Climate Change may represent one of the gravest threats to global security and U.S. strategic interests, yet it has become one of the most intractable policy issues in modern American politics. Agriculture, fresh water, and coastal cities may be under threat as the global environment changes in both predictable and unpredictable ways. Meanwhile, domestic worries over jobs and the economic impact of environmental regulation weigh heavily on the minds of many citizens and their elected representatives. How can the United States adopt policies that will address climate change while mitigating negative impacts on economic growth?

**Is Earth’s Climate Changing?**

Scientists are certain the global climate is changing because they are able to measure many aspects of the environment and have been doing so for some time. For decades, thousands of scientists have engaged in an international effort to study climate change and published their findings through the United Nations Intergovernmental Panel on Climate Change (IPCC). These reports’ conclusions are published with an associated certainty level along with models that detail future changes with different scenarios of global conditions. Their Fifth Assessment Report (AR5) updates the scientific conclusions from previous reports and models carbon dioxide concentrations in the atmosphere as rising to between 450 parts per million (ppm) and 500 ppm by 2100, which will be a forcing mechanism for global temperature rise. The National Oceanic and Atmospheric Administration reported that carbon dioxide concentrations hit a record high level in May 2019 at 414.7 ppm, and that the rate of increase is also accelerating and is now at 2.2 ppm per year over the last decade. To provide some context to that number, Earth has not experienced carbon dioxide levels above 300 ppm in over 800,000 years. The latest IPCC report concludes with a “high confidence level” (language from the report is calibrated to statistical certainty) that human activities have caused approximately 1.0°C of global warming above pre-industrial levels, that global temperatures will continue to rise by 1.5°C Celsius between 2030 and 2052, and that global sea level will continue to rise well beyond the year 2100 even if global warming is mitigated.

The scale of climate change is important to consider for context because some regions are experiencing a changing climate that is bringing heat and drought, while other regions are experiencing changing climates that are bringing harsher winters and flooding. These numbers are not very informative for the individual living in a particular location when averaged globally, but they do provide a frame of reference to compare large scale conditions over time. For the last 20,000 years, the gaseous makeup of Earth’s atmosphere has been relatively constant. Carbon dioxide levels have been in the 200-250 parts per million (ppm) range for the last one million years, that is until this century where carbon dioxide (a GHG) is now over 400 ppm (and continues to rise at about 2.2 ppm per year). Atmospheric temperature and carbon dioxide concentrations are coupled systems – a change in one can force a change in the other. There are some natural causes and some feedback mechanisms contributing to the rise in global average temperatures, but human activity is primarily responsible for the rapid increase in GHGs in our atmosphere which in turn force global temperatures to rise. Human factors include, but are not limited to, deforestation, agriculture and burning coal/wood/oil.

In addition to a changing atmosphere, rising carbon dioxide levels change the acidity of the oceans. Ocean water takes up carbon in its water chemistry, thus counteracting the temperature impacts from
the greenhouse effect by removing some of the gases from the atmosphere. However, the oceans can only take in so much carbon. With more carbon in the ocean the water becomes more acidic, and this acidity inhibits ocean life (corals, shellfish, etc.) from growing shells and skeletons to survive. Less surviving ocean life causes domino-effect changes in the food webs that sustain all life on the planet.

Sea level rise is a secondary result from a changing climate that can also be measured directly. As the oceans warm from a natural interaction with the warmer atmosphere, the water increases in volume (the physical principle of thermal expansion). Because the ocean floor is not getting deeper, that increased water volume takes up more space and results in rising sea levels. Additionally, land ice (water frozen on land) is melting and adding to the amount of water in the oceans. Sea ice is also melting from increased ocean temperatures but does not directly cause sea level rise. When sea ice melts, though, it allows the sunlight to absorb more directly into the oceans (think dark blue water versus white ice), thus heating up the water and contributing to the volume increases from rising temperatures.

