Legislative Commission on Global Climate Change
November 14, 2008
643 Legislative Office Building
Minutes

Representative Harrison called meeting to order at 10:15 a.m., stated that Mr. Garrou would not be present and welcomed everyone. She also state that Mr. Michael Regan was replacing Ms. Jane Preyer and Mr. Dan Crawford is replacing Mr. Michael Nelson. Members present include: Representative Harrison, Co-chair, Senator Albertson, Representative Underhill, Dr. Eggers, Mr. Tim Toben, Ms. Susan Tompkins, Mr. George Everett, Mr. Dan Crawford, Dr. Stanley Riggs, Mr. Michael Regan, Mr. Robert Slocum, Dr. Stephen Smith, Mr. James Stephenson, Ms. Caroline Choi, Mr. Mitchell Peele, Mr. Ivan Urlaub, Mr. Robert Glaser, and Dr. Pete Andrews. The visitor registration is attached as Exhibit A. The agenda is attached as Exhibit B. Representative Harrison called on Mr. Givens for remarks.

Mr. Givens: He thanked everyone for coming and stated that our analyst for environmental issues is on maternity leave she had a little girl and if you want more details our other Jennifer will be happy to provide that. She expects to come back at least part-time in December and I am doing my best to hold her to that.

We have a new clerk today, Patsy Etheridge who replaces Anne Misenheimer and we continue with our clerk Thelma Utley who has been with us almost since the beginning and we appreciate her loyalty and I think you know the rest of us up here.

There are several documents that have been or will be distributed – I call your attention to this document (has it come around yet) Ivan Urlaub brings this North Carolina Renewable Energy and Energy Efficiency Industry Census 2008 (EXHIBIT C) and we will enter that into the record.

Tom Peterson who has been the Department of Environment and Natural Resource's contact for the Climate Action Plan Advisory Group **(CAPAG) process has sent three documents that are being distributed and one that is being referenced but because of its volume we did not print. The first one is a memo to the Commission and copies to myself and Brock Nicholson (EXHIBIT D) summarizing the activity of the CAPAG and referencing the completion of its work. The other two documents relate to criticism of the Appalachian State University Economic Analysis. There is a Peer Review (EXHIBIT E) of the work of David C. Tuerck who presented to the Commission I think at our last meeting before the interim was recessed in May. There is also a document captioned on letterhead from the Florida Department of Environmental Protection (EXHIBIT F). Apparently there is an institute in Florida called the James Madison Institute, which I gather is an analog of the John Locke Foundation and that information is supplied by Mr. Peterson and following our usual practice we've distributed all of that for the records.**

The Co-chairs and counsel have met and discussed what we want to do in the very short time we have in this short interim and it is our hope that we will transition at this meeting from presentations about various topics and on to a serious examination of possible

recommendations. Chairman Garrou in his subsequent conversations has advised me that we must now consider the direst of situations with the state budget and what the extent to which there will be funds available to do various things and the extent to which additional burdens can be placed on the private sector.

What I would like to do – I had originally thought I might do at this point – but I have decided to provide you with some additional information that will be printed so I would like to come back Madam Chairman at a later point in the agenda and talk in further detail about how we intend to proceed with the recommendations process. So with that I would ask this question, Chairman Harrison indicated we had two changes in membership and I think that that is all but is there anybody else who is here as a designee of an appointed authority who is different from what we had before.

Today's agenda, I think it is a good one – we have timed it out for about three hours. Of course that depends upon the number of questions that are asked but we did not schedule a lunch break. The first presentation is from a new source for us, the one that Chairman Harrison and I are much involved in. I have been appointed as the staff chair for the National Conference of Environmental Legislative Committee on Environment and Chairman Harrison is the Vice-chair of that committee. The National Conference of State Legislatures (NCSL) has published a number of reports on climate change and Mr. Anderson is going to talk to us about those reports and the outcome of the trends that he has seen from the perspective of the organization of state legislatures nationally including the most recent snapshot of what is going on with the State. We will also hear the presentation from the Southern Alliance for Clean Energy (SACE). Steve Smith has asked to make a brief introduction of Mr. Wilson so with the indulgence of the Chair when we get to that we will do that. The remaining presentations that are listed on the back of the agenda are as I indicated with regard to adaptation matters many of you have expressed an interest in going forward with that.

I note the schedule of meeting on the agenda and I think probably we need to revise that a little bit. I am going to ask Ms. Matheson to look at that because I think we have two meetings in January and I am not sure that the 13th is the last one. We have scheduled two in January so that we would hopefully have time to get our recommendations together in time for the long session. We will look at that and get back to you on it – don't leave without knowing when the next meeting is. I apologize that the back of the agenda is incorrect.

We have two meetings scheduled - January 13th that is correct, we scheduled an additional meeting for January 27th – that I believe is a Tuesday and that is the day before the Legislature convenes. So we are going to try to wedge another one in and we will have two in January and we will assimilate a written notice to that. I think that is all for the moment Madam Chairman.

Representative Harrison: Thank you – minutes?

Mr. Givens: With regard to the minutes – thank you – we have dissimulated to you draft minutes for all of the meetings (EXHIBIT G) for which we have not previously submitted minutes except the last one before the session, which was 22 April. That one is in progress

– if anyone is prepared to offer a motion to approve them at this point that will be fine. If you want to take them home and read them, we will put them back on the agenda for December and you can offer any corrections that you want at the pleasure of Chair and the members.

Representative Harrison: We will proceed with our first agenda item. Glen Anderson is here with us from NCSL. Thank you for making the journey to North Carolina.

Mr. Glen Anderson: Hi my name is Glen Anderson with NCSL and I am happy to be here with you today. NCSL has been working on climate change issues and renewable energy issues for a number of years now and my focus and NCSL is climate change and renewable energy and we've recently published 12 publications that are exploring the cost of climate change in various states. This is regardless of any type of mitigation to some extent that is done since there is likely to be some type of cost regardless of whether zero emissions or significant reductions in emissions is achieved or not since we are already locked into a certain degree of warming.

Now I want to cover a number of things here basically the potential economic impacts of climate change for North Carolina and what are some of the costs that have been forecast with regards to greenhouse gas reduction policies. Also offer an update of the latest developments in state climate change policy and review how the federal climate policies may affect the state policy landscape.

Representative Underhill: The studies that you mentioned from NCSL have they been sent out or do we need to request them?

Mr. Anderson: We worked with the University of Maryland to produce these papers. Essentially they did the brunt of the scientific research, we also produced some over view information on the science of climate change and we also did the policy options part not really recommendations but more what type of options there are. Those are all published and on our web site. We have the North Carolina ones, I brought copies (EXHIBITS I, J) of that but hopefully each of you will get that as well. But we have nice color pdf's on our web site as well and all 12 states are accessible. It's a crutch I know for presenters who don't know their topic well enough, but that's really not the case here. It's really for your information but I do have a few charts and drafts that could be pretty helpful.

But in any case, the University of Maryland did much of the scientific research. We took that and put it in an understandable format and kind of refined it a bit and then we did that for 12 states. The reason that we chose those 12 was because of the geographic representation of states which were not just geographic but also population wise and also to the extent that they represented diverse economic bases throughout the nation since many of them will be seeing different impacts based on what their economic structure is and their geographical location. Part of the reason we wanted to do this was since there has been multiple forecast on the cost that greenhouse gas productions may cause the economy particular with the regards to the number of the bills that have been introduced in Congress. However few studies have really explored the economic cost of climate change so we, as I said, partnered with the University of Maryland, they have a center for Integrated

Environmental Research and have been leading in this area and a regional research was reported about a year and a half ago. So we built up that and in addition they ran some economic models that for each state, there is a number of research institutions that have developed these economic models that are able to look at different impacts and the agricultural sector in a state. How much of an impact will that have on the rest of the economic entities within the state – so how it would feedback and if the employment for instance and other transportation essentially those other economic grounds? With that there is a predicted four degree increase by 2100 for the southeastern U.S. and that is something that actually has been established by NASA and is in agreement with the Intergovernmental Panel on Climate Change (IPCC) research as well. The predictions are 7-23 in. global rise in sea-level and the reason there is such a great disparity there is different regions will see different rise depending on where they are within the globe. There is also quite a bit of range depending on how much warming we see and what type of feedback mechanisms might occur to what extent there might be melting and how much the ocean will expand. In fact most of the rise in sea-level is caused by the expansion of water as it warms not due to the melting of ice.

For North Carolina more than half of the state's shorelines are considered to be at very high risks according to the U.S. Geological Society and there is a potential for increase in severe storms and flooding for North Carolina. As well there are agricultural impacts on productivity due to increased temperatures that decreases productivity for animal reproduction and also for dairy production as well. Coastal infrastructure and drinking water supplies may also be at risk. This is just a map produced, in addition, I am not sure if where, but the coastline in North Carolina is subsiding at about seven inches per 100 years. So that compounds the increase that adds to the increase in sea-levels. So that is important to keep in mind as well. The dark red areas in this map demonstrate those areas that are highest risk, so the lowest line levels and the lighter areas demonstrate those that are at risk from higher sea-level increases. So according to the U.S. Geological actual survey more than half of the coast line falls in this highest risk area and as you can see there that is about 2,000 sq. miles. The middle risk and the low risk areas add another 2500 sq. miles to those risk laden areas. Under the 18 inch sea-level rise scenario which is considered a mid range target for increase in sea-level losses to North Carolina by 2080 have been estimated at around 10 billion dollars.

This is a break down of four different coastal counties and the estimate by 2080 under the 18 inch sea-level rise scenario and the total cost would be about, for these four counties alone, would be about 2.8 billion dollars and you can see how there is a significant loss both in residential property and non residential property values. This research comes from the National Commission on Energy Policy and it is from 2007. In addition, there have definitely been a number of studies and a number of climatologists that have modeling forecast increasing in hurricane and severe weather. I know that some, particularly in Colorado, there is a fairly well known researcher that has disputed whether hurricane incidence will increase. However base physical modeling indicates that when there is an increase in energy within a system that provides just a larger amount of energy that is available from storm systems. However, there are so many other variables included that it is hard to predict however, most of the research now indicates that there is likely to be a tendency towards more severe weather and an increase in the severity of hurricanes as

well. As an example, just of the potential costs, North Carolina agriculture suffered about 2.4 billion dollars in losses in the decade between 1996 and 2006 from 14 different hurricanes and Hurricane Fran caused 1.7 billion in forest damages. And the forest sector generates about 3 billion a year for North Carolina, so it is a fairly important sector; so that is important to keep in mind.

