

Introduction

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This book is being published at a moment of singular change and choice for Texans. As the authors make clear, the impact of global warming on their state is expected to take two basic and interrelated forms. One involves the effects of warming-caused climate change itself. The second involves the effects of any actions taken to reduce that warming.

First, geography means Texas will experience a challenging assortment of the climate changes that scientists have concluded are already spinning off from a manmade atmospheric warming trend. Chapter 10, for instance, includes a compelling, though hardly comprehensive, list of some of the things that scientists project for the state: “Temperatures will rise; heat waves will occur more frequently; there will be less rain west of the Interstate 35 corridor; severe weather will become more frequent; in-stream flows will fall; biodiversity will decline and the sea level will rise.”

Meanwhile, because of its energy-intensive economy and way of life, Texas will acutely feel the effects of any new policies designed to reduce emissions of the carbon dioxide, the principal greenhouse gas blamed for manmade warming. CO₂ is emitted whenever fossil fuels, including oil and coal, are used. In Texas, the sources include millions of motor vehicles, sprawling oil and chemical complexes that serve much of the nation and the coal-fired power plants that produce much of the state’s electricity. Chapter 8 examines the factors behind Texas’ high rank among states emitting the most carbon dioxide. Two telling details: Texas leads the United States in overall energy use, with more than a tenth of the national total, and also in the consumption of coal.

This new, second edition of [The Impact of Global Warming on Texas](#) can aid in making the decisions that now confront the state. It is a completely revised version of the original edition, published in 1995. The authors – a distinguished team of climate scholars representing a variety of disciplines – present up-to-date interpretations of experts’ current knowledge of the scientific, economic and policy aspects of climate change in the state.

The book also offers recommendations for two major realms of possible response to global warming – reducing its impacts and adapting to those effects. The authors’ work will nourish the understanding of policy makers and ordinary citizens alike at a particularly significant time in the climate issue’s trajectory. In Chapter 10, Jurgen Schmandt notes that leaders now have “fewer excuses to avoid action because of scientific uncertainty” than they did when the book’s first edition was published, because researchers have resolved key questions in the ensuing 14 years. In addition, he writes, scientists have established that “climate change is no longer a distant possibility, but occurs now.”

The likelihood of more ambitious national policies to reduce carbon dioxide emissions, including regulatory mandates, has increased recently as accumulating scientific findings and solidifying interpretations of that research have influenced and intersected with a number of other events and trends.

President Barack Obama promised change in his campaign for the White House, including a reversal of Texan George W. Bush’s refusal to launch a regulatory attack on human-caused climate change. Within just a few days of taking office, Obama signaled that he would make good on that pledge when he issued a pair of regulatory directives. They were expected to result in tougher fuel-economy standards for cars and light trucks – both at the federal level and in 14 states that have petitioned for permission to set their own efficiency rules. Still to come, at this

writing, was action on Obama's campaign pledge to enact a sweeping regulatory program aimed at reducing carbon dioxide emissions from other sources, as well.

Obama's election was just the latest in a series of major developments that have transformed the character of climate change as a political and economic issue in the last few years. Hurricanes Katrina and Rita, which devastated parts of Louisiana and Texas in 2005, profoundly heightened awareness and concern about the effects of global warming, including stronger storms, that climate scientists project. In 2006, former Vice President Al Gore's documentary film and book, both titled An Inconvenient Truth, used hurricane images among other visual and verbal tools to persuade the public to take climate change more seriously. Media coverage of a stream of scientific findings, including the 2007 reports of the Intergovernmental Panel on Climate Change, likewise accelerated attention to the issue.

The IPCC, reflecting the work of hundreds of scientists around the world, declared that evidence of warming was "unequivocal" and that most of it occurring over the previous half-century was "very likely" the result of greenhouse emissions from human activities. The organization's reports contained warnings about possible consequences of deep concern for Texas, including hurricanes ("likely" to grow stronger, according to the IPCC), sea level rise (which boosts hurricanes' storm surges) and climate events including heat waves, high temperature extremes and heavy precipitation ("very likely" to be more frequent). Early in 2007, An Inconvenient Truth won an Academy Award. Later in the year, Gore and the scientists who worked on the IPCC reports were jointly awarded the Nobel Peace Prize for heightening awareness of the issue.

