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Minutes

LEGISLATIVE COMMISSION ON GLOBAL CLIMATE CHANGE

Friday 3 February 2006

10:00 a.m.

Room 643, Legislative Office Building

The Legislative Commission on Global Climate Change convened its first meeting on Friday 3 February 2006 at 10:00 a.m. in Room 643 of the Legislative Office Building with Representative Joe Hackney, Co-Chair, presiding. Other members present were Mr. John Garrou, Co-Chair, Senators Albertson, Cowell, Pittenger, Representatives Carney, Harrison, Sherrill, Underhill and Wilkins. Other members present were Mr. Walter Clark, Dr. Dolores Eggers, Dr. Edward W. Erickson, Mr. Tim Toben, Mr. Ivan Urlaub, Mr. Thomas Cecich, Mr. Robert J. Glaser, Ms. Susan Tompkins, Ms. Caroline Choi, Dr. Douglas Crawford-Brown, Mr. Barry Eveland, George Everett, Ph.D., Mr. Preston Howard, Mr. Michael Nelson, Mr. Mitchell Peele, Dr. Daniel Phaneuf, Mr. Tim Profeta, Dr. Sethu Raman, Dr. Stanley Riggs, Mr. Michael Shore, Mr. Robert Slocum, Stephen Smith, D.V.M., and Dr. Godfrey Uzochukwu. Absent was Mr. James Stephenson.

A copy of the meeting notice for this meeting, a copy of the agenda and the visitor's registration are attached to these minutes as **Exhibits A, B and C**.

Representative Hackney opened the meeting by introducing Commission staff and Sergeant-at-Arms Staff. Commission staff includes George Givens, Commission Counsel, Jeff Hudson, Commission Council, Jennifer McGinnis, Commission Counsel, Susan Iddings, Commission Counsel, Tim Dodge, Commission Analyst, Thelma Utley, Commission Clerk and Mary Watson, Commission Clerk.

Representative Hackney said that the purpose of a legislative Commission is generally to educate and to make recommendations and he hoped that this would be an educational experience for everyone and an opportunity to make recommendations.

Representative Hackney cautioned members against concluding that we cannot do anything about global warming if we should conclude that we do need to do something. Representative Hackney said that federal officials have followed the lead of many of the states. He hoped that we would educate ourselves on what effect, if any, global warming will have on North Carolina in coming years. We are a big tourism state, forestry state, and agriculture state. We need to examine these issues carefully so we can prepare for things to come, if we need to.

Representative Hackney introduced Mr. John Garrou, Co-Chair of the Commission and asked Mr. Garrou to come forward for comments. Mr. Garrou said that he was pleased and honored to be a part of this Commission and looked forward to working with everyone. Mr. Garrou said that he had no particular expertise or qualifications to serve on this Commission other than as a managing partner in a group of

attorneys and trying to get them to reach a consensus. Mr. Garrou said that he has no preconceived ideas about what North Carolina should do about global warming. He said he feels very strongly as an interested citizen that this is an issue we should address, and that we have a duty to our State and our grandchildren. Mr. Garrou said that with goodwill and open minds, we could reach some conclusions and make some recommendations about an issue that potentially is the most important issue facing our state, our nation, and our planet.

At the request of Representative Hackney, Commission members introduced themselves and said how they were appointed to the Commission. Mr. Jim Stephenson, Program Analyst at NC Coastal Federation, was absent from the meeting because of illness.

Representative Hackney called on Mr. George F. Givens, Commission Counsel, to introduce staff counsel and explain the agenda. Mr. Givens made note of the Commission Membership List and reviewed authorizing legislation that created this Commission. Both of these documents are included in the minutes as **Exhibit D**.

Mr. Givens said that the major responsibility of this Commission is to determine whether it would be appropriate or desirable for the state to develop a global warming pollutant reduction goal and, if so, to recommend a goal to members of the General Assembly.

Mr. Givens said that the Commission's duties are to work cooperatively with other state and national governments to organize a forum on global climate change.

Mr. Givens said that this Commission is supposed to report to the General Assembly and the Environmental Review Commission on or before 1 November 2006; however, the Commission members were not appointed until recently. The reporting date will need to be changed.

Mr. Givens asked visitors to sign the visitor's registration sheets and asked members to sign and send forward their reimbursement forms.

Mr. Givens noted that House Bill 1600, a bill introduced by Representatives Harrison and Underhill to direct state agencies to evaluate and report annually on their activities and research related to greenhouse gas emissions and climate change, is included in these minutes as **Exhibit E**.

Mr. Givens said that the legislation that created this Commission was originally intended to be part of the general studies bill and House Bill 1600 would have been incorporated into that legislation by reference. As it happened, the general studies bill failed and this authorizing legislation (S.L. 2005-442) passed at the last minute.

Dr. William H. Schlesinger, Dean, Nicholas School of Environmental & Earth Sciences, Duke University and James B. Duke Professor of Biogeochemistry, gave a presentation on the state of the science related to global climate change. A copy of Dr. Schlesinger's slides and comments are included in these minutes as **Exhibit F**.

Dr. Schlesinger said that global climate change was a huge important issue for the state and for the world and was certainly deserving of deliberation.

Dr. Schlesinger introduced himself as Dean of the Nicholas School of the Environment at Duke University, which is the country's first graduate school of professional environment in the nation. The School has about 50 faculty and 400 students that deal with issues such as climate change and land use. Dr. Schlesinger said they are seeing more and more statements on climate change everyday. This issue is well before the public as shown in the February 2006 issue of **North Carolina Wildlife's** article on potential effects of climate change on the wildlife of this state by John Manuel. He urged all Commission members to take a look at that article.

Dr. Schlesinger referenced his handout and the American Geophysical Union (AGU), the largest collection of scientists that study the conditions of planet earth. The AGU came out with a statement acknowledging that the climate of earth shows variations and variability through the past, and that things are happening now that can only be explained by recognizing a human influence on the planet's climate. Dr. Schlesinger said that half of his presentation would cover carbon dioxide and our atmosphere and its effect on climate and half considering various kinds of effects this may have on the future economics of this state and on the people who live in this state. Dr. Schlesinger said that best records obtained on measures of carbon dioxide in earth's past have been from taking cores of ice from Antarctica and from Greenland that can be cored to great depth, brought back frozen to the laboratory, sectioned into what amounts to the size of hockey puck sized cookies, and melted in controlled laboratory conditions. When the ice was laid down, there were bubbles of air trapped in it and, when melted under controlled conditions in the laboratory, those bubbles can be extracted. You can melt those bubbles out and measure the concentration of gases in them. Hence, comes a record of carbon dioxide in earth's atmosphere, parts per million by volume. From 900 A.D. to about 1950, carbon dioxide concentration varies from about 275 to 285 parts per million. Some of that variation is sampling air and analytical air.

Dr. Schlesinger said that in 1850, things began to change rapidly with the timing of the Industrial Revolution, the widespread use of the steam engine with coal, the discovery of oil in Titusville, PA, and the proliferation of modern conveniences that liquid petroleum, natural gas and the widespread use of coal to generate electricity have brought to modern life. All of those fuels contained carbon and, when you burn them, it is an oxidized process that puts carbon dioxide in the atmosphere (CO₂). Today's value (in this room) would have a concentration of around 380 parts per million. Dr. Schlesinger said that essentially all scientists agree with the accuracy of these measurements, the procedures for doing so. Our carbon dioxide is rising and has risen from historically lower values.

Dr. Everett asked Dr. Schlesinger if he had a similar graph that shows sea level in the same time period.

Dr. Schlesinger said that there are such graphs available but he did not have them with him today.

Dr. Schlesinger said that gases such as carbon dioxide, water vapor, methane, nitrous oxide, various gases that have more than two atoms comprising them, have what we call a radiating force in the atmosphere. They absorb heat radiation trying to

leave earth's atmosphere. The way the greenhouse effect got to be the analogy for this is very much the way your car left in a suburban parking lot on a summer day warms up on the inside. Sunlight shines through the glass of your windshield with complete transparency, warms the inside of your car or a greenhouse, and the glass on your car or greenhouse acts exactly in analogy to gases in earth's atmosphere. It impedes the transmission of heat radiation back out to the atmosphere. The same thing is essentially true with earth's atmosphere. The sun's radiation, which is short wave or visible radiation, passes through the atmosphere transparently on a non cloudy day, warms the surface of the ground and the sea, those warm surfaces give off infrared or heat radiation and carbon dioxide water vapor and other gases tend to impede the transmission of that back to outer space, so the atmosphere warms.

Dr. Schlesinger said that we should be thankful that there is a natural greenhouse effect on planet earth. If it wasn't for natural levels of carbon dioxide water vapor and some other gases in the atmosphere, our planet, at its distance from the sun, shows every sign of being below freezing and the oceans would be frozen from top to bottom and we would not be here talking about this problem today.

What we are really thinking about the effect is not of the natural greenhouse effect that we all need to be thankful for but for what will happen as concentrations of some of these gases increase in the atmosphere. The prime culprit is carbon dioxide because it is so directly linked to fossil fuel combustion and we have such good records that it has risen quite a bit already.

Dr. Schlesinger showed a slide of a longer core taken from Antarctica. There are scientific aspects of this graph which scientists have a real curiosity about. Why the trough always seems to be a 200 parts per million (ppm), carbon dioxide and why, until humans came on the scene with the Industrial Revolution, the peak of carbon dioxide has always seemed to be 275-285 ppm. We are up to 380 ppm today. We have essentially taken the earth from a realm that includes all of civilized human society on the planet in which the carbon dioxide concentration was bounded between 200-280 ppm and raised it in about 150 years to a realm of around 380 ppm. One of the basic paradigms of the past is an index of the present and the future and so the correlations of the past very much lead us to feel that there will be a warming of earth's temperature in parallel with that rise of carbon dioxide.

