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Deputy Monica Jaramillo County Clerk, Santa Fe, NM

SANTA FE

BOARD OF COUNTY COMMISSIONERS

SPECIAL MEETING

November 8, 2005

Michael Anaya, Chairman [excused]
Harry Montoya, Vice Chair
Paul Campos
Jack Sullivan
Virginia Vigil

SANTA FE COUNTY

SPECIAL MEETING

BOARD OF COUNTY COMMISSIONERS

November 8, 2005

This special meeting of the Santa Fe Board of County Commissioners was called to order at approximately 1:07 p.m. by Vice Chairman Harry Montoya, in the Santa Fe County Commission Chambers, Santa Fe, New Mexico.

Roll was called and indicated the presence of a quorum as follows:

Members Present:
Commissioner Harry Montoya
Commissioner Virginia Vigil
Commissioner Paul Campos
Commissioner Jack Sullivan

Members Excused:
Commissioner Mike Anaya

III. Presentation: Meeting Humanity's Greatest Challenge, by architect Edward Mazria, AIA, of Mazria, Odems, Dzurec, Inc.

COMMISSIONER CAMPOS: Mr. Chairman, we have energy issues about construction and architectural issues and how they affect our present situation, our energy situation and I think he has a powerpoint and he'd like us maybe to sit in the front row so we can look at the big picture behind us. Is that okay? It's on the little screen too, I assume. Whatever you guys want.

ED MAZRIA: Commissioners, Paul, thank you very much for inviting me. I just want to start by reading – this was an article – let me just read a little bit of it. "As the storm approached the coast more than a million people evacuated. Some 200,000 people remained, however. The carless, the homeless, the aged and infirm, and those die-hard New Orleanians who look for any excuse to throw a party. The storm hit, pushing a deadly storm surge into Lake Ponchartrain. The water crept over the top of the berm that holds make the lake and then spilled over. The water poured in and reached 25 feet over parts of the city. People climbed onto roofs to escape the water. Thousands drowned in the murky brew that was soon

contaminated by sewage and industrial waste. It took two months to pump the city dry. The Big Easy was buried under a blanket of putrid sediment. A million people were left homeless. It was the worst natural disaster in the history of the US. When did this calamity happen? It hasn't – yet."

That was *National Geographic*, October 2004. About a year ago. Climate scientists have been warning us about the prospect of New Orleans going under for a long time. It would have taken a few hundred million, maybe even up to a billion dollars. Directed by the situation now it's going to cost between $200 and $300 billion to rebuild New Orleans.

Well, scientists have been saying something else now for at least the past ten, maybe fifteen years and unless we do something, take it seriously, Katrina is going to pale in comparison to what lies ahead. But fortunately, we have some time. Not much time, but some time, and that's what I want to talk to you about.

The talk I want to give you is kind of big picture but it homes in right here on Santa Fe. It's called Meeting Humanity's Greatest Challenge. This is an interesting graph. This is 1992. This is US energy consumption and it could just as well be US carbon dioxide emissions. In 1992, we actually signed what was called the UN Framework Convention on Climate Change. The US actually signed it. The president Bush, then Sr., signed it and both houses of Congress ratified it. Basically, what they said in '92 was that we would go back to 1990 levels of emissions, and basically energy consumption, because most of our energy is in the form of fossil fuel.

Well, between '92 and 2000 we increase our emissions by 16 percent, our fossil fuel consumption by 17 percent, and these are the projections now between 2000 and 2020, we're going to increase our consumption of fossil fuels and our emissions by about 37 percent. We're going to increase our consumption by 34 quadrillion BTUs of energy. Those are quads. Well, what's a quad? One quad, 34 quads, we're projected to increase. One quad, just one quad is equal to the output of a thousand megawatt power plants. Those are the big nuclear plants, Four Corners, big coal plants, those are the big ones. One quad, 40 power plants, we're going to increase in the US by over 30 quads over the next 20 years.

This is oil production in the US. We peaked in 1970. Under this part of the curve is all the oil that we have left in the lower 48 states. We've used up ¾ of all the oil that we've ever had in the US. Fortunately, we're sitting on some of it here in New Mexico. So we peaked in the seventies. We peaked in 1973 in natural gas production. We have to drill more wells just to keep production flat. That means we can't increase our production of natural gas in this country, but we have to every year drill more and more wells just to keep production steady. So we have to import gas from Canada. Canada is peaking now. Mexico doesn't have any more natural gas to give us; we're going to have to get it from somewhere else.

The global static lifetime of oil and gas, conventional oil, is 42 years. That means if we don't use any more oil than we're using today, given the known reserves, that we don't find any more, we have 42 years left of conventional oil. Natural gas is not far behind. Seventy percent of the remaining reserves of oil and gas in the world are found in what's called the strategic ellipse. You talk to any oilman, natural gas man, they'll tell you this. With Iran sitting

on top of the largest natural gas reserves in the world. So if we're going to get natural gas it's going to have to be liquefied and trucked over, boated over from the Middle East.

Those 34 quads, there's no more gas, there's no more oil – where are we going to get the energy from? We have plenty of coal. We have large coal reserves in the US. There are large coal reserves in Australia and China and India and the former Soviet Union has large coal reserves. Unfortunately, coal is the dirtiest of all technologies. It's three times as CO_2 emitting as natural gas and oil, and clean coal technology is decades away and sequestration is expensive if it even works.

So today we have a choice – all of us. We can continue on our present course or we can choose another path. Let me go over what our present course is so you can get an idea. In the blue is global average temperature over the past 450,000 years. We have basically been in an ice age during most of this time. And you can see the temperature swings globally are very dramatic. They're abrupt. They're not very, very smooth curves. You can see all the blue lines here bunched up. The last 10,000, 15,000 years we've had very stable global temperatures. And we've been able to flourish and we've been able to farm. We've been able to do lots of things and grow our species, basically.

In red is carbon dioxide in the atmosphere, parts per million. You can see that over the past 450,000 we really haven't been over 300 parts per million. Today we're at about 378 parts per million. We're way up here. We're going to 400 parts per million, 450. Climate scientists say we'll reach 700 to 100 parts per million by the end of the century if we keep burning fossil fuels and if we push coal, put it on line, we'll reach those levels.

Well, we put out about 20 billion, we burn about 20 billion tons of CO_2 every year globally. The United States is about seven of that 20. Now it's more like eight and the number is more like 24. This was the year 2000. The total earth, all the plants, the soils, the trees, the forests, soak up about two billion of the 20 billion tons. So when you hear talk about we're going to regenerate some forests and soak up all this carbon dioxide, that's not going to happen.

The oceans soak up about eight billion tons every year and about ten billion of the twenty billion tons goes into the atmosphere. And that raises the atmospheric parts per million about 1.7 parts per million a year. The last reading, 2003/2004 that they've been able to grab off of Hawaii, we increased approximately about 2.5. They don't know whether this is an anomaly or whether this is a trend. We'll know this year.

This in black is from 1900 when we started basically burning fossil fuels, global average temperature. This is actual readings, and we're about .7 to .9 of a degree centigrade above 1900 level. In blue are computer simulations done at Los Alamos, National Center for Atmospheric Research, all the big labs, pooling their computer power and doing simulations. What you see here is with just natural phenomena only, that's solar variations, volcanic activity, this is where the temperature should be. When they factor in greenhouse gases the red line shows you the difference between natural phenomena and what we're doing by forcing the environment. So we're forcing it from maybe one tenth of a degree centigrade all the way up to .7 to .9 degree centigrade.

Well, there are reports that come out every five years from the UN. About 2,000

scientists get together, atmospheric scientists. They do research over five to seven years and they put out what's called the IPPC Climate Change Report. The last one came out in 2001. The next one comes out 2007. Between 2007, 2008 is the next large report. A few months ago the G8 Group was going to meet in England and prior to that Tony Blair called a meeting of the world's leading climate scientists in Exeter, England – 200 of them came. We sent our best scientists over and he wanted a state of the planet, basically, of carbon emissions and impacts, and he wanted the scientists to basically come up with time lines and thresholds, something scientists hate to do, basically. And this would be basing an interim report on the climate science, on where we were today, before the next IPPC report.

And what they came up with was a lot more devastating than what we had thought. They came up with two thresholds, two degree centigrade global warming – remember, we're at .7, .8 right now – two degrees centigrade and three degrees centigrade. At two degrees centigrade they use the word disaster, global disaster, at three degrees they use the word catastrophe. So when are these temperatures supposed to happen? Here's two degrees centigrade. These are the computer models here. Here's where we are now. These are the models. This is the range. And actually this is moving up a little bit now in the 2007 report. We're reach two degrees centigrade by 2050, roughly, three degrees centigrade by about 2070.

What does that all mean? What's the world going to look like between 2050 and 2070 if we keep on doing what we do? Well, the arctic is going to change the most dramatically. The northern latitudes change more dramatically than the southern latitudes. In the north, between 2050 and 2070, polar bears – gone. You'll only see them in a zoo. Salmon in the Pacific Northwest – gone. Streams in the Pacific Northwest will be too warm for salmon. In the Rocky Mountains here, 50 percent of the streams will be too warm to house trout. Snowpack in the Colorado River Basin, in our basin here, supplies water, 30 percent less snowpack. Drier soils, 60 percent less moisture content in the snowpack.

There's a report that I'll leave with you that just came out a month ago for the whole Rocky Mountain Basin which talks about all the impacts that we can expect beginning in 2010 on to about 2070 and I'll leave that with you here. *[Exhibit 1]* Forest fires in the West, in New Mexico, expect it to double to quadruple the acreage burned during that period of time as temperature increases and soils dry out. The piñons now, the bark beetle, destruction of the piñons last year has now been attributed to the .7 of a degree global warming that we've been experiencing now.

New England is in for a shock. The beautiful fall colors, the maple forests in New England, between 2050 and 2070 – gone. The only place they'll see maples is in the northern top of Maine. It will be too warm for the maples. They'll try to move north into Canada. The coral reefs which house about 25 percent of all marine species that we know of, during that period – gone. The Amazon Forest, which houses about 10 to 15 percent of all known species, if we keep doing what we do, by 2050 to 2070 it will turn into a savannah. It's gone. In fact, the largest study ever done, a collaboration of scientists around the world, headed by the UK and the US, projects that 25 percent of all species on earth between 2050 and 2070 – gone.

Mosquito-borne diseases, vector-borne diseases – I don't remember mosquitoes when I

moved here 20, 30 years ago. Now we have mosquitoes here. Mosquitoes are moving to higher latitudes. Their territory is expanding. There are 50 million people at risk today from malaria. That will expand to 200 million people. At two degrees centigrade, global crop production begins to decline. Our population is going to increase from six billion to nine billion to 11 billion and crop production will decline globally by about 2050, if not sooner. The National Center for Atmospheric Research and NOA, up here in Boulder, NCAR in Boulder, have made the link between hurricane intensity and climate change and global warming. Not the number of hurricanes but the intensity of hurricanes. The categories are supposed to move up and the hurricanes will pack about 20 percent more moisture.

Jonathan Overpeck here in the West at the University of Arizona at their climate institute, they project that if the Greenland ice sheet melts, if it melts completely, sea level rises about six meters, six, seven meters. About 21 feet. Huge. Now what Overpeck did is he looked at past climates and found – scientists now project maybe 1000 years, 2000 years, 2500 years for the whole ice sheet to melt. At about two degrees centigrade, by 2050, the melting begins and it's supposed to be irreversible. But they think it's going to take a long time so we maybe have time to prepare. But Overpeck has discovered, about 120,000 years ago it melted in a period of about 150 years. A very, very short time period. And he checked what the weather was like back then and it's very similar to what it's projected to be. That doesn't mean it's going to happen. But, we know there's going to be a one to three-foot rise in sea level, roughly, approximately, hopefully on the lower end, between now and 2100.

This is Overpeck's website at the University of Arizona. This is the coast, this is present day. This is a one-meter, three-foot rise, 2100 possible. Look at what happens to the whole coast along the Gulf Coast, southern Florida, the Keys, the islands along the coast here. If it goes to three meters, if there's rapid sea level rise, you wipe out about a third of the state of Louisiana, Galveston and a lot of southern Florida. And from his website, right here is Miami, here's Ft. Lauderdale, 2100, a three-foot rise, this is the areas that are flooded below three feet, and that's a three-meter rise, nine feet.

So how do we avert this situation from happening? It's actually not that difficult. Who really holds the key to this situation not taking root? You're going to be surprised. It's the building community. It's basically all those folks who commission buildings, who build buildings, who design buildings. They hold the key to what I call the global thermostat.

Now, why? This is the way numbers are traditionally put out by the Department of Energy and the Energy Information Administration. Usually divided into four categories: Industry, transportation, residential and commercial. And if you look at that pie, you say, okay, if we're going to attack the problem, we're going to attack industry and then maybe transportation, and then we'll deal with housing and then commercial and institutional buildings. We've focused almost all of our attention to date on the transportation sector, mostly on SUVs. You read about it every day. Environmentalists are burning down SUV dealerships. In Albuquerque they tried to burn one down. They burned a few down on the east coast. SUVs, minivans and pickups. Six and a half percent of total energy consumption in this country and carbon emissions. So if you double the mileage tomorrow, if you could wipe out every SUV,

burn them all down, eliminate them from the roads, give everybody hybrids, you would have attacked 3.5 percent of the total problem. That's not going to get us there.

If we reshape the pie and we create a building sector – in the US, buildings are responsible for 48 percent of total US energy consumption and emissions. Industry gets 1.5 percent more efficient every year. That means we put out more gross domestic product with less energy. It's not growing its emission. Transportation, the economics of oil are going to push hybrids on, hybrid electric, hybrid electric plug-ins and bio-diesels and bio-fuels. The transportation sector is going to turn around very fast, as soon as we reach peak oil, and people like Matt Simmons and other oil experts feel like we're at the peak right now.

The only sector that can drive global warming – there's not enough oil, there's not enough gas – it's coal. And the only sector that can do it is the building sector. We're right in the middle of a greenhouse gas emissions task force for New Mexico and we were given this chart by the folks in New England who are running the task force here in New Mexico. And they break down carbon emissions by electricity, 40 percent, fossil fuel industry, that's extraction, 24 percent, and transportation, 17 percent. Then you get down here, residential, commercial, industrial, 9 percent. If we look at it this way, we're going to try to attack the electricity sector and the fossil fuel industry, then transportation.

So we said we don't like that pie. It's not bad. We need to address those sectors and we will try to. But we want to look at it a different way. New England has basically used this kind of sectioning to attack the problem in New England. They've been trying to attack it since 2001 and they haven't gotten very far. So we redid the pie and we created a building sector for New Mexico. Buildings produce 55 percent of all greenhouse gas emissions. That's the electricity that's in buildings, lighting, heating, cooling, building operations, and building the buildings themselves. Most of this, probably all of this part, is building operation in New Mexico. So if we're going to attack the problem in New Mexico and the US and globally, if we don't attack the building sector, we're not going to get anywhere. They're not getting anywhere in Europe. They're trying to kill the Kyoto Protocol, a new study just came out today, said they were going to kill it. So globally, we're not getting anywhere, in the US we're not getting anywhere, in New Mexico we're not going to get anywhere unless we attack the building sector.

This is emissions in the US. This is the buildings. This is industry. Since 1950 it hasn't grown emissions. Transportation is growing but it's now poised because of peak oil to come down. The only thing that can fuel global warming is if we continue to build the way we build. Every time we stick a footing in the ground we add to the demand. Period. The County builds a building, it adds to the demand in New Mexico. That energy to light the building, heat the building, cool the building and build the building has to come from somewhere. People are not going to freeze to death. They're not going to not have light to do their work. They're not going to have heatstroke in a building. It's the only sector that can fuel all the stuff that you saw in the beginning. If we don't get a handle on the sector and we don't recognize the sector, we don't get anywhere.

Dick Cheney and his US National Energy Policy Report in 1991 to President Bush, we are going to need 1300 to 1900 new power plants in this country over the next 20 years and

we're building them as we speak. Where does all that electricity go? Seventy-six percent of the electricity that we generate out of the Four Corners, or any power plant for that matter, goes to operate buildings. The rest goes to industry. Part of that goes for building materials. Most of it goes for buildings. This is the CO_2 emissions savings under Kyoto if they were able to meet their targets in Europe and the rest of the industrialized world, except for the US and Australia which didn't sign on. This is how much they'd save. These are the coal plants we're going to build – minimum scenario. These are the carbon emissions. They're not going to make this, by the way. So this is going to be on the plus side.

This is what we're building today. This is the likely scenario of carbon emissions from the utility sector from coal. Just from coal. And what nobody ever talks about because they don't understand the building sector, it's not only that we suck generation and power from Four Corners, but we put in every building here, down in the basement here, every building we have a little mini-power plant. A boiler that uses natural gas directly, water heater, furnace. Every building has it's own little power plant and that pushes CO_2 up the stack. We're going to build 22.5 million of them between now and the next 20 years in this country.

So what do we do? New Mexico was a pioneer in zero emissions building, after the first energy crisis hit in the seventies. Steve Baer, David Wright, all sorts of crazy folks all over New Mexico, tire buildings, I can't remember what went on here. It was a center of research at Los Alamos and building by all sorts of entrepreneurs, inventors, building zero emission buildings. The DOE back in the very early eighties did what was called a DOE commercial demonstration project. They hired, they had a request for proposals, I think there was 14 to 18 buildings were done nationally all around the country. Schools, community centers, libraries. They wanted to see how much reduction you could get in energy consumption, fossil fuel consumption by just design. We were fortunate; we got one of the buildings in North Carolina to do, the Mount Airy Library, which is here, and this was in the eighties.

We day-lit the entire building. It's a day-use facility. They close up at six, seven o'clock at night. So during the daytime, there are no lights on. No energy coming from the power plant. Typically, and in New Mexico it would be the same. We're using about 105,000 BTUs a square foot, that's site-use energy, for buildings here and in the mountains in North Carolina. This is the Elkin Public Library next door, next city over, and Mount Airy Municipal Building, next building over actually, from the Mount Airy Library. They use mostly for heating, lots for lighting and then cooling. Those are the big three. This is what Mount Airy used. This is just design. There was no additional cost. We had a budget. We met the budget. Just through day-lighting the building and heating, some natural heating and cooling strategies we were able to reduce consumption by 80 percent.

Now, if you add photovoltaics and things like that, you can get it down to zero. We did it here on La Vereda Compound, I think a 47 percent reduction over typical housing in Santa Fe. The Candyman Center, you're familiar with. This is all day-lit. You go in there – we don't know what the reductions are; we never monitored that. The conservatory in Albuquerque, it can run on no energy. It can actually run for a year if they manually operate the windows and maintain conditions suitable for plant life inside. Zero energy. How much

extra did it cost? In a lot of cases it costs money. In this case, it cost less. There was no cooling system in there. We saved all that money on the cooling system, put it into the architecture and into square footage, instead of a 7,500 square foot building, we gave then a 10,000 square foot building within the budget. Bosque School, we're looking at about a 46 percent reduction in Bosque in Albuquerque on the classrooms that we built down there.

So here's a blueprint for change. I always get the question: how much extra does it cost? There are studies done – it costs one percent extra, anywhere up to less to more. Depends on who you hire, it depends on the circumstances, it depends on the bidding climate. It depends on a lot of things. Trade-offs between materials, what you use inside the building. So this is what we all have to do not to reach the two degree centigrade and the three degree centigrade.

I was just talking to Paul a few minutes ago and he asked me about cost and I said, how do you put a cost on 30 percent less snowpack in this region? You can't put a price on it. It's impossible. How do you put a cost on 25 percent of all species on the planet disappearing? There's no price tag.