In 2008, just four months before this book's preview appearance in an online format, Hurricane Ike roared ashore in Texas, bringing destruction to Galveston and the Bolivar Peninsula, knocking out electric power to millions of Houston-area residents and exacting an enormous economic toll that made the storm one of the costliest in American history. In the 2008 presidential campaign, both Obama and his Republican rival, Sen. John McCain of Arizona, endorsed regulatory proposals for battling climate change that had far more in common with one another than either did with the non-regulatory approach followed for eight years by Bush. By the end of Bush's second term, the national discussion about climate change, dominated by a clamorous debate over science until not that long ago, had become more focused on policy questions about what to do about a phenomenon that a growing body of research indicated was happening.

Along with changed perceptions and a shifting public dialogue, climate change has increasingly blended with related concerns in the political arena, news coverage, corporate decision-making and elsewhere. The result was a larger, composite issue that encompasses global warming, energy policy, pollutants other than carbon dioxide that come from the same sources, dependence on foreign oil sources, national security and the broad concept of sustainability. Terms like "going green" and "carbon footprint" quickly became widely familiar through repeated usage in the popular media – news and entertainment. Two of the nation's leading newspapers, the New York Times and Wall Street Journal, for instance, both introduced blogs that regularly report on the intersection of business, economy and the environment. Both place a heavy emphasis on news that explicitly or implicitly relates to carbon dioxide emissions and climate change. When the economic meltdown that took place during the latter part of 2008 morphed into a deepening recession, it focused new attention on concepts like "green stimulus" and "green New Deal" They refer to government programs designed to revive the floundering economy through spending to boost alternative energy, energy conservation, energy efficiency,

and the like. Obama had endorsed such ideas in his campaign, and his economic stimulus proposal (the fate of which was still undecided in Congress at this writing) included funding for such initiatives.

All these changes, then, have contributed to a growing array of choices for Texans about how they will respond to the interconnected issues of climate, energy and economy. At the state government level, for instance, Bush's decision not to pursue regulations to limit global warming created a policy void that has increasingly been filled by the actions of individual states and multi-state compacts to tackle the climate issue directly. Texas has not been one of them. "So far, Texas has done very little to address the problem of global warming," Judith Clarkson writes in Chapter 8. "In fact," she adds, "the official policy appears to be to wait and see what the federal government comes up with."

With the Obama administration poised to take a very different approach to climate change than that followed by Bush, a key question loomed larger than ever: Will state government leaders in Texas still wait to see what federal policy means for the state (while trying to influence that policy, to the extent they can) or will they also begin to shape a complementary Texas response to global warming? In Chapter 10, Schmandt argues that Texas has been pursuing what is essentially "a hidden climate change policy," motivated largely by concerns about energy independence and efficiency. The hidden policy, he asserts, includes various efforts to advance alternative energy and energy efficiency and is more ambitious than many people recognized. Schmandt calls instead for "a comprehensive policy that links climate change to energy independence, regional security and management of natural resources," along with the establishment of a state Office of Energy, Security and Climate to focus such a unified, overt commitment.

Such a step would require, of course, an acknowledgement that manmade climate change is an issue worth major and explicitly directed attention and resources. There have been suggestions that some high-ranking state officials might not share that viewpoint. An advisory panel, made up of top officials of three state agencies and appointed by Gov. Rick Perry, argued in late 2008 against federal regulation of greenhouse emissions by the Environmental Protection Agency. The panel's report signaled doubt about the interpretations of mainstream climate science in a brief passage asserting that "recent climate research calls into question prevailing public perceptions of the cause and extent of global warming."

Perry argued vigorously at the same time that regulation of greenhouse gases under the federal Clean Air Act – one possible approach for federal controls, approved by the U.S. Supreme Court during Bush's second term – would "cripple the Texas economy." Instead, the governor has suggested a better approach is to make alternative energy technologies, such as wind-generated energy, less expensive.

The growth of Texas' wind-power industry is an instructive case study in the complexity and ambiguity of state actions related to global warming. Perry, for instance, on one occasion poked fun at concerns about human alteration of the climate. In 2007, speaking in California (the state that has taken the most dramatic actions to limit greenhouse emissions), news organizations reported that the governor remarked, "I've heard Al Gore talk about man-made global warming so much that I'm starting to think that his mouth is the leading source of all that supposedly deadly carbon dioxide."

The year before, however, when Perry announced a \$10-billion private-public partnership to expand wind-energy infrastructure in Texas, his office announced that "for every 1,000 megawatts generated by new wind sources, Texas will reduce carbon dioxide emissions by six

million tons over the next 20 years." The statement raises a question in light of the governor's subsequent comment about Gore: Why mention reductions in CO₂ as a benefit of the wind industry's growth in Texas, if the gas is only a "supposedly" harmful substance?