There are also potential costs to public health, North Carolina as you know, sections such as the Charlotte metropolitan area have some of the highest ozone levels and the chemical reactions that take place to create ozone from, for instance auto emissions or industrial emissions, that chemical reaction accelerates with higher temperatures. So that is why some of the worst temperature or highest temperature days also tend to be the most polluted days. If you notice some of the ozone alerts tend to be on much hotter days. An increase of say four degrees in the southeast here could or is likely to increase the amount of ozone. However, there is a number that is not necessarily taking into account the Clean Air Act and what type of clean energy policies might be pursued. There is also high incidence of asthma and other respiratory diseases in this region and those are definitely worsened by ozone and there is some research that indicates that high ozone levels and smog levels actually cause asthma. So as to regards to water, increased temperatures may increase the incidence of drought there is forecast to be actually an increase in the amount of precipitation, however, that precipitation is predicted to come in more extreme cases. So there may be a larger total amount of water however, it may not come in smaller rainfall events but more in very large rainfall events and with higher temperatures that accelerates evaporation and is likely to cause the land to dry out more quickly and higher amounts of rainfall will lead to more flooding when it hits the dry land. And that can wash off, for instance, pollutants into water bodies and threaten water fall to increase the cost of cleaning the water as well or water treatment.

In summary, North Carolina faces large, this is just for the North Carolina section here, challenges in adapting to climate change lying at the coastline. Some level of sea-level rise is inevitable since I believe that even if the most extreme carbon dioxide (CO_2) reduction is about 80 percent by 2050. If we do achieve that type of reduction in emissions then globally we are still locked into a two and a half to three degree Fahrenheit global temperature rise which will cause some significant changes. More research on the impact of climate change on coastal development on fresh water development on fresh water supplies, flooding and agriculture is needed. Really one of the things that we discovered through during these reports is there is very little information available on this issue and part of that is just because the models are not yet able to go down to the state level the smaller regions. They can go down to the regional level but right now they have not yet been refined enough to go down to the smaller regional levels. Also, there just has not been as much interest in doing research on this and I think that they're starting to grow but definitely as a place that needs to be explored more.

In addition to adapting to some things that may be considered as adapting coastal management plans as well as habitat protection plans and emergency response plans to take into account these changes in the future may be an option, maybe useful as well. Are there any questions on that particular section? I have kind of like three components of this presentation so if there are any questions, I can answer those now. Yes.

Dr. Riggs: Not a question, but a comment. We are already at the upper levels of sea-level rise in northeastern North Carolina, we will not be there in 2100, we are there now and the impact is that there is a large group of people working on most of these problems in the State here. We have a very active research group going on and there will be several presentations later today and next session that will give some of that information.

Mr. Anderson: Great, great – I think possibly when we did this research and almost a year ago I think there was a lot that was being done but we hadn't seen the results of evidence of the research at that point.

The next section I wanted to focus on some of them have been forecast by a group called the McKinsey Group and they are a global management consulting firm that have done quite a bit of research by gathering together industry experts, large companies and academics to break down the many different components or many different ways in which greenhouse gas emissions can be reduced throughout various sectors of the economy. This first graph here is the Energy Information Administration forecast on emissions levels by the year 2030, so they are forecasting almost a 30 percent increase mostly driven by the growth of the U.S. economy and the growth and population and above average growth in buildings and appliances and the increase in coal fired power generation that is likely to be needed to essentially supply a mass of growth, approximately 30, it is actually from what I have read, 25-30 percent growth in energy demand by that time, that is business as usual. So without any extreme greenhouse gas reduction policies this graph I think is… Go ahead.

Representative Harrison: Could I get a clarification – is that 35 percent growth from 2005 levels or 1990 or what?

Mr. Anderson: Yes, that is 2007 I think that was 2005 levels actually for 20-30. So they forecast for 35 percent. Of course they don't take into account uncertain policies that have not been passed yet. So that took into account those policies that had already been enacted by that time. I think this part is interesting in that it reflects with regards to electricity consumption that is different components of U.S. post residential and industrial electricity consumption and how they have grown since 1977. So it is four decades from 1977 and you will notice that it's been actually reduction in safe heating, increasing space cooling and water heating and refrigeration has not grown much at all. And that also reflects the total consumption so regardless of population growth that really shows that there has been dramatic increases in efficiency particularly for refrigeration – we cut the actual per capita consumption for refrigeration by almost fifty percent. There have been great increases in energy efficiency to offset some of the growth and electricity consumption, however, when it comes to the other categories that now make up 43 percent of the total. That comprises all of the new electronic gadgets such as computers and plasma televisions and multiple televisions and other types of devices that have become comic throughout the U.S. and there is forecast that is going to continue to grow, there will be all sorts of new appliances and electronics here that is likely to be purchased by consumers. So really we have made tremendous advances when it comes to that – energy efficiency however, this growth of the other category is something that is somewhat concerning.

Now this next chart I am not sure if many of you have seen it, this is the chart that was compiled by the McKinsey Group and I think it quite interesting in the fact that it vindicates how many different and desperate areas of the economy could be addressed to reduce greenhouse gas emissions and that there is not just one single kind of silver bullet, there are many silver bb's, to steal someone else's quote. I think that one of the largest areas of reduction is actually at the right and this shows abatement cost, all of these little sections from fuel economy back to distributed solar TV – all are less than $50 per ton of CO_2. So they only went up to about what would be three gigatons of reduction and most of the bills that have appeared on the Senate floor are looking at about 4.5 gigatons or up to 5. That is what I think has been seen as necessary to really need the stabilization of three degrees in global temperatures. So this isn't going quite that far but yet it is quite telling in that it shows that that amount of the CO_2 reductions can be gained at negative margin cost and that is costs that are below zero. They will actually pay back for those industries that engage in mostly energy efficiency practices. Although not all of them are but again the largest contributor here is only 11 percent of the total and that would be putting carbon capture in sequestration on coal fired power plants and that actually falls into a fairly high level with regards to cost. Looks like about 50 to 60 dollars per ton.

The next slide just highlights the energy efficiency components and how much can be achieved through energy efficiency. Nearly 40 percent of the total reductions could be achieved through energy efficiency and negative marginal costs. Meaning that there would be no cost to society and perhaps an economic benefit. The interesting questions one might have is why these aren't being pursued already and I think for many of you, you may have heard some presentations on this issue of there's a number of market barriers to energy efficiency in the fact that in many cases the person who benefit from energy efficiency may not be the entity that pays for it or institutes it. For instance, a building – the person that built the building they have to have a lot higher expertise and it may cost them slightly more, though not much more, but they are very competitive in the building market and housing market. It might cost slightly more and yet the consumer that purchases the building may not pay enough more for the builder to feel like they are getting compensated appropriately. Therefore, the benefits really go the owner and not the builder and that is one of the main problems actually the main market barriers. There are many others as well but this is one of the main market barriers for energy efficiency. This chart also includes what is called hard wire and energy efficiency not consumer behavior and the significant amount can be achieved through behavioral conservation. However, that is not cleared at all in any of these estimates.

One of the other interesting components of energy efficiency is that a number of states, Minnesota for example, has an energy efficiency requirement, a standard for their utilities, particularly it could sell energy for example as required to meet 1.5 percent of their total energy demand each year through energy efficiency. Their growth actually in energy demand is around 1.5 percent, so that means they are meeting almost all growth and energy through energy efficiency. So they just don't need to actually build new generations. That is the same assessment that McKinsey found was that almost all growth can be met through energy efficiency measures, mainly in buildings. That in and of itself is important in that than the other types of operatives if you can actually stop the growth in energy

demand and then there can be some fuel shifting or displacement of certain types of positive carbon intensive fuels to non carbon intensive fuels that take a significant chunk of the problem out of the way. However, I think it is important to know that keeping energy efficiency targets will take pretty aggressive policy measures to overcome a number of the market barriers and some of those also deal with long pay back on cost as well. So what types of return do investors receive on investing in energy efficiency? There are a lot of different policy approaches that different states have taken such as Delaware, which has sustainable energy utility which the utility itself actually sells since we use this energy efficiency instead of just using it as a supplemental type of demand reduction resource uses it as a supply resource. So it naturally competes on the market instead of, for instance, building new generation you can build new energy efficiency which reduces the need for new generations which is potentially the same as building a new generation. So there are actually quite a few different policies which have been explored straight up policies across the U.S. to remedy some of the market variables.

Now I am going to go into the federal versus the state policy conflict with regards to greenhouse gas reduction. First off, I just wanted to present some of the arguments that have been presented for the federal folks. I know that a number of states are interested in the federal approach as well. However, the pre-exemption issue and the ability for them to set their own levels above a certain baseline have been perceived as quite important. Some of those arguments including fuel emission standards should be federal since these laws are subject to federal regulations and pre-emption with the exception of California which can set its own emissions standard and apparently has been able to do that. I will speak to that issue a bit later. In addition, economists argue that a national market for carbon credits will be the most efficient way for carbon emission reductions to be reached. Since the larger the market, the less inefficiency there supposedly is and also it allows those players within various sectors where it may be quite expensive to be able to pursue the purchase of credits and those that are most efficient and able to reduce their carbon emissions at least cost and then sell those credits. In creating a larger market just allows a larger number of players which apparently reduce cost for the economists.

In addition, it allows a level playing field for citizens with businesses and that argument is that a password for various state regulations makes it very challenging and much more expensive for businesses to play in this arena and also addresses the need for coherent and comprehensive national and international actions. With regard to the state side of the argument most greenhouse gas and emission reductions come at the state level and under the jurisdiction of state laws currently. In addition states generally are best prepared to understand which policies are most effective and have varied resources, different states obviously have different types of renewable resources, different types of carbon rich resources and are best prepared to be enlarged and how they can utilize those resources to achieve goals. The current Clean Air Act while the Environmental Protection Agency (EPA) does administer it, it allows the state or essentially gives the power to the state to meet the goals in what ways they see fit. So that is another argument. These are just some of the different policy situations that have been looked at or whether more of the power is given or centered around the federal administration versus state administration. Federal law could, for instance set emissions levels and deadlines allowing states to design the necessary policies. Federal law could regulate sectors equally and have a rate of reduction at a rate of

six. That would mean that the states had little ability and little flexibility but had to just meet different sectored reductions. That would mean they would not have the ability to use carbon offsets or carbon sequestration or a combination of those options which some analyst have seen as being the most likely. However, recent federal climate bills have not really provided much for the states with regards to implementation as it really left it up to EPA for administering. So it would be up to EPA to decide how they would administer that. In addition, the things that have been introduced in Congress which are really cap and trade focused kind of favor the federal government when it comes to distribution on the sells of credit. So it could be billions and billions of dollars of resources gathered through the sale of these credits and whether the state gets the money and use it for their implementation or whether the federal government gets it is a definitely a sticking point there.

