

Chapter 10: Policy

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The preceding chapters document how climate change and climate variability will impact Texas: 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. The exact timing of these changes and the speed at which they will occur remain uncertain. It is also unknown whether some of the predicted changes will occur gradually or suddenly after a tipping point has been reached.

These findings echo what we presented in the first edition of this book, published in 1995. Results of more recent studies on climate change and Texas are as follows:

- In 1997 the EPA released a report on Climate Change and the States that came to similar results (EPA 1997). I summarize the EPA findings in Table 10.1.
- The First National Assessment of the Potential Consequences of Climate Variability and Change, published in 2000, added important points: The summer heat index (which combines temperature and humidity) will increase significantly; heat stress for people and livestock will be more severe; soil moisture will decline due to decreased precipitation and increased evaporation; reductions in water supply and quality will pose problems primarily for urban and poor populations; the coastal zone will suffer significant loss of property and damage to ecosystems as a result of coastal flooding and erosion; oil refineries and the Gulf Intracoastal Waterway will be at risk from more frequent and more intense storms; and the health of urban populations will be impaired by an increase in smog-forming gases from fossil fuel power plants (US Global Change Research Program 2000).
- Norwine and John (2007) concluded that South Texas by 2100 will be drier, hotter and stormier. Barrier islands will have been lost and saltwater intrusion will diminish water supplies.
- The most recent study by the U.S. Global Change Program emphasizes the risk of more intense droughts: “The consensus of most climate-model projections is for a reduction of cool season precipitation across the U.S. Southwest and northwest Mexico” (NOAA 2008).

The likely impacts for Texas fall within the range of changes predicted for North America by Working Group II of the 2007 IPCC Assessment (IPCC 2007): IPCC assigns “very high confidence” to stress and damage from extreme weather, sea level rise, as well as infrastructure, health and safety issues (for details see Table 10.2). Taken together the findings about the expected impacts of climate change on Texas have not changed fundamentally over the last decade and a half. But the evidence is now more extensive and detailed. In contrast, the context for policy development has changed substantially. There are several reasons for this.

Table 10.1. Impacts of Climate Change on Texas, EPA Estimates for 2100

Temperature	+3.5°F
Precipitation	-5-30% in winter; +10% in other seasons
Heat-related illnesses	Increase
Ground-level ozone causing more respiratory diseases	Increase
Flooding	Increase in frequency
Instream flows	-35%
Sea level rise	31 inches at Galveston
Harmful algal blooms	Increase

Source: US EPA, Climate Change and Texas 1997

[http://yosemite.epa.gov/OAR/globalwarming.nsf/UniqueKeyLookup/SHSU5BWHN8/\\$File/tx_impct.pdf](http://yosemite.epa.gov/OAR/globalwarming.nsf/UniqueKeyLookup/SHSU5BWHN8/$File/tx_impct.pdf)
(accessed June 2008)

Table 10.2. Climate Change Impacts on North America – Nature and Confidence Level

	Impact	Confidence
Adaptive capacity	Overly focused on coping with rather than preventing problems	Very high
Extreme weather	Will increase and cause significant economic damage	Very high
Other stresses	Will increase due to climate change (infrastructure, health, safety)	Very high
Coastal communities/ habitats	Will be stressed in conjunction with development	Very high
Health	Increased risk (heatwave deaths, waterborne diseases, poor water quality)	Very high
Water	Reduced supply due to diminishing snowpack, higher evaporation	High
Ecosystems	Increased risk of wildfire and insect infestations	High

Source: IPCC 2007. Climate Change 2007: Impacts, Adaptation and Vulnerability. Summary for Policymakers and Technical Summary. International Panel for Climate Change, pp. 55-56.

First, decision makers have fewer excuses to defer action because of scientific uncertainty. Key questions that were controversial two decades ago have been resolved: Yes, warming occurs not only at the earth's surface but also at higher altitudes. Yes, increased water vapor in the atmosphere amplifies global warming. However, the regional distribution of precipitation and the exact timing of predicted changes remain uncertain and require more study. Second, climate change is no longer a distant possibility but occurs now. "Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases." This is in sharp contrast to our 1995 assumption that the impacts of climate change would only be felt by 2030. Third, the overwhelming majority of scientists are confident that observed and predicted changes in natural as well as social systems are caused by human development (these three statements are based on IPCC 2007). As a result, the urgency to act on climate change has increased greatly since 1995. The 2007/2008 UN Human Development report starkly makes the point: "Climate change is the defining human development challenge of the 21st Century... Looking to the future, no country—however wealthy or powerful—will be immune to the impact of global warming" (UNDP 2007).

In this chapter I briefly review policy development in response to climate change at international, federal, state and local levels in the United States and then discuss policy options for Texas. Several of the preceding chapters also discuss policy issues related to their subject matters. Here I focus on specific policy measures that should be taken by state agencies and on development of a comprehensive state climate policy.

CLIMATE CHANGE POLICY TO DATE

International and Federal

In 1988, the United Nations convened the Intergovernmental Panel for Climate Change (IPCC) to provide policymakers and the public with reliable summaries of scientific information. The IPCC has since published four detailed assessments of steadily improving scientific knowledge about climate change. Toward the end of the first Bush administration, at the environmental summit in Rio de Janeiro, the United States signed the UN Framework Convention on Climate Change. The convention marks the beginning of international action against climate change. It soon became obvious, however, that the voluntary measures agreed on in Rio yielded little results and a binding agreement was needed.

The Clinton administration took the lead in international negotiations aimed to reach such an agreement. Against initial opposition from Europe the United States insisted on a treaty that included provisions for market-based carbon trading. The United States modeled its proposal on the successful sulfur dioxide trading system that had been introduced in the United States as part of the Clean Air Act amendments of 1990 (Environmental Defense 2008, Litz 2008, p. 11)). The resulting agreement, the Kyoto Protocol, was signed by the United States in 1997. But the Senate later passed a 95-0 resolution signaling they would not ratify the treaty in its original

form. Senator Kerry, an ardent supporter of CO₂ regulation, spearheaded the Congressional no. He did so in the belief that this action would motivate the President to renegotiate Kyoto in order to make Brazil, China and India active participants in the fight against global warming. Kerry was confident that a revised treaty would then be ratified (Kerry 2008). He was mistaken. The administration initiated no new negotiations and the Kyoto Protocol became international law with only two industrialized countries abstaining—Australia and the United States. (Australia, after a change in government, joined the treaty in 2008).

As a signatory of the United Nations Framework Convention on Climate Change, the United States currently participates in negotiations (the so-called Bali process) aimed at reaching international agreement on reducing greenhouse gases in the period after 2012 when the Kyoto Protocol will have run its course. Preparatory work on the new treaty focuses on defining an emissions reduction formula that assigns “shared but differentiated” responsibilities to industrialized and developing countries. Under the current timetable agreement on the new treaty should be reached in late 2009.

In April 2007, in response to law suits filed by 11 states, three cities and 13 environmental groups, the U.S. Supreme Court ruled 5 to 4 that the Clean Air Act gave the Environmental Protection Agency the authority to regulate CO₂ emissions, if the agency found them to be harmful to “public health and welfare”. EPA made a draft finding to that effect, but was ordered by the White House not to start regulatory proceedings. The EPA then stated that the Clean Air Act was ill suited for regulating CO₂ and a new law was needed for the purpose (Washington Post 2008). Contrary to President Bush’s statements during his second presidential campaign, the federal government limited its actions to support of research and voluntary measures.

Over the last several years there has been considerable action on climate change in both Houses of Congress. In the 107th Congress (2001-2002, the beginning of the Bush Administration), four bills setting mandatory limits on carbon dioxide emissions from power plants were introduced: S.556 (Jeffords), H.R.1256 (Waxman), H.R.1335 (Allen), and S.1131 (Leahy). A number of other bills related to climate change were also introduced, but only these four included prescribed emission limits or absolute emission reduction goals. In 2003, the McCain/Lieberman bill was defeated 55 to 43 in the Senate. Both Texas senators voted against the bill. In the 110th Congress (2007-2008), 14 bills mandating limits on carbon dioxide emissions from power plants or multiple sectors of the economy were introduced: S.280 (Lieberman/McCain), S.309 (Sanders/Boxer), S.317 (Feinstein), S.485 (Kerry/Snowe), H.R.620 (Olver/Gilchrest), S.1168 (Alexander), S.1177 (Carper), S.1201 (Sanders), H.R.1590 (Waxman), S.1766 (Bingaman), S.2191 (Lieberman/Warner), H.R. 4226 (Olver), H.R.6316 (Doggett). The Senate, in June 2008, defeated the Lieberman/Warner Climate Security Act, which would have introduced a market-based cap-and-trade system for CO₂. In October 2008 Representatives Dingell and Boucher released a discussion draft that is not yet introduced as legislation. But the fact that the discussion draft was introduced by a sitting committee chair makes it significant.

There is widespread expectation that the Congress will pass a climate bill in 2009. For a discussion of federal policy options on climate change see chapter 9 and GAO (2008).

An influential group supporting federal legislation—the Climate Action Partnership—was founded in 2007. Founding members of USCAP include a number of major corporations: Alcoa, BP America Inc., Caterpillar Inc., Duke Energy, DuPont, FPL Group, Inc., General Electric, PG&E Corporation and PNM Resources — and four non-governmental organizations including: Environmental Defense, Natural Resources Defense Council, Pew Center on Global Climate Change and World Resources Institute. These organizations “have come together to call on the federal government to quickly enact strong national legislation to require significant reductions of greenhouse gas emissions” (<http://www.us-cap.org>).