Dr. Schlesinger showed a slide on Greenland and the slight variability of carbon dioxide concentration through time and rapid rise at the beginning of the Industrial Revolution. This data was gathered from a variety of sources by Michael Mann who is now at Penn State University. The blue data are reconstructions of the temperature of planet earth, back to 1000 A.D., based on the isotopic record contained in tree rings, coral reefs. All kinds of proxy sources show us today, by looking at that ring of wood in an oak tree, the ratio in the cellulose will reflect the temperature of the year in which that ring was laid down. So, we assume that kind of relationship can be used to reconstruct the temperature of the past, way before anybody thought of setting up weather stations and recording it. The red line on the graph is the history of instrumented data recorded from when we began to have enough weather stations that persist in the same place. The line across the center of the graph is the zero point. The whole period before the Industrial Revolution showed stable environmental conditions. The entire variation of earth's temperature over that period was within plus or minus a quarter of a degree centigrade and then

began to rise very rapidly. The correlation to that of the carbon dioxide in the Greenland icepack carries that to a new temperature regime. This graph has been challenged by a number of folks who have looked at parts of it in isolation of the overall importance. For instance, a number of groups have asked why there was a big down slope in earth's temperature during that period. Dr. Schlesinger said we need not lose sight of the whole picture of what these data show which is relatively constant conditions for most of our history, followed by rapid rise at a rate and to a realm that we have never really before experienced. We can be thankful that most of human evolution and most of the history of industrialized society was actually during a relatively climate stable and favorable condition that now seems to be changing rapidly.

Dr. Schlesinger showed a graph representing over 100 years of carbon dioxide rising with mean global temperature. He said that you can focus on the variation, but he focuses on the correlation between those two, which alarms him as to where it is and to where we are headed in terms of the planet's temperature. These are data that North Carolina should be proud that we house in the National Climate Data Center in Asheville, which Tom Carl has headed up for many years. This is a gathering of all of the data from the U. S. Weather Bureau and other stations around the world that can be gathered together. So we can look at the last 100 years or so, and see land and ocean stations showing data showing average of all values and data showing colder than average and warmer than average years. Almost all of the cold years are in the late 1800's or early 1900's and almost all of the warm years are recent; 2005 was just analyzed as the warmest year on record. The trends show it getting higher each year.

Dr. Schlesinger said there was a widespread consensus that the planet is in fact getting warmer. He sees a correlation to that of rising carbon dioxide; others may argue whether this is a natural trend and we simply will expect these kinds of natural fluctuations to bring it back to some level. But, there are all kinds of reasons to look at the increasing concentration of a gas that we know very well the physics of in the atmosphere, and one gas that we know has a radiated property in our atmosphere.

Dr. Schlesinger showed a slide of a satellite picture of earth measuring temperature over a 20 year period. This data revealed areas that showed some degree of cooling, areas showing very little change, and areas of increasing warmth. In the Northern Hemisphere, in Alaska, Canada, and in North Europe and Siberia, there was strong warming of about 2 degrees centigrade over that instrumented satellite data. There have been arguments in literature about whether this is well calibrated and whether or not the satellites have had to be replaced and is the new one calibrated like the old one. Most of those arguments are now resolved and those who had questions are now convinced that this does show a warming and that the warming is real. Dr. Schlesinger showed data measuring sea ice in the Arctic as an example of this; nature's way of telling us what is going on. Every record showed a downtrend from close to 13 million square kilometers in 1970 down to about 11 ½ million square kilometers more recently to the present. Senator Pittenger asked Dr. Schlesinger if the Arctic phenomenon is also present in the Antarctic. Dr. Schlesinger said that the Antarctic has much less sea ice because there is a continent under there. And the icepack in Antarctica seems to be in a rough study state. The ice is melting on the Antarctic Peninsula, but apparently a small amount is accumulating on the center by the South Pole. Senator Pittenger said that a study he

read from NASA indicated that it was growing in terms of ice. Dr. Schlesinger said that they were probably looking at the grounded ice on the continent itself. The overall change that was reported in a paper by some NASA folks in science last year shows a rough balance; an accumulation on the continent, a loss on the Antarctic Peninsula, that about balances it. The warming is very much concentrated in the Arctic and less has been seen in the Antarctic. These results are consistent with projections based on ice cover taken in Antarctica and Greenland, which indicate the concentration of carbon dioxide and gases present in 900-1000 A.D. up to almost the present. Senator Pittenger followed up by asking Dr. Schlesinger if there are variables that could affect the outcome of the models such as water vapor. Dr. Schlesinger said that this is a difficult science, but that the models have gotten very sophisticated and can now predict much better. These results represent the consensus of earth scientists.

Dr. Schlesinger said that he would speak to effects showing a consensus of scientific opinion and where there is no consensus there is uncertainty. He said that scientific meetings are a great place for airing differences. One of these is a prediction from US Forest Service Workers of the likely dominance of tree species that would occur over the Eastern United States, late in this century, with the projected changes in temperature that the climate models show. Dr. Schlesinger showed graphs supporting this prediction. He said that if you let forests develop, you would expect an oak hickory forest to dominate over time. In the Coastal Plain, the pine trees dominate. The graph showed what would happen late in this century with the typical prediction of climate by a climate model. Sugar maple disappears from the Northeast and Midwest, the Eastern U.S. becomes widely dominated by oak hickory forests, and the various species of pines becomes the predicted dominant productive species in Arkansas and Missouri. Dr. Schlesinger said that climate change, played down on the landscape of natural vegetation, has every expectation of causing large changes in the distribution of trees as we know them. Livelihoods dependent on certain trees growing well and being productive have every reason to be of dominant concern. Dr. Everett asked Dr. Schlesinger if the trees in the Northeast would then move further north and why the pine trees disappeared on the East Coast. Dr. Schlesinger said the dominant species in a natural forest would no longer be the species of pines that we think of today. Dr. Everett asked if the pine trees were the dominant species today. Dr. Schlesinger said pines trees were dominant species in the coastal plain of North Carolina before human planting of plantations, they were just not as well managed. Dr. Everett asked if those forests would convert to oak hickory if they are left. Dr. Schlesinger said that the disappearance of pine trees is due to frequent fires or they are out competed out by a species of oak and hickory.

Rep. Wilkins asked Dr. Schlesinger what degree of climate change is predicted. Dr. Schlesinger said that the increase in global surface air temperature is predicted to be between five to nine degrees Fahrenheit by 2060.

Dr. Schlesinger displayed a graph showing the prediction of future rainfall. He said there is nowhere near the consensus, scientifically, on future rainfall patterns that there is on future temperature patterns. Climate scientists are very much in agreement about warming and how much warming and where, but there is much less agreement on changes in rainfall. Nevertheless, there are some emerging views and one of those views is that there will be some substantial areas in North America and around the world that are predicted to get lower rainfall (10 to 20

percent) in future climates. There are also areas in California that are predicted to get higher rainfall. That is largely driven by an anticipated, more frequent El Nino cycle. The alarming one is the prediction of 10-20 percent rainfall decline in the grain growing regions of the Great Plains. For our concern today, the State of North Carolina falls in a prediction that the average annual rainfall would be up to 20 percent lower. The shortfall of rainfall that we saw last summer, as various kinds of water restrictions were imposed, is predicted as the average condition in the future. It is not 20 percent seasonally because we expect a greater frequency of hurricanes. So, you might expect more rain in the fall, but our overall annual rain is predicted to be of that degree lower in the future, meaning that spring and summer show higher than 20 percent anticipated declines. Senator Pittenger asked Dr. Schlesinger how the predictions are arrived at. Dr. Schlesinger said that the predictions are arrived from general circulation models of the climate. The planet is modeled with an atmosphere surrounding it with several stacked layers, very much like an onion. Sunlight shines down through those layers and warms the surface of the earth or the sea that re-radiates heat radiation into the little parcel of air right above it. The whole atmosphere has layers that are divided into boxes. That box either re-radiates into the atmosphere or can move by the work of the wind, or it can get warmer in place. Depending on those conditions, it can evaporate water off the ocean surface or land surface. If it gets cold at night, it can rain that back out on the surface. Senator Pittenger asked if the computer model had variables in them that could affect the outcome of those models such as clouds and water vapor. Dr. Schlesinger said this is a very difficult science and that very few places around the world are able to participate in these models effectively. As the models have evolved through time, they have gotten better and better. Dr. Schlesinger showed a satellite measure of the planet's temperature and a climate model's prediction of where the temperature of the planet will warm. There is a real correspondence between the two that shows the maturity of the science.

Dr. Schlesinger spoke to the area of diseases spread globally according to climate. When we talk about a warming of the planet, there is very much the possibility that either the disease or the mosquito that carries the disease that cannot survive in the temperate zone today. Some of the best work has been done with malaria by a group out of the UK. By 2050, malaria will be present with the predicted climate changes. The place to notice is along the Gulf Coast and extending up the East Coast of the U.S. We have not had to worry about malaria as an emergency room condition; however, malaria will be a consideration as something that may come into the door 50 years from now. Some of the difficulty of this globally is the areas that are currently suitable that are becoming unsuitable. So, there are winners and losers on this on the global map. In CA, the Central Valley is predicted to become unsuitable, largely because of the dry climate predicted. The rest of the Eastern US and our State needs to be concerned about this.

