

## **Arizona's Political Leaders Should Support Strong National Policies to Stop Global Warming**

Arizona's citizens and its economy are among America's most vulnerable to the growing adverse impacts of global warming. Acting alone, the state cannot ward off these damages. Neither can the state individually take actions that will significantly reduce the global accumulation of greenhouse gases, although its renewable energy resources are outstanding. To reduce the threats and realize the opportunities posed by global warming, Arizona's leaders must support regional, national and international programs to reduce greenhouse gas emissions and accelerate a transition to clean energy. The public agrees. Two-thirds of Arizona voters indicate that global warming is occurring and a majority of Arizona voters believe that state and federal governments should do more to address global warming.<sup>1</sup>

Temperatures in Arizona have already risen by almost 2 degrees F in the past several decades, more rapidly than elsewhere in the lower 48 states, and are projected to continue increasing sharply, by another 3 to 5 degrees F in 2050.<sup>2</sup> Rapid urbanization is exacerbating this trend by extending the urban heat island over larger areas and longer seasons, raising night-time temperatures by as much as 10 degrees compared to adjoining natural areas.<sup>3</sup> Heat waves of extraordinarily high summertime temperatures for extended periods of time are becoming more common.<sup>4</sup> The number of days with low night-time temperatures above 90 degrees has been increasing sharply in successive decades.<sup>5</sup>

Climate change is also reducing precipitation, especially in the spring and early summer months and these declines are projected to continue.<sup>6</sup> Runoff in the Colorado and other river systems that Arizona's water supply depends on for direct use and for groundwater recharge will decline by 20-40 percent by mid-century, exacerbating water supply shortages that are already evident. The Colorado River system is already overstretched and unable to meet future demands.<sup>7</sup> Reduced precipitation, increasing heat and evapotranspiration from soils and plants are making serious drought a more frequent occurrence.<sup>8</sup> In the past decade Arizona has been suffering from the worst drought in a century. Wildfires have increased in

frequency and severity and will continue to do so as long as there are trees and other vegetation left to burn. Natural ecosystems, including Arizona's northern forests and its biodiversity hotspot (the Madrean Pine-Oak Woodlands) in the south, will be adversely affected by heat, drought, fire and proliferation of insect pests.

Air and water quality will suffer. Low river flows and higher water temperatures will raise water pollution concentrations. Ozone and smog concentrations will rise with higher air temperatures and growing energy use. Smoke from fires and dust from dry arid landscapes will raise particulate concentrations.

These climatic changes will have widespread impacts on Arizona's economy and citizens. Suggestions that damages will be confined to a few sectors and readily managed are mistaken. A recent study by researchers at the Sandia National Laboratory considered impacts of precipitation declines on the half-dozen industries with the greatest water consumption (e.g., agriculture, utilities, mining, chemical manufacturing), sectors that make relatively small contributions to the state's GDP.<sup>9</sup> The study found that economic damages would be spread widely throughout the rest of the state's economy because of higher input costs, lower consumer incomes and spending, population changes and changes in the state's inter-regional competitiveness. Retail trade, food manufacturing and construction would be among the sectors most severely affected by these secondary effects but no sector would be unscathed. This study found Arizona to be among the nation's most vulnerable states, even though the full range of possible future heat, drought, and precipitation impacts was not considered, and optimistic assumptions about adaptation to future water shortages were included.

In fact, adaptation to future water stresses in Arizona will be difficult and costly. Both groundwater and surface water resources are already over-allocated across much of the state. Demands that are increasing with population and economic growth will face supplies that are already inadequate and diminishing with global warming, necessitating reallocations – largely out of agriculture - and different patterns of use. Yet, such changes are not determined by price and market signals. Water use in Arizona and throughout the Southwest is governed largely by

administrative and judicial allocations involving private parties, local institutions, state, inter-state and federal authorities. Climate change will not only unsettle existing allocations, perhaps even the vital Colorado River Compact, but will also introduce uncertainty into future allocation decisions, involving courts and government agencies in difficult conflicts.<sup>10</sup>

