, as evidence of the bill's shortcomings. That said, state legislative activity specific to reversing the effects of carbon emissions has been a source of optimism. The uptick in state legislative activity has been substantial in recent years and NCEL staff and board members believe the percentage of bills that become law will improve (NCEL, 2023).

2.11. Methods

Functioning as an "advertiser," I employed Facebook's audience targeting tools to buy and position survey recruitment ads within the Facebook membership population residing in targeted states (AZ, CA, CO, NV, NM, UT, WY). Each ad is aimed at individuals aged 18 to 75, living in Colorado River Basin states. Facebook presents several options for the campaign's "marketing objective." Following discussions with advertising experts at Facebook, our default approach is to set the campaign objective as "traffic." This translates to encouraging Facebook users to click on the link embedded in the ad, leading them to our online survey. Facebook also provides the alternative to set a campaign objective that focuses on increasing "awareness" or "conversion." Given that Facebook is a private corporation, it has the authority to modify the display algorithm with minimal prior notice or clear explanations. If such modifications result in varying sample selection based on unobservable factors, then samples gathered over time might exhibit unknown biases.

Adhering to Facebook's standardized design, ads must adhere to a general structure. While each ad must link to a Facebook page, feature a headline, ad text, an image, and can include a link to an external webpage, advertisers have considerable flexibility in creating the ad

text, selecting image content, and choosing between a single image, a carousel, a video, a slideshow, or a collection.

Our ad template (Fig. 2.12.) remained simple for all advertisements. Each ad included a single image acquired from licensed stock photography accessible for free on the Facebook advertising platform. We selected images that closely resembled drought or water shortage related phenomena like wildfires. All ads then linked respondents to an "Orion Public Opinion Research" Facebook page. The "headline" field in each ad extended an opportunity for users to "Help Us Understand Drought," while inviting respondents to "Click Here Colorado. Take Our Survey."

Figure 2.12. Sample (AZ.) Facebook advertising used to encourage voters to participate in on-line survey. Source: Orion Research 2023.

Facebook provides multiple options for ad placement. Advertisers can choose to have their ads displayed on Facebook (in the newsfeed and/or the right-hand column on desktop), Instagram, or partner networks. All our campaigns were placed on Facebook's newsfeed and Instagram. Users who engage with the ad are directed to an electronic survey hosted by SurveyMonkey. The survey is accessible on both desktop and mobile devices. Participants provide their consent and then proceed with the survey.

Survey Structure: In addition to several demographic questions, our survey consists of four core batteries. Battery #1 sought to gather basic public opinion about global warming and climate change. Battery #2 investigated the degree to which voters would make sacrifices to reduce the impacts of climate change and global warming. Battery #3 looked at how voters in Colorado River Basin states prioritize climate change compared to other critical issues, as well as whether voters would prioritize candidates running for office who themselves prioritized implementing climate change policy versus candidates who prioritized other important issues. Battery #4 determined how voters in Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming feel about the drought that is currently gripping their states and water allocation policies.

2.12. Conclusion

Despite substantial scientific evidence of worsening climate change and global warming, there seems to be little reason to believe American voters will force elected officials to prioritize meaningful climate policy anytime soon. As Image #3 suggests, the percentage of American respondents to a Yale/George Mason University survey who believe climate change is occurring increased by 1%, from 71% to 72%, between 2008-2022. During this same period, atmospheric

carbon levels measured in parts per million have increased from 382 ppm to roughly 420 ppm (NOAA, 2023).

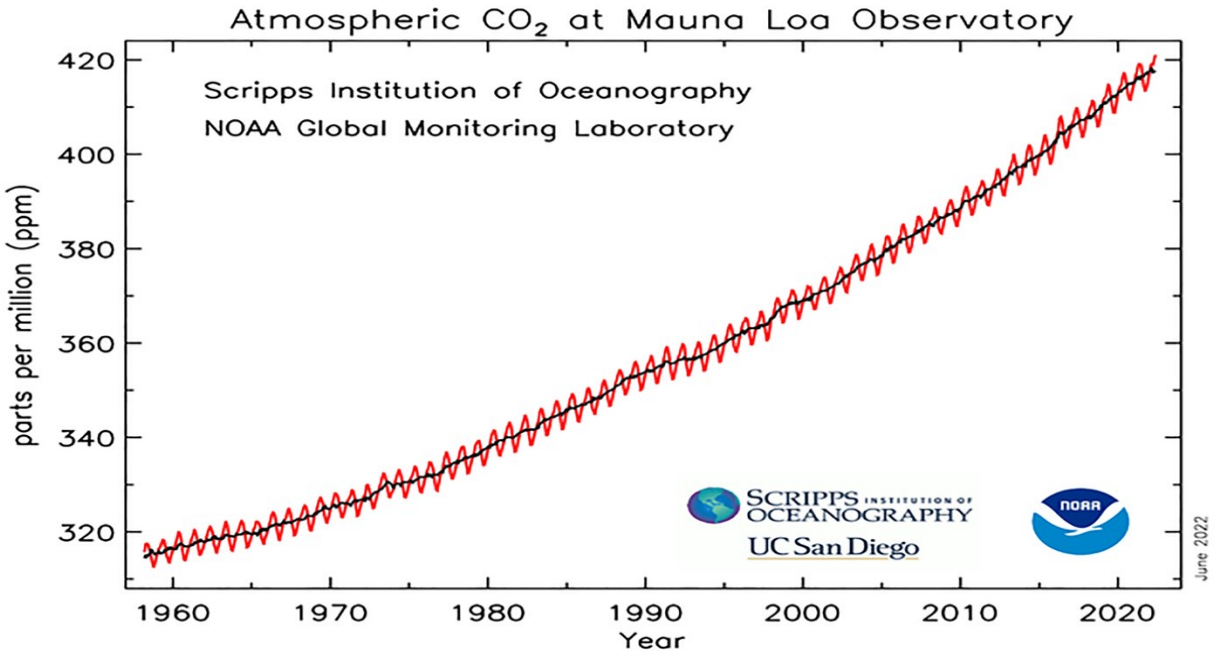

Figure 2.13. Atmospheric Carbon Dioxide levels in PPM from 1955-2023. Source: NOAA Global Monitoring Laboratory **(**2022).

Alarmingly, during this same period, the percentage of Americans who said they believe climate change is caused by human activity dropped from 57% in 2008 to 56% in 2022. A March 2022 survey conducted by the Pew Research Center found that while most Americans consider climate change to be a significant danger, it is less of a priority than issues like the economy, jobs, quality affordable health care, education, and immigration. Only 37% of Americans said that tackling climate change should be a top concern for Congress in 2023, ranking climate action 16th out of 21 national issues (Pew, 2022).

As indicators of rapid climate change like ever-increasing atmospheric carbon levels (Fig. 2.13.) (NOAA, 2023) and rising global temperatures show no sign of abating, drought and water availability in the American Southwest and the Colorado River Basin will continue to worsen. Driven by undeterred warming, factors driving continued aridity like altered weather patterns,

increased evaporation, decreased snowpack in the Rocky Mountains, altered snowmelt timing, and snow-to-rain precipitation changes will negatively impact water availability. As stated, research suggests that with each degree Celsius of warming, evaporation decreases the annual average flow of water within the Colorado River Basin by 9.3% (Bass et al., 2023). Using the temperature projections for the American West from the University of Maine/Climate Change Institute's Climate Reanalyzer modeling database highlighted in Image #2, evaporation alone may account for an 18% drop in Colorado River Basin water availability over the next 70 years. As this region becomes less hospitable, experts suggest the combined effects of climate change will continue to make previously inhabitable areas, like the American Southwest, less so (Xu et al., 2019), forcing populations northward. As heat and water availability worsen, this same research suggests that some parts of the Southwest will experience temperatures near 100° for half the year. In addition to severe water shortages, these temperature levels negatively impact human health, agricultural production, and possible mass migration. While more research needs to be done on this potential migration north, researchers believe northern state populations may increase by as much as 10%. As US representation in Congress is the product of population, the political implications of this type of population shift seem clear. Modeling suggests that most of those migrating north will reside in more liberal urban centers where jobs and public services are more abundant (Lustgarten, 2020). As such, the political clout of Southeastern states like Arizona, New Mexico, and Nevada will decrease, while northern urban centers see their influence increase. The question that arises is, will the states most affected by the combined impacts of heat increase and reduced Colorado River Basin water availability – Arizona, California, Colorado, New Mexico, Nevada, Utah, and Wyoming – act in their own best interests? The answer, according to unique public opinion research conducted for this paper, is

no. Battery #1, highlighted on page #57, asks questions like – "Would you agree, Climate Change and/or Global Warming is currently occurring?," Do you agree, Climate Change & Global Warming are a direct result of carbon dioxide and other greenhouse gas emissions that are released into the atmosphere primarily from the burning of fossil fuels?, and Scientists have suggested that recent record setting temperatures and heat waves are a direct result of climate change & global warming. Would you agree or disagree?" - to assess general attitudes specific to climate change and global warming. With only 47.3% of Colorado River Basin state voters saying they agree (strongly agree/agree combined) climate change is currently occurring, and only 13% of these same voters believing "climate change is a direct result of human activity," it is hard to see a scenario where this population puts enough pressure on elected officials to prioritize climate over other critical issues. Adding to this dire forecast, when Colorado River Basin votes were asked is they believed "recent record-setting temperatures" and/or (separate questions) "recent droughts, wildfires, flooding, and increased storm severity," were caused by climate change/global warming, nearly half said no, with 10%-13% undecided.

When voters were probed for answers to what sacrifices they would make to address climate change, only 35.3% of our respondents said they would switch their energy source to 100% renewable, even if the government paid all transition costs. Only 12.3% of Colorado River Basin voters would accept $5000 toward the replacement of their internal combustion engine car for an EV, and fewer than 20% of respondents would increase their use of public transportation. When asked in they'd be willing to pay a tax of $10 per month to transition away from fossil fuels and toward renewables, only 26.5% said yes.

In the third battery, we looked at Colorado River Basin voter's issue priorities. We asked a series of questions meant to highlight voters' issue priorities by creating election matchups

where candidate "A" prioritized "climate change remedies," vs. candidate "B" who prioritized other important issues including (in order), a) inflation, b) economic development and job creation, c) ensuring clean elections, d) education, e) race relations, f) health care, and g) protecting reproductive health care rights. Candidate "B" won six of seven matchups with the candidate prioritizing health care garnering the most support at 86.6%, clean elections – 71.7%, education – 66.3%, inflation – 57.7%, economic development – 53.5% and the candidate advocating for reproductive health rights got 52.5%. Only the candidate championing race relations (39.4%) lost to our climate change policy candidate.

In the fourth battery of questions, we focused questions on drought. Like the other areas of this unique public opinion research, voter feedback suggests a lack of urgency. While 76.5% of Colorado River Basin voters said they were either "strongly concerned" or "concerned," "that the Colorado River Basin, the main water source for the Southwestern US states, the main source of water for over 40 million Americans, for critical economic interests like farming, mining, and fossil fuel extraction, and the main source of water to Lake Meade and Lake Powell, is currently near the lowest level on record," only 36% said there was a connection between climate change and global warming and "longer, more severe droughts."

To recap the main findings of our Colorado River Basin Public Opinion Research, there are very few (13%) Colorado River Basin state voters who believe climate change and global warming are the result of human activity and a similarly low percentage are willing to make the needed sacrifices to mitigate carbon emissions. In terms of issue priorities, when compared to other important issues like health care, education and economic interests, climate change and global warming was simply not on the same level and while Colorado River Basin state residents

are concerned about the current drought, only about a third believe drought driven Colorado River Basin water shortages and climate change and global warming are connected.

Elected officials' priorities reflect the public they serve. This isn't a moral statement; it is a position of fact and survival. Candidates for office run on the issues that matter most to their potential constituents. Otherwise, they would not get elected. At this point, in the Colorado River Basin states we've focused on, voters are not prioritizing climate change and/or global warming. Therefore, it's unlikely efforts to mitigate carbon emissions in a meaningful way will be addressed. This assessment holds true for most of the country. This suggestion is supported by our review of state-level legislative efforts to mitigate CO2 emissions. At present, despite hundreds of state-level bills addressing CO2 emissions, 25 states along with the District of Columbia have adopted economy-wide targets for greenhouse gas emissions. Of the five states that set emission reduction goals for 2020 – California, Connecticut, Oregon, Rhode Island, and New Jersey – only California hit its goal.