Mr. Cecich said he had participated in the U. S. Global Change Program in 2000 and had edited the health section of that report from this program. Malaria was discounted as an impact on the United States. There are health concerns from mosquitoes, but malaria hasn't been an issue. He said he wanted to be careful that we were not misleading folks into thinking that we would have a malaria outbreak in North Carolina. Dr. Schlesinger if he was correct in saying that malaria was a grave concern for some parts of the United States. Dr. Schlesinger said this conclusion is based on modeling for a world without a public health infrastructure. Malaria is a

coastal plain disease. According to one study done, it poses a future risk for the Gulf Coast and the lower East Coast of the United States.

Dr. Schlesinger said that a paper by Emmanuel at MIT who noticed a striking correlation between sea surface temperature as measured by submarines and merchant ships over the last few decades and hurricane severity which is an index they calculated taking in account the most intense winds that the hurricane showed and how many days it lasted. A large number of climatologists have some resonance that this seems to be an important thing to expect. There is every reason to think that hurricanes feed on warm surface oceans, and as they surface of the world's oceans gets warmer, that will be a feeding ground for water vapor in hurricanes.

Dr. Schlesinger said that he did not want to be quoted as saying that Hurricane Katrina was due to global warming but an increasing intensity and frequency in hurricanes is some that very much should be on the table for discussion.

Dr. Schlesinger showed a graph on sea level rise for Baltimore that showed sea level above standard points back to 1900. Sea level has been rising, with the rate of rise recently increasing by a factor of four in Baltimore. They are subjected to high sea level rise compared to the global value by virtue of rebounding from some glacial conditions 18,000 years ago. The overall trend is one of rise during the time that we have seen rising carbon dioxide. Dr. Schlesinger said that Dr. Riggs would have some longer record of data to show on this.

Dr. Schlesinger said that Ben Poulter, a graduate student in the Nicholas School at Duke, took the rather simple approach of looking at eastern North Carolina and a topographic map of NC, and said what would happen if sea level rose a third of a meter (about a foot) or one meter (close to three feet) by the end of the century (see graph on page 6 of Exhibit F). The median predication by the IPCC is about 18 inches. The graph shows what will be flooded with the smaller rise of sea level and what will be flooded with the larger rise in sea level. A copy of this graph is reprinted in the Environmental Defense booklet. Dr. Schlesinger said that if you are interested in tourism, or if your family has a history and heritage of enjoying a beach front property in North Carolina or the Outer Banks, be somewhat concerned about this. It might be underwater. If it is not underwater on the average basis, it could very well be under water on the over washed conditions of hurricanes, which may themselves be more intense and more frequent. So, the topographic maps are pretty good maps these days and sea levels rising show how much land could be under water some day.

Dr. Schlesinger concluded by saying that it is striking that we have a prediction in the northern hemisphere with the greatest warming far north. He said that the greatest warming in North Carolina appears to be during the winter with not much change in the tropics.

Representative Hackney suggested to Commission members that they e-mail names of future presenters they wished to hear make presentations to the Commission and the Co-Chairs would consider them.

Senator Albertson asked Dr. Schlesinger when the ice core samples were taken. Dr. Schlesinger said that this program started in the 1970's. Senator Albertson asked if the information derived from these samples was agreed upon as valid and reliable information. Dr. Schlesinger said that very few people doubt the samples until you get to the top of the core, which has the ice deposited most recently in time. Senator Albertson asked Dr. Schlesinger if there was one piece of evidence he has analyzed that would convince him that global warming is indeed taking place. Senator Albertson asked about the graph showing the large rising increase in measurements. Dr. Schlesinger said that the rate of increase of carbon dioxide in the atmosphere is itself increasing as the world economies use fossil fuels. So, the rate of carbon dioxide is rising and the rate of temperature rise is not only predicted to increase but you can begin to see evidence that it is also increasing.

Senator Albertson asked Dr. Schlesinger if there is agreement in the scientific community that global warming is indeed taking place. Dr. Schlesinger said that there is consensus in the scientific community. A statement from the American Geophysical Union, the nation's premier society of more than 10,000 earth scientists, says that the temperature of the planet is warming and humans are responsible for warming above and beyond any natural variability one may expect. However, there will never be 100 percent consensus in the academic world on any issue. There are probably 10 scientists of note compared to 10,000 that might hold a contrary view.

Senator Pittenger asked Dr. Schlesinger what percentage of the natural greenhouse effect is carbon dioxide. Dr. Schlesinger said that the percentage of carbon dioxide is about one-third of the total; the remaining two-thirds from water vapor. Senator Pittenger said that he had read that only four percent of greenhouse gases are carbon dioxide related. Dr. Schlesinger said that of the gases that are increasing in the atmosphere today, somewhere between 50 and 60 percent is due to carbon dioxide.

Senator Pittenger asked Dr. Schlesinger if he was familiar with the Kyoto protocol that stated there were 17,000 scientists who opposed that agreement and did not subscribe to the same theory that global warming was anthropogenic. Dr. Schlesinger said that he was familiar with that statement and had been asked to sign that statement. He said that one should look closely at how these signatures were obtained. Senator Pittenger said that there are, however, those scientists who do not agree that global warming is taking place. Dr. Schlesinger said that number is probably 10 in 10,000 who do not agree.

Mr. Cecich asked Dr. Schlesinger if he could comment on the latest data regarding the rate of generation of carbon dioxide concentrations, as more fossil fuels are being used, and also comment on the length of time that carbon dioxide stays in the atmosphere.

Dr. Schlesinger said that the average residence time for carbon dioxide in the atmosphere is about five years. The largest sink, whereby carbon dioxide is removed from the atmosphere is the ocean. Carbon dioxide is dissolved in the ocean water. The prediction on how long it would take to get rid of the anthropogenic carbon dioxide in the atmosphere and in the ocean is 100 to 200 years.

Senator Pittenger asked Dr. Schlesinger if there was an increase in the temperatures over the last 100 years, how the cooling periods would be accounted for. Dr. Schlesinger said that the cooling periods could be due to particulates or natural variability. The magnitude of the overall trend from 1800 to today is the period of cooling is relatively small on a trend that shows a rapid temperature increase.

Mr. Clark asked Dr. Schlesinger if there are any studies that show a relationship between deforestation, hence a lack of carbon sequestration opportunities, during the rapid increase in carbon dioxide levels in the atmosphere, beginning with the Industrial Revolution.

Dr. Schlesinger said that beginning in the late 1800s when the westward expansion caused a lot of forests to be cut down in North America, there is some indication in the isotope record of carbon dioxide that some of the expansion in carbon dioxide concentrations were due to deforestation. After World War II, a lot of land was abandoned, forests grew back, and a source of fossil fuels began to dominate our economy. The source is now 80 percent fossil fuel and 20 percent from the forest.

Mr. Slocum commented on Dr. Schlesinger's data with regard to projections regarding the change in forest cover. Mr. Slocum said that review of materials show that softwood range expands, with rising temperatures, it does not contract. In fact, a warmer and potentially dryer climate in parts of North Carolina would tend to favor pines as opposed to hardwoods. Mr. Slocum said that he had not found anyone at NCSU and those looking at climate models that believe that the southern pine forests are going to contract and disappear from the United States and North Carolina.

Dr. Schlesinger said that this surprised him also and that is why he had been very careful to use the words dominant tree species and productivity. He said that it is not that they really expect it would become impossible to grow a loblolly pine in North Carolina, but whether it will be the highest productive species on managed land in those future climates. It does coincide with some of the conclusions of the U. S. National Assessment of Climate Change of differential productivity in these regions.

Mr. Slocum said that he understands that some of the work done at Duke reports that increasing carbon dioxide is improving the productivity of the world's forests, not decreasing it.

Dr. Schlesinger said that data is only based on increasing temperature. If one adds changes in precipitation, one may get a different result.

Dr. Schlesinger said that the work in Duke Forest, when grown in the atmosphere of somewhat higher carbon dioxide, one sees an increase in the productivity of a lot of species. The species that did the best was poison ivy.

Mr. Slocum said that loblolly pine is grown in east Texas and Louisiana, which is considerably warmer on average than the climate in North Carolina. He believes that productivity will improve and continue the dominance of southern pine as an intermediate species, which is what it is now in terms of overall forest evolution.

Dr. Smith asked Dr. Schlesinger if most of the sea level rise and associated land loss observed to date is largely due to thermal expansion of the ocean.

Dr. Schlesinger said that about half of the sea level rise observed to date is largely due to thermal expansion of the ocean. Dr. Smith asked Dr. Schlesinger to speak to the degradation of land ice in Greenland and Antarctica and some evidence that those land glaciers are moving more rapidly towards the sea. Dr. Schlesinger said that if all of the ice melted in the sea, it would have no effect on sea level. When ice melts that has land under it or when ice melts that is over the ocean but sitting on the bottom, these contribute to sea level rise.

Dr. Raman said that there are several stations that record the climate change in North Carolina. Based on a study for over 100 years, the NC coastal area has warmed about 4 degrees Fahrenheit, the Piedmont area about two degrees Fahrenheit and the mountains of NC have neither warmed nor cooled. The precipitation has generally increased except in the over the past 100 years. In the coastal region, there has been a decrease in precipitation in 100 years, but in the past 50 years, there has been an increase. He said he would be glad to provide more information on this at a future meeting.