States, Regions and Cities

In the absence of meaningful federal action, states and cities, over the course of the last decade, have become major players in attempts to reduce greenhouse gases and increase the energy security of their constituents. In the 50-year history of environmental policy the states have repeatedly spearheaded federal action. This was the case in early action on air and water pollution, as well as acid deposition. But the current state initiatives involve more states and spawn more cooperation among them than ever before. Lutsy and Sperling (2008), in a detailed analysis of this new trend, write: “Local, regional, and state governments are now following a prescribed pattern of inventorying their emissions, establishing climate change action plans, setting emission reduction targets ..., enacting state-level regulations and standards explicitly targeting GHGs, and forging multi-government alliances to reinforce and support their actions.” As a result of these initiatives, we are witnessing a shift in U.S. environmental policy to a decentralized bottom-up approach. It remains to be seen if this is a temporary phenomenon.

An EPA score card of state actions to combat climate change identifies 15 programmatic initiatives that the states have launched between 2000 and August 2008. I summarize the results in Table 10.3. More details are given in Chapter 8, much of it taken from the Pew Center’s web site on Global Climate Change (Pew 2008a). The research conducted by the Pew Center documents a fast rising level of state programs, currently involving more than half of all states, either acting jointly with neighboring states or on their own. A list of the state laws authorizing these initiatives can be found at Pew 2008b. Information on specific bills has been compiled by the National Caucus of Environmental Legislators (2008). Actions taken by cities and counties are listed on the website of the U.S. Conference of Mayors (2007 and 2008). Each of these is discussed below.

Table 10.3. State Initiatives on Climate Change*

	Yes	No	Texas
State advisory board	28	22	No
Member of regional initiative	30	21	No
Greenhouse gas inventory	46	4 ^a	Yes
Climate Change Action Plan	32	13 ^b	No
Statewide greenhouse gas target	19	32	No
Statewide greenhouse gas cap	5	46	No
Electricity disclosure	21	30	Yes
Greenhouse gas registry	40	11	No
Mandatory greenhouse gas registry	19	32	No
CO ₂ offset requirements	3	48	No
Greenhouse gas performance standard	4	47	No
Advanced coal technology	14	37	Yes
Power sector GHG cap and trade	12	39	No
Greenhouse gas auto standards	15	36	No
Low carbon fuel standard	1	50	No

^a In Progress 1

^b In Progress 6

*Status as of August 2008

Source: US Environmental Protection Agency

<http://www.epa.gov/climatechange/wycd/stateandlocalgov/index/html> (accessed November 2008)

California

As has been the case in response to other environmental threats, California leads the states in acting on climate change. With bipartisan support from policy leaders and broad public acceptance, California has put in place an ambitious program to reduce emissions. Industry response was divided but support eventually outweighed opposition. Several factors make it easier to act on climate change in California than elsewhere: Republicans and Democrats, after much wrangling, reached a meaningful compromise. There is no coal or automobile lobby in the state. The state economy, to a considerable extent, is focused on itself and markets across the Pacific. Consumers are more willing to adopt new solutions. Texas can learn useful lessons from several of California's programs.

In 2002, California passed a law to reduce greenhouse gas emissions from automobiles and trucks. New light-duty vehicle emission standards for greenhouse gas emissions were promulgated in 2004. This was followed by the lynchpin of California's initiative, the Global Warming Solutions Act of 2006 (AB 32). The bill mandates a 28 percent reduction of total emissions from the 1990 base by 2020 and an 80 percent reduction by 2050. These numbers equal the emission reduction targets that have been enacted or proposed by members of the European Union. Once Governor Schwarzenegger had signed the enabling legislation, implementation was entrusted to state agencies that work closely with university and industry experts. The lead agency is the California Air Resources Board, a department of the California Environmental Protection Agency. The legislation grants the Air Resource Board (CARB) wide ranging powers to set policies, draw up regulations, lead the enforcement effort, levy fines and

fees to finance it and punish violators. CARB prides itself of its technical expertise and relative insulation from political interference. Half of the Board's eleven members are scientific or professional experts; the other half represents regions of the state. CARB began its work with a detailed scoping study, then developed a precise timetable, and is now drafting mandatory rules that set energy efficiency standards for vehicles, appliances and housing (California Air Resources Board 2008a). CARB claims that the measures needed to reach the 2020 reduction goal, despite high costs, will benefit the state economy and job market. "Under the Plan, homeowners can achieve electricity savings between 1,500 and 1,800 kWh per year for older and newer homes, respectively, and over 300 therms of natural gas per year" (California Air Resources Board 2008b, p.ES-5). These savings would continue California's success in holding per capita electricity use constant since 1970, while per capita use rose by nearly 80 percent in the United States as a whole.

The main goal of the 2006 act is to reduce emissions from the transportation sector, which account for 39 percent of emissions. But all sectors of the economy, as well as private residences, must reduce emissions. Electricity generation currently accounts for 28 percent of emissions; residences contribute 9 percent and refineries 8 percent. The 2004 vehicle standards have been opposed by the automobile industry and the EPA has denied the necessary waiver for California to proceed with the new standard. CARB expects that the federal administration taking office in 2009 will approve the necessary waiver.

California expects short-term emission reductions to result from new low carbon fuel standards. As the downside of the grain-based ethanol mandate becomes clearer, this goal may be difficult to meet. Long-term improvements will result from technical innovation. For this the state relies on a clear division of labor: The state issues performance standards and monitors compliance, industry will develop successful solutions. State government does not pick winners. An education campaign is underway to encourage people to drive less. Cities and counties are required to develop their own carbon reduction strategies (Sperling 2008).

CARB is also engaged internationally by sharing engineering and policy expertise on how to measure and control greenhouse gases with regions such as Brazil's Amazon states and Indonesia's forested provinces.

Regional Alliances

Thirty states have joined regional climate change initiatives. The first one, initiated in 2005, was the Northeast Regional Greenhouse Gas Initiative. This was followed in 2007 by three others. Figure 10.1 and Table 10.4 show the participating states and the programs to which they have committed. Twenty of the participating states have Democratic governors; the others have Republican governors. The legislatures of the participating states are controlled as follows: Democrats fifteen, Republicans six, split between House and Senate nine. The alliances, therefore, have attracted significant bipartisan support. It is noteworthy that the entire Southeast region of the country and Texas are not participating. Florida decided to develop its own cap-and-trade emissions reduction program (Florida Energy and Climate Change Action Plan 2008).

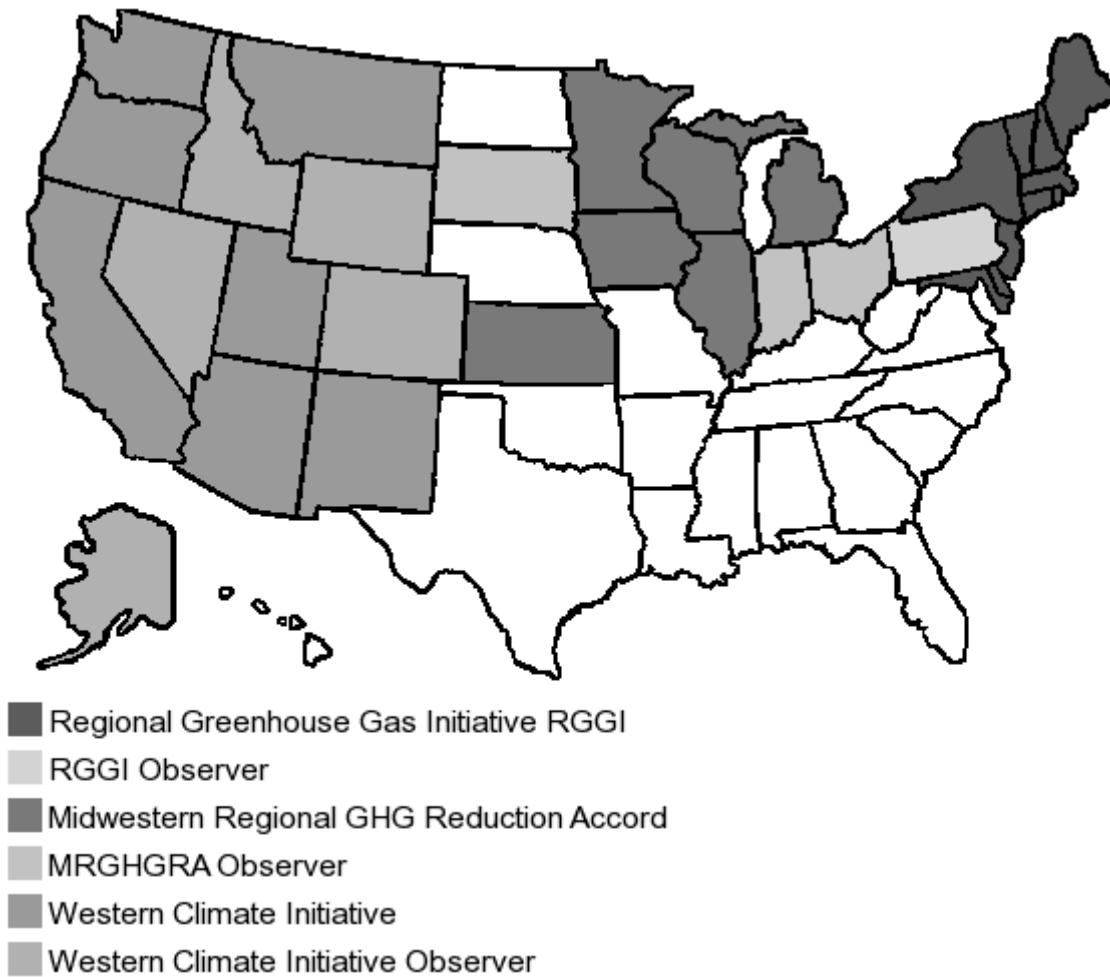
Table 10.4. Regional Climate Change Alliances