For some of the most vulnerable sectors of Arizona's economy, the direct damages from global warming are already being felt. Agriculture and ranching are facing increasing heat, drought, water shortages and pest damages that combine to reduce yields and productivity. In bad years, cattle suffer and feed shortages force many ranchers to sell off herds at distressed prices, taking heavy losses.<sup>11</sup> Arizona farmers are heavily dependent on irrigation and even those with senior water rights are likely to face increasing shortages. More marginal farmers, including Hispanics and Native Americans, are more vulnerable because their access to crop insurance, credit, federal disaster relief and other institutional support is weaker.<sup>12</sup> Although farming and ranching contribute directly only about 2 percent of the state GDP, their importance to rural economies and associated industries is considerably larger, as is their political weight. Many Arizonan farmers and ranchers who hold senior water rights strongly resist water transfers to non-agricultural uses, even though urban and industrial water values are markedly higher than in most agricultural uses. There will be increasing pressure to transfer water out of agriculture toward uses that can afford to pay more for it<sup>13</sup> but there are legal, political and institutional impediments to these reallocations. Adaptation to supply constraints is unlikely to be smooth or economically efficient.<sup>14</sup>

Global warming will confront municipal water supply agencies with increasing demands at the same time that supplies are shrinking. Urban water demands rise with increasing temperatures, since most water is used for outdoor watering. Per capita water use has been declining in Arizona's cities as the result of conservation measures but households will probably resist rate increases or administrative measures sufficient to induce even much more stringent conservation practices. Water agencies will mostly likely be forced to consider such costlier options as desalinization, waste water recycling and new diversions and storage projects to offset increasing shortages. Most of the supply enhancement projects under consideration, except conservation, are energy-

intensive, but current energy supply options are themselves highly water-intensive, creating an escalating cost feedback loop.<sup>15</sup> Inevitably, climate change will sharply raise the cost of meeting future water demands.

Electricity generating costs will also increase, for several reasons. Low-cost hydroelectric production will fall with the reduced runoff from the Colorado River. Cooling water required for coal, gas, nuclear and solar thermal generating plants will become scarcer and more costly. Non-conventional oil and gas production is extremely water-intensive and will face limits on availability. Because hotter weather boosts the photochemical reactions that create atmospheric smog and because urban areas are already out of compliance with existing national ozone standards, which are being tightened substantially, coal-fired power plants will have to install expensive controls on nitrogen oxide emissions, an ozone precursor, in order to keep operating.

Global warming will also raise the summer peak in electricity demands and extend it through a longer air conditioning season, when it accounts for 70 percent of household electricity consumption. Meeting summer peak demands is nearly twice as costly as meeting off-peak requirements and considerably more costly than meeting the lower cool season peak demand. Under heat and drought conditions, peak summer generating costs can rise to 30-50 cents per kwh. Ironically, the main objection to policies limiting greenhouse gas emissions is that they will raise energy costs but in Arizona energy costs will also increase if such policies are not enacted and climate change goes unchecked.

Arizona's most dynamic and growth-generating sectors are also surprisingly vulnerable to climate change. Arizona was once a leader in high-tech manufacturing, which generated significant sales outside the state and many high-paying jobs within it. In 2005 the high-tech sector contributed 5 percent of state GDP, 4 percent of employment and 7 percent of earnings. If indirect effects are included, high-tech's contribution rises to 11, 10 and 13 percent, respectively. Yet, Arizona's lead in these industries has been eroding to the extent that Arizona is now not significantly above the average of all the states.<sup>16</sup> Most high-tech industries are "footloose": their location is not tied to local markets or to raw material supplies. High-tech firms must be able to attract and retain highly trained

