

<p>Global Warming. E:\front\book.front\eight\warm.10dp Spring 2009</p>	
<p>1. Climate. Carbon dioxide levels in the atmosphere now are way above historic levels . . . Measures of atmospheric temperatures since Civil War show that in recent years we have had an uninterrupted and intensifying rise in the Earth’s temperature. Ten of the hottest years in history have occurred within the last 14 years. The hottest year of all time was in 2005. Al Gore, <i>An Inconvenient Truth</i> (Paramount Classics, 2006) (DVD).</p>	<p>Main Ideas: Key Words: Analysis:</p>
<p>Until now, scientists and policy-makers have generally described the problem in terms of halting the buildup of carbon in the atmosphere. The United Nations’ Framework Convention on Climate Change framed the question that way two decades ago, and many experts talk of limiting CO₂ concentrations to 450 parts per million. But Ken Caldeira and Oregon State University professor Andreas Schmittner now argue that it makes more sense to focus on a temperature threshold as a better marker of when the planet will experience severe climate disruptions. The Earth has already warmed by 0.76 degrees Celsius – nearly 1.4 degrees Fahrenheit – above pre—industrial levels. Most scientists warn that a temperature rise of 3.6 degrees Fahrenheit could have serious consequences. Schmittner, lead author of a Feb. 14 article in the journal <i>Global Biogeochemical Cycles</i>, said his modeling indicates that if global emissions continue on a “business as usual” path for the rest of the century, the Earth will warm by 7.2 degrees Fahrenheit by 2100. Juliet Eilperin, <i>Washington Post</i>, “Greenhouse Gas Study: Carbon Output Must Near Zero To Change Impact,” <i>Boulder Daily Camera</i>, March 10, 2008, 6A.</p>	
<p>Models show that human-caused global warming has already doubled the chance of “killer” heat waves like the one that hit Europe in July-August of 2003. That summer was the continent’s hottest in 500 years, killing at least 27,000 people and costing European economies more than \$14.7 billion (13 billion euros). Environmental Defense Fund, <i>Climate Change Impacts Can Be Seen Today</i>, 2008, website: http://www.edf.org/article.cfm?contentID</p>	

=4883.1.	
<p>Higher temperatures accelerate the maturation of disease-causing agents and the organisms that transmit them, especially mosquitoes and rodents. Higher temperatures can also lengthen the season during which mosquitoes are active, as has already been observed in Canada. Warming has also been linked to the recent spread of tropical diseases, including malaria, dengue fever and yellow fever, into high-altitude areas in Colombia, Mexico, and Rwanda that had never seen the diseases before. Environmental Defense Fund, 3.</p>	

<p>2. Scientific Proof. The global climate is getting warmer, and most of the increase in temperature since the mid-twentieth century is "very likely" the result of human activities, especially the production of greenhouse gasses from the consumption of fossil fuels. Such is the primary conclusion of the IPCC's fourth report on climate change, released in 2007 with the approval of 113 governments, including the United States. The term "very likely" denotes a probability greater than 90 percent, which represents an increase in certainty from the previous assessment report in which scientists only felt comfortable declaring the human influence "likely" (greater than 66 percent chance). They are still short of "virtually certain," but according to the IPCC, the growing preponderance of evidence no longer leaves much room for doubt.⁸¹ Patricia Limerick, "What Every Westerner Should Know About Energy Efficiency and Conservation," (Boulder, Colorado: Center for the American West's Southwest Energy Efficiency Project, 2007), 50.</p> <p>81. Intergovernmental Panel on Climate Change, "16 Years of Scientific Assessment in Support of the Climate Convention" brochure, (Geneva: IPCC, 2004), IPCC, Climate Change 2007: The Physical Science Basis, Summary for Policymakers (Geneva: IPCC, 2007).</p>	<p>Main Ideas: Key Words: Analysis:</p>
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<p>The only quantitative and internally consistent explanation for the recent global warming includes the intensified greenhouse effect caused by the increase in CO₂ and other greenhouse gases. The U.S. National Academy of Sciences—the independent organization of the country's most renowned scientists established by Congress to advise the nation on scientific and technical issues—has concluded: "The scientific understanding of climate change is now sufficiently clear to justify nations taking prompt action." James</p>	
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<p>Wang, Ph.D., chief scientist at Environmental Defense, is a member of the U.S. National Academy of Sciences and has been named a National Associate of the National Academies. He is also an American Geophysical Union Fellow, and has received the American Geophysical Union's Macelwane Award, Bill Chameides, Ph.D., editor of the <i>Journal of Geophysical Research</i> and is the author or co-author of more than 120 scientific publications and five books. He received his doctorate from Yale University, <i>Are Humans Responsible for Global Warming? A Review Of The Facts</i>, April 2007, 2.</p>	
<p>Global warming opponents use doubt to defend the status quo. There is a popular misconception that there is disagreement among scientists. Ten percent of the scientific articles on global warming were reviewed. Out of 928 articles, zero disagreed with those basic principles. The American Petroleum Institute works for oil and gas lobby opposes global warming initiatives. Al Gore, (2006).</p>	