How much time do I have? I will skip this section here and we will just go into the states. I was going to cover a little bit about the carbon tax and cap and trade but…

Representative Harrison: That might be good actually.

Mr. Anderson: Would you guys like to hear that? OK. It is really just a short summary since I think carbon tax has been discussed but the details of it really haven't been explored much and it has been seen as a politically unfeasible approach since it seems that all are adverse to new taxes and there are many strong powerful players that seem to be against any type of carbon tax. So just as to what it is, it is a direct fee on CO_2 emissions which is raised over time until the goal is reached. So the producer would be taxed, for instance, the coal fired powered plant, or the natural gas fired powered plant or any power plants for that matter that generates CO_2 would be taxed and then they would in turn raise their rates to recoup that fuel increase and consumer would pay increased prices. It is widely supported by economists, perceived as easy to understand and transparent and currently operating in five countries and two U.S. cities, one being Boulder, CO and the countries are Finland, Sweden, Great Brittan, New Zealand, and Canada. Both Quebec and British Columbia have implemented some type of carbon tax. San Francisco has also implemented one as has (inaudible) recently has as well.

So with regards to the pros and cons for both the carbon tax and a cap and trade there are a number of pros and cons and I think that it comes down to there are different ways to design any program and I think you can design a good cap and trade program or a bad cap and trade program and certainly you can design a good carbon tax and a bad carbon tax, one that is ineffective. As to the pros it can be seen as a revenue neutral carbon tax, that is one of the options which means that taxes in other sectors of society would be reduced so there would be no net amount of money for the government to utilize or use in any other way. Potentially it could be used to reduce, for instance, sales tax which is seen as a regressive tax. So there could be other taxes maybe income tax or property that could be reduced and creating a revenue neutral tax. In fact most economists do support it. If you're going to collect taxes you should tax those things that you want to discourage and not tax the things you want to encourage. So maybe it could be used to create a more efficient economic structure within the U.S.. If there is some revenue that is kept it could be used for carbon emission reductions incentives, slow increase in the tax could allow for transitional investment adjustment and development of new technologies. The revenue recycling issue

is really just returning that money to the economy in other ways. That would be the same as revenue neutral carbon tax or for instance taking that money and using it as an incentive to new technologies. For instance renewable energy or low carbon emission carbon capture and the like. The cons number of cap tax are politically unfavorable – there is an unpredictable outcome and it is very difficult to know what level of tax is needed to get the reduction in carbon emissions that is necessary. So when you perceive that when you wanted 80 percent reduction in carbon emissions by 2050 what level of tax do you need to get that and do we have enough time or enough ability to really ramp it up to that level and what would be the repercussions of that. In addition, revenue to carbon taxation will go to other governmental areas and that could cause problems. A lot of folks probably don't want the government collecting more money and spending it. It could burden low income families, some consider it a regressive tax that could distort the economy to some extent and could slow the economy.

Cap and trade tax in comparison is an economy wide emissions cap. Credits are an allotted option to larger carbon emitters obviously all that emit carbon it would be very challenging to monitor, very small emitter, so it would be just the largest that would be monitored. The emitters can sell or buy carbon credits on the market. The cap can be reduced over time to reach emissions goals. Those emitters with the lowest costs reduce their emissions would act first and be able to sell those credits to those that will take longer to reduce and have higher cost for reduction. As the carbon price increases, reduction becomes more attractive than credit purchases.

One of the issues with the cap and trade is the complexity as to the requirement for somewhat complex enforcement as well but the pros have been cited as it will guarantee that emissions reductions target will be met. It is much easier to set an 80 percent reduction for instance, then monitor that and restrict the credits as time goes on to meet that reduction. In addition, banking, auctioning and safety valves could help reduce price fluctuations which can be a problem. Permit auctioning provides revenues that can be recycled back into the economy through clean energy incentives or to ease the burden in lower income brackets. Again that could be also taken as a negative and that means that the government is taking in money that is then spent in various ways and that there obviously could be a lot of special interests that may be able to have access to that money and may not be the most efficient use.

In addition to auctioning, revenue recycling can increase economic efficiency through auctioning those credits and then re-investing that money as mentioned earlier. Some of the cons, large fluctuations and unpredictability in permit prices can make it difficult to decide on some of the best strategies. I don't know if any of you pay attention to the carbon market but there are dramatic fluctuations and it makes it a little bit more challenging for businesses to know what they need to do and how they need to plan if they are unable to know how much their emissions are going to cost. It is also high complexity to the trading regime and difficulties with enforcement. Allocated credits are challenging and could provide windfall profits for polluters. In Europe for example, they allocated too many credits and those polluters eventually made millions and millions of dollars by selling their actual credits as offsets to other areas of the economy that needed them. So that was not the intent to give one windfall profits to energy companies or coal burning power plants, so

that is a problem. The comprehensive program would have to be developed to cross many sectors, complicating the trading system, and trading regimes may be less efficient than carbon taxes. According to economists, again there is a little bit more complexity involved. Again the low income families may suffer, however if there are revenues that are gained possibly auctioning could be invested in helping low income families stay through likely investments.

I'll just take a few more minutes for a quick summary of state climate policies. This is just a quick glance of some of the various policies that states have looked at. One of the things I wanted to note that there has been so much focus on the cap and trade and as well as possibly carbon taxes that I think as you saw from the earlier chart that I presented that it's immense how many different disparate little areas need to be looked at or be assessed. Many of them are a lower negative cost and it is possible that these cap and trade schemes may not efficiently access those. Many states are looking at a whole host or combination of different policies and this is just a list of a few here. Some of the policy design issues to consider are what portion or carbon emissions will come from cap and trade or carbon tax versus say renewable portfolio standards, energy efficiency and other mechanisms. California, for example, in its breakdown expects cap and trade to contribute less than 40% to overhaul greenhouse gas reductions. So they are looking at their many, many other programs, energy efficiency programs, renewable portfolio standards (REPS), renewable fuel standards and the like to reach the other 60% and also complement their cap and trade program. Carbon caps do not reach all sectors equally, for instance, the high carbon price of $150 per ton which is much higher than any reasonable. I think economists have even forecast to be possible would be needed to be an incentive to use solar energy at this time. Other incentives that you may wish to at since it is different costs for every different sector and while looking at the lowest cost, it might get the lowest cost first, the problem is that if carbon reduction the 80 percent is to be met, I think most feel that many different options needs to be addressed at the same time. Not 20-30 years from now as costs decrease.

In addition most of you envision some signals are necessary for the private sector to plan accordingly. California was the first to introduce a mandatory carbon cap and many were modeled after this so it has been a little bit of time there. Caps to 1990 levels by 2020 and 80 percent below by 2050, it is an enforceable emissions cap and requires reporting and monitoring to enforce compliance. That is really one of the critical elements of any greenhouse gas reduction program is to have monitoring and enforcement and this is all taken care of through their State Air Quality Board. It is a massive program - they are hiring 120-140 full time staff just to administer it. The early action plans are plans that they actually are implementing by 2009 as a result of this bill. They include greenhouse gas emissions, control regulations for mobile sources including the low carbon fuel standard, there is also the land fill methane capture which is requiring all landfills to capture methane. Energy efficiency building requirements – they are looking at having potentially what is called net zero buildings by 2020. So they are requiring that all buildings built generate as much energy as they consume which is a pretty large step. That would be for all large buildings by 2020 and then by 2025 they would be looking at that for residential. Other measures include increased use of CFL bulbs, increased building insulation standards, increases in demand-side management, all of which involve many departments across all government.

That is just a list of those states that have actual emissions targets, seven states now have implemented mandatory emission targets with just Massachusetts and Connecticut introducing and passing bills this year. Most of those are looking at meeting about an 80 percent reduction below 2005 levels by the year 2050. This is just a summary of earlier action in 2007: Hawaii, Minnesota, Washington, and New Jersey and some of these also are participating in regional greenhouse gas trading plans such as New Jersey. It is actually a part of a mandatory regional greenhouse gas reduction initiative which nine states are participating in the northeast and they will be trading among all of those states to reach a ten percent reduction by the year 2020 or 2015 I believe it is for all of those nine states. These are just a few of the other California climate policies that they are implementing. Very significant and aggressive they are pursuing this as very challenging. From what I have heard this is a very huge challenge but they really are pursuing it aggressively. This is just an example with regard to energy efficiency and California has been aggressive since the mid 70's with regards to energy efficiency policy and you will notice that relative to the rest of the U.S. the growth in per capita energy consumption has essentially been stable or zero since 1976 has increased by about one-third for the rest of the U.S.. That had a net savings of about $1,000 a family per year. There are significant gains to be had through energy efficiency.

This just shows those states that are following the California greenhouse gas vehicle emission standards. So states can either choose the federal standard or the California standard. California is requiring a 30 percent reduction in the emissions of CO_2 in their state that is currently under consideration. The EPA denied that and is certainly being pursued in the courts. I believe they will probably at this point allow California to follow that. These are the states actually 17 are poised to adopt that standard which means that any car that gets sold will need to have this 30 percent reduction in greenhouse gas emissions by 2018 approximately.

This is a brand new bill just passed in September, a large component of emission comes from transportation and not just due to the fact that vehicles are inefficient but because of the line of communities require long distance driving and require individuals to consume a lot more in energy than they normally would in a community where they have easy access to work, school and recreational areas. SB375 adopted in September requires that each metropolitan planning organization adopt a sustainable community strategy as part of its regional transportation plan and requires it to meet greenhouse gas emissions reduction goals for automobiles and light trucks in the region. It is going to require that they do some types of transportation design whether that be through mass transit, and other types of transit implementation as well as redesigning communities so that there is much better access to the areas where the individuals need to travel.