and educated executives, engineers and scientists, who typically have nation-wide choices of employment. For this reason, “quality of life” considerations enter strongly into locational decisions.<sup>17</sup> Salient among these considerations are an attractive climate and scenery, outdoor recreation resources, and cultural and educational opportunities. Prolonged summer heat in excess of 100 degrees and rising at times to 110 and 120 degrees is a deterrent rather than an attraction. For example, there is a marked hot-season drop-off of business travel to Arizona, measured by business segment hotel rooms sold during the summer months.<sup>18</sup> Global warming is likely to discourage movement into the state by footloose high-tech industries, research centers and corporate headquarters that are sensitive to quality of life issues. Though there has been a significant movement of economic activity toward the Sunbelt states in recent decades, growth of population and employment *within* the Sunbelt has been negatively associated with temperature, favoring metropolitan statistical areas with more moderate climates.<sup>19</sup>

Even more important to Arizona’s economy is the extremely climate-sensitive travel and tourism industry. Almost 37 million visitors in 2010 spent nearly \$18 billion on a wide variety of goods and services, generating more than 150,000 jobs, nearly \$5 billion in direct earnings, and \$3.5 billion in state and local taxes.<sup>20</sup> Eighty percent of this business derived from out-of-state visitors, making this Arizona’s leading export industry. Tourism also generated \$297 million in construction investment, more than 10 percent of all non-residential construction in Arizona in 2010. This investment supported 5,300 construction jobs with earnings of \$280 million in a weak economy. Counting the earnings and employment of businesses supplying the tourism sector and the spending by employees in those businesses raises the direct plus indirect contribution of tourism to the Arizona economy considerably, to 283,000 jobs with \$9.7 billion in annual earnings.<sup>21</sup>

Recent experience confirms that visitation is highly sensitive to climate and its effects. Controlling for other influences, drought reduces visits to national parks by 7 percent. During the 1999-2003 period, when lake levels fell 2.1% at Mead and 5.4% at Powell, those changes reduced visits to Glen Canyon by half a million visitors and reduced spending by \$32 million. At Lake Powell, there were almost a million fewer visitors and \$28 million less in tourist spending. Tourism statistics show that for every 1% drop in the reservoir level, visits to Lake Powell fall by 5

percent.<sup>22</sup> Reduced river flows and deterioration of riparian habitats undermines fishing, rafting, boating and other water-based activities. Forest fires are also a deterrent.<sup>23</sup> According to the U.S. Forest Service, there are 182 communities bordering federal lands in Arizona and New Mexico that are at risk of forest fires. Many of these towns host second home developments, which make up more than 6% of all residences in Arizona. Arizona's ski facilities are also vulnerable. Rising winter temperatures, less precipitation falling as snow, and increasing water scarcity will shorten the ski season, perhaps drastically, especially at the Arizona SnowBowl where snowmaking possibilities are limited. This will hurt not only the ski operations but also the value of second homes and other real estate developments around the ski areas.

Arizona residents are among those whose skiing, fishing and other outdoor recreational activities will suffer from global warming. Forty percent of Arizonans surveyed engage in sport and fitness exercises and 25 percent enjoy outdoor recreation. More than two-thirds of the golfers on the state's 421 courses are residents, many of them retirees who have relocated to Arizona. Golfing makes an important economic contribution, estimated in 2004 at \$3.4 billion, counting direct, indirect and induced golf-related spending. The higher prices commanded by houses in golfing developments amount to a premium of over \$2 billion.<sup>24</sup> However, water scarcity has already forced golf courses to reduce consumptive water use significantly, in part by restricting the area of turf. Climate change will make further restrictions inevitable. The lack of assured sustainable water supplies may even constrain future residential real estate and golf course resort developments. A more threatening effect is that golfing becomes a less appealing sport when temperatures rise to uncomfortably hot levels. Fewer rounds are played and green fees fall in the hot spring and summer months. As the duration and intensity of the hot season increases, golf clubs revenues will suffer. The demand for membership will fall, hurting finances and making it difficult for older members to sell without taking losses.