	Members			Programs
	Full	Observers	Foreign	
Northeast Regional Greenhouse Gas Initiative	10 (a)	1 (b)		By 2009 implement first mandatory cap-and-trade-market for CO ₂ emissions
Energy Security and Climate Stewardship Platform for the Midwest	11 (c)		1 (d)	Increase energy efficiency, renewable energy sources and biofuel production By 2010 develop regulatory framework for capture and storage of carbon By 2012 site and permit regional CO ₂ transport pipeline By 2020 new coal power plants will capture and store CO ₂ emissions
Midwestern Regional Greenhouse Gas Reduction Accord	6 (e)	3 (f)	1 (d)	Reduce GHG emissions 60-80% Develop GHG reduction tracking system Adopt low-carbon fuel standards Develop cap-and-trade market for CO ₂ (observers will participate)
Western Climate Initiative	7 (f)5 (g)		2 (h)	Develop regional emission target Establish market-based system for CO ₂ control By 2020 reduce GHG emissions 15% below 2005 levels

- (a) CT, DE, MA, MD, ME, NH, NJ, NY, RI, VT
- (b) VT
- (c) IA, IL, IN, KS, MI, MN, MS, ND, NE, OH, WS
- (d) Manitoba
- (e) IL, IA, KS, MI, MN, WS
- (f) AZ, CA, MT, NM, OR, WA, UT, Quebec
- (g) AK, CO, ID, SD, WY
- (h) British Columbia, Manitoba

Source: Pew Center on Global Climate Change and websites of regional climate change alliances

Figure 10.1 Map of Regional Climate Change Initiatives



Source: Pew Center on Global Climate Change

The Northeast and Midwest regional alliances are in the process of starting cap-and-trade markets. The first auction took place in September 2008. It covers fossil-fuels based power plants in the Northeast. The Midwestern market will include the transportation sector, which is difficult to verify. It remains to be seen if these programs will avoid initial mistakes made by the major existing cap-and-trade system that became operational in Europe in 2005. During its first phase the European program suffered from incomplete data, wrong assumptions and over allocation of CO₂ allowances. The program is now in its second phase and considered to be a success (Sjardin 2008).

Cities

In 2005 a bipartisan coalition of 132 U.S. mayors, led by Seattle Mayor Greg Nickels (D) and New York City Mayor Michael Bloomberg (R), committed to reducing their municipalities' greenhouse-gas emissions to 7 percent below 1990 levels by 2012, in line with Kyoto treaty targets. This is to be achieved by a wide range of measures, including urban reforestation, building standards that increase energy efficiency, changes in landfill practices and public education campaigns. The mayors refuted the Bush administration's argument that Kyoto would devastate the economy. Instead, most of the mayor's stated that they signed on precisely for economic reasons. Nickels was jarred by a series of dry winters, threatening Seattle's drinking water and hydropower sources. The mayor of Bellevue, Neb., was worried about the effects of droughts on farms. The mayor of New Orleans was concerned about the effects of rising sea levels on "the very existence of New Orleans" (Sanders 2005). By 2007, 540 cities had joined (US Conference of Mayors). The most recent count lists 684 cities (Lutsey and Sperling 2008).

A survey of member cities conducted by the US Conference of Mayors showed that, out of 134 cities reporting, 80 percent use renewable energy; 97 percent have switched to energy-efficient lighting in public buildings, street lights and traffic signals; 72 percent power city vehicles with alternative fuels; 90 percent require new city buildings to be energy efficient and environmentally sustainable; and 70 per cent encourage private contractors to build energy-efficient structures. Almost all cities consider their actions on global warming as directly contributing to improved health and quality of life for their citizens (US Conference of Mayors 2007).

How significant are state and local actions? Lutsey and Sperling calculate that combined state and local emission reduction plans apply to 43 percent of US greenhouse gas emissions. "If the 17 states that have set their own GHG emission-reduction targets (generally to 1990 levels by the year 2020) in fact were to achieve those targets, nationwide US GHG emissions would be stabilized at 2010 levels by 2020—without any serious mitigation action taken by over half of the states... Although these reductions are nowhere near the deeper longer-term reduction that would be required for climate stabilization, they are nonetheless substantial and significant relative to federal inaction." As regional and local programs mature states and cities increasingly learn from each other and use common protocols and standards for their actions. Several years back it looked as if an uncoordinated patchwork of local and regional rules was emerging. But by now the sum of state and local actions has been described by Lutsey and Sperling as a "consistent US policy structure" based on coordinated inventories of emissions, mitigation plans and emission reduction targets.

This may be an overly optimistic conclusion. The pros and cons of bottom-up policies in the context of environmental federalism need to be clearly recognized. On the negative side, a patchwork of state or regional regulations imposes cumbersome burdens on industry, wastes regulatory resources, cannot deal efficiently with cross-boundary pollution, encourages polluters to move to more lenient jurisdictions and imposes costs on regulating states without guarantee that they will reap proportionate benefits. There are also advantages: state initiatives can help re-engagement of the federal government in developing domestic and international policy; the

experience gained by the states can guide federal policy development and define US policy preferences. Above all, local and regional involvement is essential to achieve the technological, economic and social transformations that large CO₂ reductions will require. Strong local commitment is a prerequisite for successful federal regulation (Lutsey and Sperling 2008).

It is unclear whether federal legislation, if and when enacted, will supersede regional programs or accommodate them. I share the view of the Pew Center on Global Climate Change: “Federal action on climate change is needed to achieve the significant reductions science demands and to establish a minimum level of uniformity across the U.S. economy. This federal action can preserve room for states to continue in their important roles as policy innovators, on-the-ground implementers, and policy drivers, and to capitalize on the significant experience in the states across the many aspects of climate change” (Litz 2008, p. 2).

RESPONDING TO CLIMATE CHANGE IN TEXAS

In the 1995 edition of this book we recommended that Texas develop policy in response to three threats from climate change:

1. Reduction of carbon emissions: Texas is home to 25 percent of the nation’s refining capacity and leads the country in emitting greenhouse gases. We argued that the state would be well advised to proactively contribute to the national debate about the costs and benefits of a federal carbon tax compared to a cap and trade system. State policy makers needed to know how either measure would impact the Texas economy. Would the state be hurt more than other states if the new charges were imposed at the refinery, which would be the case if a cap and trade system was introduced? Or would it be better to have the charge paid by the consumer, which would be the case if a carbon tax was imposed?
2. Sea level rise: The gentle slope of the Texas coast line will expose large coastal areas to sea level rise, erosion and salt water intrusion into aquifers. The state should use its experience with land subsidence from pumping oil, gas and water to incorporate sea level rise into its coastal management plan, as well as zoning ordinances and insurance requirements.
3. Water scarcity: A large part of Texas is semiarid. The panhandle, West Texas and the Rio Grande border region, in particular, will experience higher temperatures, higher rates of evaporation and decreased rainfall. Combined with population growth this will lead to greater demand for water and increased competition between agricultural, municipal and ecological water demands. State water management agencies should prepare for global warming through conservation, more efficient water use and better drought preparedness.

Actions to Date

Texas did not follow these recommendations. As a matter of fact, global warming rarely appeared on the radar screen of state policy makers after an initial wave of interest in the early nineties had dissipated. A scorecard prepared by the Environmental Protection Agency shows that Texas acted on only three out of 15 climate change initiatives that are currently underway in various states (see Table 10.3):

1. Texas completed a greenhouse gas inventory in 2002. As a follow up step EPA recommended that the state regularly report its greenhouse gas emissions. This was not done.
2. As of July 2002, retail electric providers (REPs) must provide the standardized format Electricity Facts Label to customers upon their request. Labels must include electricity prices, contract terms, and sources of generation and emissions levels.
3. The 2005 legislature passed H.B. 2201 that provides for the transfer of CO₂ from a future clean coal power plant to the Railroad Commission (for injection in old oil and gas wells) and the Texas Water Development Board (for injection in old water wells). Legislators also approved expedited permitting for such projects. The bill was intended to help Texas win the national competition for a clean coal demonstration plant.

In contrast, there has been considerable action on the part of local governments. Twenty-three Texas cities have joined the Mayors' Climate Protection Agreement discussed in the previous section. Signatories include Austin, College Station, Dallas, El Paso, Fort Worth, Laredo and San Antonio.

The City of Austin has set itself the goal to become "the leading city in the nation in the fight against global warming" (Austin 2007a). The City Council adopted a broad ranging Climate Protection Plan in 2007. The plan includes action on several fronts: all city vehicles, facilities and operation will be carbon-neutral by 2020; the city's electric utility will reduce emissions through large increases in conservation, efficiency and renewable energy sources; existing utility plants will be retired early and replaced by carbon-neutral plants; building codes for residential and commercial properties will require high energy efficiency; a community plan is being developed with provisions for reducing greenhouse gas emissions from all sources (Austin 2007a). The city-owned utility company has been instructed to get 30 percent of its power from renewable sources by 2020. As an important step in this direction the city council, on August 28, 2008, approved a 20-year 2.3 billion dollar contract with a private provider to build and operate a 100-megawatt biomass plant that will use wood waste as fuel (Austin American Statesman 2008). To report on progress and solicit citizen input a special climate change web site went online in June 2008 (Austin 2008). The city council approved recommendations by a special taskforce on energy efficiency requirements for new buildings (Austin 2007b). These requirements have since been incorporated into the city building code. A second task force proposed that homes older than ten years must have a mandatory energy audit

at time of sale. Commercial and multifamily properties would have an audit performed within two years. Upgrades would be voluntary and performance would be monitored every two years. The City Council approved these recommendations on June 1, 2008.

There has also been action on the part of Texas-based foundations. In February 2008 the George and Cynthia Mitchell Foundation created a three-year \$6million program to advance renewable energy and energy efficiency technologies and to help Texas develop a comprehensive global warming strategy (Mitchell Foundation 2008). The Houston Endowment has made several grants to Texas universities and environmental groups in support of research and education on global warming, air quality and energy efficiency. One of their grants makes possible publication of this book. The Houston Advanced Research Center has used grant money to publish "Texas Climate News: Reporting on Climate Change and Sustainability Issues" (<http://texasclimatenews.org/Default.aspx>).