Finally, I'll stop with this last one here. Carbon sequestration is another area where there are quite a bit of options for reducing greenhouse or at least countering greenhouse gas emissions and it is one of the less expensive options as well. Washington has introduced a bill which creates the forestry carbon offset program and establishes voluntary allowances and accounting systems for carbon storage within the forestry industry. Other states are also considering this and actually ten percent of U.S. carbon emissions are offset by the

forestry sector. There is a significant amount with re-forestation and also agricultural practices there is a significant amount of carbon that can be stored within the soil through a change in agricultural practices that are not very challenging to implement and they can also increase soil productivity as well. A number of states are looking at that. Finally, some considerations – energy efficiency is the least cost greenhouse gas reduction approach. Visible sustained signals are required so that the market can incorporate less costly emission reductions. A coordinated approach is needed for tackling the many abatement options and verification and enforcement are essential especially for businesses to realize what their cost will be and to know that they are playing in a level playing field. There are also significant infrastructure needs that may not be covered by these initial policies, so building transmission and also new types of smart grid issues which will allow consumers and the utilities to really access and pass energy efficiency and distribute energy potential.

We have a number of publications, we do policy tracking, we have a data base and I really raced through this, I probably could have spent an hour on each topic, just on allocating credits that is a topic is quite extensive as well. I am happy to answer any questions in the future and you can contact me by either e-mail or by calling me as well. We do have a tremendous amount of resources on our website which I've lifted there including our legislative tracking data base and a host of publications. Thanks are there any questions?

Representative Harrison: You sort of eluded to it, but for states that have in place on cap and trade programs or at least have a carbon cap program in place are they in a better position than federal cap and trade policies are adopting at the state level?

Mr. Anderson: Yes – I would say that those states that already understand the implementation and how the markets will work and have operating markets for instance, the northeast regional greenhouse gas initiative and they already have an operating market. It is uncertain if the cap and trade is adopted at the federal level whether they will adopt what is already existing and then just expand a model of what is already out there instead of redrawing everything to encompass those states that are not participating. They are already in operation – there is a Midwestern regional cap and trade, there is a Western Governor's Association and then the Western Climate Initiative and then there is also the northeast. It is uncertain as to how that will work but I think that it will give those states a leg up in that they will already understand how to implement this and they may be able to jump on more quickly. The other advantage they may have is they are already reaching goals they may be able to sell within the Regional Greenhouse Gas Initiative**. These carbon credits are quite valuable and other states are actually funding programs to sell these credits. Every year they get a certain amount of allotment and they can sell those credits. A number of states are able to sell those and then they are actually funding some of their energy efficiency programs. So the economics of the situation is that those states that have already made some progress are likely to be able to gain more when a federal law passes.**

Representative Harrison: Thanks and just one more on the efficiency requirements that Minnesota has one and a half percent each year and then I think Vermont has one as well. How are those implemented, is it the Utilities Commission or…?

Mr. Anderson: Yes, in Minnesota it is required that to potentially sell energy which is the main provider in Minnesota it is required to meet this one and a half percent per year. Initially they just had to spend a certain amount of money but the Legislature wanted to make sure that they were investing it efficiently. So then they changed the requirement to be one and a half percent per year increase in energy efficiency. The Minnesota Public Utlities Commission (PUC) oversees that to some extent, to the extent that they make sure that the data reflects that but the implementation is completely overseen by utilities.

Dr. Eggers: I think it is great that California has done SB375. The metropolitan planning in North Carolina could certainly benefit from looking at that. One of the things that keep coming up in my conversations with planners is that they will say we can have great plans but what's really shaping our growth is the North Carolina Department of Transportation (DOT) long range planning and of course the manifesting of those long range plans for road widening and beltway construction and all of that. And that actually undermines local government plans because it is such a strong force in where developments are actually located and our DOT right now uses existing growth patterns just projected into the future. In fact the conversations I've had they don't call it a straw pattern they say we just project what's going on now and into the future and we build roads for that which is a straw pattern. Are there any states that actually have language that directly addresses DOT long range planning and long range road widening projects and things and what.

Mr. Anderson: I definitely think the California language, the way that's designed, it requires those regional plans and taken into account and that encompasses the DOT from what I understand. So that there would be a collaborative process there that they don't … for instance I am sure there are safety issues and making sure that they get fire engines and that sort of thing to the places where they need to get; but from what I understand they are collaborating on that as well. But that is a huge issue and I am sure a lot of the augment has been that well it's a free market and this is the way our communities are because of free market. In fact it really came down to the way the planning and zoning was created. Our developments have been created by zoning not by necessarily the free market. So zoning was created before the communities grew. I think that yes restructuring the zoning requirements is probably one of the largest, the best ways to contribute and first allowing them to and then possibly restructuring the way the DOT works but obviously that takes the state and federal actions to some extent who they are funded through. There may be stipulations that the federal government will not fund certain road projects and must comply with certain requirement on the federal side.

Representative Harrison: I don't want to sort change our other speakers but we'll take one more question – Ivan.

Mr. Urlaub: I had a chance in October when I was in California to have lunch with the person that's in charge of SB375 planning for San Diego area through (inaudible). It was pretty intriguing just how well integrated their look at it is of transportation development, carbon energy, water. I am curious, are other states already talking about it or are you aware of any other states that are talking about this more integrated planning where they bring you energy and these other resources and carbon together?

Mr. Anderson: I know that Minnesota is quite aggressive as well about their climate demand and they have been talking about the smart growth issue for a long time and its growing energy as has Colorado. There hasn't been, to my knowledge, a lot of activity in the Legislature trying to make a connection and restructure the planning process. Besides California, I think there have been some bills introduced but I can easily find that information for you if you like. But off the top of my head I don't have, I know that California was the first one to actually enact any bill like that.

Representative Harrison: Thank you Mr. Anderson and I think you said you would be around for a little while if anyone had additional questions. Mr. Smith you are up next to introduce our next speaker and I neglected to thank our sergeant-at-arms. We have John Brandon, Dusty Rhoades and David Shearon and Charles Williams from the House and Charles Marsalis, Ernie Sherrell and Ron Spann from the Senate. Thank you all. I'm sorry I forgot to recognize Secretary Ross as our distinguished guest today. Thank you.

Dr. Smith: Good morning I just wanted to briefly introduce the next speaker- it is great to be back after the historic election and I think there is a lot of opportunities now that will unfold as we move forward. Our organization, SACE has for the last couple of years been paralleling very closely with Tom Peterson's group at the Center for Climate Strategies (CCS) in a number of southeastern states including North Carolina. And as part of that process we wanted to take a very focused look at building a road map for getting significant reductions in global warming pollution in the state of North Carolina very specifically and come up with very key elements, what we call cornerstones, to really get those policies moving and so this report each of you should have gotten this in the mail about six weeks ago. Hopefully you have and if you haven't it is available on our website at cleanenergy.org and you can certainly talk to me or John about getting a copy. John Wilson is our Director of Research, he received his undergraduate degree from Rice University in Physics and History and then a Master's in Environment and Economics from the Harvard Kennedy School of Government. He has been working on this project with us as well as looking at other southeastern states and he is going to outline for you some of the specifics findings that we came up with that will parallel some of the things that we've been talking about and then I hope at the end we will be able to dig into more specific discussions about some policy recommendations that we may want to look at in the up coming year. John.

Mr. John D. Wilson: Good morning and thank you very much Chair Harrison, Mr. Givens and members of the Commission. The report we put together is a comprehensive look at solutions to global warming, that is our focus and the first thing we wanted to do was simply to frame up kind of conceptually what these are. If you've tried to read the 450 page report from CAPAG, it is a really comprehensive analysis and we drew very heavily on it. But what we wanted to do was also present this in a way that would help people remember and stay focused on the key solutions to global warming and those are energy efficiency, clean energy, pollution capture and long range planning. Our goal in this report was to outline how we could get to a 60 percent reduction in global warming pollution by 2030 and that means going from about 180 million tons of global warming pollution right now. Without action we would be going up to 280 million and with action we think we can get down to 65 million. And the kind of solutions we are putting forward here today which are in many respects represented in the work of CCS process the CAPAG report are things that

are either technologically feasible today or things that with aggressive effort can be engineered to be technologically feasible, in other words, the things that are available in the market but may be require some innovation in terms of how they could be delivered cost effectively. Not really relying on scientific breakthroughs or any kind of thing like that. The other thing I would like to point out about this project is that today the average residence of North Carolina is on average responsible for about 20 tons of global warming pollution emissions per year. When I think about my four year old son emitting 20 tons of global warming pollution it is kind of a staggering thought. Of course that is an average so it may be not my four year olds responsibility. If we leave that unchecked and we continue with business as usual that number would go from about 2020 to about 23 tons per person. In contrast what we are proposing as a separate number of actions that would reduce that to six tons per person. Which still to me sounds like an awful lot but it would be a staggering and monumental change, so I want to emphasize that what we are talking about is a very large transformation and no one should think that this is going to be a simple process. Yet it is very doable and I think some of the material in the previous presentation illuminates that sort of the silver bb's approach is absolutely correct and we try to flip those bb's into these four compartments of the different cornerstones.

To give you a little bit of comparison between the two reports for the CAPAG report go back to 1990 and in contrast we started ours with 2000. We have a slightly different inventory in forecast. We use some updated data that were available at the time we got started on our technological analysis in comparison to some of the little bit older data because of the different start time and the different models that were used in the CAPAG report. You see some differences in the numbers, we also in addition to updating a lot of the data and the forecast data we had some technical adjustments based on more recent policy and scientific findings that resulted in somewhat different trajectory. And also we are urging somewhat more rapid and somewhat more expansive policies in our report than was agreed to by the CAPAG report. So we came out with about a 30 percent reduction versus 2000 in comparison to the 24 percent reduction and this is comparing 2020. We went out to 2030 as I showed you before so in the CAPAG only went out to 2020. This is just kind of trying to benchmark those two so that those who are deeply familiar with that report will have a sense that this is very similar to the exhaustive report that was done for the State but a little bit different in some respects.

The highest priority recommendation we came out with and this is energy efficiency and that actually is responsible for about 50 percent of the potential emission reduction that we project by 2030. And by energy efficiency we mean those are the things that might immediately come to mind like, for instance, compact fluorescent light bulbs and energy star appliances, we are also talking about major building renovations, improvements in energy efficiency for the industrial and commercial sectors. We are talking about energy recycling which is sometimes known as combined heat and power or waste heat recovery and we are also talking about fuel economy in the transportation sector. This is a really critical area and it is important to get going on this very quickly because if we delay action, we really do miss opportunities and I think that was discussed somewhat in the previous presentation.