In the same vein, when Perry criticized the possibility of EPA regulation of carbon dioxide and other greenhouse gases in 2008, an official announcement by his office suggested non-regulatory alternatives for reducing carbon in the atmosphere:

Modernizing the national energy grid to support wind and solar energy transmission, facilitating investments in the development of carbon capture and sequestration technologies, and removing barriers to investment in nuclear generation would reduce carbon emissions while encouraging competitiveness, innovation and growth in alternative energy sources.

Texas now produces more electricity from wind generation than any other state, thanks in large part to actions by the Legislature in 1999, and again in 2005, requiring utilities to produce a certain percentage of electricity from renewable sources. In 2008, the Public Utility Commission launched a \$5 billion project to increase transmission capacity, then in early 2009 pushed it ahead by giving seven utilities assignments to construct the new electric lines to carry wind energy from West Texas to North Texas and the Houston area.

Also in 2008, the prominent Texas businessman T. Boone Pickens gained considerable national attention through the heavy promotion of his Pickens Plan, a proposal to help wean the United States from its dependence on foreign oil through the use of wind and solar power and natural gas. Essentially, Pickens would substitute natural gas for imported oil in some vehicles, while replacing electricity now generated by that natural gas with more wind power. Pickens stresses the benefits for national security of reducing reliance on foreign oil, rather than the lowered greenhouse emissions that would result from replacing oil with carbon-free wind and lower-CO₂ natural gas. He told an audience at Rice University early in 2009 that "global warming is Page 2 for me." Nevertheless, he has made common cause with campaigners for attacking climate change such as Gore and the Sierra Club.

Such alliances might seem odd – Gore is a liberal Democrat while Pickens is a conservative Republican – but typify the sort of synergistic opportunities that have arisen along with the blending of the climate issue with other concerns in recent years. Texas is rich in natural gas reserves, and the fuel was being mentioned by some Texas officials as far back as the late 1980s as a weapon for attacking global warming.

The Pickens Plan's promotion of natural gas and wind power is only one recent sign of a growing recognition among private-sector leaders in Texas of a changing political and economic landscape with regard to the climate issue. Now-retired Shell Oil President John Hofmeister, for example, began calling for a "culture of conservation," including national policies that recognize global warming as a problem requiring action, several years ago while he led the company. In 2008, commenting on the possible EPA regulation of greenhouse gases that Perry opposed, San Antonio-based AT&T said it was ready to help the federal agency cut emissions through the development of "next-generation" information and communication technologies.

Probably no corporation has been more closely watched or more strongly criticized on the climate issue than the Texas-based giant Exxon Mobil. During the George W. Bush administration, Exxon came under increasing attack for its influential opposition to the regulation of greenhouse gases. In 2006, Britain's Royal Society, the nation's national sciences

academy, called on the company to stop supporting groups that had "misrepresented the science of climate change by outright denial of the evidence" and for Exxon itself to cease issuing "inaccurate and misleading" statements on climate science.

Exxon still has its critics over the climate issue, to be sure, but there is no denying that its public pronouncements have shifted dramatically. In 1991, the New York Times reported that Exxon's then-chairman, making a speech in Houston, had "expressed doubt that theories on global warming would eventually prove accurate."

In late 2008, an article in the Times included this passage:

Gingerly, over the last three years, Exxon has moved away from its extreme position (on global warming). It stopped financing climate skeptics this year, and has sought to soften its image with a \$100 million advertising campaign featuring real company executives, scientists and managers. One of the ads said the company aimed to provide energy "with dramatically lower CO₂ emissions."

Then, early in 2009, the Wall Street Journal reported this development: "The chief executive of Exxon Mobil Corp. for the first time called on Congress to enact a tax on greenhouse-gas emissions in order to fight global warming."

Climate-conscious transitions are evident in Texas beyond the arena of corporate policy. Sustainability initiatives have gotten under way at a number of colleges and universities, as administrators adopt policies and goals related to energy conservation, carbon reduction and related matters. At The University of Texas at Austin, for example, a sustainability plan prompted by a student proposal was announced in 2008. The university said it would "integrate sustainability in academic programs, operations, campus planning, administration and outreach" and be one of the most rigorous in the state. Meanwhile, curriculum offerings at various institutions of higher education reflect the same trend in different ways. One example of many that could be cited: In West Texas, Midland and Odessa Colleges recently announced that they would offer instruction in wind-energy technology.