City and foundation activism may have helped to generate more interest in climate change during the Texas 2007 legislative session. Twelve bills were introduced to curb greenhouse emissions or to support precautionary measures to adapt to global warming. Yet not much was accomplished. Seven bills never received a hearing. Four died after hearings in committee. Only Senate Bill 1762 passed, charging the Texas Water Development Board with studying the likely impact of climate change on drought conditions in Far West Texas. This may trigger the TWDB to change the position it had adopted in a 2007 report to the Legislature: "When considering the uncertainties of population and water demand projections, the effect of climate change on the state's water resources over the next 50 years is probably small enough that it is unnecessary to plan for it specifically"(TWDB 2007, p. 299). Overall the majority of state leaders remain skeptical about global warming. Efforts to improve energy efficiency have a better chance to succeed in the legislature if the bill does not mention climate change. The legislature is still at the point that, according to a study published in 2000, was then the norm for US cities: "Ironically, the most effective way to get municipal governments to take action on global climate change is to not talk about global climate change" (Betsill 2000, Abstract).

Sector-specific Policy Measures

What should Texas do to respond to climate change? The Pew Center for Global Climate Change, in its Agenda for Climate Action, urges action in six areas: Science and technology research, market based emissions management, emissions reduction in key sectors, energy production and use, adaptation and international engagement (Pew 2006b). In the following sections I discuss how Texas might become active in several of these areas, by contributing to the national policy debate, joining the efforts of other states and acting on its own to prepare for a changed climate.

The time for this to happen seems right as the mood in Texas is shifting from inaction to support of technological innovation and adaptation strategies. Larry Soward, one of three commissioners appointed by the governor to the Texas Commission on Environmental Quality, advocates a more active strategy: "As the nation's leading emitter of greenhouse gases, and with an extremely vulnerable coastline it only seems reasonable and logical to me for us here in Texas to step up, take a leadership role and begin to seriously and meaningfully address our greenhouse

gas emissions" (Soward 2008). In testimony before the Texas Senate Natural Resources Committee on July 8, 2008 Soward proposed as an immediate first step legislation "requiring Texas to either develop and implement our own greenhouse gas inventory and registry, or require us to join the multi-state Climate Registry". Tony Bennett, writing for the Texas Manufacturers Association, favors long-term investments in innovative technologies: "Policies should encourage technology investment to safeguard the environment without decimating the economy... Misguided and unrealistic mandates force employers to divert resources in the near-term rather than promote spending for long-term innovations to reduce greenhouse gases and increase efficiency" (Bennett 2008).

Yet public support remains weak, as several opinion surveys have shown. "Climate change and climate variability DO NOT emerge as top of mind problems" (Vedlitz 2004). "Texans are very concerned about drought. They see climate change as relevant, but less important than other factors" ((Vedlitz 2008). The governor remains staunchly opposed to federal regulation of greenhouse gases that would, in his opinion, "run this nation's strongest economy right off the tracks and into the ditch" (Perry 2008b). In this section we present policy recommendations in the areas of science policy, emissions control, water management and coastal management. We then outline elements of a comprehensive Texas policy in response to climate change.

Science policy: Make Results Relevant to Resource Managers

Managers of air sheds, water basins and ecological regions have found it difficult to integrate scientific information provided by climatologists into their plans and actions. Hydrologists, for example, use the catchment area as the basis for planning. They need data on precipitation, runoff, in-stream flow, evapotranspiration and related factors to estimate future water supply. Climatologists, by contrast, use square grids of equal size to model changes in temperature and precipitation. To this date climatologists and hydrologists do not speak the same language. To make climate model results more compatible with the needs of water managers (and other managers of natural resources) new assessment methodology and closer interaction with practitioners in the field are needed. The problem is significant but not sufficiently recognized. It warrants detailed discussion.

When climatologists study global warming they ask how an increase in the concentration of greenhouse gases in the atmosphere is likely to change temperature, precipitation, sea level, ocean currents and other factors that determine the climate of the globe. Using increasingly sophisticated climate models climatologists provide reliable information about expected temperature changes at different latitudes. This makes it possible to predict temperature changes at regional scales. For a long time, however, the square grids used by the Global Circulation Models were too large to be of much use to regional resource managers. By now GCMs have been refined to produce information for horizontal grids measuring 200 square km, about 77 square miles, and some regional models have been scaled down to 100 square km, occasionally even 10 square km. Even so, there remain unresolved problem with down scaling, in particular when predicting changes in precipitation. This is for several reasons. First, different models still come to different results on where to expect more or less rain. Second, square grids do not easily translate into the planning units that are used in water, air and ecosystem management,

such as water basins, air sheds and ecosystems. Third, climatologists and resource managers use different data sets. Most importantly, climate change research focuses on a single problem, namely the increased presence of greenhouse gases in the atmosphere and the consequences of this phenomenon. How climate change impacts existing problems in the water basin or air shed is not considered. For all these reasons it remains difficult for resource managers and policy makers to integrate climate change data into regional planning and action.

The National Academy of Sciences has proposed methodology to overcome these shortcomings. What is needed, in their view, is an integrated understanding of regional problems that, taken together, threaten sustainability. Traditional environmental threats deal with a specific disturbance of a natural system by human action. Examples include water and air pollution, contamination by toxic substances, depletion of the ozone layer or climate change. In each case, a single man-nature interaction is analyzed. The complex chain linking cause to effect is identified. Over time scientists have successfully used the traditional tools of science—formulating a hypothesis, observation, measurements, interpretation and linking data to theory—to explain the issue and provide policy-makers with a knowledge base that can guide remedial action.

However, single-issue problems, in the view of the Academy, are no longer the key obstacles standing in the way of sustainable development. People live in specific places where environmental threats arise from problem clusters, some caused by global forces, others due to regional factors. These program clusters must be understood before reliable policy advice can be given. Many regions suffer from multiple, cumulative and interactive stresses, driven by a variety of human activities. Here are two examples: some regions suffer from the combined stresses of population growth, water pollution and ill health; other areas experience the joint effects of soil depletion, drought and malnutrition. Climate change is an additional problem that needs to be integrated into the existing set of regional problems. Problem clusters of this kind are difficult to unravel and complex to manage. They are shaped by physical, ecological and social interactions in particular places. They are place-based. The Academy report recommends developing sustainability science as a new approach that can unravel complex problem clusters into their constituent components, follow their interactions, present an integrated view of the issue, and identify options for workable solutions. The Academy report concludes: “Developing an integrated and place-based understanding of such threats and the options for dealing with them is a central challenge for ... a transition towards sustainability” (National Research Council 1999, p. 8). Ralph Cicerone, President of the Academy of Sciences, offers this definition: “Sustainability science is supposed to draw upon contributions from every field of science and engineering and medicine, social science, and draw upon the observations of the direction we're headed and the likely outcomes and continue to navigate this transition to a more sustainable direction” (Personal interview March 15, 2007).

Successful sustainability science is a precondition for successful policy development. Both the science community and the policy community must understand this. Scientists must organize in teams of experts from relevant scientific disciplines who work together to untangle a local or regional problem cluster, identify interactions and feedbacks between contributing causes, and construct an integrated, policy-relevant knowledge base. This is not a revolution in scientific theory or method but a change in research organization. Sustainability science requires scientists to organize their work cooperatively by working in teams whose members are trained in different disciplines. Team members will use the methods they have been trained in to study

parts of the problem cluster. They will then work as a group to integrate their findings. They will also take the time to interact closely and repeatedly with stakeholders and decision-makers. Finally, they will present their results to the public and decision makers in a format that is accessible to the non-specialist. Policy makers and resource managers must call for and use this kind of high-level risk and scenario analysis so that their decisions rest on firm ground.

Two Texas scientists have suggested how the concept of user-focused, place-based sustainability science can be implemented and used to address climate change issues in the state. Both proposals emphasize two key points: First, climate change needs to be considered in conjunction with other regional problems, not as a standalone issue. Second, there must be better links between the research and practitioner communities. Eric Barron, until recently Dean of the Jackson School of Geology at the University of Texas Austin and now director of the National Center for Atmospheric Research, proposes the creation of Environmental Intelligence Centers where research on climate is linked to human activities. Multiple stresses are studied at local and regional scales. The Centers will specialize in what Barron calls “Stage II Sciences” that focus on the linkage between prediction and action (Barron 2008). Robert Harriss, president of the Houston Advanced Research Center, advocates the creation of Urban Sustainability Centers that “catalyze, facilitate, and support the integration process necessary to creating use-inspired solutions to ... a renewable energy future, adaptation to climate change, sustaining biodiversity and ecosystem services, reducing vulnerabilities to pollution and natural disasters” (Harriss 2008). These proposals aim at marshalling science to the solution of today’s problems in the same way that the agricultural research and extension services contributed to the success of agriculture in America and Texas for the last century and a half.

Action is needed on three fronts: Texas universities and research organizations should encourage and reward “Stage II Science” projects that are interdisciplinary, problem-focused and participatory. The Texas Agricultural Extension Service, or some other interested state agency, should prepare a concept paper and action plan for the creation of urban service centers. Texas based foundations should provide support for these initiatives.

Energy, Environment and Economy: Reducing Emissions

Up to now Texas has declined invitations to participate in regional efforts to regulate greenhouse gases. Nor have governor and legislature encouraged the Texas Commission for Environmental Quality to regulate CO₂ as an air pollutant. Continued failure to participate with others or act on its own may give other states an edge in influencing national policy during its formative stages. Actions by regions and states are getting business and people ready for the low carbon future.

Having said this, Texas does invest in programs aimed at improving energy efficiency and independence. Pursuing these strategies benefits the state’s economy, creates jobs and reduces costs over time. Whether intended or not, programs of this kind also reduce greenhouse gas emissions. Geographically, Texas is well placed to lead in the development of solar and wind power technologies. The state can also be a player in the search for better biofuels, in particular from switch grass, wood chips and algae from the Gulf of Mexico. As native oil reserves decline, more of the state’s energy needs, at least for the next twenty to thirty years, will need to be met by coal and nuclear technology, which currently account for about half of electric power produced in Texas (the other half coming from natural gas). Ten new coal plants have been permitted or are waiting for approval. Three more are on the planning board. Without

clean coal technology the state will vastly increase its CO₂ emissions and impede meeting future federal emission reduction mandates.