So Richardson has come out with some very aggressive greenhouse gas reduction targets. He followed Schwartznegger and Schwartznegger followed all the New England governors who in 2001 came out with roughly these targets. And this is what scientists are telling us. This is where we need to be in order not to reach two degrees centigrade and three degrees centigrade. And believe me, everybody has to play a part, otherwise we don't get there.

He wants to get back to 2000 levels by 2012, ten percent below 2000 levels by 2020 and 75 percent below 2000 levels by 2050. Scientists say we need to be 40 to 60 percent below today's levels by 2050 to avert dangerous climate change.

So how do we get there in the building sector that we think is the only sector that can fuel global warming and a lot of people are beginning to understand this now, nationally, finally. Oakridge just did a study, national laboratory, that basically confirmed what we've talking about now for the last two years. We need a mandate from every city, every county, every state. Basically everybody. That all new building projects or major renovation projects meet a fossil fuel energy consumption performance standard of one half the national average for that building type.

So if we're going to design a school in Santa Fe, it has to use half of what a typical school would use. We're going to design housing, use half. Whatever we're going to design, we've got to reduce it by half. The first stab you take is through design. All the stuff that you can do. For example, let's just take housing in New Mexico. We know that in housing 15 percent of the energy consumption of a typical house is domestic hot water. So we have tax incentives. We put in tax incentives to put up hot water collection and storage systems, you'd knock of ten, fifteen percent like that, in housing in New Mexico. Not very difficult. Talking about solar hot water heaters, panels. I have them on my house, I get about 80 percent of my hot water that way. I have two 4 x 8 panels. Cost $1500. With natural gas going the way it's going it's going to double. It's up 56 percent, 59 percent since last year here just in New

Mexico. Double in most of the rest of the country. I'll save that – the payback on solar hot water is what? Three years? Five years? Seven years? Something like that and then all of the hot water you get is basically free. It's a no-brainer.

So we need to enact this immediately. Not only that, but in 2010, it's got to be 60 percent reduction. By 2030, all new buildings built in this country have to be what we call carbon-neutral. That means you design out as much energy as you can and you use either site use with photovoltaics or wind, solar hot water, to make up the rest, or you buy clean power off the grid, in order not to get to the two to three degrees centigrade. So as a society, we have to determine, and we can effect immediately a reduction in the embodied energy of buildings. This is not the big energy consumer, but we specify a trillion dollars a year in goods and services in the building community. We're the largest consuming bloc in the world. I've got in my office, what? $30 million, $40 million on the board? That means I direct the purchase, myself, in my little office, of seven or eight people, of $30 to $40 million worth of goods and services over the next few years. And then I'll do it again a few years after that.

Most architects, counties, cities, have no concept of the purchasing power that they have. If they get together and decide we're going to buy only carpet that doesn't use this much energy. So for example, in Taos, you could have used vinyl composition tile on the floors in a building that we're doing up there. We could have used Forbo. This is the amount of carbon dioxide that it takes that's emitted to produce that material. Here's cork, natural cork parquet. So we specify cork parquet. A nice material, durable, everything. Now, if everybody started – if we all decided in New Mexico, in the state, a few other states, that we're going to specify only flooring materials that didn't produce that much carbon dioxide in the manufacture, you better believe that the people that make VCT and the people who make Forbo will be coming out with new products. They'll press in who knows what – paper or whatever to get a material that doesn't produce carbon. So we can change the entire industrial sector with the stroke of a pen if we want to.

The US Green Building Council is pushing LEED certification. I'm sure you've heard that. The City wants to do LEED Silver. What LEED is is a checklist and you can get a certification without getting major reductions in energy consumption and carbon emissions. And that's the problem with LEED. So we say if you're going to specify that buildings have to be LEED Silver that you add in a mandatory 50 percent fossil fuel energy consumption reduction as part of the process. And the US Green Building Council will probably very soon adopt the 50 percent. They're not there yet but they're getting a lot of pressure. The American Institute of Architects nationally now is going to set a standard for all its members that they meet this 50 percent standard, and they won't certify LEED or any other program unless they meet it also. So this is coming down the pike.

So if you do LEED, which is good, because it deals with a lot of other issues besides just energy consumption, that you add the 50 percent. Now the governor is getting ready, probably in the next two weeks, to issue an executive order – this is what we hear – to mandate that all state-funded buildings – he might exempt schools for a short period of time and then bring them in later. All state-funded buildings meet the 50 percent reduction standard.

So if you're going to get any state money, you've got to meet this fossil fuel consumption performance standard. You've got to change the University of New Mexico. We need to be able to produce architects that come out of that program. This is their new school. When they build a school next year that can do this kind of design that we need them to do. There are 30,000 students in the US, architecture students sitting in school today, half of them don't even have a course in this subject matter. The other half, most of them one course, except for a few flagship schools.

In this country we tear down about 1.75 billion square feet of building. In New Mexico, about six million square feet. We renovate in the country, about five billion square feet. In New Mexico we think – we don't have exact numbers, maybe out 17, 15 to 17 million we renovate. In this country, we build new about five billion square feet. We renovate and build about the same amount of square footage, so we averaged out New Mexico construction the same way. We build new another 17 million. We probably build new more than we renovate because we're a newer state and in New England they probably renovate a lot more than they build new.

This is the entire building stock in the US, about 300 billion square feet, between 250 and 300. In 30 years, over the next 30 years, we will destroy or take out of commission about 50 billion square feet. We'll renovate another 150 billion square feet. We'll add about another 150 billion square feet. So in the year 2035, about ¾ of the built environment of the whole United States is new. And that's the hope. If we start to do this today, build buildings that are 50 percent and then 60 percent and then 70 percent, we don't reach two degrees centigrade.

This is the building sector in the US. This is business as usual. If we just do what we're doing now, just keep going. This is carbon emissions. Ten-twenty, you hear about ten percent renewables, electricity sector, twenty percent by 2020, ten percent renewables by 2010. This is the reduction you get in the building sector. If you do the 50 percent, 60 percent, 70 percent, then you get to about 50 percent below 1990 levels through that program.

This is New Mexico. We're about 30 percent above 1990 levels now. We need to be – we can't let the atmosphere go above 450 parts per million, otherwise we have a 50-50 chance of going over two degrees centigrade. This is what scientists are telling us we need to do to get the 450 parts per million in terms of reduction. If we adopt the 50-60-70 in New Mexico, this is where we are now. We're about 30 percent above 1990 levels. Richardson wants us 70 percent above 2000 levels, which was about here. If we adopt that program we get right where we need to be by about 2050, 2060 in order not to go above two degrees centigrade.

So, that's my granddaughter. I'm out of here before any of this happens, believe me. Before we hit 2050. I won't make it to that time. I'm 64 now. But my granddaughter will see all this. So do we want to go out as the greedy generation and use up everything, or do we want to save this place for these kids so that they even have a chance of dealing with this situation. My feeling is that we owe it to them. We could use it all up but if we don't do this 50 percent reduction. If the County doesn't do it, if the City doesn't do it, if the State doesn't do it, if New England doesn't do it, if the feds don't do it, we don't make it.

Now, the County's going to build, I don't know, a few buildings. It's not huge. But

what does it mean when the County does it? It sets an example for everybody else. What does it mean when Richardson does it? It sets an example. If we even built every state building, every state-funded building, every County building, every City building to this 50 percent standard we affect between 10 and 20 percent of all building in this state. It doesn't do it, but it sets an example. Once we do it in the public sector, believe me, it will drive down into the codes and into the private sector. The private sector's got a way to go. But if we don't start in the public sector and we don't set the example in the public sector. It will never, ever get to the private sector.

I leave you with that. You guys hold the cards. You hold all the cards as an example and that's why you're so important. Thank you.

IV. Question and Answer Session

COMMISSIONER CAMPOS: Mr. Chairman, if I could just lead off with a question.

COMMISSIONER MONTOYA: Sure. Mr. Mazria, we're looking at building some new structures here at the County and we have to look at it from a pragmatic perspective. How do we start? What do we look at? How do we design these buildings? How do we get them out to proposal, bring them in and construct them appropriately? Can you give us some ideas?

MR. MAZRIA: Yes. I think since in many instances in New Mexico the cities and the counties – we're not like Seattle or New York City where we have huge resources. But the state of New Mexico has resources. We're an oil and gas state. We actually have a lot of money in the coffers. We think that Richardson is going to come out with the 50 percent standard, I think in the next two weeks, but that's what I hear anyway. I don't know. He actually made the statement at the Western Governors Conference in Albuquerque that he'd like to see all state buildings, 50 percent reduction.

If he comes out with the standards in two weeks, we've given him a list of building types and where they need to be to be at half of the US standard. His staff is probably working on it now. How are they going to implement this? They may just do the 50 percent performance standard, or they may do LEED Silver, with the 50 percent performance standard. And they'll probably do the 50 percent performance standard for all buildings 5,000 square feet and above. With adding the LEED standard to buildings 15,000 or 20,000 square feet and above, because they're more – they're larger, they have a bigger impact and they're kind of more showcase buildings in a sense.

So if you're going to do LEED, LEED gets expensive. That's where you'd start building up costs. You would want it on a larger project. For the very small projects it doesn't make sense. The 50 percent makes sense, but not going through the whole LEED certification process, which is lengthy and costs money. So my feeling is that the County should rely on what the state sets up in terms of compliance. How do you issue the RFP so you get the 50 percent, and how do you make sure that you get compliance? Now, you might do computer

simulations. Let's say a building is going to reduce its consumption by 60 percent. People use the building a certain way, it might only reduce it 40 percent.

The number is going to float. It's not going to matter that much anyway. As soon as gas prices go up, believe me, people will be shutting down thermostats and turning off lights when they don't need them. So if you had the resources to set all this up yourself then you go ahead and do it. If you don't have the resources to set it all up, then I think you work with the state to see how to implement it and see if you can even use – they might train one or two people in compliance. You might even use those folks and go through that process. So that's what I would – any new building coming out now that did not meet the 50 percent performance standard, I think personally is criminal. I just think we do everybody a disservice.

There have been studies done on the incremental costs of going to LEED certification. And the studies show that if you go to LEED Silver you're anywhere between one and two percent above. They take a whole slew of projects that have been certified, they're one or two percent above typical construction costs. Not that much. Some are below, some are a little higher, just depends on the climate, depends on what the design does. Every site is unique. Every design is unique. But you can get very close if you do simulations, performance simulations. You can get a really good idea of how a building is going to perform. So you rely on those simulations, and people who can do those simulations – there are lots of folks who can do this. There are companies that can do it. You rely on those simulations to at least tell you you're going to get in the ballpark.

You can then add commissioning if you want or an agent, so the City or the County goes out and makes sure everything is built and works the way it's supposed to work. That's an extra cost also. So you need to look at and weigh all those things. It's not just going out and doing it. It's basically setting up the framework to do it, and them implementing it.

COMMISSIONER CAMPOS: Thank you.

COMMISSIONER MONTOYA: Commissioner Vigil, do you have any questions?

COMMISSIONER VIGIL: I do. Thank you, Mr. Chairman. I'm real impressed by the propheticness of your presentation. One of the areas that I guess I'm concerned with that we probably would have more of a challenge providing standards or creating a leadership role in is in the conversion of current energy usage. Do your – do you have any information on how that would impact?

MR. MAZRIA: You find in the US as an average, we renovate almost as much as we build new. There's a lot of renovation that goes on. So by renovating buildings it makes a huge impact into what you can build new. So for example, if you use the 50 percent standard over renovation and new, that's the reason we came up with the 50 percent is that there's about as much renovation as there is new building. So if you renovate everything down 50 percent, you would reduce its consumption by 50 percent during renovation, because now you have a lot of opportunities to do things, like new lighting systems, punching a few holes in the ceiling, getting some daylight in, doing all sorts of things.

You then make way for all the new buildings at the 50 percent reduction. So you're

really not increasing demand very much. So renovation plays a huge role in what we can do, and that 50 percent standard has to carry through pretty much for a long time. So what we recommend is every renovation that you're doing of a building 5,000 square feet and over, that you require that building to meet a performance standard of one half the national average.

So for example, let's say we're renovating a County office building somewhere on Cerrillos. I don't know if you have one but maybe you do. We know what office buildings, what the US national average is for office buildings. In Santa Fe our average is probably lower than the national average because we're in a sunny climate. We have a more favorable climate, for example, than Minnesota. So we probably don't have to reduce the consumption of that building by 50 percent. Maybe by 40 percent or 35 percent, depending upon what its use is. If it's an efficient building to begin with you maybe only have to reduce it to get to that standard ten percent.

We want to be 50 percent below the US average for each building. And it just depends on if it's an old, old building and it has single glass, then you're talking about a major reduction, but if you use double glass you can get it down real quickly. If you change the light bulbs out from incandescent light bulbs to compact fluorescents you can probably get huge reductions there. If you put a few solar hot water panels on the roof you can get reductions there. You've got to get to the 50 percent reduction below the national average for us not to meet – so I think the question is absolutely renovation, every building 5,000 square feet and above to meet the 50 percent standard if you set that up as a County Commission.

COMMISSIONER VIGIL: Thank you. Am I to understand correctly that your presentation states that in the design and build of these buildings that we're trying to achieve the 50 percent mandate that it's your sense that that is only a one to two percent increase in architectural and design cost?

MR. MAZRIA: There's a study I can give you that shows – no one's done the 50 percent yet because we just in the past year or two have worked backwards from 2050 to come up with what we need to do to get to that point that the governor has come up with. We knew this before the governor made this announcement a few months ago, about two years ago. So there haven't been – there have been many studies done that show anywhere from high costs to none. Let me give you an example. Somebody wrote me an e-mail on this, George Allen from Santa Fe Interiors. Let's say, well, George you want to build a 20,000 square foot office building in Los Alamos, where he's from. 20,000 square foot, you have $2.5 million to build it, you have a site. You give it to 20 different architects in Santa Fe. You will get 20 different solutions. You will get some that will be energy hogs. You will get some that will be way below the average. Just depends on the design.

So you can't – you can say, this is my budget, you need to be 50 percent below. This is your target number; get there. Let the architects figure out how to get there. That's what they're supposed to do. They're designers. Now, they're probably going to take more time doing it. They're going to have to figure things out. They're going to have to run simulations. That's going to cost a few bucks. Can they do it within the budget? Sometimes they can, sometimes they can't. It depends on the site, it depends on a whole lot of things. Sometimes

they maybe can give you more building for the same amount of money. There are variables in there and I think you're going to have to deal with every building, work with your architects to get to that place and try to hold down costs.

It's a tough question to answer and it's not like buying a TV. You can stick a TV in any house and plug it into the wall. And you can take any TV and use it in your house. It's very different with a building. Each site is different. One slopes this way, one slopes that way. You may have solar blockage from another building. For example, we've had a lot of buildings go out where we've been under. All of a sudden this year, we put out a bid package and lord knows, China buys up all the steel in the world and concrete, and concrete and steel prices go through the roof. So the building comes in more.

Now, is it because of the design or is because of the market? I think you're going to have to have you County Manager or whoever your CIP people are work with your architects to go through the process a few times before you get a good feel.

COMMISSIONER VIGIL: I don't have a sense of knowledge of the difference between solar energy and biomass, which is something that our community is sort of steering itself towards. I don't even know whether one is beneficial over the other?

MR. MAZRIA: You need them both. What biomass is, with biomass you're using woodchips, all sorts of materials, to pretty much generate electricity. And then the heat that comes off of generating electricity, you can use to then heat buildings and do all sorts of other things. So you try to use 100 percent of whatever you burn, either by generating electricity or by using heat. There are people, Mark can talk about this. There are architects in the audience here who can address it. So you can do that. That's a little piece of the pie. That's a little piece of the puzzle.

Solar energy is – there are basically three or four types. One's a passive solar system. One is an active system. One is concentrating systems for electricity generation. If you want to make a comparison with biomass, you're probably looking at concentrating collection systems, fairly big – the stuff that Sandia does, Los Alamos, where you have some array somewhere and you're concentrating solar energy, you're generating steam. It's very high tech. You're pushing turbines, you're generating electricity, and then maybe you can use the waste heat to develop a district heating system, which is something Mark is trying to do with biomass. Or is doing. Thank God he's doing it.

So that would be the solar energy equivalent, I think to biomass. Now, another form of biomass is a wood-burning stove in a house. You just burn wood and you get heat. You don't get electricity. Solar, however, is a lot of different things. Active solar would be panels on your roof generating hot water for a tank that you'd either use for heating under a floor slab or in a baseboard, or you'd use for washing, so that's one form of solar. That would be pretty much active solar you'd use for heating or for hot water.

Passive solar, however, is very different. It's am I orienting my windows the right way. I let sun in through the window, I get heat inside the house for building, and that heat gets distributed around naturally. You have to work at it and you have to design it correctly. Do I use that window for lighting also, daylight, so I don't need any lights on. We can design

schools. We're a one and two-story state, basically. We don't have high-rise buildings like they do in New York. We can use the roof to get in light anywhere in the building. So we can daylight, for example if doing a school, we can probably daylight the whole school. The Mt. Airy Library in North Carolina, we daylit the entire library. There are no lights on in that library during the daytime. Period. It's a huge energy savings. Electricity is a premium form of energy because we have to produce it at Four Corners. There are all sorts of losses. We have to transport it. So if we can do daylighting, it's huge.

We can do what we call passive cooling also. We can cool buildings just using whatever energy comes on to the site. Shading things by lighting. We're blessed with low night-time temperatures. We open the windows at night in the house, close them up during the day, we probably don't need any cooling system in Santa Fe. We can do that in schools, we can use forced ventilation in schools at night. We can cool the spaces. There are a lot of things we can do. We put that all under the heading of solar, of passive solar. There's active solar, passive solar, concentrating solar. The analogy to concentrating solar in comparison would be biomass.

Biofuels are a whole other thing and that's more for transportation, squeezing fuel out of chicken livers or whatever else we want to use to get biodiesel and things like that, but that's more for the transportation sector, and that's going to take care of itself with people. I guarantee you that there's a solution to the transportation sector. The technology is there for hybrids. For plug-in battery technology. I don't see, I really don't see the transportation sector as a problem. I think that's going to take care of itself. It's the building sector that if we don't get a handle on it's going to bury us.

COMMISSIONER VIGIL: And finally, you gave some examples of buildings that were close to or if not at the 50 percent efficiency standard. Were any of those here in Santa Fe?

MR. MAZRIA: Oh, yes.

COMMISSIONER VIGIL: Which ones were they?

MR. MAZRIA: We haven't monitored the Candyman Center on St. Mike's but we're probably low on that one. I don't know where we are because we've never measured it. We did do measurements back in the 80s on La Vereda Compound, on the first phase, along Palace. It's built by the Nichols and we worked on the design. That was a long time ago. But those were in the – between 40 and 50 percent less than a typical residence. My own house, about 70 percent. I'm trying to think. In Albuquerque, Bosque School was 46 percent. We just did a new East School, which is not complete, so we can't monitor it until it's complete but we're looking at a 50 percent or more reduction. Right now it's running more because it's not built out yet, but as soon as it's built out then we can monitor the East School. It's kind of a flagship school on the southwest side of Albuquerque, K through 12.

Let's see, in Santa Fe – there are a lot of buildings in Santa Fe that were built a long time ago. There are some people that are off the grid, 100 percent in New Mexico. Taos, I think you have quite a bit. Your little fire station is what? That's got to be less than 50, out by Rodeo, the new fire station on the rodeo grounds. The Chavez Center we haven't monitored, but there's a lot of daylighting in that. That would be a tough building to guestimate because

we're making ice all the time and a lot of hot water for the swimming pools. But pretty much the building has a lot of daylighting that offsets a lot of the lighting. That one would be a tough one to do.