<p>3. NOAA Solomon Study. Increased drying of respective dry seasons is projected by 90% of the models averaged over the indicated regions of southern Europe, northern Africa, southern Africa, and southwestern North America and by 80% of the models for eastern South America and western Australia (see Fig. S3). Although given particular years would show exceptions, the long-term irreversible warming and mean rainfall changes as suggested by Figs. 1 and 3 would have important consequences in many regions. While some relief can be expected in the wet season for some regions (Fig. S4), changes in dry-season precipitation in northern Africa, southern Europe, and western Australia are expected to be near 20% for 2 °C warming, and those of southwestern North America, eastern South America, and southern Africa would be 10% for 2°C of global mean warming. For comparison, the American “dust bowl” was associated with averaged rainfall decreases of 10% over 10–20 years, similar to major droughts in Europe and western Australia in the 1940s and 1950s (22, 32). Susan Solomon, chief researcher National Oceanic Atmospheric Administration, leader of the International Panel on Climate Change and one of the world's best known researchers on the subject, Gian-Kasper Plattnerb, Reto Knutti, and Pierre Friedlingsteind, "Irreversible Climate Change Due To</p>	<p>Main Ideas: Analysis: Evaluation:</p>
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<p>Carbon Dioxide Emissions," <i>Proceedings of the National Academy of Sciences</i>, December 16, 2008, 1706-7.</p> <p>22. Seager R, et al. (2007) Model projections of an imminent transition to a more arid climate in southwestern North America. <i>Science</i> 316:1181–1184.</p> <p>32. Narisma GT, Foley JA, Licker R, Ramankutty N (2007) Abrupt changes in rainfall during the twentieth century. <i>Geophys Res Lett</i> 34:L06710, 10.1029/2006GL028628.</p>	
<p>The severity of damaging human-induced climate change depends not only on the magnitude of the change but also on the potential for irreversibility. This paper shows that the climate change that takes place due to increases in carbon dioxide concentration is largely irreversible for 1,000 years after emissions stop. Following cessation of emissions, removal of atmospheric carbon dioxide decreases radiative forcing, but is largely compensated by slower loss of heat to the ocean, so that atmospheric temperatures do not drop significantly for at least 1,000 years. Susan Solomon, 1704.</p>	
<p>Fig. 1 shows that a quasi-equilibrium amount of CO₂ is expected to be retained in the atmosphere by the end of the millennium that is surprisingly large: typically 40% of the peak concentration enhancement over preindustrial values (280 ppmv). This can be easily understood on the basis of the observed instantaneous airborne fraction (AF^{peak}) of 50% of anthropogenic carbon emissions retained during their buildup in the atmosphere, together with well-established ocean chemistry and physics that require 20% of the emitted carbon to remain in the atmosphere on thousand-year timescales [quasi equilibrium airborne fraction (AF^{equi}), determined largely by the Revelle factor governing the long-term partitioning of carbon between the ocean and atmosphere/biosphere system] (9–11). Susan Solomon, 1705.</p> <p>9. Revelle R, Suess HE (1957) Carbon dioxide exchange between atmosphere and ocean and the question of an increase of atmospheric CO₂ during the past decades. <i>Tellus</i> 9:18–27.</p> <p>10. Archer D, Kheshgi H, Maier-Reimer E (1997) Multiple timescales for neutralization of fossil fuel CO₂. <i>Geophys Res Lett</i> 24:405–408.</p> <p>11. Montenegro A, Brovkin V, Eby M, Archer D, Weaver AJ (2007) Long term fate of anthropogenic carbon. <i>Geophys Res Lett</i> 34:L19707, 10.1029/2007GL030905.</p>	
<p>An assessed range of models suggests that the eventual contribution to sea level rise from thermal expansion of the ocean is expected to be 0.2–0.6 m per degree of global warming (5). Fig. 4 uses this range together with a best estimate for climate sensitivity of 3 °C (5) to estimate</p>	