An important, cost-effective strategy is to reduce energy demand by improving energy efficiency in homes, businesses and transportation. Results will be driven by market forces rather than regulation: the cost of energy and changes in consumer behavior. Experts estimate that 30 percent of energy, and often more, is wasted and could be spared using currently available technologies. “In my team’s latest redesigns for \$30 billion worth of facilities in 29 sectors, we consistently found about 30 to 60 percent energy savings that could be captured through retrofits, which paid for themselves in two to three years. In new facilities, 40 to 90 percent savings could be gleaned—and with nearly always lower capital cost” (Lovins 2008). Such gains will benefit the economy and immediately lead to significant reduction in greenhouse gas emissions. The state and cities have a dual role to achieve these goals: issuing more stringent standards for construction, appliances and vehicles and monitoring compliance.

Development of new technologies should be driven by business investments. The state should not make these decisions. But it should lend support in the form of research grants and demonstration contracts. Candidates for support include clean coal technology, CO₂ storage, next generation nuclear power, safe storage of nuclear fuels and alternative fuels. The value of state leadership on these issues has been demonstrated in California. According to the December 1, 2005, summary by the Hewlett Foundation, state policies encouraging the use of natural gas and renewable resources, as well as the aggressive promotion of conservation measures, has resulted in a drop in per capita emissions of a third since 1975, while the nation’s per capita emissions have stayed flat. This has resulted in savings of approximately \$1,000 per year in electricity costs for each Californian and has helped the economy grow an additional three percent. The job growth created by the energy-efficiency industry will generate an \$8 billion payroll over 12 years (Friedman 2008, p. 279).

Some of these initiatives are already underway. The State Energy Conservation Office reports: “The U.S. wind industry grew by 45 percent in 2007, and over half of that growth was contributed by Texas. Texas is the leading wind state in the U.S., accounting for close to one-third of the nation’s total installed wind capacity, which is the equivalent of the electricity needed to power more than one million Texas homes. A single megawatt of wind energy can produce as much energy used by about 230 typical Texas homes in a year” (SECO 2008). The growth of the state’s wind power industry has been encouraged by the legislature, which created the Texas Renewable Energy Portfolio Standard in 1999. Initially the Texas RPS mandated that utility companies jointly create 2000 megawatts of renewables by 2009, based on their market share. In 2005 Senate Bill 20 increased the requirement to 5,880 megawatts by 2015, of which 500 megawatts must come from non-wind resources. The bill set a goal of 10,000 megawatts of renewable energy capacity for 2025 (Pew 2006a). This bill also required the Public Utility Commission to design plans for new transmission lines to bring this power from west Texas and the Panhandle to urban areas in the state. In July 2008 the Public Utility Commission of Texas gave preliminary approval to funding and construction of new transmission lines that will bring 18,456 megawatts of power to the eastern half of the state. The project will cost \$5 billion, will be completed in four to five years and will cost the average consumer \$4 per month (Environment News Service 2008).

In mid-2008 the installed capacity for wind power amounted to 5,300 megawatts. T. Boone Pickens plans to build the nation’s largest wind farm, capable of producing an additional

4,000 megawatts. The project was scheduled to be completed in 2014 but may be delayed due to the world wide economic crisis. The state's commitment to installation of transmission lines is an important step in the expansion of renewable energy production. Another hurdle is the need to match demand and supply over the course of the day. Wind speeds can be very variable and the development of energy storage facilities would make wind energy a more dependable source of power. A design study for underground storage of wind energy using compressed air found that excellent geological conditions exist in parts of Texas, New Mexico and Oklahoma for this technology. The study concludes: Development of compressed air energy storage in the study area "could realize approximately \$10 million per year in net value [and] integrate an additional 500 MW of wind" (Ridge Energy Storage and Control Services 2005). The US Department of Energy, in a national competition, selected Austin, Houston and San Antonio as Solar America Cities that receive cash grants and technical assistance from National Laboratories.

Taken as a whole, new sources of energy are still in their infancy, partly because the technology is not yet mature, partly because prices remain high. A recent estimate predicts that solar energy in the United States will represent only about 3-6 percent of installed electricity generation capacity or 1.5-3 percent of output in 2020 (McKinsey Quarterly 2008). However, this could change as an increasing number of states (and maybe even the federal government) adopt REPs. Geographically the greatest potential for solar energy is in the Southwest, but Far West Texas also enjoys sufficient daily radiation to participate in the development of solar power. An ambitious plan by a group of industrialists and scientists proposes a solar-based energy system that integrates photovoltaics, compressed air energy storage, concentrated mirror-derived solar power and a new DC transmission grid. The authors claim that solar energy by 2050 can provide 69 percent of electricity and 35 percent of total energy. The plan would require federal subsidies over 40 years in the amount of over \$400 billion (Zweibel, Mason and Fthenakis 2008). A more modest and probably more realistic estimate of the future role of alternative fuels in meeting the energy needs of the state is presented in chapter 9.

A few years ago there was intensive debate on testing clean coal technology in some of the planned new coal powered plants but no firm commitments have been made. The 2005 legislature approved an accelerated screening and permitting for clean technology plants. Environmental groups opposed a plan by NRG Texas to build a new coal-fired power plant in Limestone County. In July 2008 Environmental Defense Fund dropped its opposition in exchange for NRG's offer to reduce CO₂ emissions from the new plant by half using sequestration or investing in CO₂ absorbing plants (Austin American Statesman, August 18 2008, p. A1 and A7). The Texas proposal to the US Department of Energy for building a clean coal power plant was not successful, but planning work along this line is continuing at the Texas Railroad Commission. The Jackson School of Geology at the University of Texas conducts large studies of CO₂ sequestration and storage. Significant research is also underway at the University of Texas on using algae as a source of biofuel.

Transportation: Reducing Vehicle Miles Traveled

As mentioned in Chapter 8, the transportation sector accounted for 30 percent of GHG emissions in 2005 (Table 8.1). Thus, one effective way of reducing GHG emissions would be to reduce vehicle miles traveled. In urban areas public transportation is a viable option to reach this goal.

Over longer distances a modern rail system could be used to reduce truck traffic by increasing the amount of freight carried by rail. As a result of NAFTA, the quantity of goods entering the country from Mexico has increased substantially, and Texas has been building roads to transport these goods to other parts of the country.

Ever since the Second World War urban land use planning was dominated by suburban development. Single-family residences in suburban developments with associated shopping malls have encouraged sprawl and made residents totally dependent on their cars. In urban areas there is now a steadily increasing interest in “New Urbanism.” The main principles of new urbanism are traditional neighborhoods with higher-density, mixed-use development and a pedestrian-friendly street design. Most destinations should be within a ten-minute walk of home or work. The higher density development also makes it easier to develop public transportation systems. Thus, residents are likely to reduce the number trips that they make by automobile.

Most of Texas' major cities are encouraging vertical mixed-use development, often allowing higher densities than previously in exchange for a component of affordable housing. Public transportation is improving, with Dallas and Houston developing successful light rail systems. However, state policy makes this option more difficult to implement than the building of roads, by requiring voter approval, even when the funding is available. In 2000 Austin voters narrowly defeated a proposal to build a light rail system. On second try, in 2004, a much more modest system utilizing an existing 32-mile line was approved. Trains will be powered by diesel engines, thus limiting the reduction in greenhouse gases and local pollution that are obtained by electrically powered systems.

Water Management: Incorporating Climate Change

Agencies responsible for the management of natural resources—air, land, seashore, water and wildlife—must do more to consider climate change in their management plans and operating procedures. We use the management of water resources and the coastal zone to illustrate how adapting to global warming will change existing policies.

The Texas Water Development Board (TWDB) has successfully decentralized water planning. With guidance from the state the main task of preparing the state water plan is now entrusted to water managers, experts and citizens of 16 water basins. The basin reports are then integrated into a single state report that is submitted to the legislature (TWDB 2007). TWDB should use the same approach and guide the regional planning groups in broadening their planning efforts. In the next planning cycle, to be completed in 2011, basin and state reports should consider climate change and climate variability alongside traditional factors, such as population growth, agriculture, urban development, biodiversity and in stream flow requirements. The “Science for Resource Managers” section above provides guidelines on how to structure this effort. We used these guidelines in conducting an integrated assessment of water resources in the Lower Rio Grande (HARC 2000, Schmandt 2006).

Case Study: Lower Rio Grande Basin

The Lower Rio Grande Valley (LRGV), a four-county area in the most southerly part of Texas, will be especially vulnerable to climate change. This stems from several sources: poverty, dependence on surface water from Mexico, brackish groundwater and lack of infrastructure. The

LRGV is semiarid, prone to drought, and economically dependent on its agricultural base. While some of the acreage is restricted to rain-fed cotton and grain sorghum, 40–50 percent of the land is irrigated, enabling the production of high-value crops such as fruit and vegetables. Because of the widespread use of irrigation, agriculture accounts for 88 percent of water demand in the LRGV. Even so, the demand for water is so much greater than the supply that only in the wettest years all of the agricultural needs are met. In addition, with high birthrates and continuing immigration, municipal demand for water is expected to increase 2–3-fold by the year 2040. Because municipal use has a higher priority than agricultural use, this will be at the expense of agricultural users.

Water in the Lower Rio Grande is shared with Mexico. In 1944, Mexico agreed to supply 2/3 of Lower Rio Grande water from its tributaries (in exchange for water provided by the United States to Mexico in the Colorado basin). To unravel the problem cluster linking water to development in an arid, rapidly growing region a team of specialists from Texas and Mexico conducted an integrated assessment for the Lower Rio Grande basin. The questions to be answered were straightforward: “Will there be enough water, of acceptable quality, to support the sustainable development of the region to the year 2050? What will be the impact of climate change on water supply?” Team members had experience in hydrology, water quality, ecology, demographics, economic development and water management. The assessment proceeded in three stages: initial scoping of issues and concerns, detailed analysis of major issues and development scenarios, integration and policy recommendations. Throughout the process, water managers and users were consulted. With few exceptions, team members used existing information and population projections, even though some data sets from Mexico and the United States were not immediately compatible. The main task was not to generate new data but to interpret and link existing information that had been produced by different disciplines and territorial jurisdictions.