Just to kind of recap on energy recycling – this is one of the modes of this where instead of allowing a lot of waste heat to go out from a commercial, industrial or power generation process, you capture that waste heat and with no added pollution to the air you can generate additional steam and electricity. It is a really powerful tool for cutting global warming pollution and it is one that is currently across the southeast vastly underused. We are working on an initiative at our organization and they are looking for partners to develop a more extensive program to identify exactly what's holding this technology up in the southeast and overcome those barriers.

More conventional energy efficiency when you think of utilities or state agencies or individuals going out and investing and using and wasting less energy. It is by far the least expensive strategy to address our energy needs for the future. In comparison, this is a study done by Lazard which is one of the national consulting firms that benchmarks energy costs and it estimates that typical energy costs in investments in new generation are now costing, really in the range of 8-20 cents per kilowatt hour for most of those investments that are being made. And in comparison, energy efficiency is really down in the range of 2-4 cents per kilowatt hour. One of the critical things to understand is that this is not the case if you make a half hearted effort. This is a very interesting study that was recently released for the American Council for Energy Efficiency Economy by Synapse Energy Economics and you can see there on the chart that the (you probably can't see it that carefully) but what I can tell you is that there are a number of utilities that are profiled there. Each one of these it shows that as their energy efficiency investment grows, as they achieve greater and greater results the cost goes down. One of the things we are often tempted to do is think of energy efficiency as sort of in the low hanging fruit metaphor. Taking my kids out apple picking and they are the ones that get the low hanging fruit. And while I can tell you that it is a lot of fun to get the low hanging fruit it is not actually the most efficient way to get fruit off a tree. The way to get fruit off a tree is to bring out some skilled folks who are good at it with ladders and tools and strip the whole tree bare and move on to the next one. And that is what utilities across the country are finding with energy efficiency is that the more aggressive they are, the cheaper it gets. And this should not be a surprise to anybody – this is an economy of scale arguments that is very frequently applied in business. But for some reason we tend to think that when we see those charts about some of the costs being very low and others being high that we can sort of start with the easy ones and then move on to the more expensive ones and that is the way we ought to progress. In reality, the way to get it all as cheaply as possible is to go after everything at once, as fast as possible, and as cheaply as possible. Thinking in that way is very critical and so one of the policies that I think we would like to encourage would be a State energy efficiency resource standard or a standard that the state says such as the one that was discussed earlier from Minnesota of going aggressively after energy efficiency. We have a little hint of one that is often recognized nationally is that in the current renewable energy standard, but it is not nearly aggressive enough and it is not nearly as direct and focused on the issues.

The other issue that often comes up with energy efficiency is a challenge in thinking about what energy efficiency is and I've got a highlighted case that I'm looking at – Florida here compared to the southeast in the red dots there. You can see that the southeast in general, the large red dot near the zeros is every state in the southeast except for Florida and basically there is almost no energy efficiency investment in the southeast. In comparison,

California is all where you would expect it would be, way over on the right. California is a national leader on energy savings but in terms of capacity which is how much power is needed at peak periods is actually not California it's the Great Plains. And that is very much reflective of policy decisions that are made at the state level as to what direction we want to go. This is not a circumstance of geography it is what decisions have been made by political leaders and policy makers. So this Commission has an enormous opportunity to have that kind of impact. In Florida the decision in their very deliberate decisions that have been made for understandable reasons, not reasons that I would necessarily agree with, but understandable reasons that have lead to the focus on avoiding capacity which means fewer power plants get built, but not less energy use. And so the energy efficiency results is that the utilities spend less money investing in power plants but the customers are still buying almost as much energy as they would have otherwise and therefore their bills don't go down so there is not the savings for consumers. This is a fairly complicated argument that we could get into in more detail but the point being it is not all energy efficiency is created equal and it takes a focus on energy savings and global warming pollution reductions to make sure that it will have the benefits that we want.

How do we achieve that? First, as I mentioned one of the ways to do it is with state policies that can reduce energy use in homes, buildings and factories. There are also policies we can use to address the energy recycling issue specifically and finally, fuel economy, I haven't talked a lot about that. We are very supportive of the states adopting the California Clean Cars Standard, but ultimately I think that it is important to understand that this is an issue where we would require both a lot of better engineering of vehicles and also the power system so that we can move to things like plug in hybrid electric vehicles or even electric only vehicles which will drastically reduce global warming pollution. And second, to recognize that the federal government is always going to have a very strong leadership role in this area. This is a contrast area regardless of what happens with the federal government level it is going to be the state Utilities Commission and the State Legislature that is going to drive the shape and direction of programs related to energy efficiency investment in the state. But when you're talking about the fuel economy portion that is going to be a much more federal leadership area with the state playing a sort of secondary role, and so understanding that the state, regardless of what happens at the federal government level. It's going to have a huge role to play and it's essential for this Commission as it moves forward as we start to hear a lot about discussion at the federal level about different policies. Another thing about energy efficiency that is really important to understand is that it really helps us to achieve other goals that we might have with the global warming strategy. Less electricity demand means that it is easier to reach renewable energy goals. In this graph you can see outlined in red the energy efficiency component of the electricity generation forecast that we have for the state of North Carolina. If we don't take any action, we believe that energy generation would go from about 130 million megawatt hours all the way up to over 200. But with this program we would actually only need to generate from central power plants a little bit less energy than we currently do right now. We would actually have a decrease in central power plant generation and an increase in other ways of meeting our energy demand. So we would be shifting from sort of a 20th century approach of thinking of how much electricity can we sort of push out and instead think about it as energy services. How can we meet people's needs and desires with energy in the most efficient manner possible?

The other thing that is really exciting about this kind of switch is that it is actually a lower cost approach overall. The energy efficiency approach and the reduced risk of fuel cost by means that this would be a lower cost approach to generating our electricity needs than the business as usual approach. And finally, it is also very important because it saves water resources which are so critical to the State. The less energy we're generating in coal and nuclear and gas plants, the less water we're using at those facilities and therefore it makes it available for both other needs of people and also for environmental needs.

Similarly there is additional sort of side effect of benefits that we will get into in terms of energy recycling and also reducing fuel demands and together this means that energy efficiency strategies make the whole package work a better if they are aggressively perused. That is one of the reason that it is so critical that we not delay or roll these programs out gradually but that we go after them aggressively in a manner that is very sustainable, that we can count on these programs delivering results year after year after year in greater numbers.

The second cornerstone as I mentioned is clean energy and in terms of electricity this is sort of the mix that we think is feasible for North Carolina to build out over the next two decades. Specifically in terms of wind, we are looking at both ridge top winds where we have about 11 million megawatt hour potential at low impact site from the ridge top and then a huge amount of potential in off-shore wind. Really from the point of view of the future of the state a limitless potential and this has been an area that North Carolina I think has been slower to recognize than even as other states in the southeast like South Carolina and Georgia. They have a site off the coast of Georgia where the state and federal government are cooperating to sort of initiate the permitting process in that region. So we are seeing steps in the southeast that are positive steps (inaudible) really enormous resource. We think that it is certainly feasible to see a total of 20 million megawatt hours from basically zero today to generation by 2030 and that would only represent less than 10 percent of the feasible generation. In other words, to places where any sane person might think it would be reasonable to put a wind turbine once in five percent of the theoretical potential. We sort of carved out all of the bad sites there and it is still an insignificant portion of those.

Mr. Everett: Can I ask you a question about that. In your original graph kind of where you want to get to ….

Mr. Wilson: This one here?

Mr. Everett: Well really back to the original reduction. So what happens if in fact North Carolina doesn't take the steps to make those wind resources available? Do you have enough capability to modify that curve and say we don't do this it changes its projection to X?

Mr. Wilson: Yes it is interesting that you ask that. We have had actually this exact same conversation with many of our allied groups as we formulated this report because to take a different approach, let me skip forward here actually to the full electricity generation graph, right here. For instance one of the assumptions we made in this report was that we would

hold nuclear power steady across this whole report and one of the things that some of our allies said is look what if we wanted to phase out nuclear power completely and the existing power plants would be shut down. Well the answer is you need to make up for that with some other strategy and we think we've maximized the potential of clean energy and energy efficiency in this plan so you would have to look to some of the other resources to fill that gap in the interim. In the long run there are other things that we can be doing as we continue to build these out. So we put down a very aggressive build out schedule for wind energy based on trends in the energy industry in terms of how quickly and new hybrid technology can be adopted and brought on. There is a lot of, I will not say precision thinking behind this, because forecast is inherently wrong, there is no way to be correct about a forecast of any kind whether it is business as usual or the adoption of policies. But that said it is better to be wrong smart than wrong dumb and what we did was we took a very informed look at how the different technologies in the energy sector had been adopted, their adoption rates and applied that to the wind power sector to say this is what would be a reasonable build out rate for North Carolina.

Mr. Everett: I would just tell you we put out a request for proposals for wind energy at the utility-scale and we didn't get any proposals. We did get one that was infeasible in fact the project could not go forward because of hurdles that it faced and so I just wondered in looking forward whether 2015 or 30 and you project some large increment in wind in North Carolina. I know it is feasible in terms of the wind energy in there but currently we don't see anybody bringing us proposed to do, the ones that do come are very cost prohibitive or I guess in the third case, they can't get a permit to do it.

Mr. Wilson: Yes and we've heard that concern from your company and others and we've actually talked to the wind developers and what they've told us privately is the RFP process was not a good match for the way they develop projects. And we are aware of at least two projects that are currently being developed in western North Carolina. I don't know the specifics of them but they are going methodically through the first stage of the process which is to talk to the land owners first. They would really rather talk to the land owners first and get their buy in and then began to go public with the project and start negotiating with the utility and with public permitting issues. The idea that they would sort of submit to a RFP when they don't have the buy in from the land owners and the awareness of the community I think would concern them in terms of development process.