Dr. Uzochuckwu asked Dr. Schlesinger why the satellite measurements of precipitation did not show a significant change of precipitation in Africa. Dr. Schlesinger said that the lack of fieldwork and field stations in Africa and South America hamper their ability to get the data they need in those areas.

Dr. Everett asked Dr. Schlesinger to comment on where sea level was during the last ice age. Dr. Schlesinger said that it was about 120 meters below today. Dr. Everett asked if sea level was much further west than what the graph of the Nature Conservancy showed even before man was living on the earth. Dr. Schlesinger said that was during the time when the earth was warmer. Dr. Everett asked how long the earth has been warming. Dr. Riggs said that the glacial maximum was 18,000 to 20,000 years ago and there have been a whole series of ups and downs since then.

Representative Wilkins referred to the slide on the northern hemisphere and asked what caused the dip in 1575. Dr. Schlesinger speculated as to whether there was a volcanic eruption, sun fluctuations or other events of nature that may have caused the variation. Mr. Howard asked Dr. Schlesinger to give some idea of what the percentage of carbon dioxide that exists around the globe is due to natural conditions and what percentage exists due to mans activity. Dr. Schlesinger said that the amount of carbon dioxide in the atmosphere today compared to 1850 is about 30 percent higher, and it is all due to human activity. Some of it is from fossil fuel combustion, some of it from forest destruction. Today, deforestation is largely continuing in the tropics. Some carbon dioxide is dissolving in the ocean and some of it is thought to be taken up by tempered forests.

Mr. William G. Ross, Jr., Secretary of Environment and Natural Resources (DENR), gave a report on the ongoing efforts by DENR to control emissions of carbon dioxide and other greenhouse gases.

Secretary Ross said that we had started implementing the North Carolina Clean Smokestacks Act (CSA) When Governor Easley signed that bill into law in 2002, North Carolina took a great step forward toward a cleaner environment, healthier

lives and a stronger economy. This great step forward was propelled by a great consensus.

Secretary Ross said that the Clean Smokestack Act established a plan and deadlines for significant reduction of sulfur dioxides, nitrogen oxides, and mercury.

Secretary Ross said that he was happy to report that Duke Energy and Progress Energy were doing a great job in carrying out the installation of control equipment that is needed to meet those reductions on schedule.

Secretary Ross said the Clean Smokestacks Act also directed the Division of Air Quality in DENR to conduct a study on carbon dioxide emissions. That study has looked at the science of climate change and at options for reducing greenhouse gas emissions. Secretary Ross said that the CSA also directed the Division, in September of each year through 2005, to report its finding and recommendations to the legislature and to the public at large.

Secretary Ross introduced Brock Nicholson, Deputy Director of the Division of Air Quality (DAQ) DENR, to give an update on this report, its findings, its recommendations and what has been done under the carbon dioxide study that has already been undertaken. Secretary Ross also introduced Mr. Keith Overcash, Chief of DAQ, DENR.

Secretary Ross said that when the September 2005 report was completed, he asked DAQ to extend the technical efforts that were used to help produce the report to conduct a facilitated dialogue with a diverse group of parties who were interested in the subject of climate change. That group is called the Climate Action Plan Advisory Group (CAPAG). Secretary Ross said that the purpose of all of this effort by DAQ, by DENR and by partners is to support, inform, assist, and complement the work that our State, led by the Global Climate Change Commission (GCCC), is doing on the subject of climate change. Secretary Ross said that DAQ/DENR would be reporting the results of their ongoing work to the GCCC on a regular basis and would welcome suggestions and comments. Secretary Ross said that what had been learned so far makes them think that there will likely be many options for our State that would help reduce greenhouse gas emissions, help the State prepare for and respond to climate change, and provide important economic opportunities.

Secretary Ross said that his opinion of climate change is that it is center stage for a great challenge and a great opportunity that our State, our nation, our planet faces. It addresses how we sustain the earth, the planet, so that it sustains us. How do we sustain the earth so that it continues to provide for us the conditions for everyone to have a secure, healthy, decent life? Secretary Ross said that he is hopeful that the ideas of those responding to climate change will generate economic opportunity. Secretary Ross gave two examples of this opportunity—one from NC and one from PA. If you look at the outcome of the base realignment and closure commission process of North Carolina, you will see a very positive outcome for our State in many ways. The heart of that outcome was a great partnership between NC and the military focused on sustainability of environmental, social, economic and military on an ongoing basis. Secretary Ross said that Pennsylvania brought in a Spanish wind energy company that was going to create over 1,000 jobs in a five-year period. Secretary Ross concluded by saying that DENR and DAQ wanted to provide the

tools and the ability to analyze, on a cost benefit basis, the steps that our State might take to prepare for global climate change.

The Commission took a lunch break.

After the lunch break, Representative Hackney noted that a packet of information was distributed to each member that was received from the British Consulate in Atlanta.

Mr. Brock Nicholson, Deputy Director, DAQ, DENR, gave the final report on issues related to the development and implementation of standards and plans to implement programs to control emissions of carbon dioxide from coal-fired generating units and other stationary sources of air pollution. A copy of Mr. Nicholson's slide presentation and the final report on Carbon Dioxide Emissions Reduction Strategies for North Carolina, pursuant to North Carolina's Clean Smokestacks Act, are included in the minutes as **Exhibit G**.

Mr. Nicholson said that he would be focusing on recommendations from the report. Section 13 of the Clean Smokestacks Act required DAQ, DENR, to look at the issues of carbon dioxide control from power plants and other stationary sources as well as the mercury issue. The first report in September 2003 was focused on the science issue of carbon dioxide controls. Mr. Nicholson acknowledged Mr. Jim Southerland, staff member of DAQ, who did the vast majority of work on this report, and Mr. Tom Peterson, a consultant who helped to provide the technical baseline for the report.

Mr. Nicholson said that DAQ thought it would be more appropriate to look more broadly at potential for all sources in all sectors for consideration because there are many other sources than the utilities. They also talked about pollutants other than carbon dioxide. Mr. Nicholson said the recommendations are up for consideration for further refinement and fall into three groups. The first group includes the actions that are currently underway and consist of eight listed plans of action. The second is a group of regulations that one might arguably say might not require legislation. The third group is one that will require some other direction by entities such as this Commission and the legislature. These recommendations will be on the table for refinement by the advisory group process.

Mr. Nicholson said that the first recommendation will be a consensus based process of developing and facilitating a North Carolina climate action plan effort, involving technical working groups, government consultants, and the whole spectrum of stakeholders that have an interest in this subject. The next recommendation is for DAQ to initiate activities to assist in the development of a Southeastern States Regional Climate Action Plan involving other states. A meeting has been held with the Air Directors in Georgia, South Carolina and Tennessee to begin discussions on this. Another recommendation is that a required baseline, point source inventory reporting requirement for greenhouse gases CH₄ for facilities holding an air permit with the Division, will be instituted within three years. A lot of these emissions are already being reported under another program. Mr. Nicholson said it was important to continue to review rules and evaluate means to stimulate improvement and efficiencies at existing and future proposals for coal-fired units to the extent that they are complimentary. Current utilities operate at some of the highest efficiencies in the country, but it is also good to look for other opportunities in that area. Efficiency

equates to less carbon emitted. Mr. Nicholson said that it was important to look at our State Implementation Plan (SIP) and assure that when we make selections for strategies, that we do those that are most mutually complementary to reducing greenhouse gases. The next recommendation is defining carbon dioxide for other greenhouse gases. Another recommendation is to look at opportunities to see if there are opportunities for a fee system that could help support a registry or inventory effort. The eighth recommendation is a commitment to work with this Commission in any way appropriate to help understand the technical aspects of these issues and develop information this Commission would like to have in terms of benefits from various measures, especially as compared to a goal to be reached.

Mr. Nicholson added that DAQ recommends that North Carolina state government increase its leadership role and intensify efforts currently outlined in the State Energy Plan (SEP). There is a lot of information in the SAP in terms of energy efficiency and looking at alternative fuels. They also recommend that clean coal technologies and non combustion energy electricity sources such as gas fired coal systems, wind, solar, hydro or other emerging low emission technologies are strongly considered when new power plant capacity is initiated. Each five years, starting in 2010, we need to report on the state of the science and practical application of energy efficient power generation technology, such as IGCC and technology to remove and sequester carbon dioxide from coal-fired power plants. In addition, a CH₄ greenhouse gas point source inventory, a registry of greenhouse gas reductions that require state and private participation in a carbon market, should be instituted with guidance and resources for third party verification. The General Assembly and all agencies of the state should intensify actions to establish the State as a major greenhouse gas technology and information center to include educational, consulting resources, manufacturing expertise, and selling of equipment on or for the world market. There is a grand opportunity here to develop ourselves with the universities we have in our area. DAQ believes the General Assembly and Executive Branch should use their formal and informal powers with national and international bodies to make a statement of support to assure strong and sustainable reductions of greenhouse gases. While we think our efforts in this state alone are really important, we need to encourage our friends and neighbors to be doing similar things.

Mr. Tim Profeta asked Mr. Nicholson to talk about the timeframe on the decision-making for the clean air plans for the criteria pollutants for NO_x and SO_x and the incentives for those criteria. Mr. Nicholson said that, with the new standards coming on, there are plans in place for both ozone and fine particulate matter starting in 2009-10. The EPA has new proposed standards that would require plans regarding the 2012-14 fine particulate matter to be developed.