Hydrological data for the drought of record in the 1950s showed a reduction of stream flow to half of average levels and rapid declines in reservoir levels during years one to seven of the drought. During years eight to ten reservoir levels slowly recovered. Combining historical drought data with a 2 degrees C increase in temperature and a 5 percent reduction in precipitation, a reasonable assumption about climate change impacts by 2030, exhausted the reservoirs by year five, with no recovery occurring during the remainder of the ten-year drought period. This would undermine the economic and environmental sustainability of the region.

However, our research identified several management options for coping with increased water shortages:

1. Irrigated agriculture currently uses 88 percent of available river water. Improvements in water distribution and use, water metering as well as changes in crop patterns, can maintain current crop yields while reducing water use by 40 percent.
2. Urban and industrial activities use 12 percent of river water. To meet future demand of the growing population their share must rise to 20 percent.
3. The necessary transfer of agricultural to municipal water can be done in one of two ways: using regulatory changes, which will constrain the existing rights of water users, or developing a water market, which will help suppliers and users to develop a less invasive solution.

4. The region has already suffered significant damage to aquatic and terrestrial resources. While full restoration is unlikely, governments can still act to prevent further deterioration.
5. Desalination of brackish groundwater or seawater is not yet cost effective, but not out of reach as an emergency measure.

The assessment, completed in 2000, included a number of scenarios to evaluate the severity of possible future events. Two of these contingencies have since materialized—a new multi-year drought and a dramatic reduction in water delivery from the main Rio Grande tributary in Mexico. The assessment showed that a combination of these two factors would lead to severe water shortages and economic losses. Indeed, farmers on both sides of the border have suffered large losses. The study showed that climate change will aggravate a repeat of the drought of record. But remedial measures, if taken in time, can reduce the risk.

Meeting Water Demand

The TWDB, the state’s water planning agency, predicts that the Texas population will more than double between the years 2000 and 2060, and demand for water will increase 27 percent. Existing water supplies—the amount of water that can be produced with current permits, current contracts and existing infrastructure during drought—are projected to decrease about 18 percent, primarily due to the accumulation of sediments in reservoirs and the depletion of aquifers. The TWDB has identified 4,500 water management strategies and projects to generate an additional 9.0 million acre-feet per year of water supplies for Texas at a cost of about \$30.7 billion (see Table 10.5). According to the TWDB, if Texas does not implement the state water plan, water shortages during drought could cost businesses and workers in the state about \$9.1 billion per year by 2010 and \$98.4 billion per year by 2060, and result in about 85 percent of the state’s projected population not having enough water. None of these projections take into account reductions in supply as a result of global warming-induced changes in precipitation and increases in evaporation.

Table 10.5. Strategies for Meeting Texas Water Demand in the Year 2060

Management Strategy	Water Supply (million acre- feet)	Cost (\$ million)
Conservation	2.04	939
New major reservoirs	1.07	4,904
Other surface water conveyance projects, water marketing, reallocation of reservoir water	3.31	13,175
Additional groundwater supplies	0.80	2,330
Reuse of wastewater	1.26	3,965
Desalination of brackish and sea water	0.31	2,590

Conjunctive use of surface and ground water	0.23	2,800
Total	9.03	30,700

Source: TWDB 2007, Chapter 10.

Two general approaches may be taken to respond to the problem of decreased water availability in the state: resource expansion and resource management. Resource expansion is accomplished through structural solutions that involve either the construction of additional reservoirs to capture more water or interbasin transfers of existing supplies. These options face serious financial and environmental obstacles. An alternative approach is to better manage existing supplies through conservation, water pricing and enforcing the existing structure for allocation of supplies. Other ways of increasing surface water supplies include purchasing additional water through contracts with major water providers, obtaining additional water rights, reallocating water in existing reservoirs, and changing the operating framework for a system of reservoirs. Together these increases in surface water supplies would account for almost half of the total needed.

Each of these options could be utilized to improve upon the present management system and may enable the state to better cope with the widely varying regional effects of global warming. Although we have analyzed each of these alternatives as separate policy options, it is important to note that they are not mutually exclusive. Indeed, conservation efforts and marginal water pricing could enhance the current system of water allocation.

Structural Solutions

The Texas Water Development Board, in its 2007 report to the legislature, states that 14 major new reservoirs generating approximately 1.1 million acre-feet of supply are needed to meet future demand over the next 50 years (TWDB 2007a). Additionally, the TWDB estimates that 29 water conveyance projects will be required to carry water from new and existing reservoirs to areas of greatest demand. A number of these projects would serve the city of San Antonio. The magnitude and number of these projected structures raise serious concerns about the feasibility of this approach.

The construction of additional reservoirs faces four major obstacles: (1) the most favorable sites for reservoir construction in the state have already been developed; (2) reservoir construction often entails a 30-year lead time; (3) projects of this magnitude raise serious environmental concerns; and (4) federal funding for such projects has decreased dramatically in recent years. Similar problems face projects for interbasin transfers of water. A legal restriction on interbasin transfers represents another obstacle to such a response. The Texas Water Code mandates that interbasin transfers of surface water may only be considered for water that exceeds the 50-year water requirements of the originating basin. This restriction minimizes flexible water planning and does not recognize the disparate availability of water throughout the state. In the 2007 water plan TWDB has included this recommendation: “The legislature should provide statutory provisions that eliminate unreasonable restrictions on the voluntary transfer of surface water from one basin to another.”

The city of El Paso, in partnership with the Army (Fort Bliss) has received federal funds to build and operate the largest inland desalination plant that is capable of producing 27.5 million gallons daily of drinking water from previously unusable brackish ground water (see

http://www.epwu.org/water/desal_info.html). This represents one quarter of the City's current drinking water needs. The University of Texas at El Paso is opening a desalination research center with \$6 million in startup funding, of which \$2 million were provided by the State of Texas. UTEP research will initially focus on reducing the amount of water lost during desalination (in some plants 50 percent, in the modern El Paso plant 15 percent) and methods for commercializing the mineral residue (El Paso Times 2008).

Water Conservation

Water conservation constitutes a valuable first response mechanism for reducing future demand for water supplies. Expected savings through conservation are in the range of 2 million acre-feet, of which two-thirds would come from agriculture. Although the largest potential savings can be made in the agricultural sector, there is considerable pressure on municipalities to implement water conservation plans, particularly in areas that are using all of their existing supplies. These figures do not include water savings from legislation requiring more efficient plumbing fixtures. However valuable these efforts are they will be insufficient in themselves to meet future water demands in the state.

Reductions in agricultural use, from 60 percent of current statewide demand to about 40 percent, will come from a number of sources. Many of the technological improvements available for delivering water to crops can save 20–30 percent of the water currently applied. They include low energy precision application sprinklers (LEPAS), surge flow irrigation systems, and drip irrigation. Additional savings could be realized by better maintenance of water transmission systems, including lining canals to reduce seepage and limiting evaporation. TWDB also assumes that the amount of irrigated acreage will decrease. Over the last 20 years, this trend has already become apparent, particularly in the Lower Rio Grande Valley, where financial incentives have been used to encourage farmers to convert their agricultural water rights to municipal use.

Municipal users, including residential, commercial and institutional customers, make up the fastest growing use sector in Texas and have significant potential for conserving water. In 2000 daily per capita consumption in Texas cities ranged from 120 to 275 gallons. Among large Texas cities El Paso has been most successful, lowering its water use from 149 gallons of water per person per day in 2003 to 134 gallons per person per day in 2007 (*El Paso Times*, June 14, 2008). The state recommends a conservation target of 140 gallons. Water utilities in Texas currently cannot account for a significant amount of the water they treat and distribute, much of it lost through leaks in distribution systems. Proper auditing techniques and modern, electrical leak detection equipment could be used to reduce transmission and distribution losses. A 2003 state law (HB 3338) requires all retail public water utilities to submit a water audit report showing the utility system's most recent annual water loss to the TWDB every five years. The most recent report shows statewide losses for 2005 estimated at 0.21 - 0.46 million acre-feet (5.6 – 12.3 percent of all water entering the reporting system) (TWDB 2007b). In addition, a more recent state law greatly expands the number of retail public water utilities required to prepare water conservation plans and submit them to TWDB.

Reuse of treated effluent is predicted to increase threefold by 2060, saving 1.26 million acre-feet. This water can be used for such purposes as industrial water supply, landscape and agricultural irrigation, direct recharge of aquifers and other environmental uses.

Drought Management

In addition to planning for increases in water demand at a time when supplies may be limited, planning for years of less than average precipitation is an important component of water resource management in arid western states. The majority of western states have adopted drought management plans that are coordinated by the state in response to specific trigger conditions. Often the Palmer Drought Severity Index, which rates drought conditions on a severity rating of 1 to 5, is used. When the index falls below 2, certain measures, often voluntary, are instituted. At this stage the main goal is to educate the public of the potential for water shortages. As drought conditions become more severe, interagency task forces are activated and specific programs implemented. As necessary, the governor will typically work with these task forces to solicit additional legislative authority and to secure financial assistance from the federal government.

In 1999, in response to recent droughts that had brought massive losses to agriculture, the Texas legislature passed HB 2660 on drought planning and preparation. The bill formed the Drought Preparedness Council (DPC), which is housed in the governor's division of emergency management. The Council advises the governor, legislature and state agencies on significant drought conditions. It is organized as four committees:

- Drought Planning and Coordinating Committee: responsible for statewide planning, preparation of State Drought Preparedness Plan, recommending specific revisions for a statewide response, and coordinating agencies involved;
- Drought Monitoring and Water Supply Committee: assesses and reports on meteorological and hydrological conditions and forecasts, and makes a determination concerning when to activate State Drought Response Plan;
- Drought Technical Assistance and Technology Committee: advises regional water planning groups on drought-related issues, maintains a database of water suppliers, and coordinates technical and financial assistance to drought-impacted communities;
- Drought Impact Assessment Committee: assesses and reports on potential impacts of water shortages on the public's health, safety and welfare, on economic development, and on agricultural and natural resources.