The only valid conclusion one can draw from: a) the discouraging national and region polling specific to climate change, b) weak state level use of direct democratic mechanisms like ballot initiatives and state legislative action, and c) the steady march of current and future scientific projection for climate change, global warming and drought related factors within the Colorado River Basin is that the current drought conditions, and therefore dwindling water availability, will only get worse. Atmospheric CO2 levels, temperature, evaporation, snow to rain precipitation change, melt timing, monsoon intensity, snowpack levels and flow volume within the Colorado River Basin, all suggest a new normal in so far as the water allocation agreements that have governed resource allocations to basin states. Current practices are no longer sustainable in an increasingly drier climate. As temperatures continue to rise, the

population of southwestern states expand, and the demand for water rises, the region will need to agree to further concessions and rewrite antiquated allocation models. In fact, recent negotiations have done just that, resulting in California, Nevada and Arizona agreeing to use less water from the Colorado River over the next three years. These states agreed to give up 3,000,000 acre-feet of river water through 2026, about 13% of the amount they receive under the Law of the River. Farmers dependent on water from the Colorado River Basin will see reduced crop yields, but they are expected to be compensated for these losses through the Biden Administration's 2022 Inflation Reduction Act. As there seems to be no reason to entertain a possible reversal of current warming conditions, and all that is related, plausible future scenarios should focus on how quickly the current drought conditions go from bad to worse. As discussed, average temperatures in the Colorado River Basin have risen by roughly 2.7 degrees and as discussed, scientists estimate that for each additional 1.8 degrees Fahrenheit of warming, the river's flow could shrink by about 7% (Bass et al., 2023), which explains current water allocation challenges. Assessing future Colorado River Basin flow deficiencies can then be achieved by tapping previously cited modeling. If temperatures in the western United Stated increase at the rate scientists suggest, between 2023 and the end of the century, the Colorado River Basin could lose another 6-7% of its' flow volume. But another study suggests a much more rapid and severe pace, projecting as much as a 20% loss in Colorado River Basin flow by 2055 (Miller, 2010). It seems that with growing frequency these temperature assessments are being updated with projections of more rapid and steeper advances. A 2023 study by the World Meteorological Organization predicted a 66% likelihood that the annual average global temperature in 2023-2027 would be more than 1.5°C above pre-industrial levels (WMO, 2023).

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CASE STUDY #3. MORAL FOUNDATION THEORY, CULTURE WARS AND CLIMATE CHANGE

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Highlights

- Haidt's MFT premise is supported among Democratic respondents.
- Most MFT phrasing (H/C, F/C, L/O, A/S, L/B, or S/D) had an impact on partisans.
- Self-identified Moderates respond to Loyalty/Oppression phrasing.

3.1 Abstract

This research aims to assess the validity of one of the core tenets of Dr. Jonathan Haidt's Moral Foundation Theory: that modern political liberals construct their moral systems based primarily upon two moral psychological foundations, Harm/Care and Fairness/Cheating. In contrast, political conservatives construct moral systems more evenly upon six psychological foundations, the same as liberals, plus the Loyalty/Betrayal, Authority/Subversion, Liberty/Oppression, and Sanctity/Degradation foundations. Moreover, within the context of a set of public opinion surveys, this research will attempt to determine which of Haidt's six foundations are the most persuasive with Democratic voters, Republican voters, Independent voters, and self-identified ideologically Moderate voters. We fielded seven unique survey questionnaires to answer these questions, using Facebook advertising to drive survey traffic. The language of each survey is unique, with six of the seven questionnaires written to reflect the underlying themes of Haidt's six foundations and the seventh "base" questionnaire written sans persuasive language to act as a baseline reference. This research supports Dr. Jonathan Haidt's main premise, finding that liberals/Democrats showed evidence of morality centric decision-making based primarily on the individualizing foundations of Harm/Care and Fairness/ Reciprocity. In contrast, conservatives/Republicans showed a more even distribution of values, virtues, and concerns,

including the two individualizing foundations and the four binding foundations of Loyalty/Betrayal, Authority/Subversion, Liberty/Oppression, and Sanctity/Degradation.

3.2 Introduction

America's "Culture Wars," i.e., the clash of visions about such fundamental moral issues as the authority of parents, reproductive rights, the definition of marriage, and the proper response to race relations and social inequalities (Bromley-Trujillo, 2023), have defined our politics over the past several decades. Within this context, politics in the U.S. have been dominated by a binary construct pitting the left/liberals against the right/conservatives (Atkins, 2023). In the 2020 presidential election, voters were nearly evenly divided on party affiliation, with 50% identifying or leaning Democratic and 48% identifying or leaning Republican. To add another layer to the mix, "tribalism," defined as one's loyalty or preference to one's people, culture, or beliefs, has hijacked decision-making and voter behavior to the point where people are loyal to their social/political group above all else and will resort to any means, including discrimination, racism, and violence, to advance their agendas (Chua, 2018). How then, given the dynamics described here, can these barriers be overcome to address and reach compromise on, critical issues like climate change? Some believe that underneath these dramatic differences lies a set of shared fundamental characteristics that drive human behavior, including decision-making (Haidt, 2012).

Rooted in the early insights of moral philosophy proposed by Socrates, Plato, Aristotle, and Zeno of Citium's Stoics and later developed by Kant, Hume, Hobbes, and Smith (Whewell, 1867; Maritain, 2005), Jonathan Haidt's Moral Foundation Theory suggests individuals come equipped with what he calls intuitive ethics, which is a strong, fundamental moral belief about right and wrong that we can use to ground judgments that drive decision-making (Haidt, 2012).

Haidt proposes that these values are innate and that we can trace them back to common instincts refined throughout human existence. Haidt lays out six common virtue frameworks that reflect his intuitive ethics. They are the Harm/Care foundation (the instinct to protect others), the Fairness/Cheating foundation (the instinct to punish cheating), the Loyalty/Betrayal foundation (the instinct that ties one to a team), the Authority/Subversive foundation (the instinct to obey), the Purity/Sanctity foundation (the instinct to be disgusted), and the Liberty/Oppression foundation (the instinct to be autonomous and to repel tyranny). Haidt's moral foundation hypothesis then proposes modern political liberals construct their moral systems primarily upon two moral psychological foundations—Harm/Care and Fairness/Reciprocity—whereas political conservatives construct moral systems more evenly upon six psychological foundations—the same ones as liberals, plus Loyalty/Betrayal, Authority/Respect, Purity/Sanctity, and Liberty/Oppression. It is important to note, though, that while Haidt proposes these values are hard-wired within each of us, they are modifiable over time as we each learn local virtues, vices, and moral practices. As such, these foundations can influence human motivation to act on society's vital problems, including climate change (Haidt, 2012).

3.3 Supporting Research

Haidt and colleagues Jesse Graham and Brian Nosek from the University of Virginia have tested the validity of their hypothesis with a series of four studies that a) asked participants to rate how relevant various concerns were to them when making moral judgments, b) retained the abstract moral relevance assessments from Study 1 and added more contextualized and concrete items that could more strongly trigger the sorts of moral intuitions that are said to play an important role in moral judgment, c) endeavored to make moral judgments more personal and visceral than they had been in Studies 1 and 2 and defined sacred values as “any value that a

moral community explicitly or implicitly treats as possessing infinite or transcendental significance that precludes comparisons, trade-offs, or indeed any other mingling with bounded or secular values," (Graham et al., 2009). Participants confronted with choices that involved trading off a sacred value (such as human life) for a profane value (such as money saved by a hospital) showed resistance to the task and feelings of disgust and dirtiness afterward as if it were impure even to contemplate the trade-off.

The final study highlighted how liberals and conservatives use different phrasing and sentiments to create all encompassing "frames" that make policies seem morally good or bad (Graham et al., 2009). The research on conservative political tactics found that the Republican Party's success in recent elections was mainly due to its ability to find words that triggered a values-based response. The basic premise of Haidt's "moral foundations hypothesis" was upheld. All four studies showed that liberals showed evidence of morality-based decision-making based primarily on the individualizing foundations (Harm/Care and Fairness/ Cheating). In contrast, conservatives showed a more even distribution of values, virtues, and concerns, including the two individualizing foundations and the four binding foundations (Loyalty/Betrayal, Authority/Subversion, Liberty/Oppression, and Sanctity/Degradation) (Graham et al., 2009). Moreover, a 2016 study (Dickinson et al., 2016) tested Haidt's moral foundations hypothesis and supported the potential importance of moral foundations as drivers of intentions concerning climate change action. This study suggests that compassion, fairness, and, to a lesser extent, purity are potential moral pathways for personal action on climate change in the USA (Dickinson et al., 2016).

In other research testing his hypothesis, participants in Haidt's Studies #1 and #2 were randomly chosen from an existing database of volunteers. Participants' political self-

identification was reported on a scale anchored by “strongly liberal” and “strongly conservative,” with Moderates at the midpoint and "other" and "do not know/not political.” Like the seven surveys deployed for this research, gender, age, household income, and education level were also assessed, but due to small survey sample populations and larger margins or error associated with subpopulations, analysis of these subsets was limited. In Haidt’s 3rd study, the response options were the liberal-conservative scale from Study 1 plus options for “libertarian,” “other,” and “don’t know/not political.” Finally, in Haidt’s 4th. study, religious sermons were Googled from various Christian denominations (Unitarian Universalist was consistently regarded as the most liberal church, and Southern Baptist the most conservative) with varying degrees of known conservative/liberal leanings. Words the author then deemed reflective of the harm/care, fairness/reciprocity, ingroup/loyalty, authority/respect, and purity/sanctity foundations were farmed from those texts. The list included foundation-supporting words like kindness, equality, patriot, obey, and wholesome and foundation-violating words like hurt, prejudice, betray, disrespect, and disgusting (Dickinson et al., 2016).

We did not duplicate this collection method. Instead, in the seven surveys reflecting foundational elements, we used words, phrases and sentiments harvested from popular liberal and conservative news outlets and podcasts ranging from The Drudge Report, The Epoch Times, National Review, Breitbart, Ben Shapiro, Glenn Beck, and Sean Hannity on the right to The New Yorker, Slate, The New Republic, NPR, The New York Times, CNN, The Colbert Report and The Al Franken Podcast on the left. The Dickenson research relied on Random Digit Dialing (RDD) techniques very similar to those used at my public opinion research firm, Orion Research, where lists of registered voters are drawn from the continental United States. For cost purposes, our effort employed online collection methods. We created a quota profile and weighted

(statistically manipulated) all results to ensure that our final data sets are representative of the U.S. voting population.

The Haidt and Dickenson research might be best refined by abandoning the original binary construct where American politics is defined by right vs. left, conservative vs. liberal, and Democrat vs. Republican. While these labels reflect the dominant ideologies that drive voters into either the Republican/right or Democratic/left blocs, one significant practical fact is omitted. Based on recent voter registration data, among the public overall, 38% are registered Democrats, 36% are Republicans, and 26% are registered as Independent. 5% of all registered voters fall in the “other party” category. It is estimated that 10% of the American voting population are indeed "Independents,” with another 10% having a “soft” affiliation with one of the major parties. In a recent politically oriented polling review where political ideological self-identification questions were asked, roughly 28% of respondents identified as "Moderate” (Fowler et al., 2022). Our research (across seven surveys) found nearly the exact same percentage of voters that self-identified as “moderate.” And while most registered Independents and self-identified "Moderates" are not all that “independent” politically, with 90% leaning toward one party or the other, research has shown that these “free agents” are more susceptible to reason and less prone to the tribal influences currently driving America’s Culture Wars (Doherty et al., 2019). Furthermore, in the 2022 mid-term U.S. House of Representatives elections, seventy-five races were decided by less than 10% of the popular vote. At the state legislative level, hundreds of races, enough to swing the majorities in several state legislative chambers, were decided by less than 10%. This last point highlights the importance of finding messaging that may influence Moderate and Independent voters in the context of political campaigns (Hartig et al., Pew Research Center, 2023).

This unique research focuses on responses from all registered voters: Democrats, Republicans, and Independents, as well as self-proclaimed Moderates. As stated, our survey research uses messaging and language that reflects each of Haidt's six foundations adapted to highlight climate change, plus one neutral set of questions to act as a baseline.