I'm trying to think. The conservatory we know in Albuquerque. We know that can use no energy. They can operate that, if they had a power failure they would not lose a plant in the Mediterranean and Sonoran Desert environment. There are architects all over. One thing about New Mexico is that we're blessed with the brainpower to do this. I think you just have to challenge the architecture community to do it, and I think they'll rise to the challenge. At least I hope they would.

COMMISSIONER VIGIL: Thank you, Mr. Chairman. Thank you.

COMMISSIONER MONTOYA: Commissioner Sullivan.

COMMISSIONER SULLIVAN: Thanks, Ed, for your presentation. I realize that there are a lot of components that you can shave off to reach that 50 percent. You haven't mentioned anything about wind generation. In Santa Fe County do we have any opportunities for that?

MR. MAZRIA: Yes. Wind is very, very promising. There are two things about wind. If you talk to some of the wind guys – we have wind guys, solar guys, we have all sorts of guys here in New Mexico, and girls, and women. If you talk to the wind folks, they would like to see wind saved not for the building sector but for the transportation sector, for producing either hydrogen, for example, rather than using coal to produce hydrogen. We get into trouble if we use coal. So they would like to see wind – you have only so much wind. They'd like to see it used to offset the transportation sector if they could.

However, PNM has a big wind installation. We can do a hell of a lot more wind in New Mexico. But those are more centralized facilities. So we produce electricity and then the County, individuals, can buy what we call green power off the grid. What we would like to see is, let's say because of the site or through the design or whatever, you're only getting 30 percent reduction in a building that you build. Then we say buy the other 20 percent as green power from wind. And that's where the centralized facilities come in. If you can't do it through design or onsite strategies, then buy the rest up to the 50 percent from PNM. And then they'll produce more wind, because they're going to be selling it to counties and cities and everybody else when they can't meet the 50 percent.

When we go to 60 percent, 70 percent, when you get down to the carbon-neutral by 2030 you'll have to buy power. Either you produce it onsite with photovoltaics or you buy green power off the grid and you stimulate that environment. Or you buy it from Mark. Are you going to produce enough for the County? Not? Just thermal.

COMMISSIONER SULLIVAN: What about for large municipal or County buildings? Is it economical to put in an installation in a large building, wind installation that could over a few years pay for itself, just for that building to supplement power generation?

MR. MAZRIA: You would have to first see if the site was conducive. Usually, right here in the City, I don't know if there are that many sites. It's usually down in the plains where they have the wind blowing continuously. I don't know if the County owns any land

down in some other county where you can wind-generate, but you would have to first have a study of the site done, number one, to see if you have enough wind. There are studies done, I don't know how localized they are. You would have to see if your site fit. If it did, then you could use wind. You'd probably use small wind. You're not going to put some giant thing out there like they do out on the plains.

But there are now manufacturers who are doing small wind. The strategy is, and this has always been the strategy, is you design out as much as you can of the 50 percent, and then you use technology, which is expensive, to get to the other remaining amount. So if you use a 50 percent standard, and I can design out 45 percent, then I'd use wind or hot water heating or photovoltaics or whatever, to make up the other five percent to get to the 50.

Let's say down the road we're at 80 percent and I can only design out 50 percent or 60 percent or 40 percent. Then I have to use more technology to get the 80 percent reduction or I have to buy it. It's as simple as that. But the first order of business is design out as much as you can, because that's easy. That's turning the building the right way, putting the glass in certain places, those are all kinds of architectural strategies where you're using the stuff you do anyway, only you're just using information to design it out. Then you add the technology. The technology always comes second. If you start out designing a hog you would plaster the whole building with photovoltaics, just to make up the 50 percent. It doesn't work that way.

COMMISSIONER SULLIVAN: I was just thinking, and I guess we haven't had much experience in it, but south of I-25 and the Route 14/599 areas, there are still windmills that operate and there were windmills that ran the ranches and so I have a feeling, since I live in that area, every time I go outside the wind blows. I just have a feeling that we have a resource there that we're not even thinking about tapping.

MR. MAZRIA: There are people I can put you in touch with that can tell you. Ben Luce would be great. He's really been key. He's right here in Santa Fe. I'm going to see him tomorrow. We meet every week. You talk about wind, that's his language. He can tell you anything and everything you want to know about wind. You put Ben up here and he'll talk to you for two hours.

COMMISSIONER SULLIVAN: Are there any facilities that have wind generation, other than ranches and so forth, that you're aware of in Santa Fe County.

MR. MAZRIA: I'm not.

COMMISSIONER SULLIVAN: Well, thanks again. Thanks for your presentation and for your time.

COMMISSIONER MONTOYA: I had a couple of questions for staff first. Steve, what would this entail in terms of a development of an ordinance? I know we don't really have anything in the books about any of this right now. Is this something that we should, as a suggested date until the state comes up with some sort of rules or measures, or is this something that could be done internally?

MR. ROSS: Mr. Chairman, if you're talking about requiring energy efficient County buildings, it's a very easy thing to accomplish. We would just amend our current purchasing documents to require that new buildings or renovations meet certain standards.

We'd have to develop those. Probably Mr. Mazria could really help us develop procurement documents that would accomplish that objective. If you're talking about a more broad concept, like mandating energy efficiency in buildings constructed within the county that would require an ordinance and we'd have to think about all sorts of things in developing that ordinance.

COMMISSIONER MONTOYA: Okay.

MR. ROSS: Kind of two tracks.

COMMISSIONER MONTOYA: Okay. And actually I would be talking about both tracks. I don't see anyone here from Land Use but is there any expertise that we have in this regard in terms of building these types of facilities?

JOSEPH GUTIERREZ (PFMD Director): Mr. Chairman, Commissioners, we rely on architects. Right now staff has no one.

COMMISSIONER MONTOYA: Okay. And actually, Joseph, my next question is for you. In terms of, we have a contract amendment coming up today and it's for the design of the Public Works facility. Is that within the spec there, what we put out? Does it include any of what's been discussed here today?

MR. GUTIERREZ: Mr. Chairman, it doesn't include the 50 percent. It's actually an amendment [inaudible] The architect has that type of experience.

COMMISSIONER MONTOYA: Does that architect have that type of experience? Yes. Okay. And then Ed, regarding - you talked about coal but you didn't really talk about wood, just a little bit in terms of biomass. What does wood do to the atmosphere or can you talk a little bit about that?

MR. MAZRIA: Wood is in a category of a renewable source. So for example, a tree in order to grow sucks carbon dioxide out of the atmosphere, gives off oxygen, stores the carbon, mostly within the trunk of the tree. As it grows it just keeps storing carbon. When we cut it down and we burn it, we give back the carbon dioxide. So wood, or plant matter is a zero-sum game. You burn it down, another tree grows, soaks it up, we burn it, we put it out. That's why it's called a renewable resource. It doesn't increase the parts per million of carbon in the atmosphere unless like you get the whole Amazon destroyed and burned. As plant matter or wood decays, it gives back the carbon that it soaked up. If you looked at that, when I said the two billion tons, the whole plant mass of the world, basically, you see that it's not a big – there's a lot of carbon stored in soils and stuff and permafrost diminishes that carbon that's going to be released and that could be quite a bit. But traditionally we don't worry about any kind of bio-material. Just because you burn it, you grow it. It soaks it right back up.

COMMISSIONER MONTOYA: Okay. And then the last question that I have is, in terms of you mentioned we put out an RFP, get 20 different styles, architects, giving us 20 different prices. How do you determine, if we don't necessarily have the expertise in staff, how do you determine what is reasonable in terms of what you get back, knowing that we want to go to this new ordinance if you will.

MR. MAZRIA: That's a tough question. That's probably the toughest question. It's like industrial processes. You can define them very precise. Ford's making so many cars. They have a plant. Each one is coming off looking exactly the same. Cost x-amount of dollars.

They have a pay-back. All this stuff. With buildings it's really different. It's not an off-the-shelf. You don't just go, I'm going to pick this building out. I know exactly what it's going to cost, and I plop it down. It's just not that way. It's a whole different ballgame. What I might do, if I was the County, say I was sitting in your seat, I might send a staff person to get LEED certified, take a course or two, get them up to speed on what's going on.

I know that the County has much more limited resources than for example, the state. It's just bigger. It's got more money. Stuff like that. Although we're not a poor county. So that's one thing. I think we can train one or two people in the County to get up to speed on LEED certification. I'd have to look around and see what other kind of educational stuff is out there to recommend to you. I don't know if the National Renewable Energy Lab is doing any course work or any training. I know they came down to Santa Fe to do a training session not too long ago. It might be good to get those guys down to do a training session of the staff. It's something to look into to get some folks up to speed so that they can then interact with the professionals that are designing buildings in a knowledgeable way. Because that's what you want.

COMMISSIONER MONTOYA: Right.

MR. MAZRIA: You want them to be knowledgeable in order to say, well, can you look at this instead of this. Or did we look at this instead of that and be able to speak the language, basically. That would be a suggestion. I think if the state gets up to speed – I'm just trying to think. When you go through a County building, I think you have to go through Construction Industries permitting. I would hope Construction Industries, they're part of the people who are part of this group that's studying the governor's emissions targets. We've been talking to them about the 50 percent and stuff. So I would hope that they get up to speed on it and can provide some of the resources to the County and City and other entities – school boards or whatever.

I think Lisa Martinez is the head now of that agency and she's pretty good and she's been in on these conversations. So I think as a state we'll probably all be getting up to speed rather quickly as this thing travels through.

There's been, at the national level, most architects are members of the American Institute of Architects. It's a national organization and although it doesn't have any authority to do anything, as architects, most of us are members of that organization. They have just put together a sustainability task force that I addressed about five months ago, six months ago. They have now come out as a policy statement from the entire organization of which most architects are members, calling for this 50 percent reduction. That all architects should do this. No matter if they ask for it or not ask for it. Just a matter of duty. It's a matter or your moral and ethical responsibility as an architect to protect the health, safety and welfare of the public. That's what our charge is as architects.

Now, what more health safety and welfare can you -- I mean, that's probably it if you want to get to the height of what you can do. So they will vote on it as an organization, the board will vote on it in December as standard policy for the entire architecture community in the country. And they've adopted the 60-70-80, the carbon-neutral by 2030, that this will be

standard practice within our industry. That will get a lot of architects up to speed, because there will be continuing ed, it will filter down to the schools. So that's coming down the turnpike.

You have an architect on board that you already have under contract. He knows how to do it; he can get you the 50 percent. So you can do it just in the RFP process for now until things start to happen with Lisa Martinez and Construction Industries and stuff like that. You can begin to instigate the practice with the folks I think that you have and the people that you've already hired to begin to move forward in this area. And then see what happens in all the other areas, get your people up to speed and I think you'll be off and running.

COMMISSIONER MONTOYA: Great. Thank you. Commissioner Campos.

COMMISSIONER CAMPOS: I was just going to suggest that we have questions from staff. Joseph, Rudy, you guys are in the procurement aspect. You look at these issues regularly. What questions do you have Frank, Dennis? And from Legal too. I know Mr. Ross is interested in energy issues.

RUDY GARCIA (PFMD): Actually, my first question is who is the contact person from the Governor's Office that we can speak to in regards to this?

MR. MAZRIA: That would be Craig O'Hare. He's kind of spearheading it up, and he's their buildings guy. And there's another woman that works with him that just started. I'd have to get on my lap top to get you her name. But I think if you start with him – I think they're the ones who are drafting the executive order and I just got an e-mail from him today that it should come out in two weeks but I heard that about eight months ago. So –

MR. GARCIA: Does he actually work with the Governor's Office?

MR. MAZRIA: Yes.

MR. GARCIA: And is there a webpage that the governor actually has for this?

MR. MAZRIA: Yes, but I couldn't give you the – I have it on the computer. I can go to it, but there's a whole website devoted to the stakeholders' process that you can get on and see how it's unfolding for the targets that he set out. The stakeholders' process is running now. There are I don't know how many different parts of it. I'm officially not part of the original stakeholders, so they have for example utilities, PNM and all the utilities. They meet. They have all sorts of parts. I'm part of a task force that is advising the residential, commercial, institutional part of the stakeholders' process.

In fact, I'm part of two different task forces that are inputting two different parts, giving them basically – I generate information for them and give guidance. The stakeholders' process has been going on for maybe only two months now. It just got set up right after the targets were set, when the governor announced them. The process is being run by a group out of Connecticut. They've run stakeholders' processes in New England which mandated reductions in 2001. They have not seen the reductions in New England since 2001. They're carbon emissions are still going up. My sense is that they don't understand the building sector.

So these guys from New England are getting an education because I think here in New Mexico we understand the sector. There are a bunch of us. So we're now kind of guiding them – they're supposed to be guiding us through the process; we're really guiding them through the process, like the new pie chart we showed. Craig O'Hare is part of the building sector process,

so he's kind of a key guy over there. He answers to a whole bunch of higher-ups but in terms of getting things through, you've kind of got to go through him to get to Ned Fahrquar and some of the other guys up there.

MR. GARCIA: Some of the other questions you kind of touched base on is because of high cost of construction we have actually underbudgeted a lot of our projects. For example, we're going to actually construct – let's say we have an existing old County facility that was roughly an elementary school, forty, fifty years ago and is roughly 2500 square feet and we actually want to do an addition to it of 500, 700, 1000 square feet. At what point do we actually determine whether energy efficiency should be part of it or not?

MR. MAZRIA: I'd say you should do it in everything you do, but as a kind of legal target or something like that, we put 5,000 square feet on it because if you do every little thing you can drive yourself nuts. So we say 5,000 square feet and above is a decent target. Personally, now, the US Green Building Council will jump up and down but I wouldn't do LEED certification for anything under 15,000 square feet. It's just too intense. I go 15,000 square feet and above or 20,000 square feet and above to do LEED Silver with the 50 percent performance standard. Because you can use just code and get a LEED certification, meaning that you wouldn't get any reduction from the energy part of their whole program.

Now, they're going to be revising that because they're under tremendous pressure now from the American Institute of Architects. They want the American Institute of Architects to recognize them as a legitimate national group and a standard by which buildings should be judged and people should enter into contract with them to get their building certified. So they're under big pressure. So once this thing happens in December I think you'll see the US Green Building Council, their energy part become a lot more important than it is now. Now it's a small part of the whole picture.

FRANK JARAMILLO (PFMD): Let's say you do a renovation under 5,000 square feet and you go in and change the ballasts and go into energy saving ballasts and go into – would that be feasible. You're going to pay more for the ballasts but would it be worth it in the long run?

MR. MAZRIA: You know what? Electricity is going up. Gas has gone up, what? 59 percent since last year, natural gas. If these guys like Matt Simmons, this oil guy, international oil guy, advises Bush, conservative, if he's correct and we've reached the peak – now, it's going to fluctuate. If Saudi Arabia can through out more oil and stuff, it's going to fluctuate. But once we've hit the pick the projections are from this guy Simmons and some other peak oil guys, are ten times the cost of what you're paying today, what you're going to pay if we actually hit that peak. Nobody knows where the peak is because you can't get viable information out of some of the countries about their reserve. But they're kind of guessing that they think they're not where they are.

So you're talking about, if you have, let's just say a little building like yours. Let's say you're paying $1500 now. You can be paying $15,000 in ten years. Hey, I'd spend up-front money now to save the money down the line. Because you know – you do the renovation once, you forget about it for the next ten, twenty years. You're not going to do it again. You

may as well do it up front. Or change out your bulbs for compact fluorescents – huge. Talking about seven watts, 15 watts instead of 60 to 100 watts. The savings are astronomical. Of course you're paying – the bulbs are more expensive.

There are now new daylighting fixtures that people are making. They're a little more expensive. They're in a 2 x 4 grid, right? Only you take a tube that goes up to the roof, punch a hole in the roof and whenever there's light coming out of the fixture, daylight, the fixture's not on. As soon as there's no daylight then the bulbs go on. So there are all sorts of things that are coming out now because as energy goes up – the incredible thing about this country is we react to money. As energy prices go up all sorts of things are coming on the market to use. Like these daylighting fixtures. I just got a call from somebody: Would you use my fixture in a school? My daylighting fixture. I can snake it around beams. I can do whatever. Here's a 2 x4 picture. You lay it in, and I can snake this thing around and I'll take it up. All I've got to do is get it up to the roof. Would you use it in schools? I said, sure. Send me a brochure, we'll see.

In this country, the price of oil goes – look what happened with gas. You couldn't sell an SUV last month. Fifty percent reduction in sales. GM, Ford, Chrysler on all their SUVs. They couldn't get rid of them. Every ad on the television was how wonderful SUVs are and they can't get rid of the damn things. If oil goes down, well, they'll start selling them again. But I think we're in for a long-term trend on energy.

COMMISSIONER MONTOYA: Okay. Joseph, do you have questions?

MR. GUTIERREZ: Thank you. Just a couple quick questions. The presentation was very interesting. It educated all of us in our department quite a bit. My first question is, does the federal government or any other state government or any other public body, have they adopted a 50 percent energy reduction regulation in that construction environment that exists out there in the public sector.

MR. MAZRIA: Nobody's adopted it yet because we just found – we just discovered the building sector. That was in October 2003 it got discovered. The 50 percent, I just started talking about it maybe about a year ago. It takes a long time to filter through this country into the process. Oakridge National Labs have been beating on the Pugh Center for Climate Change in Washington, DC to get a study of the building sector. Just to give you an idea, there was no building sector until an article came out in 2003, when we said there is a building sector. Now all of a sudden Oakridge came out about four months ago saying there's a building sector and it consumes 50 percent of all energy in this country.

So the feds have just recognized, about three or four months ago that there is indeed a building sector. Now, you'll see them begin to attack it just like you see the American Institute of Architects is going to attack the problem. But it took us two years to get them to attack the problem.

MR. GUTIERREZ: I can understand the urgency based on your presentation and the timing is difficult because we're faced with high rising construction costs. Are any of these entities that you work with considering a phased in policy that would maybe save, maybe a certain percent over the next five years that you reach this 50 percent? Is there any consideration to that?

MR. MAZRIA: See, I think you can get – I think we know – if you talk to the National Renewable Energy Lab, the feds, they know you can get to the 50 percent through design. Not a big jump in cost, depending upon who you hire, basically. So in order to meet the 40 to 60 percent reduction over today's level of greenhouse gases by 2050, you've got to go to 50 percent today. You can't – the longer you put it off, the more expensive it gets because now the drop is steeper. So let's say you wait five years. You can't go to 50 percent anymore. You've got to be at 65, 70 percent because you're now five years up on that curve. And now the drop is not like this; the drop is getting like this.

So the longer you wait to institute the 50 percent the worse it gets and the more costly it gets. And scientists have been screaming about this to world leaders for a long time, and I know we're not world leaders here, but in a sense we are world leaders, because everybody is going to have to do this in order to make it work. It's just not going to happen if everyone doesn't get on board. So we're looking at China now. We're looking at India. We're looking to get this instituted over there also. We're looking to get this instituted everywhere.

MR. GUTIERREZ: My last question is you've developed product that meets the 50 percent efficiency and you've done it for the public sector. Did you do because of your passion in your design, or was it a requirement of the public sector when you developed this product?

MR. MAZRIA: We did it, we started doing it back in the seventies and eighties when the first oil prices hit. We were in New Mexico and we were a leader. And so we were doing it then. And we just in our offices never stopped doing it, basically. It just became part of what you do and I think there are a lot of architects that that's the case. A lot of the younger guys didn't get trained that way because what happened was oil prices went back down to $10 a barrel and there was no reason. Energy was cheap and we didn't know about climate change back then. So a lot of younger architects are not up to speed, I think.