<p>lower limits to eventual sea level rise due to thermal expansion alone. Fig. 4 shows that even with zero emissions after reaching a peak concentration, irreversible global average sea level rise of at least 0.4–1.0 m is expected if 21st century CO₂ concentrations exceed 600 ppmv and as much as 1.9 m for a peak CO₂ concentration exceeding 1,000 ppmv. Susan Solomon, 1708.</p> <p>5. Meehl GA, et al. (2007) <i>Global climate projections. Climate Change 2007: The Physical Science Basis</i>, eds Solomon S, et al. (Cambridge Univ Press, Cambridge, UK, and New York), pp 747–845.</p>	
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<p>4. Rebuttal. William Gray, the respected hurricane forecaster, Colorado State University professor and global warming skeptic. Gray has become a favorite among those who believe environmentalists, the Democrats, Al Gore, and John McCain & Co. are overdoing it with their fixation on global warming. Gray criticized what he views as a stacked system in which scientists study climate change because it's an easy way to get government grants. "This is driven by the scientists getting money to study it," Gray said. "They skew these facts in a certain way and write reports to scare people." Gray seemed taken aback at all the attention former vice president Gore has received with his global warming documentary, <i>An Inconvenient Truth</i>. "I've been 50 some years working at it (forecasting)," Gray said. "How does he know more than I do?" Todd Hartman, <i>Rocky Mountain News</i> reporter, "GOP Panel Consensus: Fixation With Global Warming Overdone," <i>Rocky Mountain News</i>, April 28, 2007, 19.</p>	<p>Main Ideas: Key Words: Analysis:</p>
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<p>William Gray . . . bemoaned the use of computer models to predict what future climate will look like. One can't possibly put all the right variables into a computer program, he said. Gray called modeling a "religion" and accused modelers of living in a "virtual world" free from the chaotic complexity of reality. I came around before the satellite ruined everything," he said. Todd Hartman, 19.</p>	
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<p>The final speaker, Mario Lewis, a senior fellow at the American Enterprise Institute, gave a crisp overview of his book-length critique of Gore's movie, arguing that Gore overemphasizes doomsday scenarios. Lewis says global warming is real, and humans play a role, but he thinks the temperature rise will be at the low end of scientists' predictions. Trying to do too much to stop warming would be a waste of money better used on new</p>	
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<p>technologies and solving other world problems, he said. At one point during his critique, he asked who in the room hadn't seen Gore's movie. Almost everyone raised a hand. Todd Hartman, 19.</p>	
<p>Rep., Ted Harvey, R-Highlands Ranch, described efforts to slow global warming as "an attack on the free-market system, an attack on capitalism and an attack on countries that have progressed to the point where their economies are excelling far beyond other countries." "I believe there is a concerted effort by many environmentalists in the world to do us harm because they don't want to have the greatest country in the world be the United States," he said. Todd Hartman, 19.</p>	
<p>George H.W. Bush: This guy [Al Gore] is so far out in the environmental extreme, we'll be up to our neck in owls and outta work for every American. He is way out, far out, man. Al Gore, (2006).</p>	

<p>5. Economy. Reducing energy use can create more jobs. Producing, marketing, and promoting energy efficiency measures prove to be relatively labor-intensive activities, while coal mining, natural gas production, and electricity generation and distribution employ comparatively few workers. And when a family or business spends the money it saved by conserving energy, it bolsters the economy and supports more jobs. Thus putting effort into energy efficiency and conservation, rather than expanding conventional energy supplies, can lead to a net increase in jobs in a community, state, or region.⁴ Patricia Limerick, 1.</p> <p>4. Howard Geller et al., for the Western Governors' Association Energy Efficiency Task Force, <i>Clean and Diversified Energy Initiative</i> (Denver: Western Governors' Association, 2006); and the Southwest Energy Efficiency Project, <i>The New Mother Lode: The Potential for More Efficient Electricity Use in the Southwest</i> (Boulder, CO: Southwest Energy Efficiency Project, 2002).</p>	<p>Main Ideas: Key Words: Analysis:</p>
<p>Southwest Study (2002) . . . The study estimates that the high efficiency scenario would provide \$28 billion in net economic benefits, with an overall benefit-cost ratio of about four to one. The study also found that the high efficiency scenario would lead to an estimated net increase of 58,000 jobs by 2020.¹⁸ Patricia Limerick, 30.</p> <p>18. Larry Kinney, Howard Geller, and Mark Ruzzin, <i>Increasing Energy Efficiency in New Buildings in the Southwest</i> (Boulder, CO: Southwest Energy Efficiency Project, 2003).</p>	
<p>After decades of operations harmful to the environment,</p>	