That said what we've got in here is the big increment in 2020. We see most of that coming on line in the latter half of the decade. I think the initial projects will be developed by 2015 but really I think that most of that is coming on line in 2020 and what we projected there was primarily ridge top wind in the early phases but by the end of the decade an off-shore wind development. Again, that is a very aggressive schedule I would agree that's going to take policy leadership from the state and if we don't have that policy leadership it is not going to happen because developing off-shore wind requires coordination of offshore permitting it requires transmission, it requires utility buy-in, requires involvement of coastal communities. All of those things need to mesh together. That is not going to happen just sort of willy-nilly it is going to take integrated leadership from the top to make that happen but it can be done it is not infeasible.

Dr. Smith: I think that in response to George's question the other big unknown is that the Minerals Management Service is still working out the actual off-shore permitting and rules. So a lot of the off-shore potential is not going to bid in the short run it is going to be coming in the next couple years as those rules for off-shore wind are further refined and then there is this outstanding questions about the ridge law that ultimately needs to be resolved here in North Carolina about the ability to in a sensitive way to develop certain areas in western North Carolina where you can tap into some potential, again requiring state leadership. Those are issues that I think are all sort of holding back this but I feel like they will be overcome in the short run.

Mr. Wilson: This is fundamentally the reason why we named the report exactly what we did calling it cornerstones. We are not saying this is the exact outcome in 2030 but we predict it will happen with certainty. I mean that would be crazy. These are opportunities for the state to change the way of its economy and how it relies on energy for the future. And if each of these four opportunities are taken and built on, exactly how it will evolve, exactly how the Legislature will respond to this and put it into action is out of our organization's hands to a large extinct. But we think this is directionally and helpful to see how these things fit together and that has been one of the major things we've tried to do in this plan.

Hydro-electric is another area that is of a lot of interest. We are projecting a modest increase potential for hydro-electric with basically very low impact facilities. This would involve shifting again the paradigm of electricity generation from central generation to a more distributed generation approach. And as an example, in Denmark over 50 percent I believe of the electricity that is used in Denmark is generated from distributed generation sources, combined heat and power and wind being the two major components of that in that country. In contrast well over 90 percent of our energy in this country is generated at central generating stations. This is a very different approach it requires a different way of thinking, a different way of operating the entire electric system. Again not a trivial thing that can be done overnight, but requires deliberative planning and execution.

Bio-power is an area where we see really the most rapid potential near term impact on clean energy resources. What we are talking here about agricultural and wood ways being the initial sector that you would draw from and also growing energy crops which happens to be very well on land that is poorly suited for food crops. So this would be the area we see moving most rapidly in the near term and a huge expansion of this.

Solar energy is an area that is really evolving – at the time we put together our plan there were not a lot of details forecast as to how much solar energy could be available in the southeast. Yet we're seeing both Duke Energy and Progress Energy putting out pilot utility projects both at the utility scale and we are also seeing a lot of small scale homes and this is being driven by again state policy, the REPS law. Solar hot water is a cost effective area and we're seeing a lot of rapid growth there. Yet nevertheless, we are seeing the customer's base problem – the recent report that tracks net metering rules, for instance, around the country gave North Carolina an "F" in this area compared to other states. In contrast, I think we got a B on the interconnection standards that have been recently overhauled. There are a lot of details there and there are others here who are better suited

than I to get into those matters but this is an area where we really need to be looking very carefully at how the whole system works, the rules, the rates, etc.

In terms of fuel – we looked at regionally produced bio-fuels and we think that realistically we can get to 25 to 30 percent of demand. But that really depends again on meeting the efficiency targets. We've got to get much more efficient vehicles if we are going to get to 25 or 30 percent of fuels from regionally produced bio-fuels. We believe that bio-diesel and cellulose ethanol would be the key pathways to that solution.

The next cornerstone is pollution capture – I am going to start out with geologic. This is the one that probably comes to mind first for many people here and we actually looked at this and we were able to integrate several different reports and come up with a cost estimate. Again this is one where efficiency and clean energy makes this possible. If we can reduce the contribution of coal to the overall energy mix substantially, then we can keep this cost down to about 800 million dollars per year to run a carbon capture and storage system for the state of North Carolina. This would be less than one cent per kilowatt hour of generated electricity in the state. So that would be a really manageable cost we believe and sort of a component of the solution that we believe is necessary to make the whole system work. And that goes back to Dr. Everett's question a little earlier.

So integrated together this is sort of how the whole electricity system works and we have already kind of gone through this so I will just pass on by this. We think this would be a responsible direction to head in terms of our electricity usage. The other aspect of pollution capture is landscaping pollution capture and here what we are talking about is across landscape, agricultural forest and even urban areas. I think urban areas get a lot less attention. But what we were looking was strategies to achieve a 20 percent increase in carbon storage and soil. And this would take us back no where near those historic levels of carbon that were in the landscapes in sort of pre-European settlement era but it would be a substantial increase. An improved management practices in all three of those sectors will go along toward doing that. One of the technologies we highlighted is biochar and I believe there has been some presentations to this Commission on that so I will not go into a lot of detail. That is just an example of the kind of approach that have been used and we think could be adapted. But this is going to require a lot of research and policy direction from the Legislature to see these things put into place. They are not just going to happen on their own. A lot of the experts who know how to do this are out there, they're already employed in the right institutions but their focus is not on increasing carbon in the soil. Their focus is on other policy matters and so it's just a matter of sort of redirection and refocus of these institutions in a lot of cases.

The final cornerstone that we've included in this project was the long term planning cornerstone. And the first thing that's really challenging about this is how slowly it developed even though we assumed that the policy would be put into place very rapidly, that the State Legislature would encourage or direct the appropriate policies, it take really all the way into 2020 to 2025 before you start to see that red stripe down there grow fairly wide. And that is because communities take a long time to evolve and we relied heavily on a lot of really excellent planning research. Ivan was discussing SANDAG that is one of the leading regional planning organizations in the country and organizations like that are

starting to think about these things but no one has really put together the package yet. This is a very challenging area and it is one where North Carolina could really be the model leader in the country if it so choose. How important is this though? This is one of the policies that really have a huge impact on family budget. And one of the things that was kind of exciting about this kind of a policy area is that there is sort of this perception that sprawl is a cost effective strategy for families to deal with their budget issues. And what this graph shows here is that actually when you look at families earning 35 to 50 thousand and I just selected that income group, but it is representative of the same story that is told in other family income levels. The amount of family income that they spend if they live away from an employment center on housing and transportation is about 50 percent. It only substantially drops when they are living in the central city. So regardless of whether they are living near an employment center or far from it, it's the combination of being both near schools, job and services all at once. It really begins to dramatically reduce both the cost of housing and especially the cost of transportation. So the kind of strategies that we are talking about in long range planning that put people together with services and jobs and schools and everything in one place, are the kinds of strategies that benefit families from an economic point of view. So again, this is not about a trade off between quality of life and economy and global warming pollution, it is about both of those things going in the same direction.

Of course there is also the sort of long range planning perspective that I know some of the later presentations are going to get into with adaptation and certainly sea-level rise, I think this is Elizabeth City shown with a substantial sea-level rise increase. You've got to integrate these two concepts, you can't think about adapting to a different climate in the future without also thinking about how you mitigated. Those two things go hand in hand, you've got to be designing cities for a different future and this is really challenging. I read a recent story about how the Nature Conservancy is struggling right now with its land purchase planning because they are trying to put the habitat, not for the plants and animals as they exist and live today, but for the plants and animals of 2050 or 2100. And of course, it was discussed earlier the forecasting of climate models is not that refined so that it really presents a huge scientific challenge for that organization. You can repeat that story for the road builders that Dee was talking about or any other aspect where there is long range planning going on where you have to take into account strategies to both reduce energy use, capture more carbon and deal with the impacts of global warming on communities. And just to give you a sense of how dramatic this could be, relative to 1900 we've already hit half a foot of sea-level rise globally. This is the most recent sort of forecast by one of the authorities in the field who is heavily involved in the global work on this topic and he is forecasting by 2100 anywhere from two and one-half to four and one-half feet of sea-level rise. This is a very dramatic impact on coastal communities and coastal eco-systems.

So is a 60 percent cut in global warming pollution enough and the answer is, no. By 2030 that would not be enough to stabilize our emissions and get to the point of sort of 450 parts per million, which is what a lot of people have said is almost surely dangerous. And recently James Hanson, who made that comment is now talking about maybe we need to get down to 350 parts per million, which would be below today's levels in the atmosphere. So his point is that we may have already shot where we need to be. So this is an enormous challenge. But what we're hoping is that if we can get on this path two decades later we are

at the 50 percent cut that by then we will have the technology, we will have the ideas, we will have the insight or we will have the will to change our behavior or whatever it takes to go the extra mile and get to where we need to be in 2050.

Just in summary here are some of the numbers – I will not go through these in detail but we are happy to provide you with support individually or as a group on the specifics of each of these areas. A lot of this work is already contained in the exhaustive and broadly accepted report from the CAPAG commissions and look forward to working with you on this. I wanted to kind of sum this up in this slide, I apologize for that. These are the four areas that we think are really most right for legislative action in the next session. The first is a energy efficiency - we do have a recommendation that this Commission has adopted for appliance standards and building energy coast that has not been turned into legislation. So we do need action on that. The second thing would be a state efficiency standard that goes well beyond the REPS rules and is actually a standard specific to energy efficiency. Similarly, we would want that extended to natural gas energy use and finally we need an energy recycling program. This Commission has adopted recommendations for a study of this subject and for net metering to be addressed but we do need actions from the Legislature on that.

Again, as Steve mentioned earlier, we need some changes in the laws and permitting programs to foster inland and offshore winds. In the area of pollution capture we have the possibility, in fact, yesterday there was a federal court ruling that addresses this topic, there is a potential that now any new power plant will require best available control technology for CO_2 emissions. If that is implemented widely across the country we would be talking about a CO_2 emissions limit and that could be a way to get at fostering the need to capture pollution and store it underground. And finally there is a whole host of issues that are detailed in our report. I will not go into it, where we believe we need either state funding or policy leadership to deal with the research and policy questions. These are not big ticket items but they are essential things to get questions resolved for issues moving forward.

Thank you very much and I would also like to mention that R. Reeves our regional program director is co-author of this research (EXHIBIT J) with us and we are both available to assist you with anything you need on that.

Representative Harrison: Thank you Mr. Wilson for that excellent report. I want to give you all a heads up about plans for the afternoon. We'd like to know if anyone has any questions for Mr. Wilson and after that we discuss the content of this report some of the recommendations that the Co-chairs are considering and then we will break for lunch for about 45 minutes and come back to the adaptation presentation if that suits everyone. Does anybody have any questions for Mr. Wilson?