But don't underestimate architects. They can get up to speed very, very quickly. They get on the Internet – boom. They'll figure things out. The incredible thing about architectural education is, for five years studio is your main course, six credits. That is what you do over five years. All you're doing in studio is solving problems. Every year you get three problems and you've got to come up with unique solutions. So for five years you're trained to problem-solve. You give architects the problem, let them solve it. You're not going to solve it for them; they'll solve it. That's my hope.

I know I'm going out on a limb here with architects but I have a lot of faith because I've talked – I just gave a talk to about 150 architects in Albuquerque a few days ago. I didn't hear one of them say we couldn't do it. All I heard was, all right, let's go. Let's get this job done. We had a symposium here in Santa Fe two years ago. We probably had 100, 150 architects. We had 300 folks attend. I didn't hear one person say we can't do this.

COMMISSIONER MONTOYA: Great. Rudy, did you have one more?

MR. GARCIA: Actually we have a lot of questions but we're strapped for time here and we'd actually like to get your card and maybe we could – we are the CIP Division for Santa Fe County among other things within the County and if we can get your card and

maybe schedule a meeting or a lunch with you.

MR. MAZRIA: Sure. I'm two blocks away, actually.

MR. GARCIA: I appreciate it. Thank you.

COMMISSIONER MONTOYA: Great. Okay. Commissioners, do you have anything?

COMMISSIONER CAMPOS: One last question. The state has a lot of money now and are they planning to spend any of that money, any additional money for these new standards, these new buildings, these new requirements at the state and perhaps filtering down to the local levels?

MR. MAZRIA: I think that will happen. I'm not sure exactly what they're going to do. I think what happens at the state level is an executive order gets written and put into place and then the staff has to figure out, how do we do this? And I think that's kind of the way, at least the way I see the political system working, but once you put the standard in, everybody's on board and everybody's looking at a lot of different ways to do things. And I would be presumptuous to say this is the way it will be done or that's the way it will be done. You have so many talented people in this state. They'll figure out all sorts of ways that I can't even imagine on how to do these things.

So I think once that executive order comes out you'll see it filter all the way down, down to wherever it's got to go to get it done because it's an order and that's it. This is what we're going to do. I kind of think that's the way politics works. You issue the order first, then you figure out how the heck you're going to do it and everybody kind of gets – in a sense it's like architecture. You give them the problem. They get on the Internet. They look to see what's out there, figure out ways to do it, and off they go.

COMMISSIONER MONTOYA: Great.

COMMISSIONER CAMPOS: Thank you, Mr. Mazria. We really appreciate it your taking the time to come and visit with us and talk to us.

MR. MAZRIA: Thanks for inviting me.

COMMISSIONER MONTOYA: Thank you, Ed.

V. ADJOURNMENT

Vice Chairman Montoya declared this meeting adjourned at approximately 2:50 p.m.

Approved by:

Board of County Commissioners
Harry Montoya, Vice Chairman

Respectfully submitted:

Karen Farrell, Commission Reporter

ATTEST TO:

VALERIE ESPINOZA
SANTA FE COUNTY CLERK

SFC RECORDED 02/20/2006

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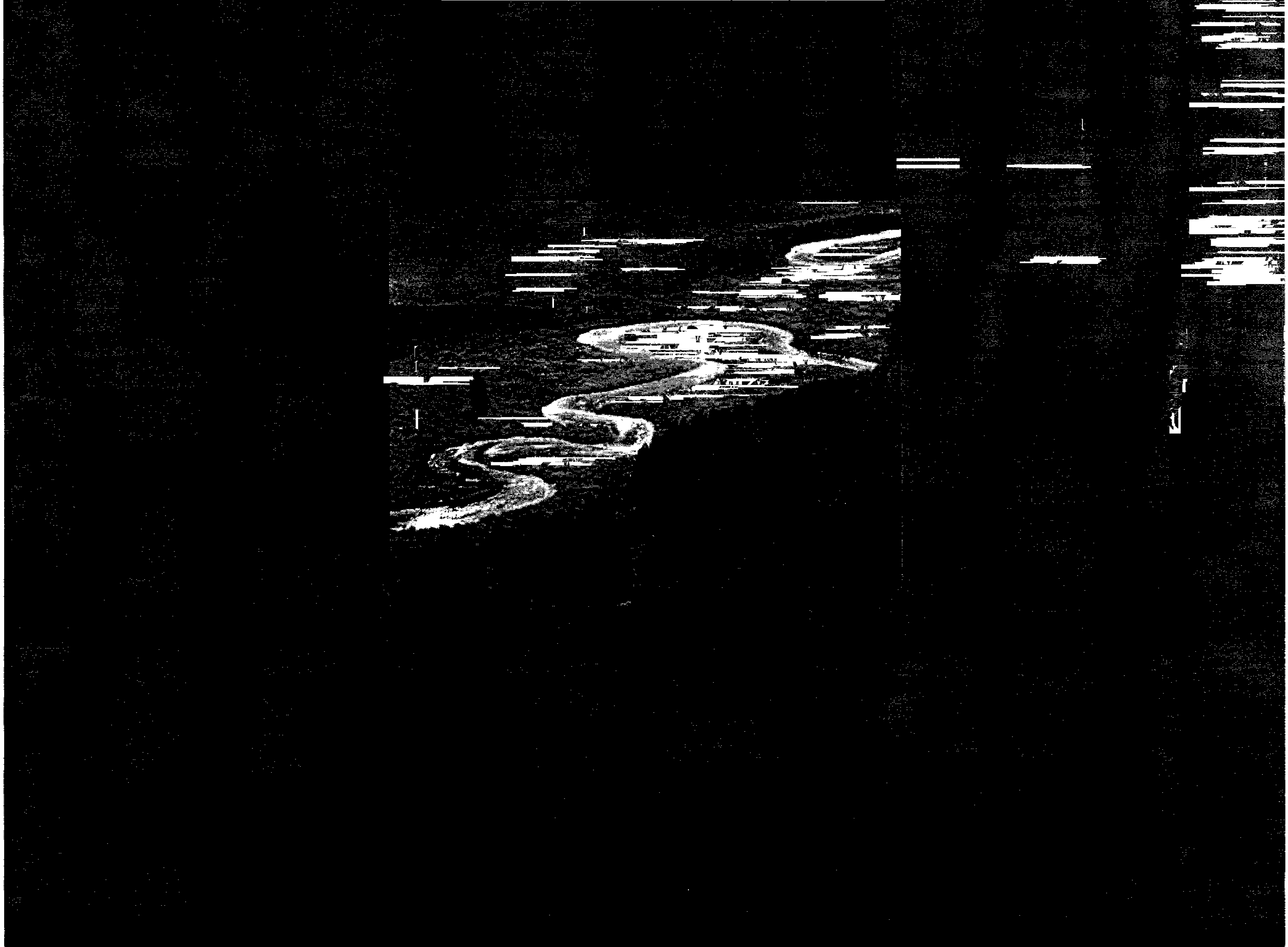
Less Snow, Less Water: Climate Disruption in the West

EXHIBIT 1

A CLEAR THE AIR REPORT

SFC RECORDED 02/20/2006



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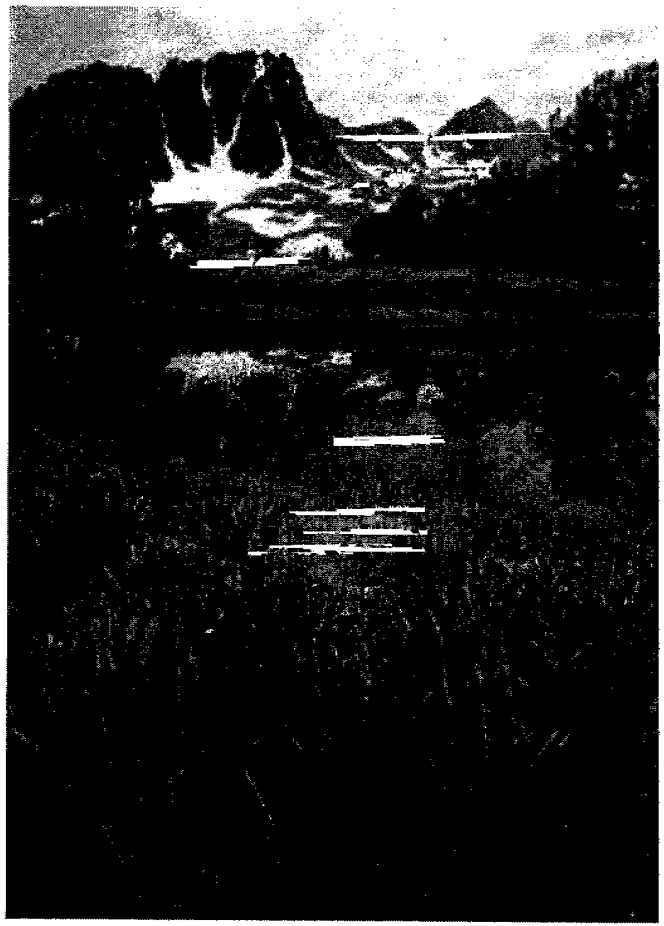

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We thank John Fielder for letting us use his photographs, which uniquely capture the beauty of the West.

We also express our particular appreciation to Abigail Taplin, research assistant at the Rocky Mountain Climate Organization; without her efforts, the new analysis of temperature and snowpack data contained in this report would not have been possible.

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Maureen Maxwell, *Senior Fellow*
The Rocky Mountain Climate Organization
Louisville, Colorado

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the ROCKY MOUNTAIN CLIMATE Organization

The Rocky Mountain Climate Organization spreads the word about what climate disruption can do to us here and what we can do about it. The initial partners in our year-old, mainstream coalition include five local governments, Colorado's largest water provider, seven businesses, and five non-profit organizations.

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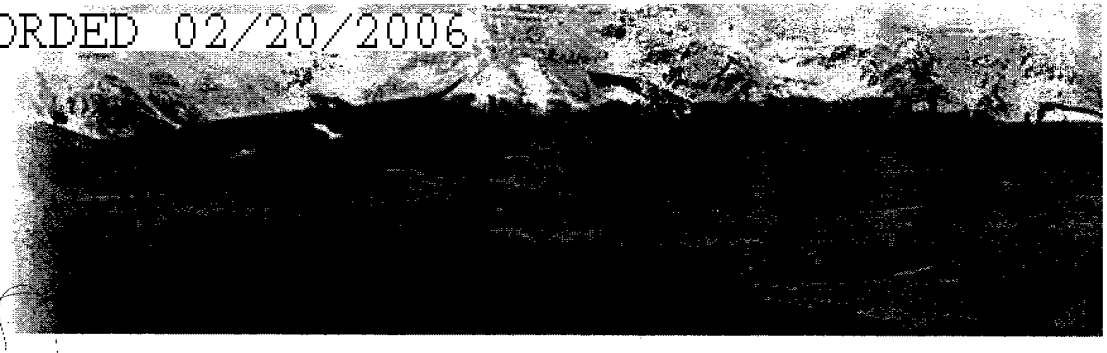
For more of John Fielder's photography, go to www.johnfielder.com.



Executive Summary

In the American West, no other effect of climate disruption is as significant as how it endangers the region's already scarce snowpacks and water supply. With the inherent vulnerability of the dry West to even small changes in the snow-water cycle, these risks alone present ample reason for Westerners to take action to protect this special region.

The Likely Effects of Climate Disruption on the West's Water

Scientists believe that climate disruption in the West likely will result in more heat, less snowpack, and earlier snowmelt and runoff. This may be accompanied by other adverse effects, including increased intensity, frequency, and duration of drought.

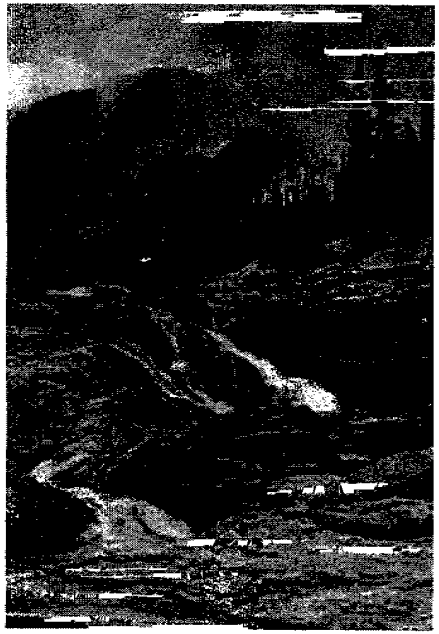
- **More heat.** Temperature increases in the West are likely to be even greater than the projected 3° to 10°F worldwide increase by the end of the 21st Century, compared to 1990. The heating is likely to be greater in the winter than in the summer and at higher elevations than in lowlands, with significant implications for snowpacks and water availability.
- **Smaller snowpacks.** It is very likely that more winter precipitation will fall as rain instead of snow, periods of snowpack accumulation will be shorter, and snowpacks will be smaller.
- **Earlier snowmelt.** Warming earlier in the year very likely will melt snowpacks sooner. Peak water flows would occur that much sooner than the summertime peak water needs of cities, farmers and ranchers, and others.
- **More evaporation and dryness.** Higher temperatures would increase evaporation from streams and reservoirs, soil dryness, and the needs of crops and other plants for supplemental water.
- **More flood-control releases.** Warming in the mountains in late winter and early spring very likely will increase snowmelt and river flows then, and reduce them later in the year. The risk of flooding likely will increase, and water managers may be forced to make flood-control releases more often from reservoirs, leaving less water to be stored for summertime needs.
- **Less groundwater.** Snowpacks also are essential contributors to the West's groundwater, so reduced snowpacks could reduce groundwater supplies, too.
- **More legal restrictions.** Environmental constraints, which sometimes now limit the water available for consumptive use in the West, may be triggered more often as a result of climate disruption. Changes in water supplies also may trigger water-use restrictions under interstate compacts.
- **More droughts.** Climate disruption could lead to more intense, frequent, and longer-lasting droughts in the interior West.

More heat, less snowpack, less available water, and possibly more droughts are likely to lead to other changes across the West. Most significantly, wildfires are likely to increase in number and severity.

Climate Disruption Is Under Way In the West

It is now accepted by the scientific community that, worldwide, the climate is changing as a result of human activities. In the American West, too, climate disruption is under way.

- **More heat.** The United States, along with the rest of the world, has warmed, with temperature increases in the West greater than in other regions of the contiguous states.



■ **Less snowfall.** As the West has warmed, less winter precipitation now is falling as snow and more as rain.

■ **Smaller snowpacks.** At most snowpack-measurement sites across the West, snowpack levels have declined over the period 1950 to 2000.

■ **Earlier snowmelt.** Across the West, springtime peak streamflows are earlier than 50 years ago. In many cases, the peak snowmelt advanced by 10 to 30 days.

■ **More wildfires.** Wildfire in the West has increased, particularly in the last two decades. Researchers have identified climate factors as being a significant contribution to this trend.

New Findings

For this report, the Rocky Mountain Climate Organization (RMCO) conducted a new analysis of government temperature and snowpack records for the upper basins of the Columbia River, Missouri River, Colorado River, and Rio Grande for evidence of human-caused climate change.

■ **Increased temperatures. In each river basin, the most recent five-year period was the hottest in the past 110 years.** In the upper Columbia River basin, 2000-2004 was 1.5°F hotter than the historic average; in the upper Missouri basin, 1.5°F hotter; in the upper Colorado basin, 2.1°F hotter; and in the upper Rio Grande, 2.5°F hotter. These temperature increases coincided with and worsened the effects of the recent West-wide drought, by increasing evaporation rates from streams and reservoirs, soil dryness, and the water needs of crops and other plants.

■ **Greatest warming in winter and spring.** In all four basins, the monthly pattern of the warming that occurred in 1995 through 2004 reveals what could be regarded as **a signature of climate disruption: The warming has been greatest in January, February, and March.** This timing is consistent with predictions that warming resulting from climate disruption will be greatest in winter and spring. Also, this is when warming has the greatest effects on the size of snowpacks and the timing of snowmelt.

■ **Reduced snowpacks.** At government snowpack-measurement sites with records going back to 1961, from 1990 on **snowpack levels have been below average for 13 of the last 16 years in the Columbia River basin, 11 of 16 years in the Colorado River basin, 14 of 16 years in the Missouri River basin, and 10 of 16 years in the Rio Grande basin.**

In sum, the RMCO analysis offers further evidence that climate disruption is already under way in the West in ways that jeopardize the region's snow and water resources.

Projections of Future Changes

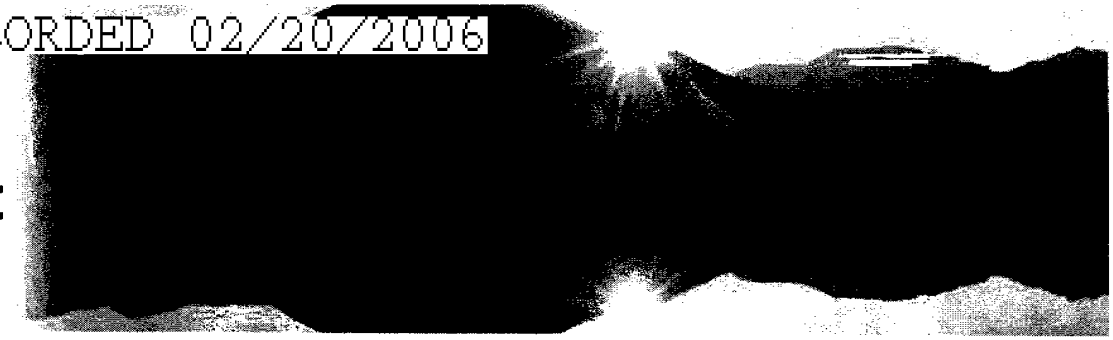
Scientists believe that the changes in climate observed so far are just a mild foretaste of what is likely to come if global-warming emissions continue to increase. A few illustrative examples of climate projections for the West from recent scientific studies include:

- For the Colorado River basin, losses of 24% of the basin's snowpack are predicted by 2010-2039 and 30% by 2040-2069.
- For the Columbia River basin, losses of 35% of the basin's snowpack are predicted by 2050 and 47% by 2090. For the milder-winter Cascade Mountains, the predicted losses are nearly 60% by 2050 and 72% by 2090.
- For California, losses of 29 to 89% of the state's snowpack are predicted by 2070-2099.

Changing the Odds

With all that the West has at risk, the region has good reason not only to do its share to deal with climate disruption, but also to be a leader in showing the rest of the nation and world what can be done. Encouragingly, there are growing signs of new western leadership and action in addressing climate disruption. Much more needs to be done, but these first steps suggest that Westerners are beginning to choose a new path to keep the region such a special place.

1 Water – the West's Great Vulnerability



"Today, in some areas of the West, existing water supplies are, or will be, inadequate to meet the water demands of people, cities, farms, and the environment even under normal water supply conditions.'

— U.S. Department of the Interior, "Water 2025: Preventing Crisis and Conflict in the West" (2003)[1]

For those of us who live in, visit, or marvel at the American West this region is special because of its large, grand landscapes, with mountains reaching to the sky, plains unfolding to the horizon, and vistas exceeding the imagination. The West's abundance, though, is accompanied by scarcity. Water is as essential to life here as it is everywhere, but scarcer here than elsewhere in the United States. It is the West's inherent, continuing vulnerability.

The lack of water has even been used, literally, to define the West. In a report to Congress written in 1878, John Wesley Powell fixed a boundary to the West that still stands, identifying it as beginning at the 100th Meridian. This line of longitude, running north-south through Dodge City, Kansas, bears a nice, round number, but Powell chose it as best approximating the fundamental difference between the wet East and the dry West. East of the line, precipitation generally exceeds 20 inches a year, enough to grow most crops without supplemental water. To the west, precipitation is generally less, and irrigation is usually needed.