Mr. Profeta also asked Mr. Nicholson if NC should be looking at the same incentives as Pennsylvania on the technology of greenhouse gases. Mr. Nicholson said they would be interested in the incentives PA created and the view of the Commission regarding those incentives. There are opportunities there to be explored.

Dr. Everett asked Mr. Nicholson if they had looked at nuclear power generation. Mr. Nicholson said that nuclear generation was not listed as an option but could be an option for reducing carbon dioxide.

Mr. Nicholson continued by saying that long term recommendations encourage strong considerations in the SEP and where we need to give incentives for getting those things done. They also recommend that the General Assembly establish a leadership center within the university system and fund agriculture and forestry and programs in other areas throughout state government or the private sector to undertake and continue programs to maximize permanent or long term carbon dioxide capturing sequestration or elimination of emissions and to utilize the state's vast bio fuel potential with partial cost recovery from sale of carbon credits on the international market. The Division also recommends that efforts be undertaken to assist new systems and technologies being implemented to treat animal waste as an energy resource and to provide the economic and technical assistance to get these programs and Smithfield Agreements in place. Mr. Nicholson added that there are vast opportunities to use the bio resources we have in this state.

Mr. Nicholson added that the Division also recommends the development of a renewable portfolio standard and environmental portfolio standard and the implementation of those at the earliest possible time. The main difference is under an environmental portfolio standard, you open it up to energy efficiency credits or considerations as opposed to not having those. Mr. Nicholson also said that they recommend that a public benefits fund be established to assist in the adoption and implementation of an energy reduction project that will also reduce emission of greenhouse gases from various private and public operations. Mr. Nicholson said that they recommend that the North Carolina governmental agencies continue to work with county, municipal, and other state and national and international and private organizations to insure that North Carolina is able to develop a more energy efficient and less emitting transportation sector. Another recommendation is for a planning group or commission to be established to evaluate needed steps and develop long range energy disaster recovery plan adaptation.

Mr. Nicholson said that the next steps are to establish the Climate Action Plan membership in groups, implementation of inventory details, and work with this Commission to develop the climate action plan advisory group (CAPAG), report to this Commission, the General Assembly and the Governor and implement these recommendations.

Dr. Smith asked Mr. Nicholson if black carbon from diesel fuel was an agent contributing to climate change and what the co-benefits would be from looking at other greenhouse gases. Mr. Nicholson said they do have options to look at black carbon.

Mr. Shore asked Mr. Nicholson if he had thought through how his work would feed back into the Commission, how the timing would be, and how he would suggest this Commission might use the information he provides. Mr. Nicholson said DENR basically plans to work with the Commission and thinks it is a logical component of what the Commission is doing. DENR proposes interacting on an ongoing basis, reporting to the Commission their findings, and offering opportunity for comments, suggestions, and advice. Representative Hackney said that he and Mr. Garrou had discussed this, met with Secretary Ross and Mr. Nicholson, and the tentative plan was to have an agenda item from DENR at each meeting, especially if there is anything new to report. Mr. Slocum asked Mr. Nicholson when the CAPAG group is going to be established. Mr. Nicholson said that the first meeting would be held on

the 16 February 2006. They are getting all of the members lined up for the kickoff. Mr. Slocum asked Mr. Nicholson if the membership had been determined. Mr. Nicholson said that the membership had not yet been fully determined. Mr. Slocum said that he was glad to hear that DENR was looking at removal and sequestration as well as emissions and hoped the CAPAG would follow their lead and look at the broad issue and not just focus on the emissions side. Dr. Eggers asked Mr. Nicholson where energy conservation and the use of alternative fuels fit into the picture. Mr. Nicholson said that the executive summary has more information on conservation efforts. He said they were totally open for all suggestions to put on the table. Representative Hackney urged all members of the Commission to read Mr. Nicholson's report. Mr. Profeta asked Mr. Nicholson if the Commission could offer suggestions to include in DENR's process. Mr. Nicholson said that they were open to all suggestions from Commission members.

Mr. Profeta asked Mr. Nicholson if the Commission could offer advice and suggestions to DAQ, DENR. Mr. Nicholson said that they were certainly open to any advice and suggestions the Commission had to offer. Dr. Everett asked Mr. Nicholson about the statistic on page 12 of the report that ranks NC as 14 in total carbon dioxide emissions and somewhere around tenth in the nation. Mr. Profeta said that we are doing really well as a nation but we have a long way to go. Mr. Nicholson said our utilities do very well as producing power as efficiently as we can; however, we can continue to look at opportunities.

Mr. Urlaub asked Mr. Nicholson to explain why it is important to establish a baseline for greenhouse gas emissions inventory. Mr. Nicholson said that knowledge of where we are is important to understand what benefit we will get from various options and to develop a tracking system whereby credits of reductions for carbon are traded. Mr. Urlaub asked Mr. Nicholson if a market value for carbon emissions would be established in the United States that this Commission would need to address. Mr. Nicholson said that he could not predict for sure, but he thought it is one option which creates an incentive for reductions.

Mr. Nicholson gave a report on specific activities and plans of the Division of Air Quality, DENR, to develop and implement standards and plans to control emissions of carbon dioxide and other greenhouse gases. A copy of his presentation is listed as **Exhibit H**. Representative Hackney said that he and Mr. Garrou thought it was important for this Commission to know what DENR is doing and they look forward to working with them.

Mr. Nicholson said that the CAPAG complements and supports the efforts of the Legislative Commission, provides technical support and knowledge on greenhouse reductions to include cost and benefits, focusing on those actions that can be taken to reduce or sequester more of the controlled approaches. He emphasized that the benefits they want to address are those that are of benefit to industry sectors in the state economy and this includes options that create jobs to the extent we can quantify those through various models and analyses. Mr. Nicholson said that the idea of ongoing reporting to the Commission is very valuable to them.

Mr. Nicholson said the purpose and goals are to develop a proposed climate action plan or recommendations for that plan. Policy options, including cost and benefit analysis, utilizing Duke University as well as a consulting team, will be a consensus

process of stakeholders. This is a facilitated, invited stakeholder process to come up with recommendations; and, if there is no consensus, it may not be worthy of consensus. Consensus does not mean full unanimous agreement, necessarily. Some of the areas they want to look at are agriculture, whether it is better sequestration of carbon in the soils through farming practices and the nature of those practices to growing certain crops for alternative fuels, tweaking of forest management practices to make more money while sequestering more carbon, energy use whether it is commercial, industrial or residential, which is a huge area for conserving emissions of carbon. That could take on more efficient electric motors and encourage industry to replace existing motors with more efficient motors to building codes that would allow for building construction to take advantage of these opportunities. Transportation and land use are big users of fuel in this country and there are ways to conserve travel. The opportunities for resources, such as bio waste, are an alternative form of energy.

Mr. Nicholson said that this is a consensus based process to come up with these options or policies. Some of the decision criteria for selection would obviously be the question of whether we have good greenhouse gas reduction potential and is it cost effective. Are there co-benefits to the economy and does it make sense. Direct savings in terms of fuel use and other feasibility issues will play into the dialogue and discussion. Economic analysis is critical because this is what will sell the programs.

Mr. Nicholson said there was a ten step, fact based process. Consultants and contractors will be present to provide those facts for each option under consideration. This is an open table for all stakeholders. There will be non stakeholder members participating in workgroups and all can observe the process and contribute their resources to the effort.

Mr. Nicholson said that there will be voting, if necessary, to come up with a recommendation. They are looking at about six formal meetings of this stakeholder group through 2007, culminating in a report with recommendations to this Commission and the legislature.

Representative Hackney told Mr. Nicholson that this Commission would look forward to hearing from him regularly about the CAPAG activities.

Dr. Uzochuckwu asked Mr. Nicholson if he had models from other states they were looking at in terms of the process. Mr. Nicholson said that similar processes had been carried out in Connecticut and are currently being considered in Arizona and New Mexico. Over time, a good model will evolve and we will benefit from that experience.

Dr. Uzochuckwu asked if other states have global warming commissions. Representative Hackney said that this information would be provided in the next presentation.

Mr. Givens asked Mr. Nicholson what he thought the potential was for future regional cooperation with the USEPA Southeast Region. Mr. Nicholson said that they are working with the other southeastern states and have had their first meeting by phone with Georgia, South Carolina, and Tennessee; however, there are no formal agreements at this time.

Dr. Smith asked Mr. Nicholson if he anticipated a member of the North Carolina Utilities Commission to be appointed to CAPAG. Mr. Nicholson said they do not presently have a member from the Utilities Commission but would certainly consider this excellent suggestion.

Ms. Judith Greenwald, Director of Innovative Solutions, Pew Center on Global Climate Change, Alexandria, VA, gave a report on actions taken by other states and local governmental units in the United States to address global climate change. A copy of Ms. Greenwald's presentation slides, a brochure on The Basics of Global Climate Change, and a handout entitled Learning from State Action on Climate Change are listed as **Exhibit I**.

Ms. Greenwald gave an overview of what other states are doing to address global climate change. Ms. Greenwald said that the Pew Center was founded in May 1998 and is an independent, nonprofit, and nonpartisan organization. They are a one-stop shop on climate change and are essentially three organizations in one. They do research, education and outreach, and work with businesses. Their work is focused on both domestic and international issues. Ms. Greenwald said their education and outreach is focused on opinion leaders and their business work is focused on 41 Fortune 500 companies who are members of their Business and Environmental Leadership Council. They work with companies in three ways, they review their research, collaborate on education and outreach, and they study the companies and draw lessons from their experience and bring those lessons to other companies who may want to take action. Ms. Greenwald said they are independent of these companies and receive no monies from them.