The Council issued a Drought Preparedness Plan in 2005. The responses to particular drought effects in a geographical area are initiated by agency representatives in each committee. These response actions will either have been planned well in advance of a drought situation, or in the case of unforeseen situations, will be the result of intense analysis of available problem data by each respective agency. Additional or emergency assistance needs that cannot be met by Council member agency resources are passed to the Governor's Division of Emergency Management for further action (Drought Preparedness Council 2005).

The Council has the task of coordinating drought planning and response of 16 state agencies. It also serves as liaison with 12 federal agencies. It is difficult to judge the effectiveness of the Council. An independent review of the Council's work should be

performed. To date the Drought Council is not on the schedule of upcoming agency reviews by the Texas Sunset Commission.

The state of Texas also requires public water suppliers and irrigation districts to prepare and update every years a drought contingency plan. Oversight of the process and review of plans submitted by large water utilities and irrigation districts is a function of the Texas Commission for Environmental Quality.

Market-Based Pricing of Water

Water is typically priced at a rate that reflects the cost of operating the collection and purification systems and the distribution network. It does not include most of the capital costs associated with constructing reservoirs and conveyance infrastructure because much of this expense has been subsidized by the federal government. If water were to be priced at its replacement cost, it would more closely approximate its market value. Taking into account the geographic region of the state, type of water use and capital costs, an economic pricing system for water could be constructed. Under this system, market forces would help to distribute the resource to those who most desire it, as indicated through their willingness to pay. Adopting marketplace pricing of water would require a fundamental cultural change and would raise controversial political questions, including the ability of poorer citizens to pay. Needless to say, the implementation of such a system would not be easy, with user groups vigorously challenging such price hikes. Agricultural users, in particular, would be hard hit, and many crops could not be grown profitably without subsidized water supplies. The economic foundation of many rural communities could be severely undermined.

Using economic factors as a means of redistributing current supplies a market for water rights has developed in the Lower Rio Grande Valley. In 1991, active water rights for irrigation alone in the LRGV exceeded 1.7 million acre-feet, well above the firm yield of the system. It is only in years of above-average precipitation that farmers are able to exercise options to the full extent of their water rights. With population growth, there has been a shift from agricultural to municipal water use, and irrigators have been able to sell or lease their rights to growing municipalities. However, the priority of the right changes when water rights are converted from agricultural to municipal use. Because of this, an adjustment in the amount of water transferred is necessary. Presently, a municipality receives a dependable 40–50 percent of water rights purchased from the irrigation districts. This conversion formula is based upon the firm annual yield of the system, so that if all the water were converted to municipal use, it would not exceed the amount of water available from the system under drought conditions.

Coastal Management: Incorporating Climate Change

Coastal vulnerabilities already exist as a result of land subsidence and coastal erosion. Addressing these problems through better land use management is a cost-effective response to sea level rise and potential storm events. Significant portions of the Texas Gulf Coast currently suffer from land subsidence and coastal erosion, with the result that coastal land is subjected to regular flooding. The Texas coast, therefore, is a particularly useful model for studying the potential effects of climate change–induced sea level rise. The impacts are potentially

devastating for urban areas (see Chapter 7) and coastal ecosystems. Increasing demand for fresh water inland and the possibility of reductions in supplies as a result of climate change will place additional strains on the coastal environment (see Chapter 4).

Several state agencies, with overlapping and sometimes conflicting authority, share responsibility for the coastal zone. The Texas Water Commission, for example, controls waste discharges into the Gulf, while the Texas Water Development Board conducts studies on the freshwater inflow needs of the estuaries. The state owns the coastline below the high water mark and attempts to clean beaches and remove squatters through the Texas General Land Office. The Texas Parks and Wildlife Department is responsible for the management of biological resources along the coast; the Texas Railroad Commission has exclusive authority over oil and gas wells; and the Texas Health Department is responsible for certifying shellfish for human consumption. Thus, it is not surprising that an integrated approach to management of the coast has been difficult to develop.

Coastal Engineering and Adaptation

Currently Texas has no comprehensive policies for the management of its coastline in response to climate change. There have been local efforts to mitigate some of the most dramatic impacts of shoreline erosion and storm damage, most notably the construction of a seawall on Galveston Island and the introduction of improved management practices by the Houston-Galveston Coastal Subsidence District. In general, policies that address these problems fall into two categories. The first, shoreline engineering, consists of physical modifications to the coast to hold it in its present position. The second is adaptation. Recognizing that the coast will change, the goal is to minimize damage from sea-level rise by, for instance, limiting development in sensitive areas.

Structural Responses

Of the possible approaches to shoreline engineering, beach replenishment is the most environmentally sound. This procedure consists of pumping sand, usually dredged from off shore, onto or near the beach. However, there are a number of problems with this approach, not the least of which is cost. In addition, after replenishment the beach is steeper, causing waves to strike with greater force than before and accelerating the rate of erosion. Other potential problems arise because the sand used for replenishment differs from the original beach sand, and offshore dredge pits, which alter wave action, can have negative effects.

Another method to deal with erosion is to construct groins. Groins are walls built perpendicular to the coast intended to capture sand carried in long shore currents. Typically, groins have worked well and sped accretion to local areas. Unfortunately, by capturing more sand locally, they speed erosion farther along the coast. Jetties also function in the same way. Like groins, jetties are constructed perpendicular to the coast, but are several times longer. The primary purpose of jetties is to protect ship channels from silting. While very successful in ensuring safe entry to and exit from harbors, they also capture as much as 50 percent of the sand supply that would otherwise go to Texas beaches.

The most dramatic example of shoreline engineering is the construction of seawalls. Constructed back from the shoreline, seawalls are intended primarily to protect inland property

from storm damage. The obvious example is the Galveston seawall, constructed to prevent a repeat of the devastation caused by the 1900 hurricane. However, the cost of construction is tremendous; roughly \$7 million per mile, and outside of the most developed locales, like the city of Galveston, the cost of a seawall is greater than the value of the property it protects. Typically, a massive seawall like that at Galveston is part of an ongoing process that began with small bulkheads intended to mitigate the effects of occasional wave impacts. However, a combination of factors results in an accelerating rate of beach erosion, and increasingly massive structures become necessary as more and more pressure comes to bear. In the end, there will be no beach left, just a huge wall overlooking the wreckage of its predecessors.

Institutional Responses

There has already been some success with new types of institutional responses to coastal problems. The Harris-Galveston Coastal Subsidence District, for example, has been successful in reducing land subsidence by restricting groundwater withdrawal. Most of the areas have effectively decreased the amount of groundwater used to 10 percent of the total water demand through conversion to surface water and water conservation. However, reliance on surface water for public supplies will create additional problems, if the availability of surface water decreases as a result of climate change.

National policies also affect coastal development. The National Flood Insurance Act of 1968 created the National Flood Insurance Program to provide low-cost flood insurance on the condition that the community directs new development out of the hazardous area, a condition that was not effectively enforced. The Flood Disaster Protection Act of 1973 required flood insurance with any type of financial loan that was federally insured for any property in a hazardous area prone to flooding and flood related erosion. This act also directed the Federal Emergency Management Agency to identify flood related erosion zones. The Upton-Jones Amendment encourages the demolition or relocation of structures in the hazardous areas by advancing payment. And the Coastal Barriers Resource Act limits federal investment on undeveloped coastal barriers.

Texas was the 30th state to receive federal approval of its coastal zone management plan, ten years after the previous applicant. It was originally submitted to NOAA in October 1995 and approval by NOAA was published in the Federal Register on January 10, 1997. NOAA approval makes the state eligible for federal financial assistance, which is used to assist the state administer the various state and local authorities included in the Texas Coastal Management Plan, as well as to fund local management efforts to increase public access, restore damaged resources and manage coastal erosion. The General Land Office was designated as the lead agency to develop a long-term plan for the management of Texas coastal public land, in cooperation with other state agencies that have duties relating to coastal matters. Although public participants in the process identified coastal erosion and wetlands loss as areas of major concern that will be exacerbated by climate change, there is no explicit reference to global warming in the current statewide coastal management policy.

Several state coastal programs are addressing climate change issues via statewide, interagency climate change partnerships – often under Governors’ climate change initiatives. The coastal programs are providing information for, or responding to, specific action items generated by these state climate commissions. In this capacity, coastal programs are playing a key role in

ensuring the consideration of coastal impacts and adaptation strategies. For instance, Louisiana's Coastal Program is participating in a state/nongovernmental organization initiative entitled "Climate, Energy, and the Coast." The initiative is focused on the restoration of Louisiana's wetlands. Although not a response to climate change, the Texas' Coastal Program is supporting development of local geo-hazard maps that include sea level rise, erosion rates, wetlands and other information, such as one developed as a planning tool for the City of Galveston by the University of Texas. A similar map is being developed with CZ Section 309 funding for Mustang Island and the City of Port Aransas (Coastal States Organization 2007).

The Coastal Zone Management Act (CZMA) should be recognized by Congress and the Administration as one of the primary statutes that can foster adaptation to climate change at the state and local levels. States' coastal programs often directly manage shoreline development and work closely with local governments on land use planning, habitat acquisition, and a variety of other activities. They also play a key role in coordinating state and local agencies, and have the authority to review and condition federal permits in the coastal zone.

Outline of a Comprehensive Texas Climate Policy

Considering the ongoing work on energy efficiency and alternative fuels I find that Texas is doing more than is generally acknowledged in the reviews of state CO₂ mitigation efforts published by EPA, Pew and other sources. This is so because the current Texas energy strategy adds up to a hidden climate change policy. The driving forces are energy efficiency and independence, as well as the income and jobs associated with industries developing alternative energy sources. Governor Rick Perry is a strong promoter of this approach: "I want Texas to be the epicenter of energy development—wind, solar, clean coal, obviously natural gas, nuclear and biofuels" (Perry 2008a). This is very much in the tradition of policy development in Texas: to endorse economic development without paying much attention to environmental goals. Fortunately, most alternative energy programs also reduce greenhouse gas emissions thus creating win-win situations that simultaneously advance energy security and a reduction in greenhouse gas emissions.