3.4 Methods

Seven distinct surveys were deployed nationally. Each comprised a series of 15 similarly themed climate-related persuasion questions and 5 demographic questions. Each question set is written using unique language and techniques reflecting a) traditional unbiased survey questions and b) questions written from the perspective of each of Haidt's six Moral Foundations Theory. Questions in the H/C survey reflect the Harm/Care foundations and incorporate language promoting instincts to save, care for, or protect something. Questions in the L/O survey reflect the Liberty/Oppression foundations and incorporate language promoting instincts to resist attempts to dominate, threaten, or rule. Questions in the A/S survey reflect the Authority/Subversion foundations and incorporate language promoting instincts to accept social hierarchies, governance ideals, or, conversely, attempts to promote rebellion against the status quo. Questions in the S/D survey reflect the Sanctity/Degradation foundation and incorporate language triggering feelings of disgust by infusing the suggestion that something is tainted, unclean, or toxic. Questions in the F/C survey reflect the Fairness/Cheating foundations and incorporate language promoting instincts of deservedness, collective aspirations, cooperation, and the notion that we are each getting our fair share. Questions in the L/B survey reflect the Loyalty/Betrayal foundation and incorporate language promoting instincts to reward membership and allegiances.

As an "advertiser," I employed Facebook's audience targeting tools to buy and position survey recruitment ads within the Facebook membership population residing randomly across the United States. Each ad is aimed at individuals aged 18 to 75. Facebook presents several options for the campaign's "marketing objective." Following discussions with advertising experts at Facebook, our default approach is to set the campaign objective as "traffic." This translates to encouraging Facebook users to click on the link embedded in the ad, leading them to our online survey. Facebook also provides the alternative to set a campaign objective to increase "awareness" or "conversion." Given that Facebook is a private corporation, it has the authority to modify the display algorithm with minimal prior notice or clear explanations. If such modifications result in varying sample selection based on unobservable factors, samples gathered over time may exhibit unknown biases.

Adhering to Facebook's standardized design, ads must adhere to a general structure. While each ad must link to a Facebook page, feature a headline, ad text, and an image, and can include a link to an external webpage, advertisers have considerable flexibility in creating the ad text, selecting image content, and choosing between a single image, a carousel, a video, a slideshow, or a collection.

Our ad template (Fig. 3.1.) remained simple, using an outline of the U.S. with three "natural resource" related images embedded within the image. All imagery was acquired from licensed stock photography accessible for free on the Facebook advertising platform. All ads then linked respondents to an "Orion Public Opinion Research" Facebook page. The "headline" field in the ad extended an opportunity for users to "Help Us Understand America's Natural Resource Priorities" while inviting respondents to "Click Here America. Take Our Survey."

Figure. 3.1. Facebook advertising used to encourage voters to participate in on-line survey. Source: Orion Research.

Facebook provides multiple options for ad placement. Advertisers can display their ads on Facebook (in the newsfeed on a mobile phone or in the right-hand column on a desktop), on Instagram, or on partner networks. All our campaigns were placed on Facebook's newsfeed and Instagram. Users who engage with the ad are directed to an electronic survey hosted by SurveyMonkey. The survey is accessible on desktop, laptop, and mobile devices. Participants provide their consent and then proceed with the survey.

Survey Structure: Seven distinct surveys were constructed and deployed nationally. Each of the seven distinct questionnaires was comprised of a series of 15 similar climate-related questions, plus five demographic questions to segment responses by political party, ideological leaning, age, gender, income level, and education level. Full responses and crosstabulations can be found in the attached index.

3.5 Sample Size/Margin of Error Per Survey

	Aggregate Sample Size	Republican Sample Size	Democrat Sample Size	Independent Sample Size	Moderate Sample Size
	Margin of Error	Margin of Error	Margin of Error	Margin of Error	Margin of Error
Base:	100	36	38	26	31
	+/- 10%	+/- 16%	+/- 16%	+/- 19%	+/- 18%
Harm/Care	106	38	40	28	34
	+/- 10%	+/- 16%	+/- 15%	+/- 19%	+/- 17%
Fairness/Cheating	100	36	38	26	26
	+/- 10%	+/- 16%	+/- 16%	+/- 19%	+/- 19%
Loyalty/Betrayal	100	36	38	26	31
	+/- 10%	+/- 16%	+/- 16%	+/- 19%	+/- 18%
Authority/Subversion	100	36	38	26	25
	+/- 10%	+/- 16%	+/- 16%	+/- 19%	+/- 20%
Purity/Sanctity	100	36	38	26	32
	+/- 10%	+/- 16%	+/- 16%	+/- 19%	+/- 17%
Liberty/Oppression	100	36	38	26	20
	+/- 10%	+/- 16%	+/- 16%	+/- 19%	+/- 22%

Table 3.1. Sample Size/Margin of Error. Source Orion Research.

3.6 Question Phrasing for Various Foundations

Other than the base questions, where we attempt to be as benign as possible, each survey question attempts to mirror the underlying biases inherent in Haidt's foundations. The following are frameworks followed to write each question as they reflect the underlying focus of Haidt's six foundations.

Harm/Care: This foundation emerged to address the pressing need to safeguard at-risk children, fostering a natural inclination to shield, nurture and shield from harm. Key H/C Phrasing: Safeguard your offspring from harm or ensure their safety. Harness the power of endearing imagery (such as animals or infants). Provoke awareness by hinting at potential threats. Condemn acts of cruelty and neglect (Dickinson et al., 2016; Kidwell et al., 2013; Phelps, 2021).

Fairness/Cheating: This foundation arose in response to the challenge of maintaining the benefits of cooperation while averting exploitation. Key F/C Phrasing: Explore notions of

fairness and entitlement. Cultivate collective goals through reciprocal altruism. Emphasize equitable distribution and fairness in allocation. Sensitize individuals to discern trustworthy cooperative partners. Highlight the merits of individual contributions and the consequences of inequity (Dickinson et al., 2016; Kidwell et al., 2013; Phelps, 2021).

Loyalty/Betrayal: This foundation emerged to address the imperative of forging and preserving alliances. Key L/B Phrasing: Foster cohesive communities to activate this principle. Incentivize membership and loyalty. Cultivate a sense of identity by delineating an 'us' versus 'them.' Provide opportunities for individuals to signal allegiance and advancement. Showcase the benefits of communal bonds and strategies for fostering solidarity (Dickinson et al., 2016; Kidwell et al., 2013; Phelps, 2021).

Authority/Subversion: This foundation developed in response to the need to navigate social hierarchies for mutual benefit. Key A/S Phrasing: Establish and uphold hierarchies. Delegate responsibilities to individuals within the hierarchy. Promote principles of respect and governance. Alternatively, encourage dissent and resistance against oppressive structures. Call out instances of misconduct and abuse of authority (Dickinson et al., 2016; Kidwell et al., 2013; Phelps, 2021).

Purity/Degradation: This foundation originated from the necessity to navigate resource scarcity and environmental hazards. Key P/D Phrasing: Evoke sensations of disgust or cleanliness. Provide access to hygiene and sanitation. Highlight the consequences of pollution and impurity. Offer solutions to mitigate contamination and maintain purity. Address issues related to toxins, sin, and disease (Dickinson et al., 2016; Kidwell et al., 2013; Phelps, 2021).

Liberty/Oppression: This foundation emerged to counteract attempts at domination within small social groups. Key Phrasing: Portray individuals as tyrants and mobilize support

against oppression. Utilize this foundation to protect vulnerable populations from bullies and oppressors. Advocate for egalitarianism and individual autonomy. Champion the principle of non-interference and personal freedom (Dickinson et al., 2016; Kidwell et al., 2013; Phelps, 2021).

3.7 Weighted Results and Analysis

This research defines a moral system as coherent, systematic, and reasonable principles, rules, ideals, and values that form one's perspective and inform decision-making. Haidt proposes that two foundational moral instincts, the Harm/Care instinct to protect individuals from harm and the Fairness/Cheating instinct to punish cheaters and reward those who follow the rules, are the primary virtues that inform liberal decision-making, while all six foundational moral instincts, the original two (Harm/Care + Fairness/Cheating) plus the Loyalty/Betrayal foundation (the instinct that ties one to a team), the Authority/Respect foundation (the instinct to obey authority figures), the Purity/Sanctity foundation (the instinct to be disgusted), and the Liberty/Oppression (the instinct to be autonomous and to repel tyranny), are the primary virtues that inform conservative/Republican decision making. We will also define support or lack of support for Haidt's premise as the degree of public opinion movement of partisan responses – liberal Democrats and conservative Republicans – within the context of the seven fielded surveys, each using questions that are specifically written to reflect one of Haidt's foundations (1. Base, 2. Harm/Care, 3. Fairness/Cheating, 4. Liberty/Oppression, 5. Authority/Subversion, 6. Loyalty/Betrayal, 7. Sanctity/Degradation), away from the dominate response to Base responses.

Table 3.2. Weighted Q5 Response. Source: Orion Research.

Question #5 Significant (+/- 20%) Variations from Base Response – Party. Significant (+/- 20%) Variations from Base Response – Ideology. * Notable Data in Support of Haidt's Premise.	PARTY			IDEOLOGY	
	Democrats	Republicans	Independent	Moderate	
Base: Would you agree, Climate Change and/or Global Warming is currently occurring?	Yes – 93% No – 0% Other – 7%	Yes – 47% No – 44% Other – 9%	Yes – 71% No – 24% Other – 5%	Yes – 85% No – 14% Other – 0%	
Harm/Care: As more and more evidence mounts that climate change will drastically and negatively impact our children's future, do you agree that climate change and global warming is currently occurring?	*Yes – 95% (+2%) No – 3% (+3%) Other – 2% (-5%)	Yes – 65% (+18%) No – 32% (-12%) Other – 3% (-6%)	Yes – 65% (-6%) No – 22% (-2%) Other – 13% (+8%)	Yes – 82% (-3%) No – 7% (-7%) Other – 7% (+7%)	
Fairness/Cheating: It has been said that the current climate crisis is the result of the rich pursuing more wealth, while their actions disproportionately harm the poor. That said, would you agree, Climate Change and/or Global Warming is currently occurring?	*Yes –89% (-4%) No –5% (+5%) Other –6% (-1%)	Yes –53% (+6%) No –38% (-6%) Other –9% (-)	Yes – 86% (+15%) No – 7% (-15%) Other – 6% (+1)	Yes – 94% (+9) No – 3% (-11%) Other – 3% (+3%)	
Loyalty/Betrayal: As more and more Americans support efforts to turn back the impacts of burning fossil fuels, would you agree, Climate Change and/or Global Warming is currently occurring?	Yes – 81% (-12%) No – 7% (+7%) Other – 12% (+5%)	Yes – 37% (-10%) No – 53% (+9%) Other – 10% (+1%)	Yes – 67% (-4%) No – 29% (+5%) Other – 4% (-1%)	Yes – 78% (-7%) No – (14% (0%) Other – 8% (+8%)	
Authority/Subversion: Would you agree, as God is in charge, if Climate Change and/or Global Warming is currently occurring, it is the Lord's doing?	Yes – 10% (-83%) No – 72% (+72%) Other – 18% (+11%)	Yes – 48% (-1%) No – 30% (-14%) Other – 22% (+13%)	Yes – 28% (-43%) No – 44% (+20%) Other –	Yes – 13% (-72%) No – 74% (+60) Other – 10% (+10)	
Purity/Degradation: As humans continue to burn fossil fuels, spewing toxins into the atmosphere, destroying Earth's oceans, killing off vulnerable species	Yes – 88% (-5%) No – 9% (+9%) Other – 3% (-4%)	Yes – 30% (-17%) No – 53% (+9%) Other – 17% (+8%)	Yes – 60% (-11%) No – 25% (-1%) Other – 15% (+10)	Yes – 73% (-12%) No – 8% (-4%) Other – 19% (+19%)	

Table 3.2. Cont.

like polar bears, and causing cancer and illnesses in humans, would you agree, Climate Change and/or Global Warming is currently occurring?						
Liberty/Oppression: Would you agree with the federal government limits on fossil fuel use because they say Climate Change and/or Global Warming is currently occurring?	Yes – 79% (-14%) No – 14% (+14%) Other – 7% (0%)	Yes – 5% (-42%) No – 92% (+52%) Other – 3% (-6%)	Yes – 86% (+15%) No – 7% (-17%) Other – 7% (+2%)		Yes – 40% (-45%) No – 45% (+31%) Other – 7% (+7%)	

Analysis – Party: In the baseline "Base" survey, 93.10% of Democrats (Table 3.2.) responded "yes," they believe climate change/global warming is occurring (Q#5). Democratic responses to the Harm/Care and Fairness/Cheating phrased Q#5 survey questions saw little movement (+2 95% and -4 89% respectively) away from the baseline "Base" Democrat response of 93.10%. Republican response to the Harm/Care and Fairness/Cheating themed survey questions saw movement (+18% and +6% respectively) relative to the affirmative "yes" "Base" response. That movement came primarily from "Base" Republican voters who responded "no." Interestingly, Independent voter "yes" responses to the H/C phrasing dropped a modest -6% from the "Base" responses, while Independent voter "yes" responses to the F/C phrased Q#5 gained +15% to 86%. Among the Liberty/Oppression, Authority/Subversion, Loyalty/Betrayal, and Sanctity/Degradation Q#5 survey responses, the most noteworthy responses were in response to Liberty/Oppression and Authority/Subversion subsets. In response to Liberty/Oppression phrasing, -42% (5%) fewer Republicans believe climate change and global warming were occurring, while +52% (92%) of Republicans said it was not occurring. The Authority/Subversion phrasing of Q#5 substantially impacted Democrats, with -83% (10%) moving off their "Base" responses. Authority/Subversion messaging had one of the most

substantial impacts, with -83% (10%) of Democrats moving away from their original "yes" responses to "Base" phrasing and -72% of Moderates doing the same.