The broader effect of global warming will be a decline in the Arizona's attractiveness as a retirement destination, which has always been based largely on its warm and dry climate. Retirees moving to Arizona make important economic contributions. In 2000, more than 20 percent of population was living in another

state 5 years previously. More than half the population was born in another state. Since retirees' incomes are not based on employment earnings, they bring a stable source of spending from outside the states. In 2000, 27 percent of the population was receiving social security benefits. Especially in Maricopa and Pima counties, subject to the widening heat island over urban and suburban population centers, life throughout much of the year will become increasingly uncomfortable and even unhealthy for seniors venturing outdoors.

Global warming will place additional stresses on Arizona's health care system, which is already constrained by rising costs.<sup>25</sup> One in five working age Arizonans are dependent on Arizona's Medicaid equivalent (AHCCCS) and an additional 18 percent have no health insurance at all. Asthma attacks and allergies will be exacerbated by higher air pollution levels, including ozone, particulates from dust and wildfires, and higher pollen counts that start earlier in the spring. Of the 7.5 percent of the state's population suffering from asthma, disproportionately from Hispanic or low-income households, many will seek medical care in emergency rooms or hospitals. Higher ozone and particulate levels are reliably linked to increases mortality and morbidity. Among the elderly, stroke and heart attack increase with rising heat.<sup>26</sup> People with chronic heart or lung diseases are twice as likely to suffer heat stroke during a heat wave. Cardiovascular disease and stroke affect more than 10 percent of Arizona's population. In the past decade a 6 percent increase in heat-related mortality was observed for each 1 degree F rise in the heat index and mortality also rose with the duration of the heat wave.<sup>27</sup> Between 1999 and 2009, the percentage of annual deaths occurring during the hot April to September months rose from 45 to 49 percent and heat-related dispatches of medical emergency teams climb sharply in the summer months, averaging more than nine a day in Phoenix alone.<sup>28</sup> Low-income households are much more vulnerable to these health effects because better off residents have extensive air conditioning and use it more consistently.<sup>29</sup> Unless global warming is brought under control, Arizona's health costs will rise more rapidly and her people will suffer.

These are compelling reasons why Arizona's leaders should support regional, national and international efforts to reduce greenhouse gas emissions along with measures specific to Arizona itself. In addition, however, Arizona is

positioned to benefit substantially from a transition to clean renewable energy. Its solar potential is the finest in the country. Arizona could become a world leader in solar technology, generating tens of thousands of high-paying jobs and billions in export earnings beyond the state's borders. The National Renewable Energy Lab has estimated that Arizona has the potential for 2.5 gigawatts of concentrating solar electricity, able to generate 5.8 gigawatt hours of electricity, more than in any other state in the nation. Little of this potential has yet been realized. There are already national, state and utility level incentives in place to make use of this enormous potential, including Arizona's Renewable Portfolio Standard, which mandates a 15 percent share of renewable generation by 2025. A recent study has produced a roadmap by which the state can stimulate solar investment and accelerate the pace of installation and simultaneously develop the supporting manufacturing and research capabilities.<sup>30</sup> A key stimulus to rapid development would be a regional or national policy that sets a price on carbon dioxide emissions through either an emission fee or a cap-and-trade regime applied to the electric utility sector. Such a policy would equalize the cost structure so that solar power could compete economically in intra-state and regional markets. With the cost disadvantage neutralized, solar's other advantages of stable operating costs and low pollution would lead to rapid deployment. It is in Arizona's economic interest to support national and regional policies of this kind.

At present, there is little apparent support within Arizona's Congressional delegation for national climate legislation, although Senator John McCain was earlier a prominent leader in co-sponsoring the McCain-Lieberman bill, which did not pass the Senate. The state's political leadership should reconsider their positions. Opposition to strong national and international policies to stop global warming is not in the interest of their people's wellbeing or their state's prosperity. Business associations in tourism, travel, real estate, agriculture, industry, utilities and health services should make their interests in climate stabilization known to candidates and office-holders, in cooperation with public interest groups. Arizona's voters should require that their representatives support actions to ward off increasingly threatening risks from global warming.

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