Mr. Everett: I wondered your estimate for what he might do for carbon capture and storage does that envision current coal plants or coal gasification plants that you've been capturing and storing?

Mr. Wilson: Yes I did kind of breeze over that – if you look up at the graph, the black are the current coal plants with conventional technology and what we envision there is the grey at

the bottom is the phase in of the plants that have the capacity for pollution capture. And what it appears now is that the only technology that is suitable for that would be new plants that would be using the IGCCC process and so what we are seeing basically the new generation of coal plants would be built and that the existing ones would be completely shut down essentially by roughly 2030. And that the new ones would basically have a 40 year life and then we're hoping that at the end of that lifetime, from our organization perspective, other solutions would be found.

Mr. Everett: So when you did your cost estimate on the per kilowatt hour, did you make an assumption about what the cost of coal gasification versus conventional coal in terms of building the plant would be?

Mr. Wilson: This particular increase is the capture component at the plant, the pipelines in the storage, so it is the additional cost of new capture and storage but it doesn't include the cost of the plant itself.

Mr. Everett: Which you should add in there if you want realistic estimates.

Mr. Wilson: Except that there is some degree of turnover in plants.

Mr. Everett: Sure there is but we are building a large coal gasification plant in Indiana and the cost is significantly different.

Dr. Eggers: Two questions – first do you know what the carbon concentration levels in soils were estimated to be in pre European settlement times. Like what percent down we are?

Mr. Wilson: I do not have that number off the top of my head but it is on the order of 50+ percent in reductions in fuel carbon.

Dr. Eggers: I was just curious I figured it much higher and bio-chard hopefully we get a refresher on this because a lot of the amazing possibilities haven't been covered yet in the Commission but thank you for bringing it up. Could you go back to slide 9 – alright I'm feeling kind of stupid right now so that y axis is the cost per kilowatt hour saved. When I think about the McKinsey report figure I think, ok so these are actual programs and actual cost per kilowatt hour saved and annual incremental savings, so if we think about this with the McKinsey report it seems like if we simultaneously optimize beyond the McKinsey graph that this is over and the distance is down and went for the cheapest best pay off things we could do first and marched on down the line. Seems like we might end up with a different kind of figure and if we went all the way out through the most costly items on the McKinsey graph seems like we might end up with a parabolic figure here. Are you following me at all?

Mr. Wilson: I am I mean what you're saying is that at some point if we really push the envelope will the cost start going up.

Dr. Eggers: Yes and also the x at the very top of the one that was the most costly and the annual savings… oh no excuse me, that was highest cost per kilowatt hour but yes not very much in terms of annual savings. Didn't they just pick the wrong thing obviously?

Mr. Wilson: What is fascinating about this topic is that there is sort of this impression that after we do the easy things it's going to get more expensive. We have the sense that there is going to be some expensive stuff out there and what's really surprising when you talk to people in the field, and this is really the first study that ever looked at this question. There is this concept that you can keep going back to the well. Don Gillian who is the president of the National Association of Energy Service Companies who owns a firm that does these kind of investments as well as working for this national organization, talks about going back into the same facility ten or fifteen years later and doing a follow-up energy efficiency upgrade that was more cost effective today than the one was many years ago first. Things get cheaper not more expensive and there is not a utility in the country that has come to that point where it starts going back up. Maybe that point is out there, we are not anywhere near that certainly in North Carolina where we are off basically up to zero on this chart.

Dr. Eggers: Right there is no danger of that happening any time soon?

Mr. Wilson: It is not something that I am worried about when advocating on these policies that things are going to start getting more expensive. We run into this with some of the utilities we talk to in other states that have been resistant to doing energy efficiency because they go out and they do a very small program and they find that the cost are six or seven cents a kilowatt hour. And they come to us and say, but you the collective you in the whoever we are, you guys told us it would be cheap and so they stop and the point is that the cheap programs are the big ones. The little programs tend to be more expensive. Now you can see that there are some of the smaller programs also come in more inexpensively and we can talk about the reasons for variation across the country in cost effectiveness with these resources. But the point is that this is a proven area that we've been doing these programs for three decades. Many of these programs you're seeing up here are in their third decade of operation. They are not discovering sort of untapped markets that no one looked for before they are going after second and third generation energy efficiency accomplishments and doing it very cheaply and very big.

Representative Harrison: Any additional questions for Mr. Wilson?

Representative Underhill: Thank you Madam Chair. You made reference back to the windmills off the coast that South Carolina and Georgia had gotten ahead of this. Could you tell me approximately how far off-shore these would be placed, is there any data on that as far as the view from the beach for…

Mr. Wilson: While there are, if you look at the maps the wind potential maps, there are opportunities that are close into the beach. The real opportunities are much further off and the advantage that we have in the south Atlantic coast is that the Continental Shelf extends out very far into the Atlantic and the wind generally picks up as you go further off-shore. So there is actually going to be sort of this trade off between the best sites the furthest off-shore and yet the additional cost of servicing a wind farm that is further off-shore and the

additional transmission line (inaudible) and so forth. So my expectations, we're talking five miles off-shore, maybe ten miles off-shore, these are not going to be anything that anybody's going to swim out to. They may be visible on a very clear day but I haven't been to the beach on a low humidity day in a while.

Representative Underhill: Follow-up? On to another subject – the small piece that was pink on your graph of hogs and landfill methane capture, does that include a complete doing away of the lagoon system in North Carolina, moving to other technology? Not going to do away with landfills but I know there are many people who feel strongly that we should be moving in that direction but you didn't make any mention of that.

Mr. Wilson: Yes I know there are a lot of details in here. In that case, I believe we assumed a 90 percent accomplishment by roughly 2030 I don't remember exactly what date in our model we picked of the large farms. The smaller farms we don't expect whatever be cost effective but that's less than 10 percent of the big farms in the state, so somewhere around 80 or 90 percent administration rate into that market. So essentially basically what you said but not exactly.

Representative Harrison: If I could just make a comment and ask a question on the wind issue we have at the Environmental Review Commission (ERC). We heard a brief presentation from the Environmental Management Commission which is looking at the permitting issues and the Coastal Resources Commission is looking at the permitting issues on wind so hopefully we will have some recommendations so we can get a structure in place. In the offshore did you all look at wave energy at all?

Mr. Wilson: We have looked at it – we did not include it in this plan because again we were focusing on technologies that are really ready to go and that is one where while the concept is sound the engineering is really just happening in the past six months or so that's beginning to prove out sort of how that will actually work in practice. I think within a year or two we are going to be much further along on that issue and we will be able to start looking at it. And that actually addresses the question from Dr. Everett earlier about sort of if you don't do one of these things, what else could happen. Well that is one of the other what else's that could happen. I am very hopeful that that will be an opportunity but we did not want to count on it in this report.

Representative Harrison: Thank you any additional questions? Thank you for that presentation and I am going to turn it over to the commission counsel and he'll talk about in general our recommendations.

Mr. Givens: Thank you Madam Chairman. I've got several things to do and I'll try to do these very quickly. First of all, I distributed to you a one page flyer front and back that is about a symposium that will be held at the Law School at the University of North Carolina at Chapel Hill tomorrow. I think all of that information is there except the tomorrow date. The flyer is captioned The Greenhouse Gas Marketplace: Commercial Regulation of Climate Change Solutions (EXHIBIT K). We sent you a notice of this some time ago and I'll give you the agenda and encourage any of you who possibly can to attend. If you are an attorney it is offering, I think about five hours of continuing legal education and I encourage you to go.

I want to quickly go over the documents that we have given you that I mentioned earlier and also the documents I am giving you now will lead us into the third part of my discussion which has to do with this development of recommendations. First of all as alluded to earlier you have been given five sets of minutes (EXHIBIT G). There's no action on those at this meeting but they will be back on the agenda at the next meeting as an action item. We owe you one set of minutes and we hope to have those to you before the next meeting. You received and all of these documents are in addition to documents distributed in connection with the presentations. I am not trying to inventory them. You received this document entitled North Carolina Renewable Energy and Energy Efficiency Industry Census 2008. Then you received three documents from Tom Peterson, when I mentioned them before I indicated they were at your place and it turns out they weren't and nobody called me on it but I will remind you again what they are. One of them, the basic document is a final report from the consultants about the deliverable under the CAPAG process and what you're receiving there are three documents and these are the big fat ones. There is the final report (EXHIBIT L), that is the biggest one it looks like this and everybody gets one and then there is the executive summary (EXHIBIT M) which looks much the same but it is thinner and then there is the Secondary Economic Impact Analysis of Greenhouse Gas Mitigation Options for North Carolina (EXHIBIT N) which has a white cover. Now you will recall that we've had a presentation at earlier meetings about the Appalachian State Economic Analysis and then at the last meeting we had a speaker who was from the Beacon Hill Institute and who was critical about economic analysis and so Mr. Peterson provides you with two documents – the document from Florida (EXHIBIT F) and the Peer Review (EXHIBIT E) that rebuts the critique. So you have those.

Then I am going to give you something that I have been giving some thought as to what to do and this I think will lead us into the discussion of recommendations. Right at the beginning of 2007 the beginning of the long session, the Commission discussed recommendations to that session to be included in its interim report. The staff prepared an interim report draft but we never formally adopted it, that was at the time when then chairman of this Commission Representative Hackney was transitioning to become the Speaker and we were gearing up for the long session, had major legislative proposals including the REPS and it was simply a bridge too far, if some of you are familiar with the book or movie, to have another meeting to actually get this report approved for dissimilation. What actually happened in 2007 was the focus was on the REPS, which was one of the recommendations in this stocking. I give it to you now for information (EXHIBIT O) in that it has the following in it and because it is a draft two or three of the pages are out of sequence but they are all there and I think it will make sense. It was a graph letter of transmittal which was never executed, a list of members and staff of the Commission from the beginning of the Commission to that time in 2007 authorizing legislation with which you are familiar. A section entitled Commission proceedings which is basically a summary or abstract of the minutes. In other words, it is a short summary of the minutes up to 2007. This is different from the minutes we are asking you to approve at the next meeting which are minutes of this Commission since that time. And then the thing that I think will be of greatest interest to you are those matters that the Commission acted on in early 2007 as recommendations.