City government is another arena where programs and policies that implicitly or directly address climate change have multiplied in Texas, reflecting a municipal trend that has paralleled state government initiatives across the country. Houston, Dallas and other cities, for instance, formed the Texas Clean Air Cities Coalition, which joined forces with environmentalists and others in 2006 to oppose a proposal by the Dallas-based utility company then called TXU to build 11 new coal-fired power plants in Texas. The opposition was based on concerns about smog-forming pollutants' health impacts, as well as the carbon dioxide that the plants would release over decades of operation. In 2007, the company was acquired by buyers who, after consulting with opponents of the plants, dropped plans for all but three of them. In 2008, the coalition of cities, by that point numbering 37 cities representing more than half of Texas' population, and the Environmental Defense Fund dropped their joint opposition to the expansion of an NRG power plant after the company agreed to implement measures that would offset a large part of the coal-fired plant's carbon dioxide emissions.

By early 2009, 25 Texas mayors had committed their cities to the goals of the U.S. Mayors Climate Protection Agreement, a pact managed by the U.S. Conference of Mayors and signed by more than 900 mayors. Texas participants range from large cities, including Austin, Dallas, Fort Worth, San Antonio, to smaller ones like College Station and Sugar Land. The agreement commits participants to try to meet or exceed the CO₂ reduction targets in the Kyoto Protocol, an

international climate treaty, and to urge their states to do the same. The agreement is discussed in Chapter 8, where Clarkson also provides a detailed account of climate-related initiatives in Austin. The capital city, she reports, takes pride in being a municipal leader in reducing fossil fuel consumption.

Participation in the U.S. Mayors pact does not convey the full extent of Texas cities' efforts to cut greenhouse emissions and otherwise deal with climate change. Houston, the state's largest city, has not signed the agreement, but has launched a number of climate-linked projects in recent years. They include a project undertaken in concert with former President Bill Clinton's Clinton Climate Initiative to improve energy efficiency in municipal buildings through retrofits.

Besides such actions aimed at reducing carbon emissions, Houston has taken steps to be better prepared for hurricanes following its experience with Hurricane Ike in September 2008. Two months later, responding to the massive power outages that Ike caused, Houston Mayor Bill White appointed a Task Force on Electric Reliability, made up of individuals with relevant expertise, to recommend how to make the power grid "more durable and resilient." Such steps might include actions like burying some power lines.

Heightened preparedness for strong hurricanes like Ike also has been on the minds of Houston-area citizens, as reader comments on the Houston Press website in early 2009 illustrated. Regarding an article relating Galveston's struggles to recover from the storm, a Galveston resident wrote, "The No. 1 issue is now to minimize or eliminate catastrophes in the future, whether it involves raising houses or providing surge protection on the bay."

A Houstonian added this comment, referring to the famous sea wall that Galveston residents constructed after their city was devastated by the catastrophic hurricane of 1900:

Galveston has a dike, but it stops after ten miles. Did Ike know it was not supposed to go beyond the dike and flood the city from the back side? I grew up in Holland, where taxpayers spend billions of dollars on keeping their feet dry. What do we do here? Pray!

Preparedness for stronger hurricanes and other possible outcomes of climate change is a key theme that runs through the diverse contributions assembled in The Impact of Global Warming on Texas. Neal Lane, in the Foreword, urges that global warming be treated as "a risk-management problem." Time will tell whether Texans and their leaders increasingly adopt that viewpoint. If they do, the careful, comprehensive and evidence-based assessments in this book can serve as a useful guide. In any event, the book's publication means the state is being briefed at a crucial time about the risks and opportunities that some of Texas' most knowledgeable climate experts foresee.

The authors' summary of their key conclusions:

Climate Science and Climate Change: Climate science has evolved over the last thirty-five years to a point where predictions by climate models can be considered to have significant information content. The greenhouse effect has clearly established itself as a driver of climate change and the main agent is the continuing increase in the concentration of carbon dioxide in the atmosphere. There are several ways of assessing the status of climate change research, the most recent and comprehensive is from the Intergovernmental Panel on Climate Change: Fourth Assessment Report, released in 2007. According to this report greenhouse gases are expected to cause global temperatures to rise 5.4°F (plus or minus 1.8°F) by the end of the century. Temperature changes

in Texas are expected to be comparable. A notable feature of the predictions is the expansion of the tropical zone, familiar in summer for Texans, to include more of the spring and fall. This could lead to less rainfall especially in regions that are already dry. Other important effects include possible changes in El Niño (climate variability) and hurricane behaviors; further research will more accurately specify these and other effects.