Ms. Greenwald showed a slide listing the members of the Environmental Leadership Council and said that most of these companies are large greenhouse gas emitters. She said the companies tend to be active on pollution on one of three fronts: reducing their own greenhouse gas emissions, developing products or services that will reduce greenhouse gases ultimately, and they will be working with policy makers to design solutions that are both environmentally effective and business friendly.

Ms. Greenwald said that state level emissions are significant. If you put the southeastern states together as a group, emissions come out somewhere between that of India and Germany. If you just look at North Carolina alone, it has emissions similar to the Netherlands or Venezuela. The United States is a big emitter, but it is comparable to many countries that are engaged in this issue globally.

Ms. Greenwald said the motivations for greenhouse gas reductions are all over the place. A lot of people are reducing greenhouse gases because they care about climate impacts but they also do it because of a side benefit or other things they are trying to pursue, i.e. economic development, energy price volatility, energy independence, air quality concerns, traffic congestion, and all other things. Ms. Greenwald said that North Carolina has been particularly active in dealing with hog waste issues that can have significant greenhouse gas co-benefits.

Ms. Greenwald said that if you look around the country at what states are doing and at both policies that are being directly done for purposes of reducing greenhouses gas emissions and those achieving initial reductions indirectly, just about every state

is doing something. This action is occurring both on the legislative side as well as the executive branch. Most states are involved in some sort of regional initiative on either climate change or clean energy. Twenty eight states have climate action plans and a number of states have greenhouse gas reporting. There is a lot going on in the electricity sector which is the biggest contributor to greenhouse gas emissions and states have a lot of relevant authorities to bring to bear on that issue. Transportation is the second biggest sector in contributing to greenhouse gas emissions. There is also quite a bit going on in agriculture and forestry; however, they do not have that many greenhouse gas emissions, although there are some emissions from the agriculture sector. But the biggest role for agriculture and forestry is a potential sink for the emissions from other sectors. What trees, soils, and plants can do is absorb carbon dioxide from the atmosphere and turn it into carbon. This is a way of offsetting emissions from other sectors. Agriculture and forestry have the potential to be the producers of biofuels and biofuels can displace fossil fuels and fossil fuels are the major cause of climate change. The reason why biofuels work on a life cycle basis is that the carbon dioxide that you absorb from the atmosphere during the time when the trees and plants are growing is then released when you burn that energy, but then you plant it again. On a lifecycle basis, you have zero emissions.

Ms. Greenwald said that the regional greenhouse gas initiative in the northeast, announced in December 2005, is a regional cap and trade program that will initially cover power plants and carbon dioxide emissions. Ms. Greenwald explained that a cap and trade program means that you put an overall cap on a group of sources of emissions. In this case, it is about power plants which have a cap. But any individual source can emit as much as it wants as long as the whole region stays under the cap and holds an emission allowance. The state has to figure out some way of distributing these emission allowances which are certificates that allow you to emit one ton of carbon dioxide. As long as you hold ten tons of emission certificates, you can emit ten tons of emissions. If there is a power plant that has a particularly difficult time reducing their emissions, they can buy allowances from someone else, by reducing extra and selling some of their allowances. It is an especially efficient and effective way to achieve a particular environmental goal.

Ms. Greenwald said that there is a lot of experience in this country with the sulfur dioxide program, which is a cap and trade program. That is how dramatic reductions in the emissions that cause acid rain have been achieved. The European Union is now engaging in their cap and trade program to meet their Kyoto targets and is the first mandatory greenhouse gas cap and trade program in the world. The Northeast Regional Greenhouse Gas Initiative is the second mandatory cap and trade program in the world and the first in the U.S.

Ms. Greenwald said the beginnings of this initiative are interesting from Europe's perspective. Governor Pataki had a process looking into what NY could do on the issue of climate change. They did a lot of analysis which indicated that if they could involve more states and more sources, they could do more for the environment for less money, working with other states. Governor Pataki invited his fellow governors throughout the northeast to participate in this process which took about two years to development an agreement which seven of them signed onto in December. Just a few days prior to the agreement, it looked like there were going to be nine states, but at the last moment, Massachusetts and Rhode Island decided not to participate.

Massachusetts has decided to go its own way and has its own carbon dioxide power plant initiative. Others speculate that these initiatives will merge and they, along with Rhode Island, will come into the northeast initiatives. The goals for this program are to stabilize power plant emissions at current levels, starting in 2009, they are going to hold that to 2015, and then start reducing in a second phase and get to ten percent reduction by 2019.

Ms. Greenwald said that California is doing quite a bit to reduce greenhouse gas emissions. Governor Schwarzenegger in June 2005 announced targets and timetables for the state to achieve 2000 levels by 2010, 1990 levels by 2020 and have a long term target of 80 percent below current emissions by 2050. The Governor's Climate Action Team, which is a group of folks from state government, has worked on a draft report that is out for public comment. This is their first cut at what California is already doing that will help it meet its targets and what more needs to be done to bridge the gap as to where they are headed and to where the Governor's targets have demanded that they go. California has an aggressive renewable portfolio standard that will help them meet their targets with vehicle greenhouse standards requiring cars and light trucks to meet certain greenhouse gas standards, achieving a 22 percent reduction by 2012 and a 30 percent reduction by 2016. The auto industry has sued the State of California over these standards, so it is not clear what their fate is. If they are upheld, this will be a fairly significant reduction and makes a big difference in California's ability to meet these targets. CA has an unusually large fraction of its emissions coming from its motor vehicles. Every agency in CA is in on this game; all different agencies are participating in different ways.

Ms. Greenwald said that the California Energy Commission and Public Utilities Commission have a policy statement that standards should be set requiring coal-fired power plants to capture and sequester their carbon dioxide emissions. Carbon capture and sequestration, or CCS, is an important potential solution to continuing to use the coal that we have such an abundant resource of in this country, in a carbon constrained future. There is a lot of interest in this technology which has tremendous potential. It looks like it can be done but there are still issues with integrating the various components of this technology, demonstrating that it can be done at the scale needed, and demonstrating that once you capture the carbon and inject it into underground, geological formations determine that it actually stays there. There is a lot of work to be done but a lot of interest in this technology. The CA Public Utility Commission already requires utilities to use a carbon adder in their analyses which means they have to assume that in the future, carbon dioxide is going to have some price. They have to take this into account when they make their investment decisions. There are a number of other states that require this as well. Ms. Greenwald said that the CPUC also just announced they are going to start a proceeding looking at a load cap or cap on their utilities overall emissions both from a power in its generators as well as the power that it brings into the state. There is quite a bit going on at the various California agencies that bears looking at.

Ms. Greenwald said that Pennsylvania has an alternative energy portfolio standard (AEPS), which is their variant of a renewable portfolio standard (RPS). A renewable portfolio standard means a certain fraction or a certain amount of generation has to come from renewables. There is a variation among states on how renewables are defined. PA is the only state that includes coal in its renewable portfolio standard

and that is why they are calling it an AEPS and not a RPS. It will require a significant amount of renewables as well. They have a tiered standard. Tier one standard will require an eight percent of generation to come from renewables by 2020, including solar, wind, low impact hydro, coal mine methane and fuel cells, and Tier Two, which will be ten percent by 2020 and has waste coal, large hydro, municipal solid waste, and integrated gasification combined cycle. They have a program called Energy Deployment for a Growing Economy (EDGE). This is an initiative that was recently announced by their Governor to promote these advanced clean coal technologies. They are using a number of different tools to advance these technologies, including procurement authority to buy output of some of these projects that helps them get financing, using state monies to provide financing and using some of their regulatory powers to help some of these projects pass through their PUC. They have asked the USEPA to provide some regulatory relief for some smaller plants if they do innovative projects. It is not clear if EPA has the authority to grant this relief, but they are trying a multiplicity of approaches to try to get these projects moving. They also have an Energy Harvest Grant Program which includes smaller projects on renewables. They have an Energy Development Authority which provides all kinds of innovative financing, including grants, bonds, loans, etc., and they have an Alternative Fuels Incentive Grant Program that focuses on developing alternative fuels infrastructure.

Ms. Greenwald said there was also a lot of action in the southwest. In Arizona, Governor Napolitano had an executive order that established an advisory committee to develop a plan and greenhouse gas emission targets for the state. They already have a RPS that would help them meet any targets with recommendation due in a few months. In New Mexico, Governor Richardson actually has set a target similar to what Governor Schwarzenegger did. Their emission targets are to achieve 2000 levels by 2012, ten percent below 2000 by 2020, and presenting a report on impacts of what climate change would mean for the state. Their report is due to the Governor at the end of 2006. The key differences between these two processes are that in New Mexico, the Governor set the target and the group is assigned as to how to meet it. In Arizona, the group is trying to figure out what the target should be as well as how it should be met. In North Carolina, the question is open to whether or not there should be targets at all.

Ms. Greenwald said that electricity and transportation are the two biggest emitters in North Carolina as well as opportunities in other sectors. If you look at the U.S. as a whole, electricity is 32 percent of the emissions and in North Carolina it is 42 percent. If you look at transportation, emission is twenty-six percent nationally and 30 percent in North Carolina.