Precipitation in the West is not just scarce, it is scarcest where and when it is most needed. Westerners, whether in cities and suburbs or on farms and ranches, need water where they are, which is overwhelmingly in the region's lowlands. And they need water in the heat of summer, when everything – people, crops, livestock, lawns, and even power plants – needs water the most. Perversely, most of the West's precipitation falls in a different place and at a different time.

Western precipitation falls mostly in the mountains, not the lowlands. Driven by the winds, air meets the mountains and is forced higher to pass over them; as it rises, it cools. Air when it cools can no longer hold as much moisture. So when air rises to pass over mountains, its moisture is forced out as precipitation. This process works so efficiently that the small area represented by the mountains gets blessed with the lion's share of the West's precipitation. As long as the water is on top of the mountains, it is useless for the city dwellers, farmers, and ranchers who need it below. Gravity, so long as it wins a race against evaporation and thirsty plants along the way, saves the day by bringing the water downhill.

The other complication is that western precipitation falls disproportionately in the winter, not in the summer, when heat makes it more needed. In California, about 80% of the state's precipitation falls between October and March, but about 75% of all water use occurs in the rest of the year.[2] The city of Portland, Oregon, gets only one-tenth of its precipitation in the summer.[3] If the region's precipitation were to run off the mountains when it falls in the winter, it would be gone before summer.

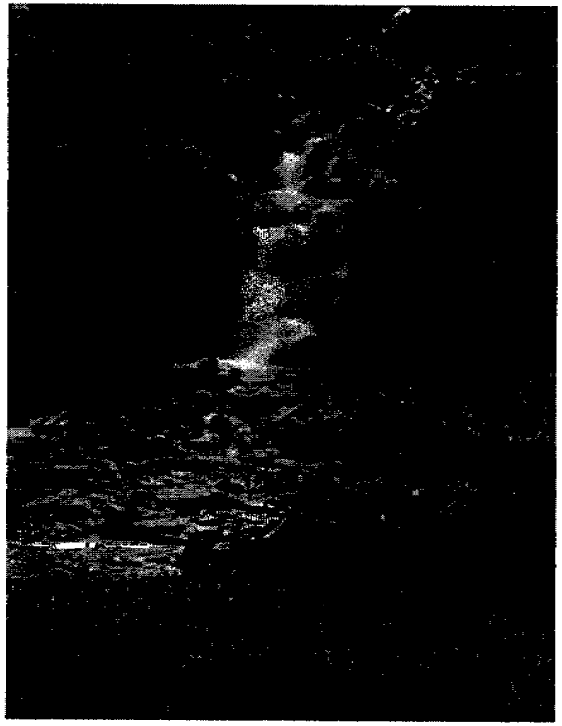
The West's saving grace is that winters in the mountains are cold enough that the precipitation falls as snow, not rain, and stays in the high country in snowpacks through the winter. These snowpacks – the region's largest reservoirs, dwarfing those people have built – conveniently delay the runoff until spring's warmth releases it as snowmelt to flow to the lowlands, often months after it fell as snow. This essential serendipity of the West, the age-old cycle of winter snowfall and accumulation and spring runoff, provides nearly three-quarters of the West's water.

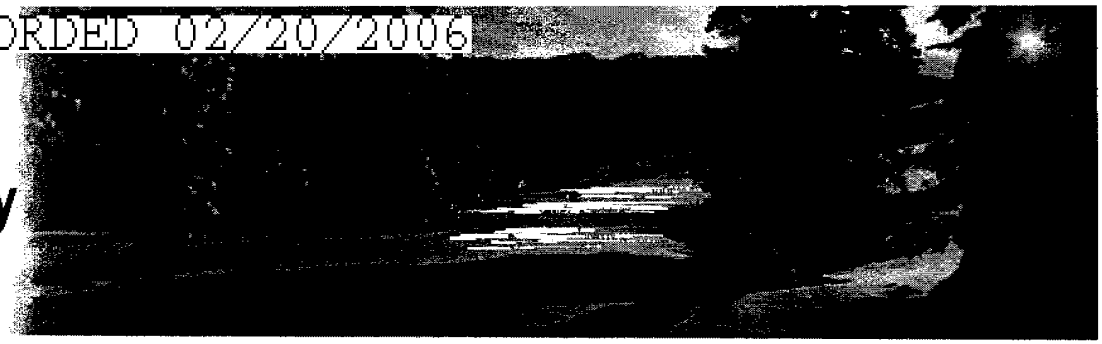
Because the natural water cycle does not meet all of the region's needs, people have augmented it through extensive engineering. In the water-rich Columbia River basin, reservoirs capture about 30% of the annual runoff. In the arid Colorado River basin, reservoirs can hold four times the river's annual flow. Conveyance systems deliver the water where it is needed when natural watercourses fail to do so. Water from the Colorado River is diverted through tunnels under the Continental Divide to meet the need of the cities and farms and ranches at the edge of the Great Plains, and through an aqueduct across the California desert to supply much of southern California's water needs.

"The most significant threat to our economic security is not having a secure future water supply."

Denver Mayor John Hickenlooper (2004)[4]

Even with these Herculean engineering efforts, demand for water in the West often exceeds supply. Now evidence is mounting that people's actions are affecting the region's water in another, altogether different way, this time making it harder to meet our water needs. Pollutants from human actions are changing our atmosphere so it traps more heat, unnaturally warming our planet. This is a global phenomenon having many serious effects. In the West, no other effect of climate disruption rivals in importance how it endangers our already too-scarce snowpacks and water supplies. With the inherent vulnerability of the dry West to even small changes in the snow-water cycle, these risks alone present ample reason for Westerners to take action to protect this special region, and these risks are the subject of this report.





2 Climate Disruption's Likely Effects in the West

"Temperature increases in mountainous areas with seasonal snowpack will lead to increases in the ratio of rain to snow and decreases in the length of the snow storage season (very high confidence). It is likely that reductions in snowfall and earlier snowmelt and runoff would increase the probability of flooding early in the year and reduce the runoff of water during late spring and summer. Basins in the western United States are particularly vulnerable to such shifts."

— Dr. Peter H. Gleick, "Water: The Potential Consequences of Climate Variability and Change for the Water Resources of the United States" (2000)[5]

Predicting future climate is difficult, and scientists are uncertain about many of the ways that human-caused climate changes will manifest themselves. But the degree of uncertainty varies. Most scientists believe that some predicted changes, such as temperature increases, are likely, and that others, such as projections about how precipitation may change in a particular region, are still unreliable. In the West, scientists consider some key changes to be either very likely or likely, including more heat, less snowpack, increased runoff in winter and early spring, and reduced runoff in late spring and summer. These and other possible but less certain changes are summarized in this section.

More Heat

The scientific community expects that global warming likely will raise the world's average temperatures by 3° to 10°F by the end of the 21st Century, compared to 1990.[6] Such a broad range in the predictions comes half from uncertainty about what future levels of climate-changing emissions will be, and half from uncertainty in the various models used, which yield different results. In any event, the American West is likely to heat up more than the worldwide average, as there likely will be more warming over land than over water and in the northern hemisphere than in the southern.[7] As a result, regional climate models suggest that the temperature increases in the West could be 4° to 13°F.[8]

At first blush, being several degrees warmer might not sound like much. But an 8°F increase in average temperatures would make:

- Seattle as warm as Sacramento now is.
- Portland as warm as Los Angeles now is.
- Missoula as warm as Denver now is.
- Aspen as warm as Colorado Springs now is.

Less Snowpack

As startling as these higher average temperatures would be, they actually understate what could happen. Low temperatures in the nighttime are likely to increase more than high temperatures in the daytime.[9] Warming is also projected to be greater in the mountains than in lowlands and, particularly in the mountains, greater in the winter than in the summer. (In part, this will be because if there is a reduction in mountain snow cover in the winter, there will be less

Key Collaborative Scientific Reviews

The Intergovernmental Panel on Climate Change assesses information on climate change. Thousands of scientists and others have contributed to this international effort.

Hundreds of specialists worked on a water-sector report for a national assessment of climate-change impacts in the United States. The report is "Water: The Potential Consequences of Climate Variability and Change for the Water Resources of the United States," its lead author is Dr. Peter H. Gleick.

The U.S. government also organized regional assessments of how climate change could affect different parts of the country. Five regional assessments covered parts of the West.

reflection and more local absorption of the sun's heat.[10]) This means that heating likely will be particularly pronounced where and when snow falls, making less common the conditions necessary for snowfall and snowpack accumulation.

If the West gets less snow, one obvious effect would be less skiing and other snow sports. The season for skiing, snowboarding, and other snow-dependent winter recreation could be shorter and the snow slushier – reducing enjoyment for skiers, profits for skiing-dependent businesses, and tax revenues for state and local governments. If the changes are extreme, skiing could be eliminated at low-elevation resorts.[11]

> [A] significant decline in skiing, or certainly its complete demise, would mean serious economic loss to the resorts, and to the economies of communities heavily dependent on skiing. (*Rocky Mountain/ Great Basin Regional Climate Change Assessment*[12])

"This is not something we treat as a tertiary issue. This is front and center."

Michael Berry, president, National Ski Areas Association (2003)[13]

Less Available Water

While some avid skiers may care more about what happens to their sport, for most Westerners a larger concern is that changes in snowpack, together with other climate changes, may lead to less water being available where and when we need it. In most places around the world, higher temperatures likely will lead to more evaporation of surface water, more moisture in the air, and more precipitation, and therefore to increased water supplies. But in some places, potentially including the West, climate changes could instead lead to less available water.

> Climate change is projected to substantially reduce available water (as reflected by projected runoff) in many of the water-scarce areas of the world, but to increase it in some other areas. (Intergovernmental Panel on Climate Change[14])

Several factors put the West at risk of being one of the water-scarce areas ending up with less available water.

- **Smaller snowpacks.** As a result of increased warming, especially in the winter and at high elevations, it is very likely that more winter precipitation will fall as rain instead of snow, periods of snowpack accumulation will be shorter, and springtime snowpacks will be smaller.[15]

- **Earlier snowmelt.** Warming earlier in the year very likely will melt snowpacks sooner.[16] Peak water flows would occur that much sooner than the summertime peak water needs of cities, farmers, ranchers, and others.

  > Current water source management along the eastern edge of the Rocky Mountains depends on the storage of winter precipitation as high elevation snowpack well into the growing season. Under a climate shift to earlier snowmelt runoff, not only would there be a great demand for water to irrigate during the extended growing season, but water would be released from its very efficient high-elevation natural seasonal reservoir well before the July and August interval of peak irrigation. (*Central Great Plains Regional Climate-Change Assessment*[17])

- **More evaporation and dryness.** Higher temperatures would increase evaporation from streams and reservoirs.[18] According to one study, in the Colorado River basin, a 7.2°F increase in temperature – by itself, without any changes in snowpack – would increase evaporative losses enough to reduce snowmelt runoff by 9 to 21%.[19] Higher temperatures also would increase soil dryness and the needs of crops and other plants for supplemental water.[20]

- **More flooding and flood-control releases.** Warming in the mountains in late winter and early spring very likely will increase snowmelt and river flows then, and reduce them later in the year.[21] The volumes of springtime peak flows likely will increase, and with them the risk of flooding. Water managers may be forced to make flood-control releases more often from reservoirs, leaving less water to be stored for summertime needs.[22]

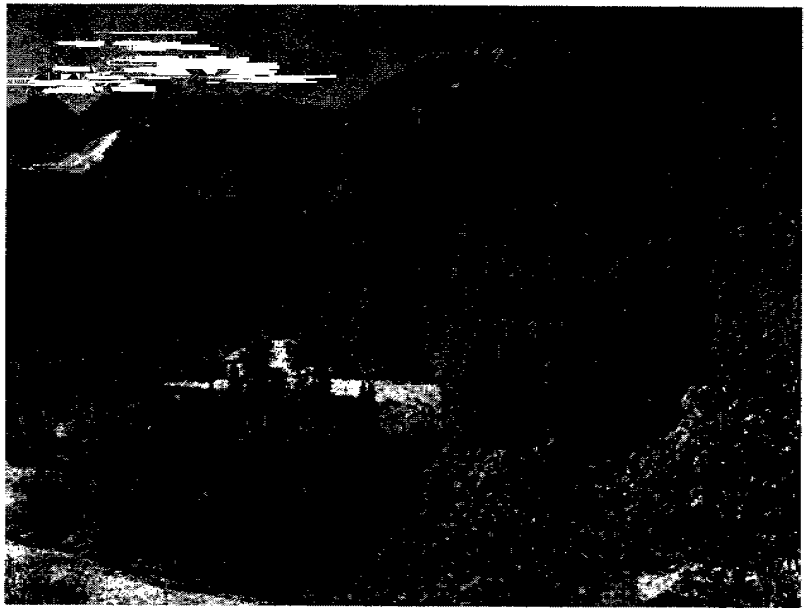
■ **Less groundwater.** Scientists recently learned that snowpacks are essential contributors to the West's groundwater, which supplies 28% of the region's water needs.[23] So smaller snowpacks could reduce groundwater supplies as well.

> Because mountains are generally wetter and cooler than adjacent basins, groundwater in the West is derived mainly from mountain precipitation. Because large and intense infiltrations of water are required to break through the region's thick unsaturated zones, and because snowpacks store and then release precipitation from several storms at once, snowmelt provides more recharge than does rain. Isotopic studies in western settings have suggested that 50 to 90% of [groundwater] recharge is from snowmelt. (Earman and Dettinger, "Warming Trends and Groundwater Recharge in Western Mountains, With Implications for Groundwater and Surface-Water Resources"[24])

■ **More legal restrictions.** Environmental constraints, which sometimes now limit the water available for consumptive use in the West, may be triggered more often as a result of climate disruption. More aquatic species are likely to be listed as endangered and threatened because of changed water temperatures and flows and other stresses, and so restrictions under the Endangered Species Act are likely to be imposed more often.[25] Reduced summer water flows also may increase salinity levels and aggravate other water-quality problems that already limit water use.[26] And as described on page 20, changes in water supplies may trigger water-use restrictions under interstate compacts.

■ **More droughts.** Climate disruption could lead to more droughts in the interior West.[27] The projected combination of earlier snowmelt, more heating, and increased soil dryness could lead to less summertime evaporation, recycled moisture, and precipitation, and so "is a recipe for increased intensity, frequency and duration of drought."[28] Reconstructions of western droughts over the past 1,200 years show that the region's driest periods were all in the period 900 to 1300 AD, coinciding with what climatologists call the Medieval Warming Period, suggesting a linkage between heat and drought.[29]

> If elevated aridity in the western US is a natural response to climate warming, then any trend toward warmer temperatures in the future could lead to a serious long-term increase in aridity over western North America. (Cook and others, "Long-Term Aridity Changes in the Western United States[30])



"The most simple thing I can think of as a definition of drought is not enough water to meet needs. Under that definition, the recent years of rapid growth in the Southwest are tipping the region further into drought.'

Dr. Kelly Redmond, Deputy Director and Regional Climatologist, Western Regional Climate Center (2004)[31]

More Wildfire

More heat, smaller snowpacks, less available water, and possibly more droughts are likely to lead to additional changes across the West. Most significantly, wildfires are likely to increase in number and severity as higher temperatures likely will lengthen fire seasons and make fires worse.[32] In addition, an increased level of carbon dioxide, by itself, is predicted to change the atmospheric chemistry in a way that will increase lightning, which starts most wildfires.[33]

Increases in Rainfall?

It is possible that the risks outlined above could be largely overcome if climate disruption leads to sufficient increases in rainfall. As pointed out above, higher temperatures likely will increase overall levels of precipitation in most, but not all, areas of the world. Counting on a large enough increase in rainfall in the West to head off the adverse impacts of climate disruption would be risky, though, for at least three reasons.

"We've already got our hands full with trying to provide enough water to the region to keep up with population growth. To add the additional problem of climate change just exacerbates an already difficult situation."

Marc Waage, Manager of Raw Water Supply
Denver Water (2005)[34]

"Global warming threatens California's water supply, public health, agriculture, coastlines and forests – our entire economy and way of life.'

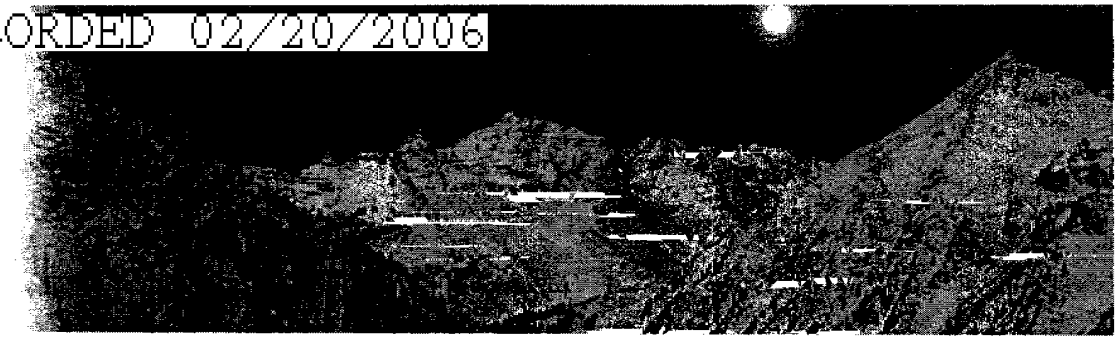
Governor Arnold Schwarzenegger (2005)[35]

First, models of future climate changes, while improving, are still unreliable about predicting changes in regional and local precipitation. Eighteen different projections for California, for example, range from 14 inches less overall precipitation per year to 11 inches more.[36]

Second, to offset the very likely effects of more heat and smaller snowpacks, much more rainfall would be needed. For instance, a study concluded that if Colorado River basin temperatures were to increase 7.2°F, a precipitation increase of 15 to 20% would be needed to offset evaporation losses enough to keep flows at previous levels.[37]

> In the arid and semi-arid western United States, it is well established that relatively modest changes in precipitation can have proportionately large impacts on runoff. Even in the absence of changes in precipitation patterns, higher temperatures resulting from increased greenhouse gas concentrations lead to higher evaporation rates, reductions in streamflow, and increased frequency of droughts. In such cases, increases in precipitation would be required to maintain runoff at historical levels. (Gleick, "Water: The Potential Consequences of Climate Variability and Change for the Water Resources of the United States"[38])

Third, climate disruption may set in motion cascading changes with additional effects on western water beyond those identified above. One study has suggested that reductions in Arctic sea ice (which are already well underway) could change the track of winter snow storms, pulling them far enough to the north to bypass the American West, reducing western precipitation by as much as 30%.[39]



3 Climate Disruption Is Under Way In the West

"It's kind of taken us all aback. It's kind of hard to see all this happening right under our nose without us noticing."

— Dr. Kelly Redmond, Deputy Director and Regional Climatologist Western Regional Climate Center (2004)[40]

The previous section identified what climate disruption may do to the West's snow and water. An obvious next question is whether these changes are already occurring. In the last few years, evidence has mounted that, indeed, climate disruption is under way across the West, as it is across the world.

It is now accepted by the scientific community that, worldwide, the climate is changing as a result of human activities.

> There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities. (Intergovernmental Panel on Climate Change[41])

"The IPCC's conclusion that most of the observed warming of the last 50 years is likely to have been due to the increase in greenhouse gas concentrations accurately reflects the thinking of the scientific community on this issue."

National Academy of Sciences (2001)[42]

In the American West, too, climate disruption is under way.