Analysis – Ideology: Moderates responded vigorously to L/O messaging, with -45% (40%) leaving the affirmative ranks, and +31% (45%) moving to the "no" column. Even more ardent though were Moderate responses to Authority/Subversion messaging with -72% (13%) responding "yes" as compared to the base response, and +60% (74%) landing on "no."

Analysis – Haidt's Premise: Democrats response to Harm/Care phrasing added +2% (95%) to 93% baseline "yes" response totals, and the Fairness/Cheating wording to Q5 maintained an 89% response rate.

Question #6. Significant Variations from Base Response – Party. Significant Variations from Base Response – Ideology. * Notable Data in Support of Haidt's Premise.	PARTY			IDEOLOGY	
	Democrats	Republicans	Independent	Moderate	
Base: Of the following options, would you say that Climate Change and/or Global Warming is a) the direct result of human activity, b) the result of naturally occurring trends and cycles or, c) the result of a combination of both human activity and naturally occurring cycles. Please choose a, b, c.	A: 59% B: 3% C: 34% Other: 4%	A: 0% B: 39% C: 47% Other: 14%	A: 24% B: 29% C: 47% Other: 0%	A: 34% B: 11% C: 54% Other: 1%	
Harm/Care: With the fate of species like polar bears, pandas and arctic fox hanging in the balance, not to mention the future of our children, would you say that Climate Change and/or Global Warming is a) the direct result of human activity, b) the result of naturally occurring trends and cycles or, c) the result of a combination of both human activity and naturally occurring cycles.	*A: 38% (-21%) B: 5% (+2%) *C: 57% (+23%) Other: 0%	A: 3% (+3%) B: 35% (-4%) C: 61% (+14%) Other: 1% (-13%)	A: 26% (+2%) B: 39% (+10%) C: 35% (-12%) Other: 0%	A: 3% (-30.5%) B: 18% (+7%) C: 79% (+25%) Other: 0%	

Table 3.3. Weighted Q6 Response. Source: Orion Research

Table 3.3. Cont.

Fairness/Cheating: Despite some people's heroic efforts to reduce their carbon footprint, live a more responsible life and help humanity through the current climate crisis, would you say that Climate Change and/or Global Warming is a) the direct result of human activity, b) the result of naturally occurring trends and cycles or, c) the result of a combination of both human activity and naturally occurring cycles. Please choose a, b, c.	*A: 27% (-32%) B: 2% (-2%) *C: 70% (+36%) Other: 1% (-3%)	A: 9% (+9%) B: 33% (-6%) C: 49% (+2%) Other: 9% (-5%)	A: 14% (-10%) B: 21% (-8%) C: 57% (+10%) Other: 8% (+8%)		A: 4% (-30%) B:6% (-5%) C: 83% (+29%) Other: 7% (+6%)	
Loyalty/Betrayal: 98% of scientists say that our collective actions created the current climate crisis, and that only by working as one America can we avoid further warm. Of the following options, would you say that Climate Change and/or Global Warming is a) the direct result of human activity, b) the result of naturally occurring trends and cycles or, c) the result of a combination of both human activity and naturally occurring cycles. Please choose a, b, or c.	A: 31% (-28%) B: 12% (+9%) C: 54% (+20%) Other: 3% (-1%)	A: 3% (+3%) B: 50% (+11) C: 40% (-7%) Other: 7% (-7%)	A: 22% (-2%) B: 35% (+6%) C: 43% (-4%) Other: 0%		A: 27% (-7%) B: 21% (+10%) C: 52% (-2%) Other: 0%	
Authority/Subversion: If we are to believe that, as our parents taught us, we are responsible for our actions and that, as God teaches us…we reap what we sow, of the following options, would you say that Climate Change and/or Global Warming is a) the direct result of human activity, b) the result of naturally occurring trends and cycles or, c) the result of a combination of both human activity and naturally occurring cycles. Please choose a, b, or c.	A: 38% (-21%) B: 7% (+4%) C: 55% (+20%) Other: 0% (-4%)	A: 5% (+5%) B: 28% (-11%) C: 58% (+9) Other: 0% (-14%)	A: 17% (-7%) B: 17% (-12%) C: 67% (+20%) Other: 0%		A: 27% (-7%) B: 10% (-1%) C: 63% (+9%) Other: 0%	
Purity/Sanctity: As we belch-out toxins into the warming atmosphere and destroy Earth's natural resources, of the following options, would you say that Climate Change and/or Global Warming is a) the direct result of human activity, b) the result of naturally occurring trends and cycles or, c) the result of a	A: 47% (-12%) B: 9% (+6%) C:41% (+7%) Other: 3% (-1%)	A: 8% (+8%) B: 43% (+4%) C: 45% (-2%) Other: 5% (-9%)	A: 20% (-4%) B: 5% (-24%) C: 75% (+28%) Other: 0%		A: 22% (-12%) B: 10% (-1%) C: 67% (+13%) Other: 1% (0%)	

Table 3.3. Cont.

combination of both human activity and naturally occurring cycles. Please choose a, b, c.						
Liberty/Oppression: With authoritarian efforts like a federal government carbon tax, the phase-out of gas powered cars and dramatic regulations on industry design to degrease the use of fossil fuels in mind, of the following options, would you say that Climate Change and/or Global Warming is a) the direct result of human activity, b) the result of naturally occurring trends and cycles or, c) the result of a combination of both human activity and naturally occurring cycles. Please choose a, b, or c.	A: 43% (-16%) B: 4% (+1%) C: 50% (+16%) Other: 4% (0%)	A: 3% (+3%) B: 39% (0%) C: 58% (+11) Other: 0%	A: 18% (-6%) B: 29% (0%) C: 29% (-18%) Other: 24% (+24%) *		A: 19% (-15%) B: 0% (-11%) C: 74% (+20%) Other: 7% (+6%)	

Analysis - Party: Nearly 59% of Democrats (Table 3.3.) believe climate change or global warming was "a direct result of human activity," while 24% of Independents came to the same conclusion. 0% of surveyed "Base" Republicans believe "climate change or global warming is the direct result of human activity," while 47% of "Base" Republicans believe climate change/global warming is the result of a combination of human and natural occurrence. Democrat response to the Harm/Care phrasing of Q#6 saw a -21% drop in the "direct result of human activity" responses from "Base," while roughly +23% more Democrats in the Harm/Care survey believe climate change was "the result of a combination of both human activity and naturally occurring cycles." There was a -32 % Democratic shift away from the "Base" responses that climate change or global warming is a "direct result of human activity," in response to the Fairness/Cheating phrasing, with +36% more Democrats agreeing with the position that climate change was "the result of a combination of both human activity and naturally occurring cycles." +26% of Republican respondents to the H/C phrasing moved from their "Base" positions to the "climate change is the result of a combination of both human activity and naturally occurring

cycles," while only 2% of Republicans made a similar move in response to the Fairness/Cheating phrasing. Again, Independent voter responses to the H/C and F/C phrasing moved in different directions to their "Base" responses, with -12% more H/C respondents supporting the "combination" response and +10% of the F/C supporting the same position. -28% (31%) of Democrats also moved away from their "climate change was the direct result of human activity" position based on Liberty/Betrayal phrasing, and +28% (75%) of Independents moved to the "climate change is the result of a combination of both human activity and naturally occurring cycles," based on Sanctity/Degradation messaging. -21% (38%) of Democrats abandoned their position that "climate change was the direct result of human activity," based on Authority/Subversion messaging. Independents also strongly reacted to the A/S phrasing of Q#6, as +20% (67%) adopted the C-combination position.

Analysis – Ideology: As can be seen in the above Q#6 crosstabulation, 34% of self-identified Moderates selected option a.) that "climate change is the direct result of human activity" option, 11% chose option b.) that "climate change is the result of naturally occurring trends and cycles," and 54% of Moderates chose option c.) that "climate change is the result of a combination of both human activity and naturally occurring cycles." Option c. "climate change is the result of a combination of both human activity and naturally occurring cycles" saw substantial gains in response to both the H/C and F/C phrasing, picking up +25% and +29% over "Base" responses, respectively. Among the Liberty/Oppression, Authority/Subversion, Loyalty/Betrayal, and Sanctity/Degradation Q#6 survey responses, the most noteworthy movement included +20% (74%) more Moderates supporting the position that "climate change is the result of a combination of both human activity and naturally occurring cycles," based on Liberty/Oppression messaging over their "Base" responses. -21% (38%) of Democrats

abandoned their position that "climate change was the direct result of human activity," based on Authority/Subversion messaging. Independents also strongly reacted to the A/S phrasing of Q#6, as +20% (67%) adopted the C-combination position.

Analysis – Haidt's Premise: Of note, the responses offered to respondents here gave three possible options. Option A, we would argue, falls in line with more liberal thinking, while Option B, might be more aligned with more conservative thinking. Option C, the compromise answer, was intended to be an option for those with less ardent positions. As such, we content, Democrat movement away from A toward C supports Haidt's premise. The Harm/Care messaging saw a -21% drop in A response and a +23% pick-up for C, while the Fairness/Cheating phrasing produced a -32% drop in A response and a +36 gain for C.

Table 3.4. Weighted Q7 Response. Source: Orion Research.

Question #7: Significant Variations from Base Response – Party. Significant Variations from Base Response – Ideology. * Notable Data in Support of Haidt's Premise.	PARTY			IDEOLOGY	
	Democrats	Republicans	Independent		Moderate
Base: Scientists suggest that catastrophic events, like stronger hurricanes and monsoons, rising temperatures, wild-fires, floods, crop failures, water shortages from drought, sea level rise from melting polar ice caps and species extinction are occurring as a direct result of climate change & global warming. Would you agree or disagree?	A/SA – 79% D/SD – 0% None – 17%	A/SA – 22% D/SD – 50% None – 25%	A/SA – 47% D/SD – 41% None – 12%		A/SA – 67% D/SD – 20% None – 13%
Harm/Care: Scientists suggest that harmful events, like stronger hurricanes and monsoons, rising temperatures, wild-fires, floods, crop failures, water shortages from drought, sea level rise from melting polar ice caps and the extinction of species like the bumble bee, panda bears and monarch butterflies are occurring as a direct result of climate change & global warming. Would you agree or disagree?	*A/SA – 92% (+13%) D/SD – 0% (0%) None – 8% (-9%)	A/SA – 39% (+17%) D/SD – 35% (-15%) None – 26% (+1%)	A/SA – 26% (-21%) D/SD – 39% (-2%) None – 35% (+23%)		A/SA – 64% (-3%) D/SD – 14% (-6%) None – 18% (+5%)
Fairness/Cheating: As Americans struggle to find common ground and remember that we are stronger together, scientists suggest that climate change/global warming related	*A/SA – 84% (+5%) D/SD – 3% (+3%) None – 14% (-3%)	A/SA – 27% (+5%) D/SD – 40% (-10%) None – 31% (+6%)	A/SA – 71% (+24%) D/SD – 21% (-20%) None – 7% (-5%)		A/SA – 69% (+2%) D/SD – 3% (-17%) None – 28% (+15%)

Table 3.4. Cont.

events, like stronger hurricanes and monsoons, rising temperatures, wild-fires, floods, crop failures, water shortages from drought, sea level rise from melting polar ice caps and species extinction are increasingly putting the quality of life we have all worked so hard for in jeopardy. Would you agree or disagree?						
Loyalty/Betrayal: Scientists suggest that catastrophic events, like stronger hurricanes and monsoons, rising temperatures, wild-fires, floods, crop failures, water shortages from drought, sea level rise from melting polar ice caps and species extinction are occurring as a direct result of climate change & global warming that threatens every community regardless of race, wealth, ideology, or education level. Would you agree or disagree?	A/SA – 81% (+2%) D/SD – 4% (+4%) None – 15% (-2%)	A/SA – 13% (-9%) D/SD – 74% (+24%) None – 13% (-12%)	A/SA – 43% (-4%) D/SD – 26% (-15%) None – 30% (+18%)		A/SA – 66% (-1%) D/SD – 12% (-8%) None – 22% (+9%)	
Authority/Subversion: Respected government scientists from organizations like the National Oceanic and Atmospheric Administration and NASA suggest that catastrophic events directly tied to the burning of fossil fuels, like stronger hurricanes and monsoons, rising temperatures, wild-fires, floods, crop failures, water shortages from drought, sea level rise from melting polar ice caps and species	A/SA – 86% (+7%) D/SD – 10% (+10%) None – 3% (-14%)	A/SA – 18% (-4%) D/SD – 45% (-5%) None – 36% (+11%)	A/SA – 55% (+8%) D/SD – 28% (-13%) None – 17% (+5%)		A/SA – 74% (+9%) D/SD – 10% (-10%) None – 17% (+4%)	