Ms. Greenwald said that are two ways to look at electricity. Generators with facilities located within the borders of the state of North Carolina, you have a pretty big coal fraction, sixty one percent in NC versus 50 percent in the nation as a whole. Nuclear fraction is also larger in NC than the national average of 32 percent versus 20 percent. NC uses less natural gas than the US as a whole. What this means is that the overwhelming majority of the emissions that are from this sector come from coal. Natural gas emits much less carbon dioxide than coal. The other way to look at this is by consumption of power from outside the state. On that basis, coal is about half of the emissions from the power that is used to serve the citizens of NC. This is pretty much in line with the rest of the country. Nuclear power in NC is about 45 percent of the fuel mix to serve the citizens and 20 percent nationally.

Ms. Greenwald said that since coal is such a big part of this problem, solutions need to be made. The Northeast Regional Greenhouse Gas Initiative covers coal plants, natural gas plants. The Massachusetts Power Plant Initiative will also cover coal plants through a cap and offset program which is slightly different from a cap and trade program. The Western Governor's Association has a process to consider incentives for demonstrating the carbon capture and sequestration technology that people think is so important to the future of coal. There are also many efforts around the country to advance integrated gasification combined cycle (IGCC). IGCC has many benefits in terms of air and water quality. On carbon, IGCC gets so much attention because the way the technology is set up and makes it much easier to capture the carbon dioxide and store it. By itself, IGCC is no more efficient than the best conventional coal power plants. There are people who think it has the potential to be significantly more efficient because it is a newer technology; however, at the moment, it does not give a greenhouse gas benefit by itself. What it does is set up an easier way to capture and store the carbon.

Ms. Greenwald said that 22 states, plus the District of Columbia, have RPS's. The approach where you require a certain amount of electricity to come from renewables is becoming fairly popular around the country. Each state has an interesting story, especially Texas. Texas enacted its RPS in the late 1990's while it was doing electric restructuring. It was signed into law by then Governor George W. Bush. The Texas law was one of the first states to do renewable energy credit trading, which is similar to the cap and trade program, and has been copied by many other states. The economic development benefits in Texas have been enormous. West Texas has a tremendous wind resource and a lot of jobs have been created. The state has updated its target that is much more aggressive and includes a small solar component.

Ms. Greenwald said that a lot of states have worked together to track renewable energy credits across state lines to set up renewable energy credit trading. Twenty two states have public benefit funds, 14 of them with energy efficiency and renewables. The rest have renewables only, funded through a fee on electric power, and this money has been used to promote energy efficiency and renewables in a variety of ways.

Ms. Greenwald said that 10 states have formally adopted the CA greenhouse gas standards. If the standards are upheld and these ten states follow CA with these greenhouse gas standards, then over one third of newer vehicles sales will be subject to these emissions standards. There are more states considering this, pending the outcome of the lawsuit.

Ms. Greenwald said that 27 states have incentives and mandates for promoting ethanol. Ethanol is potentially very helpful on climate change. If you make ethanol from cellulose, which is the plant matter that comprises most plant stalks, you get 100 percent improvement in greenhouse gas emissions compared to fossil fuels. That is the goal and where everyone would like to be headed. However, at the moment, most of the ethanol in this country is made from corn. The benefit from ethanol made from corn is much smaller than the benefit from ethanol made from cellulose. Best estimate is a 30 percent benefit on a life cycle basis if you make it from corn, with a range of estimates and differing opinions on the subject.

Ms. Greenwald said that 28 states have Climate Action Plans (CAP). What these plans mean is that you have looked at emissions and what might be done to reduce these emissions. The impacts tend to vary by region such as impacts on sea level rise or storm intensity on the coast and water availability and drought concerns in the west, and specialized concerns such as in Vermont regarding Sugar Maples.

Ms. Greenwald said that many states are working on greenhouse gas reporting and registries. A few of these are mandatory but more of them are voluntary. Several states have moved into regional groups to work on these registries—one in the northeast under development and one in the Midwest who are working together on a registry. A number of individual states have greenhouse gas registries, already. A number of states are especially focusing in on carbon sequestration registries.

Ms. Greenwald said that in June 2005, the U. S. Conference of Mayors adopted the Kyoto targets with over 200 mayors agreeing to this. These targets have three components: smart growth, urban tree planting, and building codes. They also committed as a group to lobby other levels of government to get them to do their part to meet the Kyoto targets. They also endorsed that the federal government should develop a national cap and trade program.

Ms. Greenwald said that a group is working with cities around the world on climate protection plans, and over 600 cities worldwide are implementing plans to reduce greenhouse gas emissions. They have quite a bit of information around the world on cities adopting climate strategy, transportation, water management, building standards, renewable energy procurement, smart growth and energy efficiency similar to what is happening at the state level but with a flavor or what local government is better able to do. Atlanta has an interesting set of standards under its transportation department. Salt Lake City has been doing a number of interesting things with more efficient traffic lights, urban tree planting and other things. Ms. Greenwald suggested that NC might want to look at what other cities are doing when planning their work.

Ms. Greenwald said there is an interesting initiative in the upper Midwest called Powering the Plains that NC may want to look at carefully. Most of these initiatives are Governor to Governor with mostly state legislators being involved as well as private sector businesses. Their big focus is on rural economic development with regard to wind power and bio fuels. They also have a coal initiative and are trying to move ahead on a number of technological fronts as well as figuring out a plan for the region. The Northeast Regional Greenhouse Gas Initiative, cap and trade program, as well as the New England Governors and Eastern Canadian Premiers have an initiative and have set targets and timetables and an action plan to meet these targets and timetables. There is a lot going on with states working together. Each of the west coast states is quite active on its own and is working cooperatively as well.

Ms. Greenwald said she was here today to help the Commission decide which policies they might want to pursue. Many recommendations in DENR's report have precedence in states around the country. North Carolina may want to look to these other states and find out their experience as you explore some of these initiatives. Ms. Greenwald said that The Pew Center would be happy to provide as much

information as needed on these specific initiatives and would connect NC to officials in other states who can fill you in on their initiatives.

Ms. Greenwald said that some of the DENR recommendations are to promote cleaner coal and renewable energy capacity, mandatory greenhouse gas reporting, energy efficiency becoming a center of low carbon technology development. There is also The Third Frontier Initiative in Ohio is working on developing their capacity to work on low carbon and other technologies of the future. There is a particular emphasis on fuel cells. DENR wants to work with other states in the southeast and there are a lot of models for regional cooperation around the country. There is quite a bit going on in agriculture. A number of states have public benefit funds; a lot of states have RPS's, and a lot going on in transportation emission reductions. There is a wealth of experience for NC to draw on as you look through these options.

Ms. Greenwald concluded by saying that states are actually leading on climate change with most of the efforts having extensive stakeholder involvement, including the private sector, which has been quite important in their success. There are multiple drivers and multiple benefits of these initiatives, not just about climate change, and they are achieving real emission reductions. States are providing lessons for potential federal action, which is a big interest to The Pew Center. Even with federal action, states will have a role to play because of the relevant authorities. Whether it is a federal program implemented through the states or complimentary programs that the states can do that the feds do not have a particularly good grip on, there is a role for the states over time. The Pew Center is seeing a trend toward regional action which is a positive step toward better efficiency and effectiveness. There is some interest in NC in working regionally, and NC is well positioned to be a leader in this region and could benefit from cooperation with the other states and the other states could benefit from cooperation with NC. There are tremendous resources here with universities, research, and the desire to move ahead.

Ms. Greenwald gave the website for the Pew Center, and said it offered a lot of information on the issues this Commission would be dealing with regarding the science, the impacts, technologies, and what is going on in the rest of the world with climate change.

Dr. Eggers asked Ms. Greenwald if the Pew Center had looked at carbon reduction goals, and which states have penalized components. Ms. Greenwald said that the Pew Center is stronger at the federal level but tends to prefer an approach with more specific goals for the private sector. They believe that this is a big problem that will be solved with a number of little pieces. Mr. Toben asked Ms. Greenwald if it would be useful to look at North Carolina specifically and where our opportunities are for some of these alternative energy and transportation opportunities.

Mr. Toben also asked Ms. Greenwald if there was an opportunity for a carbon tax instead of the CAP and trade system. Ms. Greenwald said that they are in contact with Commission staff as to how the Pew Center can help North Carolina. A case study was done with the North Carolina hog waste agreement after a major hurricane flooding. It is a good example of companies implementing technologies. There is a lot of North Carolina specific opportunity that DENR is exploring. Ms. Greenwald said with regard to Mr. Toben's question on CAP and trade versus taxes, this is both economic and political. Analytically, there are many reasons for a tax. Economists

say that, depending on how you design your cap and trade program, you can get very similar outcomes on a tax versus a cap and trade program. What cap and trade does is it gives you the opportunity to award good behavior and punish bad behavior. Ms. Greenwald said that in a cap and trade program, you don't just have one step where you set the tax and let things happen. You also have a step on how you are going to distribute the allowances. In that process, which can be quite messy and politically difficult, you actually make decisions on who is going to get those allowances and who is not. Ms. Greenwald said that one of the things that can be done is an initial distribution, which helps transition high emitters into being low emitters, but over time you can make it a more level playing field. The distinction between a cap and trade program and a tax program is, under the cap and trade program, you can make some choices about what you are going to do with the emitters. That can include revenue choices.

Mr. Urlaub asked Ms. Greenwald how North Carolina could take a more integrated look. He asked the Pew Center to direct us to resources that can help us bring the transportation and electric sectors together, with energy efficiency measures, alternative fuels, and energy renewables, along with nuclear power. Ms. Greenwald said that the short answer is yes. NC DENR is going to be doing some modeling analysis and they should be able to get a lot of information from this process.