- **More heat.** The United States, along with the rest of the world, has warmed. Increases in annual temperatures have been greater in the West than in other regions of the contiguous states, according to National Weather Service data.[43]

- **Less snowfall.** As the West has warmed, snowfall and snowpack trends have begun changing as predicted. A new study shows that at more than two-thirds of 200 western mountain sites, less winter precipitation is falling as snow and more as rain. The greatest changes have been at lower-elevation sites – where winters are milder than higher elevations, and therefore where the effects of warming are predicted to show up first.[44]

- **Smaller snowpacks.** In the most thorough review yet of changes in the West's snowpacks, an analysis of the records of 824 government snowpack-measurement sites across the West with records from 1950 to 1997 shows that snowpack levels have declined at most of those sites over that period.[45]

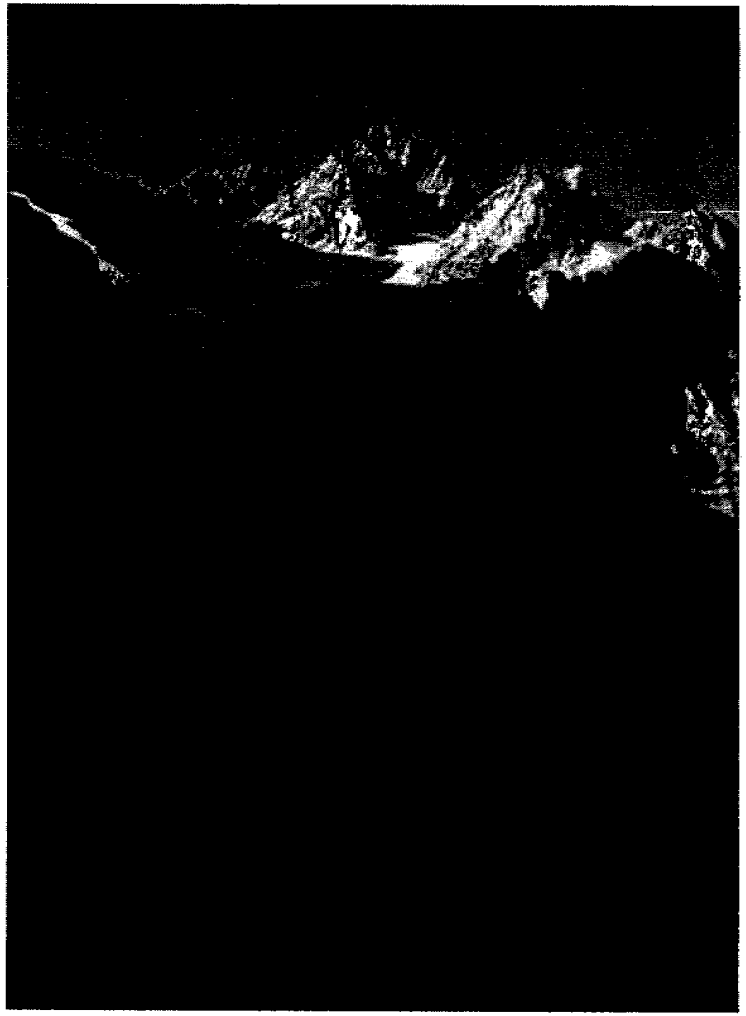
> Much of the mountain West has experienced declines in spring snowpack, especially since mid-century, and despite increases in winter precipitation in many places. Analysis and modeling shows that climate trends are the dominant factor, not changes in land use, forest canopy, or other factors... Taken together, these results emphasize that the West's snow resources are already declining as Earth's climate warms. (Philip Mote and others, "Declining Mountain Snowpack in Western North America"[46])

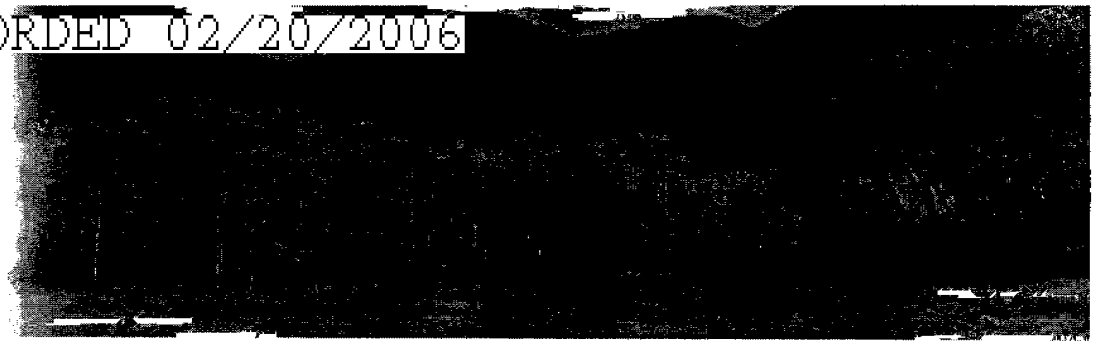
■ **Earlier snowmelt.** Western snowpacks are now melting earlier in the year. A study shows that for a majority of 279 snowmelt-dominated western rivers and streams, the timing of peak flows advanced over the period 1948 to 2000, with the peaks coming 10 to 30 days earlier in many cases.[47]

■ **More wildfires.** Wildfire in the West has increased, particularly in the last two decades. A study of wildfire on western federal lands over the period 1916-2002 showed that the five years with the largest number of acres burned were all in the period 1987-2002. The researchers identified climate factors as being significant.[48]

"Forget talk of global warming and speculation of what it might do in 50 years, or 100. Here and across the West, climate change already is happening. Temperatures are warmer, ocean levels are rising, the snowpack is dwindling and melting earlier, flowers bloom earlier, mountain glaciers are disappearing and a six-year drought is killing trees by the millions.'

Angie Wagner, Associated Press (2003)[49]





4 New Findings: Changes in the West's River Basins

"Certainly, in the Pacific Northwest we are seeing climate change."

— Karl Dreher, Director, Idaho Department of Water Resources[50]

For this report, the Rocky Mountain Climate Organization (RMCO) analyzed government temperature and snowpack records for the upper basins of the Columbia River, Missouri River, Colorado River, and Rio Grande for evidence of climate disruption. These rivers are among the West's major sources of water, and each has its particular vulnerabilities to climate change.

- The Columbia River basin, despite its reputation as a wet area, is dry in the summer and depends on upper-basin snowmelt for much of its summer water. Changes in the amount and timing of water flows also could affect hydroelectric production and ongoing multi-billion dollar efforts to recover endangered salmon populations.
- The Colorado River basin is dry, averaging less than four inches of rainfall a year, and hot, with 87% of its precipitation evaporating and only 13% becoming runoff.[51] Snowmelt produces 70 to more than 86% of the river's flow.[53] The river supplies water to more than 25 million Americans, not only in the basin but beyond, from Denver to San Diego. Despite the basin's scarcity of water, this is one of the fastest growing areas of the country. Three states in the basin – Nevada, Arizona, and Utah – are among the five states in the nation expected to grow the fastest.[54]
- The Missouri River provides water for the ten states in its basin. About 70% of the river's flow comes from melting snow in Montana. Barge traffic on the river, one of the nation's critical transportation systems, is also dependent on the river's volume.[55]
- The Rio Grande provides water to Colorado, New Mexico, Texas, and Mexico. This is one of the most water-short river basins in the country, and highly vulnerable to drought. In 2002, Rio Grande flows in New Mexico fell to only 13% of normal.

"The Colorado River is the canary in the coal mine for global warming.'

Eric Kuhn, General Manager Colorado River Water Conservancy District (2004)[52]

It's not just the drought, it's the heat.

The RMCO analysis of climate changes in these river basins began with an examination of temperature changes over the past 110 years. RMCO aggregated into a basin-wide average the temperature data reported by the National Oceanic and Atmospheric Administration (NOAA) for its climate divisions that correspond to the upper portion of each river basin – the portion that includes mountain snowpacks. (For an explanation of the methodology used in the analysis of both temperature and snowpack data, see the Appendix.) A historical average temperature for each upper basin was calculated for the period 1895-1990, and the average temperatures for each five-year period from 1895-2004 – for 1895-1899, 1900-1904, and so on – were compared with the historical average, showing temperature variations over the period of the NOAA instrumental record.

River Basins in the RMCO Analysis

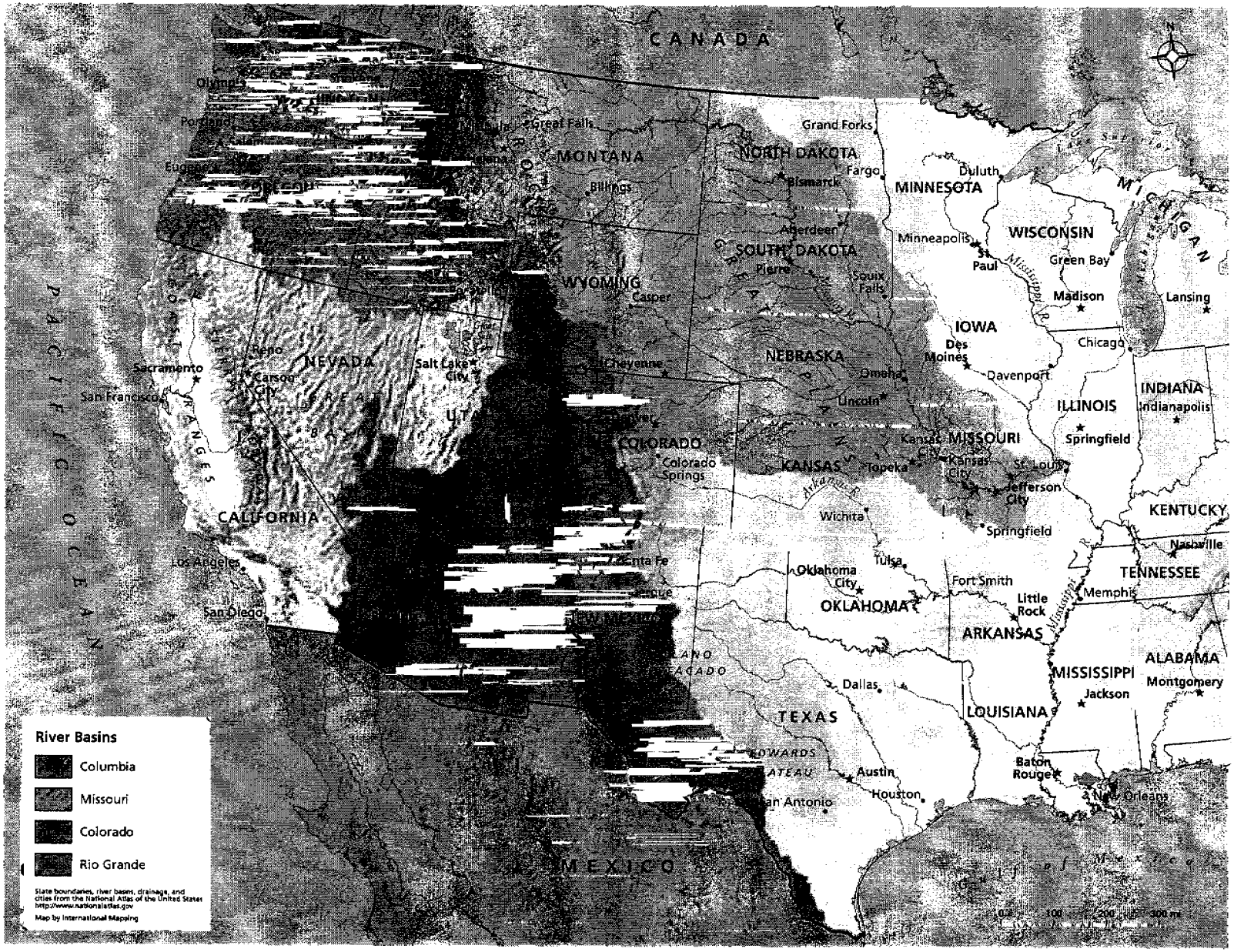


Figure 1

The results are shown in Figure 2. In each river basin, the most recent five-year period was the hottest on record. In the upper Columbia River basin, 2000-2004 was 1.5°F hotter than the historical average; in the upper Colorado basin, 2.1°F hotter; in the upper Missouri basin, 1.5°F hotter; and in the upper Rio Grande, 2.5°F hotter.

These recent temperature increases coincided with the much more widely noted recent West-wide drought. Heat and drought always go together; heat increases evaporation and therefore dryness, and a lack of moisture reduces the cooling effect of precipitation and evaporation. But other severe droughts have occurred since 1895 without the high temperatures of 2000-2004. The heat that accompanied the West's recent drought made it worse, by increasing evaporation rates from streams and reservoirs, soil dryness, and the water needs of crops and other plants. Future droughts accompanied by even more heat could be even worse.

A possible signature of global warming.

RMCO next examined the monthly pattern of the recent warming in each basin, to determine whether the warming has been uniform across all months, random, or, as predicted to result from human-caused climate change, greater in winter and early spring.

As shown in Figure 3, in all four basins, the monthly pattern of recent warming reveals what could be regarded as a signature of climate disruption: The warming has been greatest in January, February, and March. This timing is consistent with predictions that the warming resulting from climate disruption will be greatest in winter and spring. Also, this is when warming has the greatest effects on the size of snowpacks and the timing of snowmelt.

Snowpacks are declining.

As a final step in this analysis, RMCO analyzed records of the Natural Resources Conservation Service (NRCS), part of the U.S. Department of Agriculture, of April 1 snowpacks (measured as snow-water equivalent, the depth of water that the snow would represent if melted) for each basin's snow-measurement sites with data for 1961 through 2005. Using sites with records going back to 1961 made it possible to establish a historical baseline for the analyzed sites in each basin for the period 1961-1990, covering the 30-year length of time climatologists generally consider necessary to avoid distortion from short-term variations. For each basin, the total April snow-water equivalent for the analyzed sites for each year from 1961 through 2005 was calculated as a percentage of the 1961-1990 historical average.

This analysis differs from the average snowpack values reported by NRCS, which uses a 1971-2000 baseline in calculating how snowpack values compare to historical averages. By including recent years in its baseline for historical averages, NRCS masks the changes that are occurring as snowpacks have declined in recent years in response to increasing temperatures. The RMCO analysis makes possible a comparison with a statistically sound, 30-year historical average ending in 1990, before changes in temperature likely began having larger effects on western snowpacks.

The RMCO analysis, represented in Figure 4, shows that, for each of the four basins, in a significant majority of the years from 1990 on the total snowpack volumes of the analyzed sites have been below the historical averages.

In sum, the new RMCO findings offer further evidence that climate disruption is already under way in the West in ways that jeopardize the region's snow and water resources.

Warming Where the Snow Falls

5-Year Average Temperatures, 1895 to 2004, Compared to Historical Averages

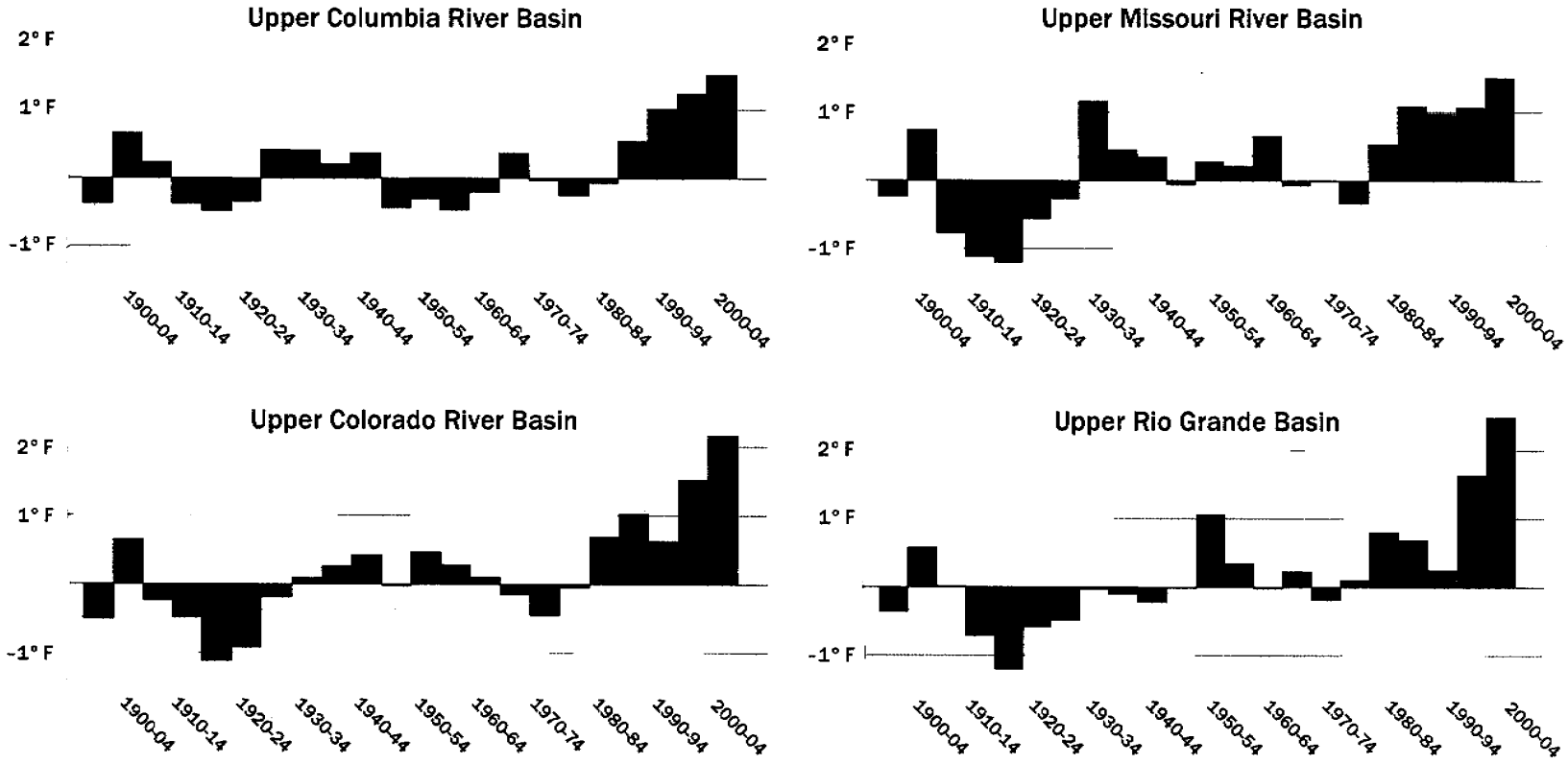


Figure 2 — *Data from the climate- division series, National Oceanic and Atmospheric Administration. Analysis by the Rocky Mountain Climate Organization. The historical average is for the period 1895-1990.*

Consistent With Global Warming: Warming Greatest in Winter, Early Spring

Average Monthly Temperatures in 1995-2004, Compared to Historical Average Monthly Temperatures