Table 3.4. Cont.

extinction are occurring as a direct result of climate change & global warming. Would you agree or disagree?					
Purity/Sanctity: Religious leaders suggest that global warming and climate change are triggering events like stronger hurricanes and monsoons, rising temperatures, wild-fires, floods, crop failures, water shortages from drought, sea level rise from melting polar ice caps and species extinction which are occurring as a direct result of man's sloth, sinfulness, and the burning of fossil fuels. Would you agree or disagree?	A/SA – 62% (-17%) D/SD – 17% (+17%) None – 20% (+3%)	A/SA – 18% (-4%) D/SD – 58% (+8%) None – 23% (-2%)	A/SA – 40% (-7%) D/SD – 20% (-21%) None – 40% (+28%)		A/SA – 51% (-16%) D/SD – 7% (-13%) None – 40% (+27%)
Liberty/Oppression: Government scientists are forcing on Americans the position that catastrophic events, like stronger hurricanes and monsoons, rising temperatures, wild-fires, floods, crop failures, water shortages from drought, sea level rise from melting polar ice caps and species extinction are occurring as a direct result of climate change & global warming. As a free-thinking American, do you agree or disagree?	A/SA – 81% (+2%) D/SD – 4% (+4%) None – 15% (-2%)	A/SA – 13% (9%) D/SD – 74% (+24%) None – 13% (-12%)	A/SA – 17% (-30%) D/SD – 47% (+6%) None – 29% (+17%)		A/SA – 61% (-6%) D/SD – 0% (-20%) None – 28% (+15%)

Analysis - Party: A combined 79% of baseline "Base" Democrats agreed/strongly agreed that "catastrophic events, like stronger hurricanes and monsoons, rising temperatures, wild-fires, floods, crop failures, water shortages from drought, sea level rise from melting polar ice caps and species extinction are occurring as a direct result of climate change and global warming," (Table

3.4.) with roughly 17% in the "neither agree or disagree" column and 0% "disagreeing/strongly disagreeing." Both Republicans and Democrats responded positively to the Harm/Care messaging with +13% and +17% of both partisan groups subscribing to the "agree/strongly agree" position over "Base" responses, respectively. Liberals and conservatives each added +5% to their "Base" tallies in response to the Fairness/Cheating messaging. As has been the case with both Q#5 and Q#6, Independent voter responses to H/C and F/C Q#7 phrasing were split, with a -21% drop from "Base" Q#7 H/C "agree/strongly agree" responses, and +24% gain in Independent "agree/strongly agree" responses to the Fairness/Cheating phrasing.

Analysis – Ideology: There was modest change from the "Base" Moderate responses (67% agree/strongly agree, 20% disagree/strongly disagree, 13% neither agree or disagree/none of the above) to the H/C phrasing responses (64%, 14%, 18%, respectively), with more robust movement from the "Base" Moderate responses to the F/C Moderate responses of +2% agree/strongly agree, -17% disagree/strongly disagree, and +15% of self-identified Moderate voters migrating to the “neither agree or disagree” camp. Among the Liberty/Oppression, Authority/Subversion, Loyalty/Betrayal, and Sanctity/Degradation Q#7 survey responses, only Moderates (-20% “disagree/strongly disagree” L/O & +27% “neither” S/D), Republicans (+24%) L/B, had sizable movements off their “Base” positions.

Analysis – Haidt’s Premise: Democrats response to Harm/Care phrasing added +13% (92%) to 79% baseline “agree/strongly agree” response totals, and the Fairness/Cheating wording to Q7 added +5% (84%) to an already strong 79% “agree/strongly agree” baseline response.

Table 3.5. Weighted Q8 Response. Source: Orion Research.

Question #8: Significant Variations from Base Response – Party. Significant Variations from Base Response – Ideology. * Notable Data in Support of Haidt's Premise.	PARTY			IDEOLOGY	
	Democrats	Republicans	Independent	Moderate	
Base: Would you support or oppose the US government subsidizing efforts to transition our economic and residential energy use away from fossil fuels and toward 100% renewable energy options like solar, wind, nuclear, and geothermal?	Support – 83% Oppose – 7% Neither – 7%	Support – 17% Oppose – 72% Neither – 8%	Support – 53% Oppose – 35% Neither – 6%	Support – 61% Oppose – 30% Neither – 9%	
Harm/Care: In order to protect our children, the vulnerable from the catastrophic impacts of climate change and global warming, would you support or oppose the US government subsidizing efforts to transition our economic and residential energy use away from fossil fuels and toward 100% renewable energy options like solar, wind, nuclear and geothermal?	*Support – 89% (+6) Oppose – 5% (-2%) Neither – 3% (-4%)	Support – 16% (-1%) Oppose – 61% (-11) Neither – 23% (+15%)	Support – 43% (-10%) Oppose – 48% (+13%) Neither – 9% (+3%)	Support – 43% (-18%) Oppose – 36% (+6%) Neither – 18% (+9%)	
Fairness/Cheating: If you were convinced that a country using 100% renewable energy could create an equitable distribution of wealth based on the amount of work one was willing to contribute, and good-paying jobs that would provide our families with a secure future, while reversing the catastrophic effects of global warming, would you support or oppose the US	Support – 78% (-5%) Oppose – 8% (+1%) Neither – 5% (-2%)	Support – 53% (+36%) Oppose – 25% (-47%) Neither – 13% (+5%)	Support – 57% (+4%) Oppose – 14% (-21%) Neither – 14% (+8%)	Support – 72% (-+11%) Oppose – 10% (-20%) Neither – 17% (+8%)	

Table 3.5. Cont.

government subsidizing efforts to transition our economic and residential energy use away from fossil fuels and toward 100% renewable energy options like solar, wind, nuclear, and geothermal?						
Loyalty/Betrayal: Would you support or oppose efforts to rally support within your specific community, club, or organization around the US government subsidizing efforts to transition our economic and residential energy use away from fossil fuels and toward 100% renewable energy options like solar, wind, nuclear, and geothermal?	Support – 81% (-2%) Oppose – 12% (+5%) Neither – 8% (+1%)	Support – 13% (-4%) Oppose – 74% (+2%) Neither – 13% (+5%)	Support – 48% (-5%) Oppose – 39% (+4%) Neither – 13% (+7%)		Support – 62% (+1%) Oppose – 30% (0%) Neither – 8% (-1%)	
Authority/Subversion: Would you support or oppose the US government mandating efforts to transition our economic and residential energy use away from fossil fuels and toward 100% renewable energy options like solar, wind, nuclear, and geothermal?	Support – 69% (-14%) Oppose – 17% (+10%) Neither – 3% (-4%)	Support – 18% (+1%) Oppose – 70% (-2%) Neither – 10% (+2%)	Support – 44% (-9%) Oppose – 39% (+4%) Neither – 11% (+5%)		Support – 54% (-13%) Oppose – 17% (-13%) Neither – 15% (+6%)	
Purity/Sanctity: In order to reduce the release of the toxins produced from humans burning fossil fuels, would you support or oppose the US government subsidizing efforts to transition our economic and residential energy use away from fossil fuels and toward less destructive renewable energy options like solar, wind, nuclear, and geothermal?	Support – 82% (-1%) Oppose – 15% (+8%) Neither – 3% (-4%)	Support – 25% (+8%) Oppose – 62% (-10%) Neither – 13% (+5%)	Support – 60% (+7%) Oppose – 15% (-20%) Neither – 25% (+19%)		Support – 67% (+6%) Oppose – 16% (-14%) Neither – 17% (+8%)	

Table 3.5. Cont.

Liberty/Oppression: Would you support or oppose a US government effort to put natural gas, oil, and coal companies out of business by subsidizing efforts to transition our economic and residential energy use away from fossil fuels and toward 100% renewable energy options like solar, wind, nuclear, and geothermal?	Support – 68% (-15%) Oppose – 11% (+4%) Neither – 14% (+7%)	Support – 0% (-17%) Oppose – 97% (+25%) Neither – 3% (-5%)	Support – 71% (+18%) Oppose – 24% (-11) Neither – 0% (-6%)		Support – 43% (-18%) Oppose – 36% (+6%) Neither – 14% (+5%)

Analysis - Party: 83% of baseline "Base" Democrat respondents support (Table 3.5.) U.S. government subsidizing efforts to transition our economic and residential energy use away from fossil fuels and toward 100% renewable energy options, with only 7% of Democrats opposing and 7% neutral. Only 17% of Republicans supported the same policy, with 72% opposing, while 53% of Independent voters supported U.S. government subsidies, and 35% opposed. Democrat response to the Harm/Care phrasing of Q#8 resulted in a modest +6 (89%) gain among those supporting subsidies, while -11% (61%) fewer Republican voters opposed subsidies based on H/C phrasing. Within the Independent voter subset -10% (43%) supported subsidies based on H/C phrasing, while +13% (48%) Independent voters opposed. Democratic support for government subsidies dropped -5 (78%) from the "Base" set based on the Fairness/Cheating phrasing, while Republican support soared +36% (53%) and opposition dropped -47% from 72% to 25%, also based on F/C messaging. Among the Liberty/Oppression, Authority/Subversion, Loyalty/Betrayal, and Sanctity/Degradation Q#8 survey responses, the most noteworthy responses came from Republicans (+25% "Oppose") based on Liberty/Oppression language, and a -20% (15%) drop in those Independents who "oppose" based on Sanctity/Degradation phrasing.

Analysis – Ideology: In our baseline survey, 61% of self-identified Moderates supported subsidies, 30% opposed, and 9% were neutral. There was an -18% drop (43%) in support for subsidies among Moderates based on H/C phrasing and an +11% gain in support for subsidies among Moderates in response to the Q#8 F/C messaging.

Analysis – Haidt's Premise: Democrats response to Q#8 Harm/Care phrasing added +6% (89%) to the baseline 83% "support" response.

Table 3.6. Weighted Q9 Response. Source: Orion Research

Question #9: Significant Variations from Base Response – Party. Significant Variations from Base Response – Ideology. * Notable Data in Support of Haidt's Premise.	PARTY			IDEOLOGY	
	Democrats	Republicans	Independent	Moderate	
Base: Some scientists believe we can remove carbon dioxide from the atmosphere and/or from combustion engine exhaust streams and that we can then store that carbon dioxide in underground facilities for hundreds of years. Would you agree to having one of these facilities in your community.	Yes – 38% No – 34% Neither – 10%	Yes – 14% No – 75% Neither – 6%	Yes – 29% No – 47% Neither – 29%	Yes – 31% No – 55% Neither – 10%	
Harm/Care: Some scientists believe if left unchecked, fossil fuel emission and global warming will devastate vulnerable species and harm human life. They also believe we can better protect our families and planet from climate change by removing carbon dioxide from the atmosphere and/or from combustion engine exhaust streams storing the captured carbon dioxide in underground facilities for hundreds of years. Would you agree to having one of these facilities in your community if you were convinced it might lead to a safer future for our children?	*Yes – 76% (+38%) No – 11% (-23%) Neither – 5% (-5%)	Yes – 42% (+28%) No – 45% (-30%) Neither – 6% (0%)	Yes – 30% (+1%) No – 48% (+1%) Neither – 22% (-7%)	Yes – 58% (+27%) No – 25% (-30%) Neither – 14% (+4%)	
Fairness/Cheating: Some scientists believe we can remove carbon dioxide from the atmosphere and/or from combustion engine exhaust streams and that we can then store	Yes – 32% (-6%) No – 41% (+7%) Neither – 11% (+1%)	Yes – 18% (+4%) No – 60% (+15%) Neither – 16% (+10%)	Yes – 36% (+7%) No – 36% (-11%) Neither – 7% (-22%)	Yes – 32% (+1%) No – 50% (-5%) Neither – 11% (+1%)	

Table 3.6. Cont.