<p>Kennecott Copper Co. is now engaged in environmental restoration - cleaning up older smelter operations, removing mining wastes, restoring disturbed land, and treating contaminated groundwater. Kennecott is also transforming itself into a more diversified business that takes energy efficiency and sustainable development seriously . . . Last but not least, Kennecott is advocating construction of public transit (light rail lines) from downtown Salt Lake City to Daybreak and its future new communities. Kennecott has discovered that conserving energy and being environmentally responsible can also be good for the company's bottom line. As of September 2006 there was a waiting list for new homes in Daybreak." Patricia Limerick, 12.</p>	
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<p>University of New Mexico Hospital . . . By 2002, the hospital had implemented major upgrades to its air exchange systems, and had completed a facility-wide lighting retrofit. The cost for installing these two projects was \$450,000, but the investment cut energy costs by nearly \$320,000 per year. This represents a 70 percent annual return on investment and a payback period of just seventeen months.¹⁷ Patricia Limerick, 12-3.</p> <p>17. Southwest Energy Efficiency Project, "Regional Case Studies: University of New Mexico Hospital," available at http://www.swenergy.org/casestudies/newm/ico/urun-hospital.htm.</p>	
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<p>6. Denmark. While countries like the U.S. let tax credits for renewable energy wax and wane, smothering infant green industries in the crib, Denmark has stuck with them. How come? In a word: fear. When the 1973 oil crisis hit, 90% of Denmark's energy came from petroleum, almost all of it imported. Buffeted by supply shocks, Denmark launched a drive for energy conservation. Eventually, Middle East oil started flowing again, but unlike most other countries, Denmark never forgot the lessons of 1973 and kept working for greater energy efficiency and a more diversified supply. For example, the Riso National Laboratory for Sustainable Energy, which has long been on the cutting edge in wind technology, is now a global leader in hydrogen-fuel-cell research. From the use of combined heat and power plants to the way it builds homes to maximize efficiency, Denmark leads the way. Bryan Walsh, "The Gusty Superpower. How Denmark's Green Energy Initiatives Power Its Economy," <i>Time</i>, March 16, 2009, 43.</p>	<p>Main Ideas: Analysis: Evaluation:</p>
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<p>The challenge for Denmark now is to help the rest of the</p>	
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<p>world catch up. Beyond wind, the country (pop. 5.5 million) is a world leader in energy efficiency. Carbon emissions are down 13.3% from 1990 levels, and total energy consumption has barely moved, even as Denmark's economy has continued to grow at a healthy clip. Bryan Walsh, 43.</p>	
<p>A day later, I flew back to Denmark . . . you knew it was rush hour because 50 percent of the traffic in every intersection was bicycles. That is roughly the percentage of Danes who use two-wheelers to go to and from work or school every day here . . . Unlike America, Denmark, which was so badly hammered by the 1973 Arab oil embargo that it banned all Sunday driving for a while, responded to that crisis in such a sustained, focused and systematic way that today it is energy independent. (And it didn't happen by Danish politicians making their people stupid by telling them the solution was simply more offshore drilling.) What was the trick? To be sure, Denmark is much smaller than us and was lucky to discover some oil in the North Sea. But despite that, Danes imposed on themselves a set of gasoline taxes, CO₂ taxes and building and-appliance efficiency standards that allowed them to grow their economy - while barely growing their energy consumption - and gave birth to a Danish clean-power industry that is one of the most competitive in the world today. Denmark today gets nearly 20 percent of its electricity from wind. America? About 1 percent. Thomas L. Friedman, <i>New York Times</i>, <i>Boulder Daily Camera</i>, August 15, 2008, 10A.</p>	
<p>And did Danes suffer from their government shaping the market with energy taxes to stimulate innovations in clean power? In one word, said Connie Hedegaard, Denmark's minister of climate and energy: "No." It just forced them to innovate more - like the way Danes recycle waste heat from their coal-fired power plants and use it for home heating and hot water, or the way they incinerate their trash in central stations to provide home heating. (There are virtually no landfills here.) There is little whining here about Denmark having \$10-a gallon gasoline because of high energy taxes. The shaping of the market with high energy standards and taxes on fossil fuels by the Danish government has actually had "a positive impact on job creation," added Hedegaard. "For example, the wind industry - it was nothing in the 1970s. Today, one-third of all terrestrial wind turbines in the world come from Denmark." In the last 10 years, Denmark's exports of</p>	