The latest IPCC models conclude that harmful global impacts are inevitable based on human activities that have already taken place (GHG emissions, agriculture changes, pollution, deforestation, population growth). The international consensus on the next viable target is to limit the temperature increase (globally) to 1.5 degrees Celsius (2.7 degrees Fahrenheit) before 2050. The IPCC also cautions that the international ambitions submitted under the Paris Agreement, if achieved, would not be enough to limit global warming to 1.5°C. Current and emerging technology to capture and sequester emissions (such as carbon dioxide removal, or CDR) are promising but themselves require increased energy and natural resources to scale up to a level that would mitigate risks. The rallying point seems to be the year 2030, which is now a decade away, and “the lower the emissions in 2030, the lower the challenge in limiting global warming to 1.5°C after 2030 with no or limited overshoot (high confidence).”

Understanding Climate Change Terminology

Policymakers and elected officials must understand the terminology of climate change and apply this terminology precisely so that discussions and policies are developed accurately and with transparency. Weather and climate are not the same phenomena and those terms should not be used interchangeably. Weather is experienced and recorded on a short time scale, as in day-to-day or seasons of the year. Climate is a characterization of weather conditions that are averaged over several decades. For the weather to change, the cause might just be a storm passing through or a few particularly sunny days. For the climate to change, the average of the weather would have to change consistently over several decades.

Global warming is sometimes used interchangeably with the greenhouse effect and climate change, but those three terms are not precisely the same phenomena either. The greenhouse effect is a scientifically testable effect that is part physics, part chemistry, and occurs when heat waves and other electromagnetic radiation interact with molecules of gases in our atmosphere. The gases that cause the lower atmosphere to retain heat (and thus warm the part of the planet where humans live) are called Greenhouse Gases (GHG). There are other materials that can have the opposite effect and temporarily cool the lower atmosphere, such as smoke, clouds, and particulate matter. Scientists study these other materials as much as they do GHGs, but the important point is to understand that the greenhouse effect is a physical phenomenon that is very well understood. The changing levels of
GHGs in our atmosphere are resulting in rising temperatures by way of the greenhouse effect. *Global warming* only refers to rising temperatures and can be measured directly with instruments. Earth is experiencing global warming now because the global average temperatures are rising. *Climate change*, on the other hand, describes a long-term change in climate conditions (both temperature and precipitation). The planet’s climate is changing for many more reasons than just rising GHGs levels: it is the confluence of many natural processes that include the use of natural resources, the healthy functioning of biological and natural systems, and the human interaction that functions as a part of this holistic system of systems. The climate can and does change over long periods of time, and some of those changes occur naturally due to things like solar energy output, the Earth’s orbit, and the Earth’s internal processes (plate tectonics). This paper’s focuses on the precise impacts of the changing climate humans are likely to face in the future. It is important not conflate climate change with the physics of the greenhouse effect or the narrow term global warming.

Lastly, it is important to distinguish the terms theory and hypothesis whenever dealing with scientific topics. In science, a *theory* is a conclusion based on facts and observations that are scientifically testable. A theory is ranked higher than individual facts because it is a unifying concept that explains many testable observations, and a theory is not a guess or a hypothesis. A law is considered even higher in the hierarchy than a theory – i.e. the “theory of relativity” and the “theory of plate tectonics,” then the “laws of gravity” and the “laws of thermodynamics.” A *hypothesis* is a testable statement that is formed after collecting observations that the observer wishes to explain or make conclusions about a cause and effect. Furthermore, one constantly second-guesses observations, and tries to disprove them. There are no beliefs, just conclusions, and if new observations are made then the hypothesis can be retested and new conclusions can be drawn to contribute to a scientific theory. The overwhelming scientific consensus is that climate change is occurring. However, the question of what can or should be done to adapt to the changing climate, and to mitigate the results of human activity in the future, remains a more complicated and hence difficult question to answer.