that carbon dioxide in underground facilities for hundreds of years. As we are all impacted by climate change and global warming, would you agree to having one of these facilities in your community.						
Loyalty/Betrayal: Many Americans believe there's nothing humans can do about climate change, still others agree with scientists who say we can remove carbon dioxide from the atmosphere and/or from combustion engine exhaust streams and that we can then store that carbon dioxide in underground facilities for hundreds of years. Would you agree to having one of these facilities in your community even if it meant convincing members of your community who prescribed to a NIMBY (Not In My Back Yard) philosophy.	Yes – 56% (+18%) No – 28% (-8%) Neither – 16% (+6%)	Yes – 27% (+13%) No – 57% (-18%) Neither – 16% (+10%)	Yes – 42% (+13%) No – 58% (+11%) Neither – 0% (-29%)		Yes – 59% (+28%) No – 38% (-17%) Neither – 3% (-7%)	
Authority/Subversion: Some scientists believe we can remove carbon dioxide from the atmosphere and/or from combustion engine exhaust streams and that we can then store that carbon dioxide in underground facilities for hundreds of years. If the federal government decided that each US state should build dozens of these facilities, would you agree to having one of these facilities in your community.	Yes – 41% (+3%) No – 24% (-10%) Neither – 10% (0%)	Yes – 18% (+4%) No – 65% (-10%) Neither – 18% (+12%)	Yes – 39% (+18%) No – 28% (-9%) Neither – 22% (-7%)		Yes – 37% (+6%) No – 37% (-18%) Neither – 10% (0%)	
Purity/Sanctity: Some scientists believe we can dramatically reduce impurities from the atmosphere and create a cleaner climate by removing carbon dioxide from the atmosphere and/or from	Yes – 62% (+24%) No – 26% (-8%) Neither – 6% (-4%)	Yes – 28% (+14%) No – 65% (-10%) Neither – 8% (+2%)	Yes – 50% (+21%) No – 35% (-12%) Neither – 10% (-19%)		Yes – 47% (+16%) No – 38% (-17%) Neither – 10% (0%)	

Table 3.6. Cont.

combustion engine exhaust streams with "carbon capture" technology and that we can then store that carbon dioxide in underground facilities for hundreds of years. Would you agree to helping reverse the immoral practices that have put our planet in peril by having one of these facilities in your community?						
Liberty/Oppression: Some government officials believe we should fund programs designed to remove carbon dioxide directly from the atmosphere and/or from combustion engine exhaust streams and then store the captured carbon dioxide in mandated underground facilities located in every state across America. Would you agree to having one of these facilities in your community.	Yes – 50% (+12%) No – 29% (-5%) Neither – 14% (+4%)	Yes – 16% (-2%) No – 68% (-7%) Neither – 16% (+10%)	Yes – 29% (0%) No – 47% (0%) Neither – 12% (-17%)		Yes – 48% (+17%) No – 38% (-17%) Neither – 3% (-7%)	

Analysis - Party: 38% of Democrats said "Yes," they would agree to have a carbon capture storage facility placed in their community (Table 3.6.), while just 14% of Republican voters and 29% of Independent voters answered similarly. 75% of Republicans said "No." Interestingly, when H/C foundation phrasing was used, +38% (76%) of Democrats and +28% (42%) of Republicans switched their position to the affirmative. Also of note, -22% (7%) of Independent voters moved away from the "Base" "none of the above" response column to either "Yes" or "No" in response to the Fairness/Cheating phrasing. Among the Liberty/Oppression, Authority/Subversion, Loyalty/Betrayal, and Sanctity/Degradation Q#9 survey responses, -29% (0%) of Independents moved away from their "Base" "none of the above" position based on Liberty/Oppression phrasing to Q#9, +21% (50%) of Independents responded "yes" to Q#9 S/D

messaging. +24% (62%) of Democrats moved into the "yes" column based on the Sanctity/Degradation messaging.

Analysis – Ideology: +27% (58%) of self-identified Moderates switched their response to "Yes" after hearing Q#9 from the H/C perspective. Moderates were generally unmoved by F/C phrasing. On the other hand, +28% of Moderates (59%) responded ‘yes” to the Loyalty/Betrayal messaging.

Analysis – Haidt’s Premise: Democrats response to Q#9 Harm/Care phrasing added +38% (76%) to the baseline 38% “yes” response.

Table 3.7. Weighted Q11 Response. Source: Orion Research.

Question #11: Significant Variations from Base Response – Party. Significant Variations from Base Response – Ideology. * Notable Data in Support of Haidt's Premise.	PARTY			IDEOLOGY	
	Democrats	Republicans	Independent	Moderate	
Base: Do you agree that because industrialized countries, like the US, China, Russia, Britain, and Germany, have contributed the most carbon dioxide to the atmosphere over the past 100 years, that those countries should pay a greater share than other countries toward the cost of transitioning from a carbon dioxide-based economy and society to a 100% renewable world?	A/SA – 76% D/SD – 3% Neither – 14%	A/SA – 19% D/SD – 42% Neither – 39%	A/SA – 59% D/SD – 17% Neither – 24%	A/SA – 74% D/SD – 6% Neither – 16%	
Harm/Care: Do you agree that because industrialized countries, like the US, China, Russia, Britain and Germany, have contributed the most carbon CO2 to the atmosphere over the past 100 years, that those countries have a greater responsibility to reverse the harmful impacts of fossil fuel emissions and protect our children's futures and should therefore should pay a greater share than other countries toward the cost of transitioning from a CO2-based economy and society to a 100% renewable world.	*A/SA – 95% (+19%) D/SD – 3% (0%) Neither – 2% (-12%)	A/SA – 32% (+13%) D/SD – 42% (0%) Neither – 22% (-17%)	A/SA – 39% (-28%) D/SD – 35% (+18%) Neither – 22% (+2%)	A/SA – 47% (-27%) D/SD – 25% (+19%) Neither – 28% (+8%)	
Fairness/Cheating: Some experts contend that humans are inextricably linked regardless of which country they live. These experts say that many of the problems	*A/SA – 84% (+8%) D/SD – 8% (+5%) Neither – 8% (-6%)	A/SA – 31% (+12%) D/SD – 42% (0%) Neither – 27% (-12%)	A/SA – 43% (-16%) D/SD – 7% (-10%) Neither – 29% (+5%)	A/SA – 62% (-12%) D/SD – 3% (-3%) Neither – 20% (+4%)	

Table 3.7. Cont.

facing humanity, like hunger, injustice and climate change require collective action. As such, do you agree that because industrialized countries, like the United States, China, Russia, Britain, and Germany, have contributed the most CO2 to the atmosphere, that those countries should pay a greater share than other countries toward the cost of transitioning from a carbon dioxide-based economy and society to a 100% renewable world.						
Loyalty/Betrayal: Do you agree that because industrialized countries, like the United States, Britain, France, and Germany, have contributed the most CO2 to the atmosphere over the past 100 years, that those countries should pay a greater share than other countries toward the cost of transitioning from a carbon dioxide-based economy and society to a 100% renewable world. Or do you believe the United Stated and its' allies should stick together as other countries like Russia and China press the US to pay a larger share.	A/SA – 38% (-38%) D/SD – 11+ (+8%) Neither – 50% (+36%)	A/SA – 13% (-6%) D/SD – 67% (+25%) Neither – 20% (-19%)	A/SA – 17% (-42%) D/SD – 54% (+37%) Neither – 29% (+5%)		A/SA – 25% (-49%) D/SD – 39% (+33%) Neither – 36% (+20%)	
Authority/Subversion: As nations and leaders from across the globe gather to assess who is most responsible for Global Warming, many respected leaders and scientists strongly suggest the blame lies with more advanced countries. Do you agree that because industrialized countries, like the	A/SA – 62% (-14%) D/SD – 14% (+11) Neither – 24% (+10)	A/SA – 25% (+6%) D/SD – 40% (-2%) Neither – 33% (-6%)	A/SA – 50% (-9%) D/SD – 11% (-6%) Neither – 39% (+15%)		A/SA – 63% (-11%) D/SD – 9% (+3%) Neither – 28% (+12%)	

Table 3.7. Cont.

United States, China, Russia, Britain, and Germany, have contributed the most C02 to the atmosphere over the past 100 years, that those countries should pay a greater share than other countries toward the cost of transitioning from a carbon dioxide-based economy and society to a 100% renewable world.						
Purity/Sanctity: Do you agree that because industrialized countries, like the United States, China, Russia, Britain, and Germany, have recklessly discharged climate warming toxins like carbon dioxide to the atmosphere, that those countries should pay a greater share of the cost to correct their immoral practices than other countries as we transition away from a fossil fuel-based economy and society to a 100% renewable world.	A/SA – 62% (-14%) D/SD – 12% (+9%) Neither – 27% (+13%)	A/SA – 32% (+13%) D/SD – 58% (+16%) Neither – 10% (-29%)	A/SA – 55% (-4%) D/SD – 10 (-7%) Neither – 35% (+11%)		A/SA – 62% (-12%) D/SD – 3% (+3%) Neither – 36% (+20%)	
Liberty/Oppression: . Do you agree that because economically powerful countries, like the United States, China, Russia, Britain, and Germany, have inflicted the most climate related damage to the atmosphere over the past 100 years, that those countries should pay a greater share than smaller less developed countries toward the cost of transitioning from a carbon dioxide-based economy and society to a 100% renewable world.	A/SA – 86% (+10%) D/SD – 7% (-4%) Neither – 7% (-7%)	A/SA – 26% (+7%) D/SD – 26% (-16%) Neither – 47% (+8%)	A/SA – 23% (-36%) D/SD – 29% (+12%) Neither – (41% (+17%)		A/SA – 47% (-27%) D/SD – 14% (+8%) Neither – 38% (+22%)	

Analysis - Party: 76% of Democratic voters (Table 3.7.) either agreed or strongly agreed that the industrialized nations mentioned, those nations that may have contributed disproportionately to higher atmospheric carbon levels, should contribute more to the transition away from carbon-based fuels and toward renewables, while 19% of Republicans and 59% of Independents also either agreed or strongly agreed. After hearing the question using Harm/Care messaging, +19% (95%) of Democrats and +13% (32%) of Republican voters agreed or strongly agreed that industrialized nations should contribute more to funding a transition to renewables than less industrialized nations. Conversely, -20% (39%) of Independent voters answered "agree/strongly agree" in response to H/C phrasing. Moreover, while Democrats and Republicans (+8%/84% & +12%/31%) also responded more positively to a Fairness/Cheating phrased Q#11, and Independent responded more negatively (-16%/43%), they did so less fervently than to the H/C phrased Q#11. Among the Liberty/Oppression, Authority/Subversion, Loyalty/Betrayal, and Sanctity/Degradation Q#11 survey responses, the most noteworthy responses came from the Liberty/Oppression messaging with all subsets (Democrats -38% (38%) agree/strongly agree, +25% (67%) of Republicans, disagree/strongly disagree, and -42% (17%) of Independents moving off their original "Base" positions, based on Liberty/Betrayal phrasing of Q#11. Additionally, -36% (23%) of Independents abandoned their "agree/strongly agree" stance to Q#11 based on Liberty/Oppression phrasing, while -29% (10%) of Republicans opted out of their original "neither" stance, based on Sanctity/Degradation messaging.

Analysis – Ideology: 74% of self-identified Moderates also either agreed or strongly agreed with the baseline messaging to Question #1, while -27% (47%) of Moderate voters answered "agree/strongly agree" in response to the Harm/Care phrasing. Three other sets of survey questions had impacts on Moderate voters. Loyalty/Betrayal messaging resulted in a -

49% (25%) move off the agree/strongly agree Base response, and a +33% pick-up for the disagree/strongly disagree response. +20% moved into the "neither column in response to L/B messaging. In response to Purity/Degradation messaging, +20% (36%) of Moderate voters moved to "neither," while the Liberty/Oppression version of Question #11 saw a -27% loss (47%) in agree/strongly agree sentiment and a +22 gain in "neither" responses from Moderates.

Analysis – Haidt's Premise: Democrats response to Q#11 Harm/Care phrasing added +19% (95%) to the baseline 76% "agree/strongly agree" response, while the Fairness/Cheating phrasing to Q#11 added +8% (84%).