<p>energy efficiency products have tripled. Energy technology exports rose 8 percent in 2007 to more than \$10.5 billion in 2006, compared with a 2 percent rise in 2007 for Danish exports as a whole. "It is one of our fastest-growing export areas," said Hedegaard. It is one reason that unemployment in Denmark today is 1.6 percent. In 1973, said Hedegaard, "we got 99 percent of our energy from the Middle East. Today it is zero." Thomas L. Friedman, 10A.</p>	
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<p>7. Food. Eat less meat. A United Nations report says internationally the meat industry generates about 18 percent of greenhouse gas emissions. Basically, that's a lot of methane and nitrous oxide from manure - worse than carbon. Eating meat also requires fertilizers and pesticides to grow animal food. McClatchy Newspapers, "Calculate Your Carbon Footprint," <i>Greeley Tribune</i>, April 22, 2007, A15.</p>	<p>Main Ideas: Key Words: Analysis:</p>
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<p>Thirty percent of our carbon dioxide emissions come from burning trees and rainforests for slash and burn agriculture. Al Gore, (2006).</p>	
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<p>Recycle, Recycle, Recycle. Sorting glass, plastic, batteries and other recyclables costs you nothing, but saves you considerably. Carbon savings: 1,200 lb./year. Environmental Defense Action Fund, 2007.</p>	
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<p>In 2006, the UN's Food and Agriculture Organization published "Livestock's Long Shadow," a report that states animal agriculture is a major contributor to climate change, pollution, reduction of biodiversity, and land and water degradation. Among its assertions: Livestock generate more greenhouse gas emissions than transport does. Then, last month, the results of a 10-year study of more than 500,000 subjects ages 50 to 71 came out in the <i>Archives of Internal Medicine</i>. It showed that eating red and processed meat increases the chance of dying prematurely, particularly from heart disease or cancer. (Meat industry groups dispute the findings of both.) Devra First, <i>Boston Globe</i>, "Is Meat Going Out of Style?" <i>Boulder Daily Camera</i>, April 15, 2009, 2B.</p>	
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<p>In a much cited statistic from the 2006 report "Diet, Energy, and Global Warming," geophysicist Gidon Eshel and University of Chicago assistant professor of geophysics Pamela Martin conclude that reducing our intake of animal products by 20 percent would save the same amount of energy as if we all switched from driving a Camry to a Prius. Devra First, <i>Boston Globe</i>, "Is Meat Going Out of Style?" <i>Boulder Daily Camera</i>, April 15,</p>	
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2009, 2B.	
<p>It's still a rare service in the rest of the U.S.-less than 3% of the more than 30 million tons of organic waste we produce annually is recycled. "This represents a great opportunity in the world of waste," says Kate Krebs, executive director of the National Recycling Coalition. "We just think about this stuff as garbage, but there's so much we can do with it" . . . Buried food breaks down in these oxygen-free environments, it produces methane, a greenhouse gas that has a warming effect 23 times as potent as carbon dioxide. Global methane emissions from garbage are estimated to be as high as 70 million metric tons a year. By recycling organic waste-composting it-methane emissions are eliminated. Bryan Walsh, "Going Green: Recycling Food Scraps," <i>Time Magazine</i>, June 23, 2008, 116.</p>	