**What Are the Threats?**

Understanding the threats posed by a changing global environment is critical to developing options for how to mitigate the negative impacts of climate change. Humans and the natural environment have always adapted to our changing planet. What is concerning now is the fact that natural conditions are changing at a faster rate than anything humans have experienced before. Smaller civilizations have faced rapid and life-threatening changes to environmental conditions throughout our history, but those groups either perished or migrated as an adaptation strategy. The world today is one of highly interconnected populations that are approaching the theoretical carrying capacity of the planet’s existing resources. Adaptation must occur, but that adaptation will be accompanied by serious domestic, global, and strategic threats.

*Domestic Threats.*

The Fourth National Climate Assessment (NCA4) of the United States⁹ asserts that current and future conditions can no longer be assumed to resemble the recent past, that the climate is changing faster than at any point in history, and that it is primarily a result of human activity.¹⁰ The threats vary by region, and are shaped by social, economic, and geographic factors. The NCA4 categorizes the domestic threats in 12 categories:
1. Communities – human health, safety, quality of life, and economic growth.
2. Economy – losses to infrastructure and property, impeded rates of economic growth.
3. Interconnected Impacts – cascading impacts to the natural, built, and social systems.
4. Actions to Reduce Risk – inability to approach the scale necessary to mitigate and adapt.
5. Water – quality/quantity impacts agriculture, energy, industry, recreation, and environment.
6. Health – extreme weather, air quality, disease, food, water.
8. Ecosystem and Ecosystem Services – loss of unique habitats that provide essential benefits.
9. Agriculture and Food – declining crop yields, livestock health, food security, price stability.
10. Infrastructure – stress to already aging and deteriorating energy and transportation systems.

Global Threats.
Populations worldwide are likely to experience similar impacts, but again the threats vary by region. The trend towards globalization now means that interconnected social, economic, and natural resources systems have global impacts whereas just a few decades ago these same impacts might have been contained within a single region. The IPCC models of global and regional impacts outline issues of food security, disease, migration, and energy and water security.

Threats to U.S. Strategic Interests
The National Security Strategy (NSS) addresses climate change (though not by name) and allows for climate change mitigation efforts to also meet strategic threats. President Trump’s NSS calls for the United States to embrace energy dominance by becoming a leading energy producer, consumer, and innovator with secure and resilient infrastructure. The strategy recognizes that climate policies will continue to shape the global energy system, and that US leadership is essential to balancing energy security, economic development, and environmental protection. It goes on to state that the US “will remain a global leader in reducing traditional pollution, as well as greenhouse gases, while expanding our economy…” and that this achievement “flows from innovation, technology breakthroughs, and energy efficiency gains, not from onerous regulation.” The innovation may very well come from policy solutions that satisfy the “onerous regulation” test while also growing the economy, increasing energy independence and energy security, and protecting the environment. Meanwhile, energy markets are beginning to reflect new economic realities. A recent report from a renewable energy analysis firm found that 74% of coal power plants in the United States are producing energy that is more expensive than local renewable energy sources, and by 2025 that percentage is projected to be 86%.

Studies on environmental security have shown that environmental degradation can exacerbate or even trigger conflict, both domestically and internationally. The IPCC reports dedicate an entire volume with each update to outlining impacts and mitigation strategies by region across the globe. The US can use this report as a planning document for locations that are likely to either require humanitarian assistance or may be at risk of becoming regions of conflict or failed states. The United States’ international interests outlined by NCA4 contain four key threat areas:

1. Economics and Trade – import and export prices, business with overseas operations and supply chains.
2. International Development and Humanitarian Assistance – slow/reversed progress on development and increased need for humanitarian assistance and disaster relief.
4. Transboundary Resources – shared resources across land and maritime boundaries are at risk, multinational frameworks to manage those resources and the transboundary decision-making.