Question #13: Significant Variations from Base Response – Party. Significant Variations from Base Response – Ideology. * Notable Data in Support of Haidt's Premise.	PARTY			IDEOLOGY	
	Democrats	Republicans	Independent	Moderate	
Base: How concerned are you about the increase in frequency of climate change related natural disasters like forest fires, drought, soaring temperatures, hurricanes, floods, and sea level rise?	C/VC – 90% U/VU – 3% Neither – 4%	C/VC – 31% U/VU – 47% Neither – 11%	C/VC – 65% U/VU – 35% Neither – 0%	C/VC – 76% U/VU – 16% Neither – 0%	
Harm/Care: When you think about the safety and well-being of our children and vulnerable species like the snow leopard, monarch butterflies and sea turtles, how concerned are you about the increase in frequency of climate change related natural disasters like forest fires, drought, soaring temperatures, hurricanes, floods, and sea level rise?	*C/VC – 97% (+7%) U/VU – 3% (0%) Neither – 0% (-4%)	C/VC – 55% (+24%) U/VU – 35% (-12%) Neither – 6% (-5%)	C/VC – 56% (-9%) U/VU – 30% (-5%) Neither – 4% (+4%)	C/VC – 75% (-1%) U/VU – 21% (+5%) Neither – 0% (0%)	

Table 3.8. Weighted Q13 Response. Source: Orion Research.

Table 3.8. Cont.

Fairness/Cheating: When you think about the fact that climate change disproportionately impacts the poor, marginalized and disenfranchised peoples, how concerned are you about the increase in frequency of climate change related natural disasters like forest fires, drought, soaring temperatures, hurricanes, floods, and sea level rise?	C/VC – 89% (-1%) U/VU – 0% (-3%) Neither – 3% (-1%)	C/VC – 51% (+20%) U/VU – 31% (-16%) Neither – 16% (+5%)	C/VC – 71% (+6%) U/VU – 14% (-21%) Neither – 0% (0%)		C/VC – 83% (+13%) U/VU – 3% (-13%) Neither – 6% (+6%)	
Loyalty/Betrayal: When you consider your desire to keep your community safe and protect those who share your values, how concerned are you about the increase in frequency of climate change related natural disasters like forest fires, drought, soaring temperatures, hurricanes, floods, and sea level rise, as well as the thousands of migrants forced to leave their homes due to these catastrophes?	C/VC – 96% (+6%) U/VU – 0% (-3%) Neither – 4% (0%)	C/VC – 42% (+11%) U/VU – 45% (-2%) Neither – 13% (+2%)	C/VC – 54% (-11%) U/VU – 45% (+10%) Neither – 0% (0%)		C/VC – 79% (+3%) U/VU – 21% (+5%) Neither – 0% (0%)	
Authority/Subversion: As many scientists and federal government officials have left little doubt that our burning of fossil fuels has led to rapid climate change and global warming, how concerned are you about the increase in frequency of climate change related natural disasters like forest fires, drought, soaring temperatures, hurricanes, floods, and sea level rise?	C/VC – 86%% (-4%) U/VU – 7% (+4%) Neither – 0% (-4%)	C/VC – 38% (+7%) U/VU – 43% (-4%) Neither – 13% (+2%)	C/VC – 50% (-15%) U/VU – 22% (-13%) Neither – 28% (+28%)		C/VC – 77% (+1%) U/VU – 23% (+7%) Neither – 0% (0%)	
Purity/Sanctity: As we absorb the constant news about worsening natural disasters and the unabated release of planet warming toxins into our atmosphere,	C/VC – 82% (-8%) U/VU – 17% (+14%) Neither – 0% (-4%)	C/VC – 61% (+30%) U/VU – 28% (-9%) Neither – 8% (-3%)	C/VC – 70% (+5%) U/VU – 15% (-20%) Neither – 1-% (+10%)		C/VC – 73% (-3%) U/VU – 10% (-6%) Neither – 7% (+7%)	

Table 3.8. Cont.

how concerned are you about the increase in frequency of climate change related natural disasters like forest fires, drought, soaring temperatures, hurricanes, floods, and sea level rise?						
Liberty/Oppression: When you consider the federal government's attempts to impose draconian regulations on the fossil fuel industry, how concerned are you about the increase in frequency of climate change related natural disasters like forest fires, drought, soaring temperatures, hurricanes, floods, and sea level rise?	C/VC – 86% (-4%) U/VU – 11% (+7%) Neither – 0% (-4%)	C/VC – 37% (+6%) U/VU – 50% (-3%) Neither – 5 (-6%)	C/VC – 35% (-30%) U/VU – 41% (+6%) Neither – 12% (+12%)		C/VC – 88% (+13%) U/VU – 7% (-9%) Neither – 0% (0%)	

Analysis - Party: In Q#13 of the "Base" survey, 90% of Democrats, 31% of Republicans, 65% of Independents, and 76% of Moderates (Table 3.8.) were either concerned or very concerned about the increase in the frequency of climate change-related natural disasters like forest fires, drought, soaring temperatures, hurricanes, floods, and sea level rise. +7% (97%) and +24% (55%) more Democrats and Republicans, respectively, were either concerned or very concerned about the increase in frequency of climate change related natural disasters based on the Harm/Care phrasing vs. the more neutral "Base" phrasing. Again, conversely, both Independent and Moderate (-9%/56% and -1%/75%) respondents were less moved by H/C phrasing. As compared to "Base" messaging, nearly all voters (Democrats -1, Republicans +20, Independents +6, and Moderates +13), regardless of party affiliation or ideology, became more concerned about the increase in frequency of climate change related natural disasters after hearing Q#13 written from the Fairness/Cheating perspective. Among the Liberty/Oppression, Authority/Subversion, Loyalty/Betrayal, and Sanctity/Degradation Q#13 survey responses,

Independent voters experienced the most movement away from their "Base" positions with a -30% (35%) drop in concerned/very concerned responses based on Liberty/Oppression language, a +28% (28%) pick up to the "none of the above" position based on Authority/Subversion messaging, and a -20% (15%) drop in unconcerned/very unconcerned responses based on Sanctity/Degradation messaging. Only Republicans had a comparable move, with +30% (61%) more saying they were either concerned or very concerned based on Sanctity/Degradation messaging to Q#13.

Analysis – Ideology: There were no significant variations from the base responses among Moderate voters.

Analysis – Haidt's Premise: Democrats' response to Q#13 Harm/Care phrasing added +7% (97%) to the baseline 90% "concerned/very concerned" response.

Question #14: Significant Variations from Base Response – Party. Significant Variations from Base Response – Ideology. * Notable Data in Support of Haidt's Premise.	PARTY			IDEOLOGY	
	Democrats	Republicans	Independent	Moderate	
Base: Do you believe that the fossil fuel industry has had knowledge about the harmful effect of C02 emissions for decades and hid the facts from the public?	Yes – 83% No – 3% N/A – 4%	Yes – 19% No – 58% N/A – 19%	Yes – 47% No – 35% N/A – 18%	Yes – 68% No – 24% N/A – 8%	
Harm/Care: Do you believe the fossil fuel industry has had knowledge about the harmful effects that CO2 emissions is having on both our children's future and the future of vulnerable species for decades and hid the facts from the public?	*Yes – 86% (+3%) No – 8% (+5%) N/A – 3% (-1%)	Yes – 39% (+20%) No – 42% (-16%) N/A – 13% (-6%)	Yes – 53% (+5%) No – 30% (-5%) N/A – 5 (-15%)	Yes – 61% (-7%) No – 21% (-3%) N/A – (7% (-1%)	

Table 3.9. Weighted Q14 Response. Source: Orion Research.

Table 3.9. Cont

Fairness/Cheating: Do you believe that the fossil fuel industry has had knowledge about the harmful effect of C02 emissions for decades and put their profits ahead of what was best for humanity by hiding the facts from the public?	Yes – 78% (-5%) No – 8% (+5%) N/A – 0% (-4%)	Yes – 36% (+17%) No – 44% (-14%) N/A – 16% (-3%)	Yes – 57% (+10%) No – 21% (-14%) N/A – 0% (-18%)		Yes – 61% (-7%) No – 14% (-10%) N/A – 6$ (-2%)	
Loyalty/Betrayal: The fossil fuel industry now admits to knowing about the warming effects of burning fossil fuels for decades. Do you believe that the fossil fuel industry put its profits above the wellbeing of communities across American by hiding the truth about the harmful effect of C02 emissions from the public?	Yes – 88% (+5%) No – 12% (+9%) N/A – 0% (-4%)	Yes – 22% (+3%) No – 59% (+1%) N/A – 19% (0%)	Yes – 50% (+3%) No – 32% (-3%) N/A – 18% (0%)		Yes – 66% (-2%) No – 20% (-4%) N/A – 13% (+5%)	
Authority/Subversion: Do you believe that the fossil fuel industry has had knowledge about the harmful effect of C02 emissions for decades and hid the facts from the public?	Yes – 83% (0%) No – 7% (+4%) N/A – 7 (+3%)	Yes – 28% (+9%) No – 43% (-15%) N/A – 22% (+4%)	Yes – 61% (+14%) No – 17% (+18%) N/A – 22% (+4%)		Yes – 74% (+6%) No – 17% (-7%) N/A – 0% (-8%)	
Purity/Sanctity: Do you believe that the fossil fuel industry has had knowledge about the harmful effects the climate warming toxins released through the burning of gas, oil, and coal, and for decades they hide the facts from the public?	Yes – 76% (-7%) No – 9% (+6%) N/A – 12% (+8%)	Yes – 28% (+9%) No – 43% (-15%) N/A – 25% (+6)	Yes – 65% (+18%) No – 5% (-30%) N/A – 25% (+7%)		Yes – 66% (-2%) No – 6% (-18%) N/A – 20% (+12%)	
Liberty/Oppression: Deep state conspiracy theorists suggest that the fossil fuel industry has had knowledge about the harmful effect of C02 emissions for decades and hid the facts from the public. Do you agree or disagree?	Yes – 82% (-1%) No – 7% (+4%) N/A – 0% (-4%)	Yes – 21% (+2%) No – 45% (-13%) N/A – 24% (+5%)	Yes – 35% (-12%) No – 41% (+6%) N/A – 12% (-6%)		Yes – 55% (-13%) No – 14% (-10%) N/A – 12% (+4%)	

Analysis - Party: 83% of "Base" Democrats, 19% of Republicans, 47% of Independents, and 68% of self-identified Moderates (Table 3.9.) believe that the fossil fuel industry knew about the harmful effect of C02 emissions for decades and hid the facts from the public. Affirmative Republican responses increased +20% (39%) in response to Harm/Care phrasing, compared to "Base," while +17% (36%) more Republicans responded "yes" based on Fairness/Cheating messaging, again compared to "Base." -7% (61%) fewer Moderate voters responded "yes" to Q#14 in response to both H/C and F/C phrasing. Among the Liberty/Oppression, Authority/Subversion, Loyalty/Betrayal, and Sanctity/Degradation Q#14 survey responses, only the Independent voter responses to the Sanctity/Degradation phrasing had a notable impact with -30% (5%) moving away from their original “Base” “no” positions.

Analysis – Ideology: There were no significant variations from the base responses among Moderate voters.

Analysis – Haidt’s Premise: Democrats response to Q#14 Harm/Care phrasing added +3% (86%) to the baseline 83% “yes” response.

3.8 Discussion Question #1 – Does Haidt’s premise, specific to Democratic voters, hold up?

We have defined moral systems as those made up of coherent, systematic, and reasonable principles, rules, ideals, and values that work to form one's overall perspective, inform decision-making, and act as the basis of impactful persuasion messaging relative to the dominant "Base" position. Haidt proposes that two foundational moral instincts, the Harm/Care instinct to protect individuals from harm and the Fairness/Cheating instinct to punish cheaters and reward those who follow the rules, are the primary virtues that inform liberal/Democrat decision-making. Again, the respondent movement relative to the dominant response in our Base survey questions,

based upon the phrasing of questions in alternative surveys representing Haidt's various foundations, will indicate persuasion strength and, therefore, support for Haidt's premise.

For example, the “Base” phrasing to Q#5 asks, "Would you agree, Climate Change or Global Warming is currently occurring? Yes, or No?” We would suggest responses to the alternatively phrased questions, phrasing based on Haidt's six foundations, that are closest to the "Base" dominant Democratic response support Haidt's premise and those responses furthest from the dominant positive "Base" response or those responses that show the great erosion of the dominant "Base" positions, are least supportive of Haidt's premise. Moreover, this research will compare the combined average departure from the dominant response in "Base" to the Harm/Care & Fairness/Cheating phrasing vs. the combined average departure from the dominant response in "Base" to the Liberty/Oppression, Authority/Subversion, Loyalty/Betrayal and Sanctity/Degradation phrasing. Specific to Q#5, the average H/C-F/C response departure from Q#5 "yes" Democrat response is -1% (H/C +2%/F/C -4%) = -1%, whereas the average departure from the "Base" Q#5 "yes" Democrat responses to the L/O, A/S, L/B & S/D (L/O -14%, A/S -83%, L/B -12%, S/D -5%) = -29%. The average Democrat "yes" response to Q#5 H/C & F/C are closest to the "Base" response to Q#5, supporting Haidt's premise. It should be noted, given the extremely high 93% “yes” response to “Base” Q#5, the Harm/Care response of +2% (95%), and even the -4% (89%) Fairness/Cheating response, shows a high level of persuadability for each.