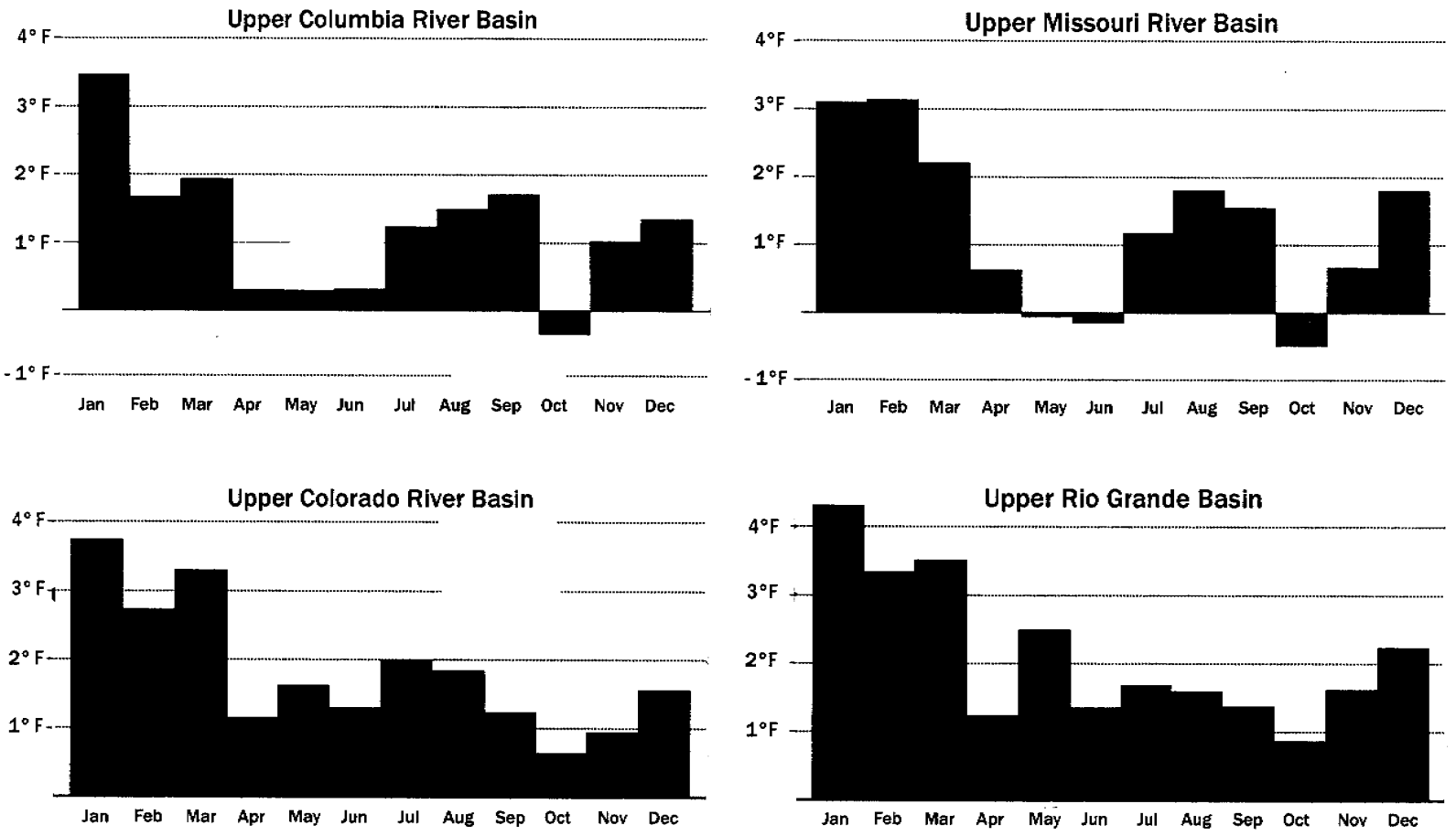
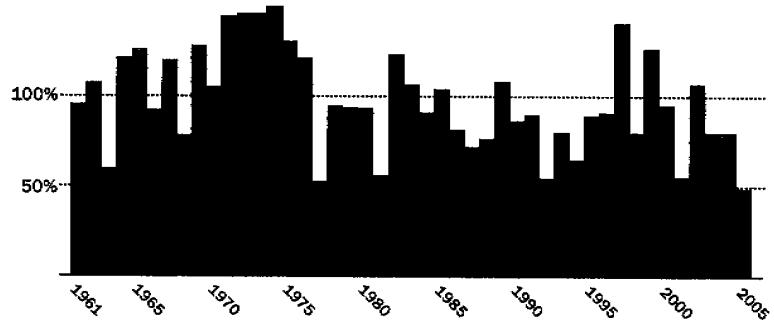


Figure 3 — *Data from the climate division series, National Oceanic and Atmospheric Administration. Analysis by the Rocky Mountain Climate Organization. Historical average monthly temperatures are from the the period 1961-1990.*

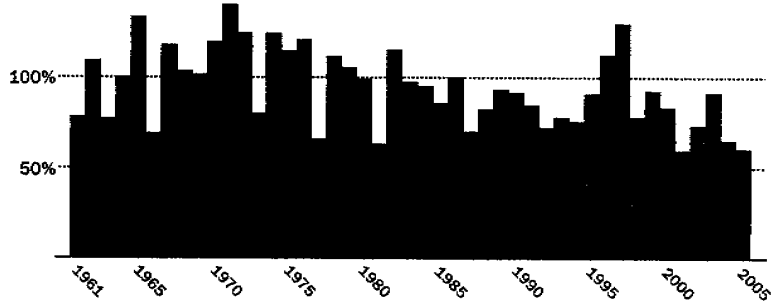
Declining Snowpacks By River Basin

April 1 Snowpacks, 1961-2005, Compared to Historical Averages

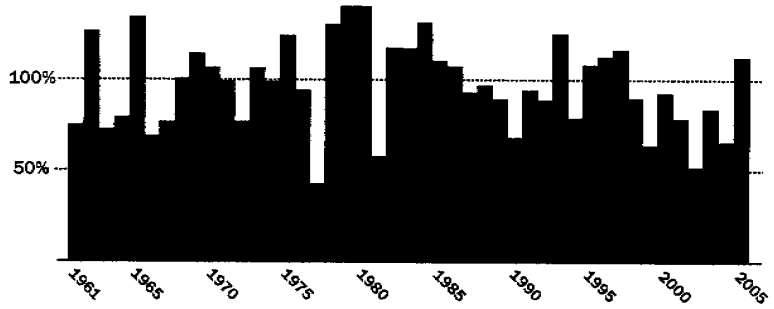
Columbia River Basin Sites
From 1990 On, 13 of 16 Years Below Average



Missouri River Basin Sites
From 1990 On, 14 of 16 Years Below Average



Colorado River Basin Sites
From 1990 On, 11 of 16 Years Below Average



Rio Grande Basin Sites
From 1990 On, 10 of 16 Years Below Average

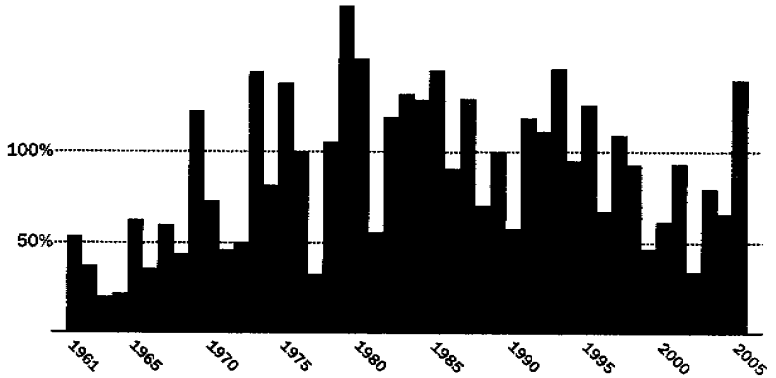
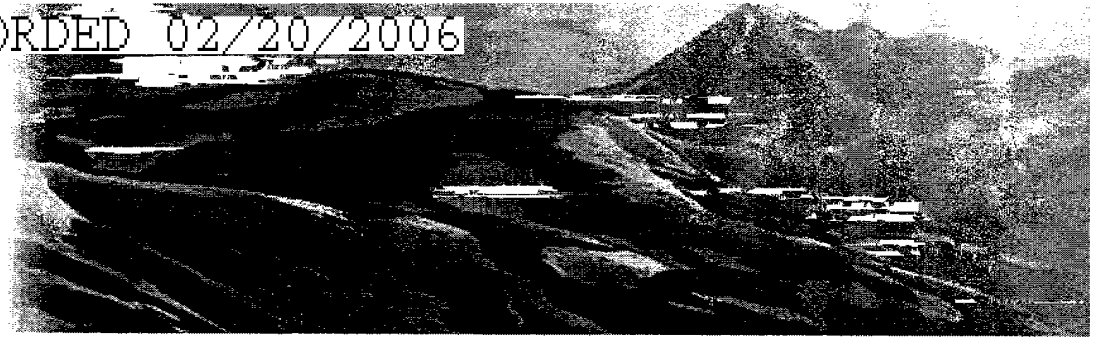


Figure 4 — *April 1 snowpacks compared to historical averages. Data from the Natural Resources Conservation Service. U.S. Department of Agriculture. Analysis by the Rocky Mountain Climate Organization. Historical averages are for the period 1961-1990.*



5 Projections of Future Changes

"What this work shows is that, even with a conservative climate model, current demands on water resources in many parts of the West will not be met under plausible future climate conditions – much less the demands of a larger population and a larger economy."

— Dr. Tim P. Barnett and others, "The Effects of Climate Change on Water Resources in the West: Introduction and Overview" (2004)[56]

Having identified the likely effects of climate disruption in the West and shown that they are already occurring, the next question is, what changes might the future hold?

Scientists believe that the changes in climate observed so far are just a mild foretaste of what is likely to come if global-warming emissions continue to increase. This section considers how some projections using climate models suggest the extent to which climate disruption could change the region.

As scientists using climate models are quick to point out, models are much cruder than the world's actual geography and climate and at best can only approximate plausible future conditions. This is particularly true with respect to the West, where the varied terrain that influences climate is not yet well represented in climate models. Models, for instance, sometimes treat the Rocky Mountains as a single very wide, low rise. Still, when different projections are in general agreement with one another, they can provide a reasonable picture of what could be in store for the West (depending on, among other things, the future levels of global emissions).

A few illustrative examples of climate projections for the West are summarized here.

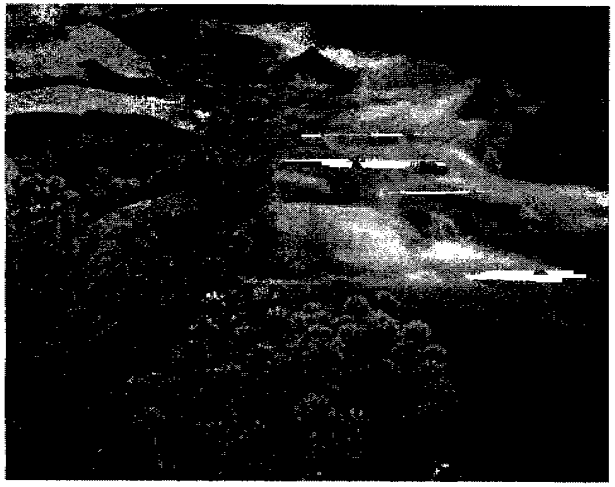
Colorado River

As part of a coordinated series of studies on the possible effects of climate disruption on western water resources, a team of researchers used a state-of-the-art climate model developed by the National Center for Atmospheric Research (NCAR) in Boulder, Colorado, to project possible changes in the Colorado River basin. Because the NCAR model predicts relatively small temperature changes, the researchers

Climate Disruption's Effects in the Colorado River Basin: A "Best-Case" Scenario

Projected Changes	Time Period 2010-2039	2040-2069
Temperature	+ 1.8°F	+ 3.6°F
Precipitation	- 3%	- 6%
Snowpack	- 24%	- 30%
Runoff	- 14%	- 17%
Water Storage	- 36%	- 40%

Table 1 — *Source: Christensen and others (2004).[57] Predicted impacts are compared to average observed values through 1995.*



called their projections a "best-case" scenario. Particularly as a best case, their results, summarized in Table 1, are far from reassuring.

> Basically, we found the fully allocated Colorado system to be at the brink of failure, wherein virtually any reduction in precipitation over the Basin, either natural or anthropogenic, will lead to the failure to meet mandated allocations. (Barnett and others, "The Effects of Climate Change on Water Resources in the West: Introduction and Overview")[58]

Columbia River

In parallel with the Colorado River study just referred to, another group of researchers used the same NCAR climate model to project possible changes in the Columbia River basin. They projected a loss of 35% of the Columbia River's snowpack by 2050 and 47% by 2090. Within the basin's Cascade Mountains, snowpack losses could reach nearly 60% by 2050 and 72% by 2090. The milder winters there mean temperatures will get pushed above freezing more often.[60] The study also projected that earlier snowmelt would require changes in reservoir operations that could reduce hydropower production by 9 to 35%.[61]

> In the Columbia River systems, residents and industries will likely be faced with the choice of water for summer and fall hydroelectric power or spring and summer releases for salmon runs, but not both. (Barnett and others, "The Effects of Climate Change on Water Resources in the West: Introduction and Overview")[62]

California

Several studies have identified the vulnerability of California's in-state water supplies to climate disruption. (The southern part of the state depends on the Colorado River for much of its water, as previously noted.) California is particularly at risk, as its water demand already substantially exceeds available supplies, and a predicted population growth of more than 15 million additional people by 2020 could increase urban water use by 30%.[63]

- Two climate models – the NCAR model and one developed by the Hadley Climate Centre – were used to predict impacts on California under two different levels of global emissions: a higher-emissions future that could occur if we continue on a "business as

Climate Distruption's Effects in California Under Higher vs. Lower Emission Levels

Predicted Effects in California in 2070-2099

	NCAR Model		Hadley Climate Centre Model	
Projected Changes	Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions
Temperature	+ 4°F	+ 7°F	+ 6°F	+10°F
Precipitation	+ 7%	-17%	-22%	-30%
Snowpack	-29%	-73%	-72%	-89%
River Flows	- 7%	-14%	-23%	-33%

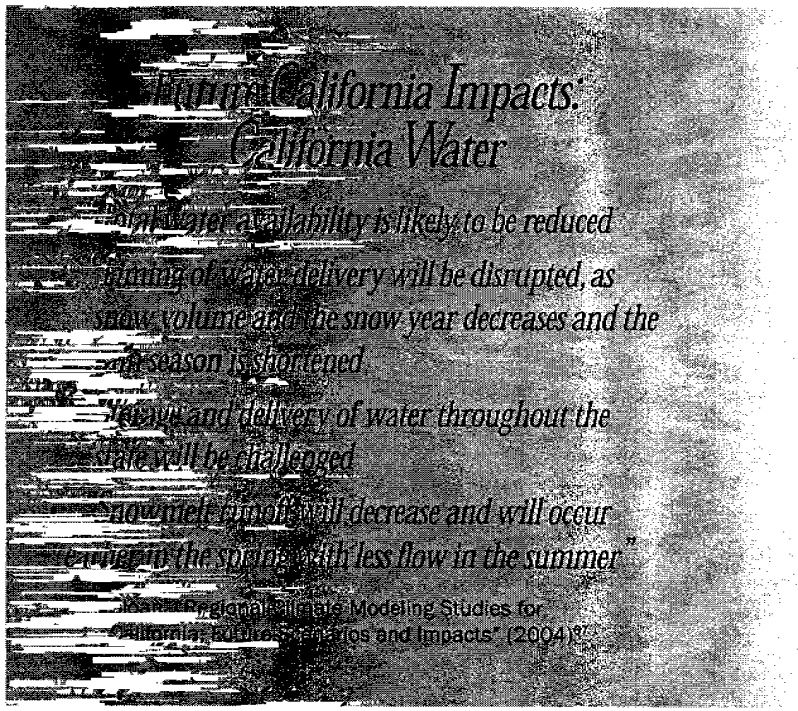
Table 2 — *Source: Hayhoe and others (2004).*[59] *"Lower emissions" reflect aggressive but realistic action to reduce greenhouse gas. "Higher emissions" reflect a business-as-usual approach. Predicted impacts are compared to historical averages for the period 1961-1990.*

usual" course, and a lower-emissions future that assumes the world takes aggressive but realistic actions to reduce global warming. Their conclusions about the effects on water resources are summarized in Table 2. This study illustrates that the effects will be substantial either way, but much less if we slow down the growth of emissions rather than let them continue increasing as they have been.

- Another study concluded that the snowpacks supplying water to California's Central Valley, the source of much of the nation's food, could decline by 26% in the period 2010-2039, by 38% in 2040-2069, and by 52% in 2070-2098. The number of "critically dry" years was predicted to more than double by the last three decades of the century.[64]

  In the Central Valley of California, it will be impossible to meet current water system performance levels; impacts will be felt in reduced reliability of water supply deliveries, hydropower production and in-stream flows. (Barnett and others, "The Effects of Climate Change on Water Resources in the West: Introduction and Overview")[65]

- A parallel study predicted that by 2070-2098, the winter-long average amount of snow in California's Merced River basin could decline by 51%; in the Carson River basin by 67%; and in the American River basin by 21%. The changes projected in this study, unlike those in most other studies, are in total season-long volumes of snow, not in the levels of snowpack at the end of the season (typically measured on April 1).[66]



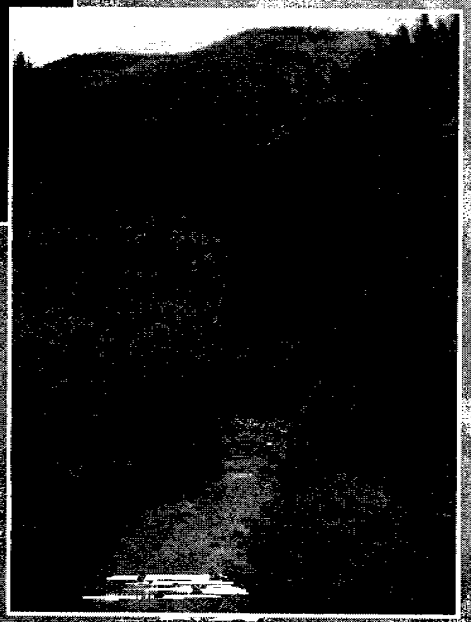
"In California, climate change is likely to severely exacerbate the existing mismatch between where and when rain falls and where and when people need to use water."

Dracup and others, "Climate Change and Water Supply Reliability" (2004)[68]

Interstate River Compacts: A Complicating Factor

Interstate compacts often allocate the authority to use a river's water among the different states through which the river flows. These compacts could end up aggravating in particular states the effects of climate disruption on river flows. The Colorado River Compact is a good illustration.

The Colorado River Compact of 1922, negotiated when river flows were believed to be greater than they actually have been, puts the primary burden of water shortages on the upper basin (portions of Colorado, Utah, Wyoming, New Mexico and Arizona). The compact guarantees that the upper basin will allow the delivery of a minimum amount of water – 75 million acre-feet every ten years, plus an additional amount for Mexico – to the lower basin (portions of Nevada, Arizona, California, Utah and New Mexico), regardless of how much water is needed in the upper basin.



Lake Powell, the largest reservoir in the upper basin, is designed to store surplus water that ensures adequate releases to the lower basin in water-short years. Lake Powell's level declined from 95% of capacity in 1999 to 34% in early 2005, raising for the first time a realistic prospect that the reservoir may not always hold enough water to fulfill the lower basin's entitlement. That could lead to a compact "call" from the lower basin for the release of additional water from the upper basin. According to David Getches, dean of the University of Colorado Law School, "If there is a compact call, we hit the wall. We wouldn't be able to use water called by the lower basin."[69] Providing water to the lower basin in this scenario could lead to widespread water restrictions throughout Colorado, Utah, Wyoming, and New Mexico.

"Imagining a worst-case scenario, Bill McEwen, water commissioner for the Eagle River district, said that, with not all its Colorado River Compact water available, impacts to this state could include massive rationing, taking out all nonnative landscaping or eliminating half the farming in Colorado.'

Summit Daily News (2004)[70]

6 Changing the Odds in the West

"I say the debate is over. We know the science, we see the threat, and the time for action is now."