Conflict Between Economic Growth and Climate Change Adaptation

Humans and their governments will have no choice but to adapt to a changing environment. Yet, policy responses have often been delayed due to political factors and anxiety over potential economic impacts of adaptation policies. It is worth asking whether adaptation activities are necessarily in conflict with domestic economic interests. While the economic costs of climate change policy are concentrated in some sectors such as coal, oil and gas production, and in high-energy consumption industries, new markets are emerging which create economic opportunities. Renewable energy industries created by demand for solar and wind energy, and more efficient homes, businesses and transportation have produced hundreds of thousands of new jobs, representing the “fastest growing occupation in America.” These new industries include not only traditional energy sector workers such as wind turbine manufacturing and maintenance technicians, but also those building or adapting energy efficient homes and businesses. It is plausible that jobs created in these new industries will replace those lost in industries most impacted by regulation aimed at reducing carbon emissions.

The desire for economic growth and the long-term sustainability of our planet do not necessarily conflict with each other. In fact, the impacts of climate change also come with significant economic loss. Recent studies correlate reductions in GDP associated with climate change impacts. In a study of 174 countries over the years 1960-2014, an increase in annual global temperature by 0.04°C per year through 2100 will reduce GDP per capita by 7.22% if no mitigation policies are enacted. The same study found that if countries abide by the Paris Agreement, the losses in GDP per capita could be reduced to 1.07% per year.

Until recently, the impacts of human activities on the environment have been largely ignored because those impacts were not costly and were easily dismissed as economic “externalities.” These externalities are now beginning to accumulate real economic, social, and environmental costs. Americans are experiencing higher health care costs, increased food and fuel prices, and more frequent unanticipated costs from natural disasters, many of these directly link to climate change. Addressing climate change appears to be in everyone’s best interest, and the ability to act exists. The technology is available, the science is understood, and the necessary behavioral changes are known. However, convincing everyone of these assumptions is more difficult. In fact, an aggressive approach to climate change mitigation and adaption may be detrimental to some populations. A middle-aged coal miner in West Virginia, for example, is not likely to experience major climate changes in his or her lifetime, yet may pay an unbearably high price through the loss of his livelihood and access to healthcare. Such an individual is unlikely to seamlessly transition into a new job without uprooting to another region and learning new skills for which one requires time-consuming and costly technical training. Not only is this individual unlikely to possess the will to address climate change, he or she has a strong incentive (short-term threat to livelihood) to actively oppose climate change mitigation efforts.
Current Climate Change Policy and Mitigation Efforts

Global initiatives are progressing to address climate change and advance policies for mitigation and adaptation. For example, the Paris Agreement was signed and entered into force in November 2016. While President Trump has publicly pledged to withdraw from the Paris Agreement, the United States cannot formally withdraw until November 4th, 2019 (three years from the date it entered into force), at which time the withdrawal takes effect one year after that (theoretically November 2020). The United States is certainly a global influencer on climate policy, and its withdrawal will have significant negative impacts on collective efforts. However, other nations are taking this in stride and continuing to advance policies aimed at mitigating climate change impacts. Within the United States, some state and local governments, as well as private businesses, are creating goals to comply with the Paris Agreement goals despite America’s withdrawal.

Despite these efforts, significant variation exists across states and regions, often based on economic and political considerations. While citizens in so-called “blue states” (those with strong majorities who identify with the Democratic Party) often pressure their elected representatives to adopt climate change adaptation and mitigation policies, those in “red states” (those with strong majorities who identify with the Republican Party) remain skeptical of regulatory changes that target climate change. Moreover, states that are likely to be most impacted by climate change-related regulations understandably balk at enacting such policies. West Virginia’s economic need to maintain its large coal industry, for example, makes the state’s citizens, and therefore elected representatives, highly unlikely to support any climate change policy that would place additional costs on the coal industry. In other regions, large portions of the American populace continue to express concern over the potentially negative impacts on local economies. This concern, coupled with skepticism about the long-term impact of climate change makes this part of the population a potent political constituency that policy makers often dare not oppose, and ignore to their political peril.