The Changing Climate of Texas: Texas temperatures increase from south to north, whereas precipitation increases dramatically from west to east. The seasonal patterns of precipitation also vary greatly across the state (e.g., dry winters in the west, more even distribution in the east). Texas also experiences a variety of severe weather such as tropical storms, tornadoes, drought and flooding. The wide variations in weather and climate across Texas imply a broad range of vulnerabilities to climate change. Averaging over Texas the temperature over the last few decades has been increasing. Precipitation has also steadily increased over the past century, but with variation among the different regions. In the future, Texas temperatures are likely to continue rising. Precipitation changes are much less clear, with most models projecting a decrease. Even if precipitation were to remain stable, rising temperatures would increase evaporation and dryness. The expected changes in temperature and precipitation will have an impact on other sectors of the state's resources as discussed below.

Water Resources: Taking flows to the coast as a measure of river-basin impact, we calculate which changes will occur by mid-century under constant and changes climate conditions. Considering only population growth and the resulting increased water demand flows will be reduced by about 25 percent under normal conditions and by 42 percent under drought conditions. When also considering climate change (3.6°F increase in air temperature and 5 percent decrease in precipitation) 2050 projected flows to the coast are 70 percent of the 2000 values under normal conditions and 15 percent of 2000 normal under drought conditions.

Coastal Zone: There are two direct effects, which are already observable, in the instrumental record: rapid sea-level rise and rising sea temperatures. The sea-level rise rates are specially high in Texas because of the added effect of land subsidence, which is caused by oil and groundwater extraction. The increasing temperatures are already manifesting indirect changes in habitats and water quality.

Biodiversity: Climate is a key determinant of species distribution. As the earth warms, species tend to shift to northern latitudes and higher altitudes. But climate change represents just one of a set of stressors. Other changes challenging fauna and flora are due to land development, habitat fragmentation, invasive species, chemical stressors, and direct exploitation. Comprehensive assessments in each of Texas' ecological regions—coastal marshes, forests, deserts, prairies and western mountains—are needed to develop science-based management practices for wildlife and plant communities.

Agriculture: Agriculture in the U.S. and Texas is sensitive in terms of land and water usages, as well as crop and livestock production. However, in terms of agricultural-based economic welfare, the simulated effects of climate change are not large. We find that under the climate change conditions simulated herein that statewide Texas cropped acreage declines by about 20 percent.

Cities: Coastal population centers, from Houston to the Lower Rio Grande Valley, are vulnerable to sea level rise, increased storm intensity and accompanying flooding. All major Texas cities face the possibility of impacts on air quality, energy, health and other temperature related effects. All major cities face the prospect of declining water resources within the timeframe examined here.

Greenhouse Gas Emissions: Due to its large population and energy-intensive economy, Texas leads the nation in oil refining capacity and energy consumption, accounting for more than one-tenth of total U.S. energy use and 11 percent of U.S. greenhouse gas emissions. Although more than 30 U.S. states have taken some measures to address the issue of global climate change, Texas has not been willing to take direct action. It has, however, been a leader in renewable energy, and legislative action in 1999, and again in 2005, has resulted in Texas leading the nation in wind power production. There are many other, cost-effective measures that could be taken that would both reduce greenhouse gas emissions and improve the competitiveness of Texas' products.

Economy: Looking to mid-century, it is clear that the cost to Texas of a national cap and trade policy would likely exceed any possible measurable benefit in terms of avoided damages. But over a longer time frame, if the harmful impacts of climate damage continue to increase the cost-benefit balance might shift. But time is not on our side. Texas would benefit economically by taking stronger actions today to address climate change impacts at the State level, and by supporting the adoption of cost-effective, equitable policies at the national level to limit GHG emissions and encourage the use of non-fossil fuel alternatives.

Policy: Texas is a leader in the gradual shift to renewable energy. Energy and water conservation are also priorities, mostly at the community level. The driving forces of these policy initiatives are energy efficiency, resource conservation, and the income and jobs associated with industries developing alternative energy sources. These measures help to reduce greenhouse gas emissions. Thirty states have joined regional climate change alliances. Texas has not done so. We recommend that Texas develop a comprehensive climate change policy to serve the goals of reducing greenhouse gas emissions, increasing energy independence, ensuring regional security, and improving management of water, air, land and wildlife.