— Governor Arnold Schwarzenegger (2005)[71]

With all that the West has at risk, the region has good reason not only to do its share to deal with climate disruption but also to be a leader in showing the rest of the nation and world what can be done. The federal government, the region's elected representatives to Congress, state and local governments, and the private sector need to act on two fronts – first to reduce the extent to which the climate is disrupted, and second to prepare for and deal with the impacts likely to occur anyway.

To reduce climate disruption, actions to reduce greenhouse gases will be necessary. The most prevalent greenhouse gas is carbon dioxide, primarily from the combustion of fossil fuels. Other greenhouse gases, such as methane, occur in smaller quantities but, molecule for molecule, can have a stronger greenhouse effect than carbon dioxide. Evidence is also growing that another category of global-warming pollution – certain aerosols, particularly black carbon (or soot) – may have a particularly potent climate-changing effect. To reduce climate disruption, reducing emissions of all these pollutants will be necessary.

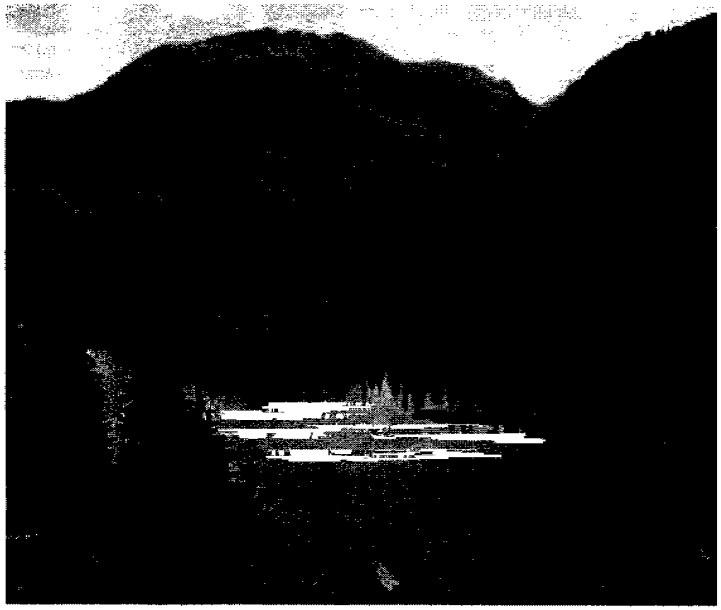
What is done to reduce emissions in western states is important. The United States, as a whole, emits one-quarter of the world's global-warming pollutants.[72] The emissions of western states, together and individually, are significant, too, as Table 3 shows. The emissions of carbon dioxide from fossil-fuel combustion in each

Western States Pollute More Than Most Nations

Emissions of Carbon Dioxide From Fossil Fuels in 2000
State Emissions Compared to Those of 212 Nations

State	Exceeds Emissions of:
California	211 nations
Arizona	174 nations
Colorado	174 nations
Washington	174 nations
Utah	171 nations
Wyoming	170 nations
New Mexico	163 nations
Nevada	155 nations
Oregon	151 nations
Montana	142 nations
Idaho	129 nations

Table 3 — *Source: Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory.*



western state are greater than those from each of over half the nations in the world.

Reducing the impacts of climate disruption also will be necessary. It is impossible either to immediately eliminate new emissions of global-warming pollution or to remove pollutants already in the atmosphere, so further climate change is almost certainly coming (with the extent to be determined by what is done to reduce emissions). The West, in particular, needs to prepare. Since water is an all-important resource for this region, public officials and water providers need to consider the likely effects on future water supplies and determine how to manage water supplies and demand to meet future needs.

All this will take a lot of leadership and work. Encouragingly, there are growing signs of new western leadership and action in addressing climate disruption. The primary sponsors of two leading climate-protection measures in the U.S. Congress are Westerners, Senator John McCain of Arizona and Senator Jeff Bingaman of New Mexico. Increasingly, western state and local governments are stepping up to reduce greenhouse gases. Protecting the West's interests will take much more, but these first steps suggest that Westerners are beginning to choose a new path to protect their interests.

"We must take action, and act appropriately. Many have hidden for too long behind what we do not know or the uncertainties around climate change. Their shield is shrinking. The time has come for us to accept what is known and start to solve this highly complex problem. As many of the top scientists throughout the world have stated, the sooner we start to reduce these emissions, the better off we will be in the future.'

Senator John McCain (2004)[73]

National Action

(Contributed by Jonathan Banks, Clean Air Task Force/ Clear the Air)

Much time and many resources have been committed over the past two decades to an international debate on what the world, and specifically the United States, should do to address the threats posed by climate disruption. Much of this debate focused on proposals to establish binding international emissions-reduction requirements and the prospects for and costs of meeting such requirements. Recently, the U.S. Senate took up several different proposals to begin addressing the climate problem. While none of the proposals fully address the need for deep reductions in global-warming emissions, they represent, nonetheless, steps in the right direction, some greater than others.

The United States can produce substantial, near-term reductions in domestic greenhouse-gas emissions. An effective near-term climate policy would:

- Enact comprehensive power-plant emissions-reduction requirements that include a power-system carbon cap.
- Enact simple-to-implement policies to expand production of electricity from renewable sources.
- Adopt a stronger federal fuel-economy standard to improve light-vehicle fuel efficiency.
- Aggressively implement existing federal authority to set equipment and building energy-efficiency standards and codes.
- Adopt either a manufacturer's agreement or other measures to reduce greenhouse-gas emissions from the automotive sector.
- Increase the energy efficiency of power generation through the cogeneration of electricity and useful heat.

In addition, the United States should begin to lay the groundwork for much deeper reductions in global-warming emissions. These actions should include:

- Replacing the highest emitting sources with cleaner sources, such as renewable-energy or advanced fossil-energy systems with low or no greenhouse-gas emissions.
- Researching and developing technologies that permanently capture and sequester carbon from commercial fossil-fueled energy sources.
- Developing action plans for significantly reducing several non-carbon-dioxide greenhouse emissions or concentrations (methane and ozone formation), along with emissions of black-carbon aerosols.
- Reengaging in the international dialogue to effectively construct an international policy to address climate change worldwide.

Comprehensive State Climate Plans

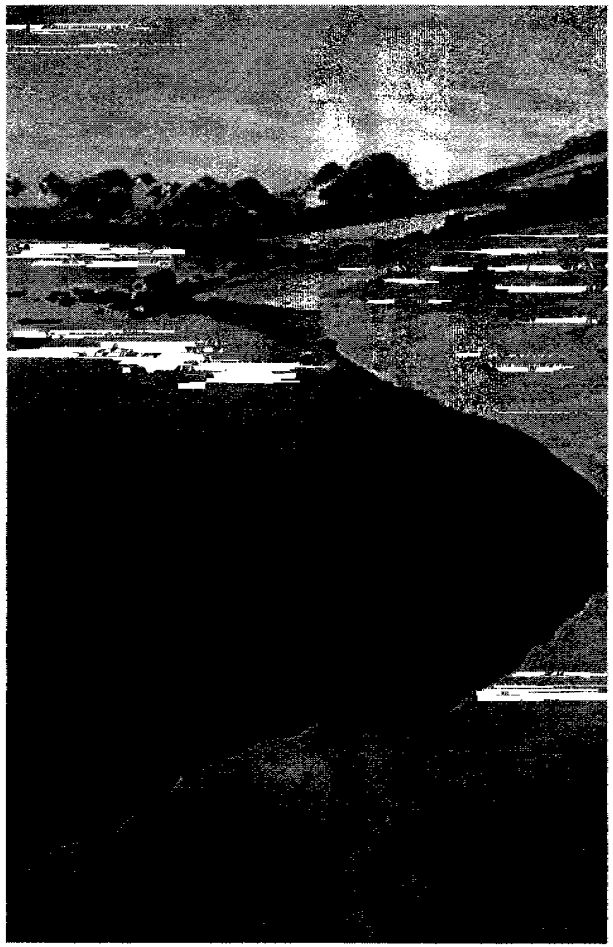
California, Oregon, Washington, Arizona, and New Mexico are among the states that have adopted or are developing climate-action plans to reduce global-warming pollutants and reduce the likely impacts.

- Governor Ted Kulongoski of Oregon appointed a broad-based advisory group that in December 2004 developed a state strategy for reducing global-warming pollutants.
- In February 2005, Arizona Governor Janet Napolitano issued an executive order creating an advisory panel to develop a state climate-protection strategy.
- In June 2005, California Governor Arnold Schwarzenegger signed an executive order establishing state goals of bringing levels of global-warming pollutants back down to 2000 levels by 2010, to 1990 levels by 2020, and 80% below 1990 levels by 2050. The executive order directs state agencies to develop plans to achieve these targets.
- Also in June 2005, New Mexico Governor Bill Richardson signed an executive order setting state goals for global-warming pollution reductions – by 2012, bring emissions back down to 2000 levels; by 2020, 10% lower; and by 2050, 75% lower. The governor appointed a broadly representative advisory panel to come up with ways to meet the goals. The first four reasons cited by the governor in his executive order for taking action are that climate disruption in New Mexico is likely to lead to:
  - "A reduction in water supplies
  - "Shorter and warmer winters with winter precipitation falling more often as rain
  - "Earlier snowmelts
  - "Greater water loss due to evaporation."[74]

Regional Initiatives

States in the West are beginning to work together on a regional basis to address climate disruption.

- The governors of California, Oregon, and Washington have entered into a West Coast Governors' Initiative on Global Warming to cooperate regionally to reduce climate-changing pollution.



The U.S. Mayors Climate Protection Agreement

"We urge the federal government and state governments to enact policies and programs to meet or beat the Kyoto Protocol target of reducing global warming pollution levels to 7% below 1990 levels by 2012...

"We urge the U.S. Congress to pass the bipartisan Climate Stewardship Act sponsored by Senators McCain and Lieberman and Representatives Gilchrest and Oliver...

"We will strive to meet or exceed Kyoto Protocol targets for reducing global warming pollution by taking actions in our own operations and communities."[15]

Specific State Actions

State governments also have begun taking specific steps to reduce climate-changing pollutants.

- Under Governor Schwarzenegger, last year California adopted the world's first global-warming emission standards for motor-vehicles, to reduce emissions by 30% by 2016. The federal Clean Air Act allows other states to adopt California's motor vehicle emission standards. Washington has conditionally adopted them, and Oregon is among other states considering doing so.
- The California Public Utilities Commission adopted a new requirement that the state's electric utilities should assume that new power plants will have to meet future carbon-dioxide emission standards, and include the likely costs of doing so in determining which future sources of power meet the state's least-cost standard.
- Arizona, California, Colorado, Nevada, and New Mexico are among states that have adopted requirements that utilities use clean energy sources, such as wind, solar, and biomass, to produce at least a certain amount of their electricity.

Local Government Actions

- Many western cities are among the 152 local governments in the United States participating in the ICLEI Local Governments for Sustainability's Cities for Climate Protection Campaign, in which they commit to take inventory of their global-warming emissions, set a target for future reductions, develop a local action plan to achieve the target, and monitor their progress. Participating western cities include Albuquerque, Denver, Missoula, Portland, Salt Lake City, San Diego, San Francisco, and Seattle.
- Portland, which in 1993 became the first local government in the country to adopt a local plan to address climate disruption, recently documented that it has reduced citywide global-warming emissions below 1990 levels. The city's achievement has resulted from such actions as the installation of a major light-rail public-transit system, renewable energy purchases, expanded recycling, the construction of nearly 40 high-performance green buildings, the planting of more than 750,000 trees and shrubs, and the weatherization of 1,000 multifamily residential units and more than 800 homes.
- Seattle Mayor Greg Nickels challenged America's mayors to sign his U.S. Mayors Climate Protection Agreement, which commits cities to take local action to meet or exceed Kyoto Protocol targets for reducing global-warming pollution. As of August 24, 2005, the agreement has been signed by the mayors of 176 cities – 64 of them from the West – exceeding Mayor Nickels' initial goal of having the agreement endorsed by as many cities as the 140 nations that ratified the Kyoto Protocol. The U.S. Conference of Mayors also unanimously adopted a resolution endorsing the agreement in June 2005.
- Salt Lake City Mayor Rocky Anderson, actor Robert Redford, and ICLEI Local Governments for Sustainability held a July 2005 conference in Utah where 45 mayors spent three days learning about local actions they can take to reduce climate disruption.

Seattle Mayor Nickels: "his focus on global warming has local roots"

Profiling Seattle Mayor Greg Nickels' leadership on climate protection, a newspaper wrote:

"Nickels, who does not face well-funded opposition in his re-election bid this year, says his focus on global warming has local roots.

"Here in Washington, the warming effect is seen in rising temperatures and declining mountain snowpacks.

"At first, Nickels said he was not distressed by these trends. 'I think like most Americans I sort of said, "So what? It would be nice if it were a few degrees warmer..."'

"But then he learned more about how Seattle's water and electricity supplies could be hurt by a shrinking snowpack. In meetings with Seattle's water and electricity department chiefs, Nickels said he heard repeated forecasts for below-average snowpack. Eventually he said he realized 'we're never going to get average again.'"

– *Seattle Times* (2005)[16]

Water Managers

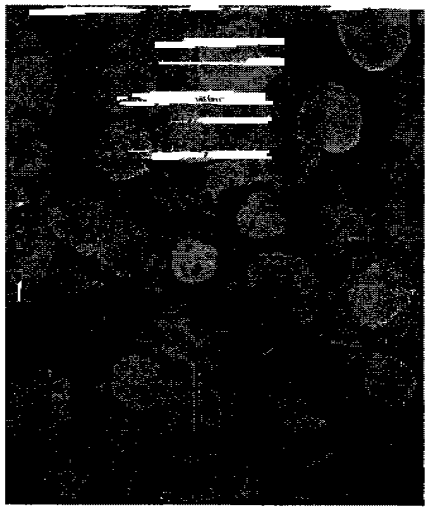
Some western water providers are beginning to consider the effects that climate disruption will have on their future water supplies.

- The Northwest Power Planning Council and the Idaho Department of Water Resources have worked with scientists at the Climate Impacts Group at the University of Washington to consider the effects of climate disruption on hydropower operations, irrigation, and other water needs.
- The Portland Water Bureau arranged for Climate Impacts Group researchers to evaluate in a 2002 report the effects that climate disruption will have on its ability to reliably provide water to its customers.
- Denver Water will include in its 2006 update of its Integrated Resources Plan, its primary planning document, consideration of climate disruption's impacts on its ability to provide water to its users.
- With funding from the National Oceanic and Atmospheric Administration, a team of consultants will evaluate the potential effects of climate disruption on the water supply system of Boulder, Colorado.

As important and encouraging as these actions are, they are just first steps. The risks to the West outlined here have been created by the emissions of global-warming pollution resulting from millions of decisions and millions of actions, and it will take broad-based, far-reaching actions by all levels of government, businesses, other organizations, families, and individuals to reduce those risks. Fortunately, there are many common-sense, no-regrets steps that can be taken, amply detailed elsewhere, that will not only limit the extent of damage threatened by climate change but also serve other important national and regional goals, from reducing our dependence on foreign oil to strengthening our national and local economies. Those of us who live in and love the West have more reasons than most to lead the way in taking these steps. The West is a special place to live, and we want to keep it that way.

"There are many benefits of reducing greenhouse gases that go beyond doing our part to stem the tide of climate change. Many actions outlined in this plan have significant local environmental and energy benefits. These benefits range from reduced air pollution, reduced energy bills for businesses and families, expanded recycling opportunities, new jobs, reduced urban sprawl and traffic congestion, and decreased reliance on non-renewable energy sources. If implemented, these actions will preserve and even improve the quality of life in our community."

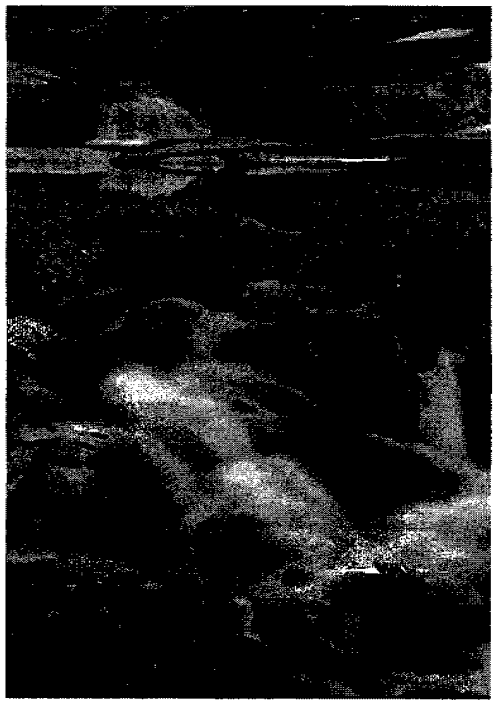
"Local Action Plan to Reduce Greenhouse Gas Emissions"
City of Fort Collins, Colorado (1999)[77]



Appendix: Research Methodology

For the new analysis of temperatures and snowpacks in four river basins, reported in Section 4 of this report, RMCO used the following methodology.

For the temperature analysis, RMCO examined National Oceanic and Atmospheric Administration (NOAA) data from its climate-division series, using climate divisions corresponding to upper portions of each of the four studied river basins, i.e., the portions of the basins in which mountain snowpacks are located. For the upper Columbia River basin, a total of 21 climate divisions in Montana, Wyoming, Idaho, Washington, and Oregon were analyzed. (The portion of Canada comprising 15% of the Columbia basin was excluded, as the same data are not available for it.) For the upper Missouri River basin, nine climate divisions in Montana, Wyoming, and Colorado were used; for the upper Colorado River basin, six climate divisions in Wyoming, Utah, Colorado, and New Mexico; and for the upper Rio Grande basin, two climate divisions in Colorado and New Mexico. For all calculations, the temperature data for the appropriate climate divisions were aggregated into basin averages, weighting the data from each division based on its area, just as NOAA does in aggregating data from the climate divisions in a state into a statewide average.



For the temperature analysis reflected in Figure 2, for each basin a historical average temperature was calculated as a benchmark using the period from 1895, the first year for which NOAA reports temperatures, to 1990. Basin-wide average temperatures for each five-year period – 1895-1899, 1900-1904, and so on – were calculated and compared with the historical average, showing variations from that historical average over the period 1895-2004.

For the monthly temperature analysis reflected in Figure 3, for each basin a historical average was determined for each month, again using the period 1895-1990. The average basin-wide temperatures for each month over the most recent ten years, 1995-2004, were calculated and compared to the historical monthly averages, showing monthly departures over the past 10 years from those historical averages.

For the snowpack analysis reflected in Figure 4, RMCO analyzed April 1 snow-water-equivalent values reported by the Natural Resources Conservation Service (NRCS), U.S. Department of Agriculture, for all snow-measurement sites in the each basin with data for 1961 through 2005. When NRCS reports estimated values for sites, those estimated values were used. Sites were included in the analysis if there were no more than five years of missing data over the 45-year period of the analysis. A total of 163 sites meeting these criteria were examined for the Columbia basin, 109 for the Missouri basin, 59 for the Colorado basin, and 19 for the Rio Grande basin.

When data were missing for a site included in the analysis, RMCO estimated values for the missing year(s) based on the average percentage of snow-water equivalent represented by that site of the total snow-water equivalent for all sites in that state included in the analysis for all years in which all sites had complete data; of 15,750 total data points in the snowpack analysis, 173 were estimated this way. Using sites with records going back to 1961 made it possible to establish a historical baseline for the sites in each basin for 1961-1990, covering a period of 30 years, the length of time climatologists generally consider necessary to avoid distortion from short-term variations.

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