Considering Future Policies

Responding to climate change is politically contentious in part because the issue represents a classic case of the “Tragedy of the Commons.” Addressing climate change comes with economic costs that are likely to borne by local populations in some regions. However, ignoring climate change has even greater long-term economic costs in the aggregate. Contributors to climate change cannot be named or blamed on finite numbers of people or corporations, while the impacts affect nearly everyone. Many sectors of the U.S. economy will bear the costs of not taking actions to mitigate future climate change, to say nothing of the costs of climate change already being experienced. Enacting policies in the United States and across the international community will have economic costs on specific sectors of the economy, primarily the ones contributing to the problem through emissions and the unsustainable consumption of natural resources.

Framing the issue with transparency and a complete life-cycle understanding of resources, supply chains, and socio-economic impacts is important for bipartisan appeal. Policy proposals should take a benefit-cost approach to outlining the concepts and provide comparisons of the new policy to the benefits and costs of the status quo (or business-as-usual) future. When the costs of not doing anything outweigh the costs of the policy proposal, then voters are likely to understand the necessity for the policy change. Policymakers must also explore the alignment of the new proposals to existing national strategies, such as the National Security Strategy. Many policy proposals involving renewable energy and resource conservation would contribute to the goals for technology and innovation.
superiority outlined in the current National Security Strategy. Furthermore, policy proposals should include a broad view of impacts to job markets and the long-term prospects for sustainable business opportunities.

The landscape of climate change policy is constantly evolving, but one should be familiar with a few key proposals when considering future policy options. Historically, the Kyoto Protocol was a treaty that resulted from the United Nations Framework Convention on Climate Change (UNFCCC) in 1992. Since then, annual meetings of the Conference of the Parties (COP) have adjusted the pledges from countries, the stipulations of the treaties, and most recently negotiated the Paris Agreement, which creates an entirely new agreement rather than simply amending the Kyoto Protocol. The Paris Agreement is still being negotiated and monitored by UNFCCC members, and the 25th meeting of the COP, named COP 25, is scheduled for December 2019 in Santiago, Chile. The COP 25 agenda will likely focus on transparency, mitigation, adaptation, means of implementation, and cross-cutting issues.

Domestically, policies of note are those aimed at reducing GHG emissions and motivating technological innovations that transition resource consumption to types that are sustainable over longer periods of time. The “Green New Deal” is a partisan proposal that attempts to set goals instead of quantifiable regulations, achieved through a 10-year mobilization of federal initiatives around jobs, infrastructure, agriculture, and manufacturing. The idea is framed in the same way as the World War II era New Deal, but so far has been sharply opposed by Republican members of Congress, and has not gained the support of Democratic Party leadership. Economic or market-based strategies that show some promise are a tax on carbon, where a fee is attached to the cost of fuel according to its carbon emissions, or a carbon “cap-and-trade” system similar to the sulfur dioxide and nitrous oxides cap-and-trade markets under the Clean Air Act Amendments that successfully reduced acid rain problems in the Northeast United States in the 1990s. State and local governments are making their own policy changes related to climate change, but might in the future be challenged in the courts for the broader national impacts from those with large and influential economies like California. This year, California’s ability to set fuel economy standards within their state is being challenged by the Federal Government because of the theoretical financial impact on the automobile industry. The automobile industry is not advocating for this fight because they have already anticipated the changes and are on track to innovate and advance their technology to meet the demands for increased fuel economy.

Bipartisan support for policy changes that address climate change are likely to succeed when both sides have mutual interests – sustainability of the economy, society, and the environment. While policy changes are likely to remain contentious, they are possible even if made incrementally.

Endnotes


NOAA (2019).


Ibid., page 18.

Ibid.

Ibid., pages 12-19.

Ibid., pages 24-26.


Ibid.

Ibid.


Ibid.


Kahn et al. (2019).

White House (2017), page 22.


**Recommended Reading**