<p>8. Transportation. For every gallon of gas we burn, we create 19 pounds of CO₂ are produced. Chris Paine, <i>Who Killed the Electric Car</i> (Culver City, California: Sony Pictures, 2006), (DVD).</p>	<p>Main Ideas: Key Words: Analysis:</p>
<p>Keep Your Car Tuned Up. Tuning up your car can save you hundreds of gallons of gas. So align those wheels, inflate those tires, check that engine and mind the spark plugs, sensors, filters, hoses and belts. Carbon savings: 28 lb./gallon of gas saved. Environmental Defense Action Fund, 2007, Website: www.FightGlobalWarming.com.</p>	
<p>Japan, China and Australia have set higher mileage standards that American carmakers refused to meet. Their automakers are meeting those standards and are thriving economically. Our car companies, such as General Motors and Ford, do not meet those higher standards and are losing money. Al Gore, (2006).</p>	
<p>Check your tires. Keeping your tires at the proper inflation can improve gas mileage by 3 percent or more. If we all did this we could save 500 million gallons of gas a year. McClatchy Newspapers, A15.</p>	
<p>Transportation was responsible for nearly 27% of U.S. CO₂ emissions in 2000 by EPA estimates (US EPA, 2002), and fuel use has been growing more rapidly in transportation than in other sectors. Sergey Paltsev, John M. Reilly, Henry D. Jacoby, A. Denny Ellerman and Kok Hou Tay, <i>MIT Joint Program on the Science and Policy of Global Change Emissions Trading to Reduce Greenhouse Gas Emissions in the United States: The McCain-Lieberman Proposal (June 2003)</i>, 2.</p>	

<p>9. Polar Caps. A one degree increase in world temperature results in a five degree increase in temperature at the poles . . . Ice reflects 70 percent of sun's rays, whereas open water absorbs 90 percent of the sun's heat. Al Gore, (2006).</p>	<p>Main Ideas: Key Words: Analysis:</p>
<p>Lonnie Thompson took samples from Antarctica's ice core drill sites, which date back 760,000 years, and measured the CO₂ bubbles in the ice. During the past seven ice ages in the last 650,000 years, Carbon dioxide levels have never been above 350 parts per million. Al Gore, (2006).</p>	
<p>Since 1950, the Antarctic Peninsula has warmed by 4 degrees F (2 degrees C), four times the global average increase. In 2002, a Rhode Island-sized section of the Larsen B ice shelf, which sits offshore of the Peninsula, disintegrated in only 35 days. The ice shelf acts as a dam for glaciers on land; its break-up is causing a worrisome speed-up of glacier flow into the ocean, which could raise global sea level. The surface area of the Arctic's sea ice has shrunk by 10 to 15% in spring and summer, and the ice has thinned by about 40% in late summer and early autumn. A shortened season for hunting ice-dwelling seals is seriously damaging the health of the Hudson Bay's polar bears and causing them to have 15% fewer cubs. At present rates of shrinkage, Arctic sea ice could disappear completely each summer by the end of this century, pushing polar bears to the brink of extinction. Environmental Defense Fund, 2-3.</p>	
<p>Arctic sea ice is melting so fast that most of it could be gone in 30 years. A new analysis of changing conditions in the region, using complex computer models of weather and climate, says conditions that had been forecast by the end of the century could occur much sooner. A change in the amount of ice is important because the white surface reflects sunlight back into space. When ice is replaced by dark ocean water that sunlight can be absorbed, warming the water and increasing the warming of the planet. The finding adds to concern about climate change caused by human activities such as burning fossil fuels . . . "Due to the recent loss of sea ice, the 2005-2008 autumn central Arctic surface air temperatures were greater than 5 degrees Celsius (9 degrees Fahrenheit) above" what would be expected, the new study reports. That amount of temperature increase had been expected by the year 2070. The new report by Muyin Wang of the Joint Institute for the Study of Atmosphere and Ocean and James E.</p>	