Q#7 asks, “Scientists suggest that catastrophic events, like stronger hurricanes and monsoons, rising temperatures, wild-fires, floods, crop failures, water shortages from drought, sea level rise from melting polar ice caps and species extinction are occurring as a direct result of climate change & global warming. Would you agree or disagree?” The dominant Democratic response to “Base” Q#7 is that 79% either agree or strongly agree with this statement. The

average level of support for this response based on H/C and F/C phrasing is +9%, compared to -.25% for L/O, A/S, L/B, and S/D responses, suggesting support among Democratic voters for Haidt's premise. Again, given the extremely high 79% “agree/strongly agree” response to “Base” Q#7, the Harm/Care response of +13% (92%), and even the +5% (84%) Fairness/Cheating response, shows a high level of persuadability for each.

Q#8 asks, "Would you support or oppose the U.S. government subsidizing efforts to transition our economic and residential energy use away from fossil fuels and toward 100% renewable energy options like solar, wind, nuclear, and geothermal? Support? Oppose?” The dominant positive Democrat response to this question is 83% "support." The average Harm/Care + Fairness/Cheating "support" response was +.50% vs. an average -8% loss against the "Base" Q#8 responses to L/O, A/S, L/B, and S/D. The high 83% “support” response to “Base” Q#8, the Harm/Care response of +6% (89%), and even the -5% (78%) Fairness/Cheating response, shows a high level of persuadability for each.

Q#9 asks, "Some scientists believe we can remove carbon dioxide from the atmosphere or from combustion engine exhaust streams and that we can then store that carbon dioxide in underground facilities for hundreds of years. Would you agree to have one of these facilities in your community? Yes? No?" Here, the dominant Democrat “Base” response is 38% “yes.” The average Harm/Care + Fairness/Cheating "yes" response was an +18% gain over "Base" vs. an average +14% gain against the "Base" Q#9 responses to L/O, A/S, L/B, and S/D. Here the Harm/Care response of +39% (76%), shows a high level of persuadability and support for Haidt’s premise.

Q#11 asks, “Do you agree that because industrialized countries, like the United States, China, Russia, Britain, and Germany, have contributed the most carbon dioxide to the

atmosphere over the past 100 years, those countries should pay a greater share than other countries toward the cost of transitioning from a carbon dioxide-based economy and society to a 100% renewable world? Agree? Strongly agree? Disagree? Strongly disagree?" The dominant Democrat "Base" response is 76% "agree/strongly agree." The average Harm/Care + Fairness/Cheating "agree/strongly agree" response was a +13.5% gain over the baseline vs. an average -14% loss against the "Base" Q#11 responses to L/O, A/S, L/B, and S/D. The high 76% "agree/strongly agree" response to "Base" Q#11, the Harm/Care response of +19% (95%), and even the +8% (84%) Fairness/Cheating response, shows a high level of persuadability for each, and further support for Haidt's premise.

Q#13 asks, "How concerned are you about the increased frequency of climate change related to natural disasters like forest fires, drought, soaring temperatures, hurricanes, floods, and sea level rise? Concerned? Very concerned? Unconcerned? Very unconcerned?" The dominant Democratic response to the baseline Q#13 is 90% "concerned/very concerned." The average Harm/Care + Fairness/Cheating "agree/strongly agree" response was a +3.% gain over the baseline Q#13 responses vs. an average -2.5% loss against the "Base" Q#13 responses to L/O, A/S, L/B and S/D. Given the extremely high 90% "concerned/very concerned" response to "Base" Q#13, the Harm/Care response of +7% (97%), and even the -1% (89%) Fairness/Cheating response, shows a high level of persuadability for each, and support for Haidt's premise.

Q#14 asks, "Do you believe that the fossil fuel industry has known about the harmful effect of C02 emissions for decades and hid the facts from the public? Yes? No?" The dominant Democratic response to the "Base" baseline Q#14 is 83% "yes." The average Harm/Care + Fairness/Cheating "yes" response was a -1.% loss against baseline Q#14 responses vs. an

average -1.5% loss against the “Base” Q#14 responses to L/O, A/S, L/B and S/D messaging. Here again, given the high 83% “yes” response to “Base” Q#14, the Harm/Care response of +3% (86%) shows a high level of persuadability for each and support for Haidt’s premise.

These results suggest that Haidt's premise holds up within Democratic voter subpopulations. In addition, Republicans showed more even responses over the six foundation sets, including the two individualizing foundations and the four binding foundations (Loyalty/Betrayal, Authority/Subversion, Liberty/Oppression, and Sanctity/Degradation) (Graham et al., 2009).

3.9 Discussion Question #2 – Across the three main party categories - Democrat, Republican, and Independent, which of Dr. Haidt's foundation messaging is most persuasive?

Again, using partisan responses to "Base" questions as the benchmark, which phrasing (H/C, F/C, L/O, A/S, L/B, or S/D) had the most significant impact on the three partisan subsets.

Question #5
Democrat: Authority/Subversion = -83% (10%) “yes” vs. baseline 93%.
Republican: Liberty/Oppression = +52% (92%) “no” vs. baseline 44%.
Independent: Authority/Subversion = -43% (28%) “yes” vs. baseline 71%.
Question #6
Democrat: Fairness/Cheating = +36% (70%) “c” vs. baseline 34%.
Republican: Harm/Care = +14% (61%) “c” vs. baseline 47%.
Independent: Sanctity/Degradation = +28 (75%) “c” vs. baseline 47%
Question #7
Democrat: Sanctity/Degradation = -17% (62%) “agree” vs. baseline 79%.
Republican: Loyalty/Betrayal = +24% (74%) “disagree” vs. baseline 50%.
Independent: Liberty/Oppression = -30% (17%) "agree" vs baseline 47%.
Question #8
Democrat: Liberty/Oppression = -15% (68%) “support” vs. baseline 83%.
Republican: Fairness/Cheating = -47% (25%) “oppose” vs. baseline 72%.
Independent: Sanctity/Degradation = -20% (15%) “oppose” vs. baseline 35%.
Question #9
Democrat: Harm/Care = +38% (76%) “yes” vs. baseline 38%.
Republican: Harm/Care = -30% (45%) “no” vs. baseline 75%.
Independent: Liberty/Betrayal = -29% (0%) “n/a” vs. baseline 29%.
Question #11
Democrat: Loyalty/Betrayal = -38% (38%) “agree” vs. baseline 76%.
Republican: Sanctity/Degradation = -29% (10%) “n/a” vs. baseline 39%.

Independent: Loyalty/Betrayal = -42% (17%) “agree” vs. baseline 59%.
Question #13
Democrat: Sanctity/Degradation = +14% (17%) “unconcerned” vs. baseline 3%.
Republican: Sanctity/Degradation = +30% (61%) “concerned” vs. baseline 31%.
Independent: Liberty/Oppression = -30% (35%) ‘concerned” vs. baseline 65%.
Question #14
Democrat: Loyalty/Betrayal = +9% (12%) “no” vs. baseline 3%.
Republican: Harm/Care = +20% (39%) “yes” vs. baseline 19%.
Independent: Sanctity/Degradation = -30% (5%) vs. baseline 35%.

3.10 Discussion Question #3 – Among self-identified "Moderates," which Moral Foundation Theory based messaging is most effective?

Over the last decade, the percentage of voters who self-identify as being neither conservative nor liberal has been on the decline (Fowler et al., 2023), making persuasion messaging and targeting middle-of-the-road voters more complex and vastly more important than ever. The most coveted voter subset is self-identified "Moderates" primarily because they are more open to persuasion messaging and less likely to be locked into a partisan mindset. Moderates are known to be less influenced by party affiliation and more likely to look at a candidate's unique positions on critical issues. As such, "Moderates" are the persuasion “holy grail,” with most late campaign resources used to convince these objective voters to support one candidate over the others. In this late campaign tug-of-war, persuading this critical subset is often the difference between winning and losing. This research was vital to see which of Haidt's Moral Foundations are more persuasive with Moderate voters. Our seven questionnaires, six of which were written using language/messaging to ask respondents whether they considered themselves as either very conservative, conservative, moderate, liberal, or very liberal. We then isolated the Moderates and cross-referenced that subset against the various MFT survey question sets representing Haidt's foundations to determine which foundation-related phrasings were most persuasive. While most questions were persuasive to some degree, we used a +/- 20-point

movement away from "Base" responses as a threshold to determine which foundations were the most persuasive.

The Authority/Subversion phrased questions produced one (1) response greater than +/-20%. In response to A/S messaging to Q#5, -72% (13%) of Moderates moved away from the "Base" "yes" response (85%).

Three surveys (Fairness/Cheating, Liberty/Betrayal, Sanctity/Degradation) produced two (2) responses within the Moderate subset that exceeded a +/-20% change. The Fairness/Cheating phrasing of Q#6 produced a -30% (4%) drop in the "a" response – "climate change and global warming are a direct result of human activity - compared to the Base response (34%), while the percentage of Moderate respondents to the F/C phrasing of Q#8 dropped by -20% (10%) "opposed." There was a +28% (59%) jump in Moderates who responded "yes" to the Liberty/Betrayal phrasing of Q#9, compared to 31% "yes" in "Base," while -49% (25%) fewer Q#11 Moderates chose "agree/strongly agree" compared to "Base" Q#11 (74%) "agree/strongly agree" responses. Two questions phrased with Sanctity/Degradation messaging produced +/-20% responses away from the baseline. S/D Question #7 +27 (40%) of Moderates chose "neither agree or disagree/none of the above" vs. the Q#7 Moderate baseline (67%) response, while +20% (36%) "neither agree or disagree/none of the above" more Moderates chose the "neither agree or disagree/none of the above" option in response to the Sanctity/Degradation phrasing of Q#11 over the baseline (16%). The Harm/Care messaging produced three (3) responses that exceeded 20%. Q#11 was -27% (47%) "agree/strongly agree," vs. "Base" (74%), and both Q#6 and Q#9 of the H/C survey saw -30% drops vs. "Base." Finally, the Liberty/Oppression phrasing produced four sets of question responses - Q#5 -45% (40%) "yes," Q#6 +20% (74%) "c", Q#7 -20% (0%)

"disagree/strongly disagree" & Q#11 -27% (47%) "agree/strongly agree," as compared to "Base" responses. The L/O phrasing was the most persuasive.

3.11 Conclusions

This research supports one of Dr. Jonathan Haidt's main premise, finding that liberals/Democrats showed evidence of morality centric decision-making based primarily on the individualizing moral foundations - Harm/Care and Fairness/Cheating. In response to Questions #6, #7, #8, #9, #11, #13, and #14, 100% of the Harm/Care messaging affirmative responses exceeded those of the Base survey responses, while 50% of the Fairness/Cheating responses exceeded Base F/C responses. In total, 75% of the questions phrased with Harm/Care & Fairness Cheating messaging exceeded the affirmative response levels of the Base survey responses. Of note, if this research had considered Fairness/Cheating responses that maintained Base levels within 6% (a relatively small percentage) as supportive of Haidt's premise, the results for both the Harm/Care and Fairness/Cheating messaging would have been 100%. Moreover, given the extremely high affirmative responses to several Base questions (Q#5-93% "yes," Q#8-83% "support," Q#13-90% "concerned/very concerned," and Q#14-83% "yes,") Fairness/Cheating responses within a few points of the Base responses could be considered in support of Haidt's premise. In contrast, and also in support of Haidt's premise, conservatives/Republicans showed a more even distribution of values, virtues, and concerns, including the two individualizing foundations and the four binding foundations - Loyalty/Betrayal, Authority/Subversion, Liberty/Oppression, and Sanctity/Degradation. As to which phrasing (H/C, F/C, L/O, A/S, L/B, or S/D) had the most significant impact on the three partisan subsets, the results are inconclusive and require more research. Specifically, there were wide variations in survey responses, regardless of foundation phrasing, across partisan

subgroups. Given the research methods used here, quantifying the impact of specific words and phrases used in the different phrasings, would likely produce inconclusive results. Finally, specific to which Moral Foundation Theory based messaging proved most effective at persuading Moderates, the Liberty/Oppression phrasing produced four sets of question responses exceeding the +/- 20% threshold used to evaluate persuadability.

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BIOGRAPHY

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