But more is needed. The time has come for Texas to develop a comprehensive policy that links climate change to energy independence, regional security and the management of natural resources. Such a policy will serve the interests of Texas in several ways.

In the first place it will make it easier to separate win-win from win-lose strategies in promoting energy efficiency and searching for new energy sources. Win-win strategies include green buildings, more stringent vehicle and appliance standards, and energy from renewable sources such as wind, sun, wood chips, switch grass and algae. Win-lose strategies include corn-derived biofuels, increased use of coal without investment in clean coal technologies, and more nuclear power without securing safe storage for spent nuclear fuel, to name three examples. The economic and environmental costs and benefits of these technologies must be compared to each other, so that policy makers receive reliable guidance for their decisions. In the case of biofuels from corn, for example, the amount of energy and water needed and the increase in food prices make this technology an unwise choice (National Research Council 2008). Even though evidence supporting this conclusion is strong, Texas continues to support farmers who grow corn for biofuels.

Climate and Security

As we have shown, Texas has begun to increase its energy independence. But other policy issues also need to be addressed. Recent research has identified climate-related security risks (Busby 2007, CNA 2007). As the author of one of these studies argues, the country “needs to ‘climate proof’ its domestic infrastructure including military installations, particularly along its coasts, [by] substantial investment in risk reduction: coastal defenses, building codes, emergency response plans, and evacuation strategies” (Busby 2008). I add the electric distribution network to this list. The impacts of Hurricane Ike would have been less dramatic if more electric utilities had been buried underground. Texas should not wait for federal action but needs to improve security-related infrastructure on its own. As a first step, four possible risk scenarios need to be evaluated:

- Coastal infrastructure: the large refineries, chemical plants and utility lines in proximity to the Gulf coast and the Gulf Intra-Coastal Waterway are vulnerable to catastrophic storms and ocean surges.
- Water conflicts: international conflicts can result from decreased water supplies on the border with Mexico.
- Migration: current climate change assessments predict severe droughts in Northern Mexico. This can lead to increased trans-border migration.
- Tropical diseases: the northward march of tropical diseases such as dengue fever and water borne diseases creates new health risks that medical doctors are not sufficiently trained to diagnose and treat.

Scenarios do not predict the future; they illustrate possible futures. As such, they are useful starting points for study and discussion. Once this is done decision makers should review results for possible changes in policy and management (Table 10.6).

Better Policy Advice

Texas needs a strong research and planning effort to prepare for climate change. Its primary task will be to provide first class policy advice to state and regional decision makers and agencies about possible risks of climate change, win-win solutions, non starters as well as new security risks. Following the already mentioned recommendation by the National Academy of Sciences, regional climate change is best not examined as a single issue but in conjunction with other

Table 10.6. Challenges and Responses

Challenge	Response
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Link climate predictions to management of air shed, water basins and ecological regions	Conduct multi-disciplinary, place-based sustainability assessments; include stakeholders in assessment process
Link climate predictions to urban management	Establish Urban Service Centers using model of Agricultural Research and Extension Service
Regulate greenhouse gas emissions	Encourage federal regulations that do not penalize Texas for its oil and gas services to the rest of the nation
Develop alternative fuels	Support industry to become a leader in wind, solar and biofuel energies
Develop clean energy	Support electric utilities to bring storage of CO ₂ and nuclear fuel to maturity
Increase energy efficiency	Revise building codes, adopt advanced standards for appliances and vehicles
Prepare for water scarcity	Reward conservation; increase irrigation efficiency; prepare for droughts; manage water as an economic good
Prepare for sea level rise	Develop comprehensive coastal management plan; adopt and enforce stringent zoning and insurance requirements
Increase regional security	Evaluate risks to coastal infrastructure; from conflicts between water users; from drought-induced cross-border migration; from northward shift of tropical diseases
Planning and coordination	Establish State Office of Energy, Security and Climate

issues standing in the way of a watershed's, air shed's or city's sustainability. Interdisciplinary research of this kind should be undertaken by Texas research universities and think tanks, with coordination by the New Technology Research and Development Program (see below) and funding by the just mentioned state program, as well as federal agencies and foundations.

A Texas Office of Energy, Security and Climate

Our single most important recommendation is this: Texas should create an Office of Energy, Security and Climate. A plan for its organization and function should be developed as a first step. The legislature, governor and lieutenant governor should convene a joint study committee to prepare such a plan and make recommendations on the mission, organization and location of the Office.

The Office should develop a comprehensive climate policy. Much of its work should focus on opportunities that can make the state a leader in renewable energy, energy efficiency, clean coal technology and management of drought and sea level rise. Creation of the Office will present an opportunity to assess the need for consolidation of related efforts currently located in different agencies—Governor's Office, Comptroller's Office, Texas Commission for Environmental Quality, Railroad Commission, State Energy Conservation Office, Drought Preparedness Council, among others.

The example of California, discussed earlier in the chapter, provides useful guidance on how to proceed. Key steps in California included enabling legislation, implementation by a technically experienced agency and coordination with other state agencies and cities. Florida, more conservative in its approach, provides another model. First, the governor convened an action-focused conference on climate change. He then appointed a 27 member Action Team on Energy and Climate Change. Based on the Action Team's recommendation the governor signed three Executive Orders aimed at reducing Florida's greenhouse gases, increasing energy efficiency and pursuing renewable energy sources. In addition, Governor Crist is partnering with Germany and the United Kingdom to discuss and promote initiatives that broaden the Kyoto Protocol and reduce the emission of greenhouse gases beyond 2012 (<http://www.dep.state.fl.us/climatechange/team/default.htm>).

The following actions should be taken by the Texas Office on Energy, Security and Climate: preparation and updating of a greenhouse gas inventory, recommendations on statewide greenhouse gas targets and caps, preparation of a climate change action plan, consulting and possibly cooperation with regional climate change alliances, convening of a state action team on climate change, and public outreach and education. The Office would also assist line agencies responsible for water, air, land, wildlife and coastal management on how to integrate climate change into their operations. Similarly, the Office should help business participate in federal low-carbon programs and transition to a low-carbon economy.

Establishment of the Office will take time. In the meantime two immediate initiatives can build on existing programs.

Texas Emerging Technology Fund

We recommend a significant increase in state funding for development, design and testing of clean energy, alternative energy, energy storage and CO₂ capture and storage projects. The Texas Emerging Technology Fund would manage the new projects. The Fund, created by the 2007 Legislature, has awarded \$110 million as research, matching and commercialization grants. So far, the main focus has been on information technology and the life sciences. A few grants deal with biofuels and energy. One of these, totaling \$4 million, was awarded at the governor's urging to advance knowledge about the use of algae for biofuels (Texas Emerging Technology Fund 2008). A \$2 million grant supports water desalinization research (El Paso Times 2008). The Fund should broaden its focus and support emerging technologies that advance energy efficiency, regional security and greenhouse gas mitigation.

New Technology Research and Development Program

The New Technology Research and Development Program should receive additional resources to address new tasks. This program is sponsored by the Texas Commission for Environmental Quality and currently provides financial incentives to support research, development and commercialization of technologies that reduce air pollution. The program awards \$2 million each year for air quality research and \$9 million for new technology development. The Texas Environmental Research Consortium, a non-profit organization based in Houston, Texas, administers the program under contract with the TCEQ. The program has made excellent progress in identifying the sources and pathways of air pollutants in the Houston and Dallas-Fort

Worth metro areas. The research results have then been synthesized for use by local, state and national decision makers (Texas Environmental Research Consortium website; Olaguer et al. 2006). This coalition of universities, local stakeholders and the state has won national recognition for its innovative work at the interface between research and action.

The New Technology Research and Development Program should expand its activities and initiate, manage and coordinate regional assessments of climate change impacts. As in the case of its current studies, the Program will issue requests for proposals to the Texas research community, carefully select grantees and summarize research results for policy makers. In addition, the Program should convene study groups that respond to information requests by the Legislature, Governor and state agencies. This would give Texas institutional capacity for the study of and policy advice on issues related to energy, security and climate. These issues will play a critical role in shaping the future of Texas. The National Research Council, a branch of the National Academy of Sciences, has long provided unbiased research assistance of this kind to the Congress and federal government. Texas policy makers should consider emulating this model and adjusting it to the regional scale.

Texas and Federal Policy

With regard to mitigation we repeat our 1995 recommendation that Texas engage actively in the national debate about regulating CO₂. Chapter 9 provides details on the impact of federal legislation on the Texas economy. Whatever national legislation is passed, Texas must watch that no disproportionate burden is imposed that would penalize the state for the large energy services it provides to the rest of the nation. To date, with few notable exceptions, the Texas congressional delegation, has been absent from the national debate. Congressman Lloyd Doggett, in June 2008, introduced the Climate MATTERS Act (Climate Market Auction Trust and Trade Emissions Reduction System). Five Texas representatives—Frost, Hinojosa, Jackson-Lee, Johnson and Reyes— have co-sponsored bills with mandatory carbon limits. The governor’s draft 2008 energy plan finally endorses a stronger Texas contribution: “State policymakers should bring a Texas perspective to federal carbon policy debates. Texas needs to participate actively in the carbon discussion and educate Washington decision makers on the economic value of Texas’ energy production to the nation and prevent Texans from being punished for providing the energy and petrochemical products that the rest of the nation consumes” (State Energy Plan 2008).

Identifying and financing adaptation measures will be largely the responsibility of the state and its cities and counties. However, Texas should aggressively pursue federal research and demonstration opportunities similar to the federal support received for the “new water in the desert” partnership between El Paso Water Utility, Fort Bliss and UTEP.

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