<p>Overland of the National Oceanic and Atmospheric Administration's Pacific Marine Environmental Laboratory, appears in today's edition of the journal <i>Geophysical Research Letters</i>. They expect the area covered by summer sea ice to decline from about 2.8 million square miles normally to 620,000 square miles within 30 years. Last year's summer minimum was 1.8 million square miles in September, second lowest only to 2007 which had a minimum of 1.65 million square miles, according to the National Snow and Ice Data Center. The Center said Arctic sea ice reached its winter maximum for this year at 5.8 million square miles on Feb. 28. That was 278,000 square miles below the 1979-2000 average making it the fifth lowest on record. The six lowest maximums since 1979 have all occurred in the last six years. Randolph E. Schmid, <i>Associated Press</i>, "Arctic Sea Ice In Hot Water: Millions Of Square Miles Expected To Melt In 30 Years," <i>Boulder Daily Camera</i>, April 3, 2009, 2A.</p>	
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<p>10. Fresh Water. The flow of water in the world's largest rivers has declined over the past half-century, with significant changes found in about a third of the big rivers and a 14 percent decrease in the Columbia in the Pacific Northwest. An analysis of 925 major rivers from 1948 to 2004 showed an overall decline in total discharge. The reduction in inflow to the Pacific Ocean alone was about equal to shutting off the Mississippi River, according to the new study appearing in the May 15 edition of the American Meteorological Society's <i>Journal of Climate</i>. The only area showing a significant increase in flow was the Arctic, where warming conditions are increasing the snow and ice melt, said researchers led by Aiguo Dai of the National Center for Atmospheric Research in Boulder. "Freshwater resources will likely decline in the coming decades over many densely populated areas at mid to low latitudes, largely due to climate changes, Dai said. "Rapidly disappearing mountain glaciers in the Tibetan plateau and other places will make matters worse." Added co-author Kevin Trenberth, "As climate change inevitably continues in coming decades, we are likely to see greater impacts on many rivers and water resources that society has come to rely on." Randolph E. Schmid, <i>Associated Press</i>, "NCAR Study Finds Drop In Third Of World's Big Rivers," <i>Boulder Daily Camera</i>, April 22, 2009, 6A.</p>	<p>Main Ideas: Analysis: Evaluation:</p>
<p>There was considerable year-to-year variation in the flow of many rivers, but the overall trend over the period</p>	

<p>showed annual freshwater discharge into the Pacific Ocean fell by about 6 percent, or 526 cubic kilometers of water. That's close to the 552-cubic kilometer average annual flow of the Mississippi, the researchers reported. The annual flow into the Indian Ocean dropped by about 3 percent, or 140 cubic kilometers. In contrast, annual average discharge into the Arctic Ocean rose about 10 percent, or 460 cubic kilometers. There was little change in inflow to the Atlantic Ocean, where increases in the Mississippi and Parana rivers were balanced out by decreases in the Amazon River. Randolph E. Schmid, 6A.</p>	
<p>Desertification is a problem around the world. In the 1880s, only 9.4 percent of the land on the Earth was desert. By the 1950s, 23.3 percent was desert. The Sahara is the largest desert in the world, and it is also the fastest spreading. In Niger, the desert has spread 60 miles in less than twenty years. Africa's population is growing--which will cause the desert to spread even faster, unless some action is taken. Wendy Svec, <i>Pacemaker World Geography and Cultures</i> (Parsippany, New Jersey: Pearson Education, 2002), 164.</p>	
<p>Mountain snowpack and glaciers constitute critical reservoirs of fresh water. In almost every mountainous region across the world, glaciers are retreating in response to the warming climate. In the European Alps, ice that had hidden and preserved the remains of a Stone Age man melted for the first time in 5,000 years. In the Peruvian Andes, glacial retreat has accelerated sevenfold over the past four decades. In Africa, 82 percent of the ice on Mt. Kilimanjaro has disappeared since 1912, with about one-third melting in just the last dozen years. In Asia, glaciers are retreating at a record pace in the Indian Himalaya, and two glaciers in New Guinea will be gone in a decade. Environmental Defense Fund, 2.</p>	
<p>11. Ocean Levels. As California officials see it, global warming is happening, so there's no time to waste in figuring out what to do. California's interagency Climate Action Team on Wednesday issued the first of 40 reports outlining what the state's residents must do to adapt to the floods, erosion and other effects expected from rising sea levels. Hundreds of thousands of people and billions of dollars of Golden State infrastructure and property would be at risk if ocean levels rose 55 inches by the end of the century, as computer models suggest, according to the report. "Immediate action is needed," said Linda Adams,</p>	<p>Main Ideas: Analysis: Evaluation:</p>