Mr. Profeta said that the Nicholas Institute School of Environmental Earth Sciences at Duke University and Duke Energy are working together on a climate change policy project that focuses on assessing carbon taxes (versus cap and trade) how to optimize both policy options, and which option better transitions our economy in terms of greenhouse gases.

Senator Cowell asked Ms. Greenwald if the Pew Center has a position on nuclear energy as part of the mix of energy resources that could be used to reduce greenhouse gases. Ms. Greenwald told Senator Cowell she would send her a paper she had written on nuclear energy as a source for greenhouse gases reduction. Ms. Greenwald said that the Pew Center's view on nuclear power is that it is potentially part of the solution to climate change, but it has troubles of its own. Because of climate change, it is worth making a significant public investment to try to solve those problems. They are in favor of various initiatives that would lead to improvement in nuclear power, particularly with waste and cost issues.

Mr. Peele said that it is important for us to look at what we are already doing in North Carolina. There are a number of projects already in place that Commission members may be interested in hearing from such as Advanced Energy, North Carolina GreenPower, the State Energy Policy Council, and the North Carolina Biomass Council. Representative Harrison asked Ms. Greenwald about her comments on ethanol gas. Was this science capable of producing a 30 percent reduction rate? Ms. Greenwald said that the 30 percent was not universal, but it was their best estimate.

Representative Hackney noted that reading material had been passed out to Commission members provided by Mr. Shore on Economic Opportunity in Addressing Global Warming and Understanding Global Warming for North Carolina. These reports are listed as **Exhibit J**.

Senator Pittenger said that he had distributed to members of the Commission a copy of a book, The Skeptical Environmentalist by Bjorn Lomborg; and if others were interested, he would be glad to provide them with a copy of the book.

Representative Hackney called on Mr. Jim Havens to bring the Commission up to date on what he was doing regarding greenhouse gas emissions. Mr. Havens said that he worked on the subject of greenhouse gas emissions since 1995 with EPA and DOE under a five-year pilot program on climate life, and submitted many recommendations to them for how to establish so-called climate leaders. North Carolina leads the nation for having a number of industries that report their greenhouse gas emissions to the DOE. Since the monies ran out for the pilot program, the same program has been reincorporated into global warming initiatives and continues to date. North Carolina has been recognized as leading the nation in textile companies that are reporting greenhouse gas emissions. He offered to give a more in depth report at a future meeting.

Representative Hackney said that the Commission would meet monthly. The Commission would not be meeting when the legislature is in session, but would resume its meetings in the next interim. Meeting dates would be selected three to four weeks in advance.

Representative Hackney asked members to comment on future speakers, topics, and their ideas for direction of the Commission.

Senator Pittenger said that all of the presenters today were strong advocates of the anthropogenic base causes of global climate changes. He had read material from those scientists who do not share that perspective and would encourage some of these folks be invited to speak to the Commission in order to broaden our perspective. Senator Pittenger suggested inviting Dr. Richard Lindzen, professor of Meteorology at MIT and member of the National Academy of Sciences, Dr. Fred Singer, Atmospheric Physicist from George Mason University and Dr. Bjorn Lomborg from the University of Denmark, to address the Commission.

Representative Harrison asked Dr. Riggs to comment on what is being done at East Carolina University with regard to greenhouse gas emissions. Dr. Riggs said that he and 40 other scientists are working on a program funded by the US Geological Survey dealing with sea level and climate curves for the last 10,000 years, the last 1,000 years, and up to the present. A coastal geologist looks backward and can put together the evolutionary development of the state. They know where they are based on where we are headed, with respect to the changes that are going on. He reminded members that our coastal system does not have a very high elevation, and the changes taking place are traumatic. He said we have a very good understanding of what those changes are and the cost of those changes for North Carolina if we do nothing. He said that it is important to calculate the cost of doing nothing. He reminded everyone of the hurricanes that went into the gulf this past year. They could have come up our coast and would have done the same thing to North Carolina that they did to the Gulf coast states. He said he would like to put before the Commission the information that they have at this time. Representative Hackney said that we would look at that in the future. Dr. Crawford-Brown said that he had worked with both Dr. Fred Singer and Dr. Bjorn Lomborg from Denmark, whose positions are not that different from the rest of the scientific community. They both

claim that there is a lot of uncertainty surrounding this issue. Where they disagree with most of the scientific community is whether that uncertainty is so profound that we ought to be willing to invest in resources to reduce carbon dioxide emissions. Dr. Crawford-Brown said that there is scientific uncertainty at the moment. We need to understand that the emissions we are producing are coming out of legitimate human needs. Our task is to find out how we can satisfy those legitimate needs in ways that do not produce so much carbon dioxide. Every one of us got us into this situation, and every one of us is part of the solution.

Dr. Eggers said that if we err on the side of addressing global warming and we are wrong, we are probably okay. If we err on the side of not addressing global warming and, it happens, the consequences would be grave. The stakes are high in being wrong in that direction. Carbon standards are coming, and greenhouse gas emissions standards are coming. At www.businessweek.com/go/carbon where there is a list of companies that have saved billions of dollars by reducing their carbon emissions. Representative Hackney asked Dr. Eggers to send that link to our staff and we would e-mail the link out to members of the Commission. Dr. Eggers said the state needs access to data and systems models predicting carbon emissions in the future, under alternative energy scenarios. Southern Alliance for Clean Energy has some good information available. DAQ is also getting together some good information. We need to coordinate with other bodies to get a grip on what the future looks like under various scenarios. Senator Pittenger asked Dr. Crawford-Brown to respond to statements by Dr. Singer and Dr. Lindzen. Dr. Crawford-Brown said that the economy of the United States fluctuates. It is not to say that interventions by people in the market do not also cause changes to the global climate. We do not know if the climate fluctuations that are occurring right now are due to human influence or due to a natural variability. Mr. Toben said it would be good to invite members of the business community to speak to the Commission, such as folks from General Electric, DuPont, and BP, who have made a decision to move down a path that foresees a carbon constrained world and have actually made investments and see opportunities for growth and profitability.

Mr. Profeta quoted Senator Joe Lieberman as saying, "if we take action and we are right about global warming, we save the world. If we take action and we are wrong about global warming, we just get more energy efficient and less dependent on foreign oil." Mr. Profeta said that when he considers this topic of global warming, he thinks of two concepts. One is inevitability and one is opportunity. Unless you are one of the ten scientists who do not believe global warming is occurring due to human activity, there is an inevitability that we are going to have to address this problem. If you believe there is inevitable change, change begets opportunity.

Mr. Urlaub said if we do want more information on science, perhaps we should go to the nation's expert, the Director of National Center of Atmospheric Research. We are sitting on top of a lot of opportunities. We have industries in rural counties that are looking for opportunities to carry them into the economic future and need to become more sustainable to protect our state's economic future. Mr. Urlaub said he thinks business can help show us the way and would second the recommendations to bring business speakers to address this Commission.

Dr. Smith commended the leadership provided by the elected representatives to get this Commission going. He said, as a father of three, he believes we have a

responsibility to our children to take action on global warming. Dr. Smith said that we should pay close attention to the co-benefits that will flow from this rural economic development and increased efficiency fuel diversity. As the co-chair of the U. S. Climate Action Network, he believes we need to spend more time understanding the benefits of the emerging carbon trading network and take a hard look at this and how it could benefit NC. Mr. Shore said that he agrees with Senator Pittenger that we need to find out where we have consensus in the science and where we do not have consensus. We will find that there is a tremendous platform on which we can build a solution for NC. The responsibility for us as a state on the issue of climate change will ultimately be solved at the national and international levels. We can only go so far to make a difference; however, states are the foundation for experimenting with policies and this will have an effect at the national level. We need to see what the winning opportunities are, and how we can focus all 34 members of the Commission to deal with some narrow range of issues.

Mr. Cecich said there are many opportunities to move forward to address climate change. If we stopped generating carbon tomorrow and went back to 100 years ago, the carbon in the atmosphere would probably exist another 100 years. So, despite many positive steps that are occurring, we need to look at how to adapt to the impacts of climate change.

Mr. Nicholson said that DENR had prepared an updated comprehensive inventory for the state and projected it forward for a number of years. This will be presented at the first CAPAG meeting on 16 February 2006.

The next meeting date for this Commission is tentatively set for March 3, 2006.

The meeting was adjourned at 3:00 PM.

Representative Joe Hackney
Presiding Co-Chair

Mary R. Watson
Committee Assistant

LIST OF EXHIBITS

EXHIBIT A	Meeting Notice
EXHIBIT B	Meeting Agenda
EXHIBIT C	Visitor's Registration
EXHIBIT D	Commission Membership List and Session Laws
EXHIBIT E	House Bill 1600
EXHIBIT F	PowerPoint presentation and comments made by Dr. Schlesinger on the state of the science related to global climate change
EXHIBIT G	PowerPoint presentation by Brock Nicholson and the final report on Carbon Dioxide Emissions Reduction Strategies for North Carolina
EXHIBIT H	PowerPoint presentation by Brock Nicholson on specific activities and plans of the Division of Air Quality of the Department of Environment and Natural Resources to develop and implement standards and plans to control emissions of carbon dioxide and other greenhouse gases
EXHIBIT I	PowerPoint presentation by Judith Greenwald of the Pew Center, a brochure on The Basics of Global Climate Change, and a handout entitled Learning from State Action on Climate Change
EXHIBIT J	Reading material distributed to Commission members provided by Mr. Michael Shore on Economic Opportunity in Addressing Global Warming and Understanding Global Warming for North Carolina