<p>Secretary for Environmental Protection. "It will cost significantly less to combat climate change than it will to maintain a business-as-usual approach." Margot Roosevelt, <i>Los Angeles Times</i>, "California Officials Concerned About Rising Ocean Levels," <i>Boulder Daily Camera</i>, March 12, 2009, 6A.</p>	
<p>Sea levels along California have risen nearly 8 inches in the past century, although this varies with coastal dynamics. According to the Pacific Institute report, 260,000 Californians already live in flood zones but are assumed to be protected by existing structures, such as levees and sea walls. A 55-inch sea level rise would increase the population at risk to 480,000. Currently, 1,900 miles of roads and highways are at risk of flooding, which would grow to 3,500 miles under the sea level rise projections. The report estimated the cost of one adaptation strategy: protecting the coast with 1,100 miles of new or modified sea walls and levies. It would cost at least \$14 billion to construct, and another \$1.4 billion a year to maintain. Margot Roosevelt, 6A.</p>	
<p>The report's estimate of 55 inches of sea level rise by the end of the century was calculated using two models from the United Nations' Intergovernmental Panel on Climate Change, a gathering of the world's top climate scientists. One model assumes countries will cut their emissions of the planet-heating greenhouse gases, and another assumes a business-as-usual emissions level. Margot Roosevelt, 6A.</p>	
<p>12. Coal Power Plants. Almost 88 percent of the greenhouse gases from electricity in Colorado are from coal. Coal-fired power plants are the largest single source of carbon dioxide in Colorado, producing almost twice as much carbon dioxide as that from all the motorized gasoline transportation in the state. Micah Parkin and Steve Bauhs, "Guest Commentary: Failure To Reach Climate Goals Unacceptable," <i>Boulder Daily Camera</i>, March 22, 2009, 9B.</p>	<p>Main Ideas: Analysis: Evaluation:</p>
<p>Xcel Energy is slowly increasing its supply of clean renewable power, but not to the extent needed. last year the utility asked for bids for up to 150 megawatts of wind power projects and 25 megawatts of solar projects. In response, Xcel received 2,400 megawatts of acceptable bids from 16 wind project developers (more than 15 times the capacity they sought) and 400 megawatts from 18 solar developers (16 times more than they asked for). Manufac-</p>	

<p>turers and suppliers of wind, solar and geothermal energy are ready to meet our challenges with renewable sources of energy if given the full opportunity. Micah Parkin and Steve Bauhs, 9B.</p>	
<p>The playing field that sits below the now-skeletal 1920s facade of Casey Middle School in Boulder was polka-dotted with miniature dirt mountains last week, the result of digging 70 holes, each 400 feet deep. Once all the holes are filled with pipe and the playing field is again smoothed with sod - and when students return to a rebuilt Casey in 2010 - the building's temperature will be moderated by the earth. The new geothermal system being installed at Casey is just one of a collection of green measures planned for the school, which is aiming for at least a gold certification under the Leadership in Energy and Environmental Design, or LEED, program. "If it's designed properly, this will do it all, heating and cooling," said Jim Lynch, vice president of Rocky Mountain Geothermal, which is installing the system. "It can reduce utility bills by half." Geothermal systems take advantage of the fact that just a few feet below the Earth's surface, the temperature remains relatively constant - between 50 and 60 degrees - all year long. At Casey, water will be piped below the playing field where the Earth will cool it in the summer and warm it in the winter, reducing the amount of electricity needed by the school's heat pump to adjust the final air temperature. Laura Snider, <i>Camera Staff Writer</i>, " Geothermal Project Heats Up At Casey," <i>Boulder Daily Camera</i>, March 16, 2009, 1A.</p>	
<p>A geothermal system that will eliminate the need for natural gas to heat the building and cut the school's utility bills in half. Solar panels that will generate learning opportunities as well as electricity. A computer monitor, like the one already used at Manhattan Middle School, will likely give students a live readout of electricity as it's generated. Day lighting that will bring natural light into the classrooms, allowing the sun to provide 70 percent to 90 percent of the lighting needs, reducing electricity use. Water-thrifty landscaping that will reduce water use outside the school by 50 percent. A smart roof that will be highly reflective in some areas, keeping the building cool inside, and covered with live plants in other places. Less pavement around the school in order to reduce the "heat island" effect. To make this possible, some of the parking will be built underground. Laura Snider, 5A.</p>	
<p>According to the Web site for Al Gores movie "An</p>	

Inconvenient Truth;" [www.climate crisis.net] the average American's carbon footprint is the equivalent of 7.5 tons of greenhouse gas emissions a year. Other sources put the number far higher. McClatchy Newspapers, A15.	
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