When I talked about the extract or excerpts of the minutes we have minutes for all of the meetings period but we are not able at this junction to locate minutes for the last meeting at which the recommendations were discussed. So what you see if you look at that document on page 21 it's just a brief reference of the 22 February 2007 meeting and then the recommendations. Those recommendations span, in my opinion, as recommendations of this Commission and it will be up to you when you vote as I hope we'll get to this time, when you vote on a new report as to whether to include these.

Now as to how we propose to proceed. Co-chairs and counsel met in late October and decided at this point to proceed as follows. We want to spend the majority of the next meeting on the discussion of recommendations and limit presentations to those that are necessary to deal with specific recommendations one way or another. As I mentioned at the beginning of the meeting, I've had discussion since the Co-chairs and counsel met with Co-chairman Garrou, he himself does not have to deal with this issue but as many of you know his wife is the chairman of the Senate Appropriations Committee and we are looking at a three billion dollar hole in the state budget. That has obvious implications for what we can do and what we can expect private sectors to do.

That said the Co-chairs and counsel propose that we start dealing with the following six recommendations. First of all this sets a greenhouse gas remission reduction goal - the proposal according to my notes at the departure point is an 80 percent reduction from 1990 levels by the year 2050 which is the most commonly adopted expressed version of that goal there are of course others. The second one is with regard to a permanent commission to replace this commission so that we would not be extending this from time to time and the permanent commission would have the following characteristics. First of all it would in all likelihood be smaller in terms of the number of members. Secondly it would have a greater legislative representation on it to assure legislative buy in into actions the commission proposal recommendations. Thirdly, it would have some representation or input from the executive branch of the next governor I think will be more interested in these issues than the current administration. I have already talked with the Governor-elect policy people and have been assured that that is the case. For most states that are engaged in climate change, the initiative has either in the executive the start with or at least the executive has a substantial role which has not been the case in North Carolina. Then lastly that there would be a clear delineation and not overlap of the role of a climate change commission with that of ERC which is the long standing legislative oversight and study entity. As long as I am here and my staff and we are staffed to both we can largely take care of that concern because we do staff both. But who knows what the future will bring and part of the question will turn in any event upon whether the commission we are talking about continues to be a legislative commission or become sort of an executive branch commission and what its powers, duties and functions should be. I invite you all to think about that.

One more point, upon reflection it appears that one of the functions of a new commission would be to deal with the adaptation issue. There has been some talk about a separate commission for adaptation – it seems I think our view at this point that a separate commission would be just one commission too many and that a permanent commission could deal with both issues. We hope to prove that point with regard to the adaptation issue and this commission today because we have fine presenters on that topic. The third

item is what often referred to as clean cars and what really involves the adoption of the California Emission and Inspection Standards for motor vehicles. The study of that matter was assigned by the Studies Act of 2008 and ERC. There has been some question about whether ERC will actually undertake that study. It is my belief now that that commission will and will generate a report which probably will take longer than just between now and January to have a robust report that addresses all the issues and that has buy in at the onset by the interested parties. If I find in the next few weeks that that study is not likely to proceed in ERC after all, then that matter can come back to this commission.

The fourth matter is energy efficiency in the state buildings. There was a bill passed in the 2007 session and then revised in 2008 on that subject. I think the proposal here, Chairman Harrison can correct me if I am wrong, but I think the thought is to extend the provision to Senator Cowell's bill that had been enacted to buildings that are constructed with state funds at some level and one of the issues will be how much state funding would be a factor before the requirements would go in. But these would be buildings constructed in whole or in part by state funds that are not state buildings. It may surprise you to learn that the state funds to construction of buildings that ultimately do not own but that is the case.

The fifth matter is some work on making the state building code greener – that's a complex issue and one that is easy to articulate the concept. By greener I mean more energy efficient. Easier to articulate the concept and much more difficult to implement and factor. Lastly, with regard to adaptation, at least as an outset to ensure that state agencies are taking into account the ways in which their global climate change would impact their functions and anticipating those and not only anticipating but making plans to adjust what they do and how they do it to take global climate change into account.

Now I come to this point and this is personal to staff and that is this – it is important that we have in my mind that we have recommendations that are more than just aspirational or goals are important if you want to accomplish something to have an actual plan. But what the legislature can do is adopt laws and we do so to either require something or prohibit something or we levy revenues for the purpose of obviously making money or perhaps for the purpose of discouraging certain activities. We can use tax credits and we can use appropriations – all that requires draft bill language. Leaving myself aside, I will tell you that the people who are assigned to this Commission are among the best bill drafters the legislature has but it is beyond our ability to take 15 or 20, just as a matter of time if nothing else, it is beyond our ability to take 15 or 20 good ideas, well intended ideas and turn them into draft bills. So we need help and if you intend to propose something, please come with something that will help us get started perhaps something that's been done in another state or perhaps something that some outside organization has worked on.

Co-chairs and counsel desires to hear from any of you who have thoughts on these particular matters and how we might best address them at the December meeting. I am in fact looking to you as members of the Commission to assist Co-chairs and myself in putting the next two to three meetings together. We also invite your suggestions as to what particular topics we might look at beyond the six once we have dealt with those six that the Co-chairs have determined that these are where we ought to start. I certainly stand to have any of this modified or corrected or whatever by Chairman Harrison this month and by

Chairman Garrou next month. That outlines our thinking at this point on where we hope to go and that we hope to get this done in time so that we can actually have a draft report with recommendations and legislative proposals that can be submitted to the legislature, if not by the study commission bill introduction deadline, which is generally quite early that it could be submitted in time for the public bill deadline that members can introduce their own bill if not a study commission bill. The language would be the same and they could point to the recommendations of the commissions as a source if they wanted to. That would buy some additional time from a procedural point of view. Of course it would be the sun and the moon and the stars come all together if we had a report on the day the session convened which is I believe the 28th that had all the things you may want in there as proposals and well written legislation. My experience two years ago as we tried to take away from the short interim, its just as easy to think about and say and hope and very difficult for us to do. So we are getting started not in January but in November. I'll be happy to answer any questions and I look forward to hearing responses from any of you. I will tell you in all candors that I've accumulated about 15 hundred document backlog in my email. Ms. Matheson does triage for me so don't bombard me with emails sending me site emails just what you are proposing and we will do our best to respond appropriately as we develop the agendas for December and January. Thank you Madam Chair.

Representative Harrison: If I could just add to what he stated – these are just preliminary goals that we thought would be manageable. We know that there are a lot of recommendations in the CAPAG report. The reduction goal we anticipated interim steps to not just eighty percent by 2050 but obviously we need to start reducing now so we had opted you all to recommend at what stage we need to achieve those reductions. On the permanent commission piece Mr. Givens mentioned that we need more legislators and we're hoping to take advantage of all the expertise that you all have and if you don't fit into the commission we are anticipating setting up an advisory board to the commission. Is that accurate?

Mr. Givens: I failed to mention that piece. We have invested far too much money in the citizen members of this commission not to take advantage of it and so we don't anticipate casting you aside but finding some mechanism and there are models in place for example there is the Coastal Resources Commission which is regulatory commission that has also a Coastal Resources Advisory Commission, a rather large body that is there to advise the regulatory commission. I am not necessarily suggesting an exact parallel in fact I'm wanting to distance myself from any proposal that we create a new commission with regulatory powers, rather that we create more permanent advisory and study commissions that could advise all organs of state government. Right now if there is any trend at all in state government organizations it is toward consolidation and not creating additional entities and I see Representative Underhill nodding in agreement.

Representative Harrison: And finally I was just going to point out that we did talk about green jobs component to this – we were not sure what formula it would take, we talked about it in the context of a greener building code so I am going to refer to Ivan and others who have some expertise in that area to come up with the recommendation on the green jobs but that was part of it. We talked about in the context of building codes.

Dr. Riggs: I am sorry I did not understand what you said about the adaptation going forward with adaptation sub-commission or commission it was not clear to me at all.

Mr. Givens: What I said was that there has been some talk as you know about whether or not there should be a separate commission to deal with adaptation. The Co-chairs and counsel believe and of course, Co-chair can speak for herself and the other in the next meeting, but I'll tell you that the counsel believe that it would be not desirable to try to have two commissions dealing with global climate change but rather one commission study and recommend in a coordinated fashion on both points. Now how that might be organized so that there might be a subcommittee on adaptation that might be appropriate. For this Commission the Co-chairs since the inception of the Commission have chosen not to appoint subcommittees for reasons that they deemed to be adequate. But to solace Dr. Riggs is to have this Commission charged specifically and to place emphasis on the adaptation issue but not to have a separate adaptation entity. Now when telling you all of this I am telling you what I understand to be the thinking of the three of us. That does not mean that you all are bound by that and what you do. These are thoughts about how we hope to proceed as your leaders I suppose. One final observation and this came to me long before I went to law school and long before I came to the General Assembly, it has been my experience that it is a bad idea well written will beat a good idea that's just a thought every time. The most powerful thing is a good idea, we are good writers but we have to deal with lots of things. Mr. Hudson, Ms. McGinnis and I are trying to solve solid waste issues, water allocation issues, Stanley County and Alcoa issues, in other words we have a lot on our plate. We have a lot of expertise in the bulk in this room, we don't have enough lawyers I suppose but that might be a debatable point. At any rate we solicit your help in getting the work with this Commission in going forward. Thank you very much.

Mr. Stevenson: Thank you Chairman Harrison. I wanted to thank you for bringing forth the interim report. The interim report is primarily based on CAPAG recommendations and some recommendations from the Commission members from I guess the early part of the Commission up until early 2007. I think that is the last date I see in here. There was a product that Bill Holman produced for the Commission, which I believe was earlier this year and it chronicled a series of potential adaptation recommendation that we might want to bring back before the Commission in a future meeting.

Mr. Givens: OK we'll take a look at that. What I was trying to do is give you what I had to work with. I had several request and Ms. Tompkins had asked about the minutes or some other documentation about the recommendations that were previously adopted so I gave you the best evidence of what I have.

Representative Harrison: OK well if that is it we are going to break for 45 minutes and come back at 1:30 and hear the presentations from the folks on adaptation. I hope all of you will be able to make it back. We did not anticipate needing a break for lunch but we've gone over so thank you all.

<u>After Lunch</u>

Representative Harrison: We are going to try and get started on the second half of our agenda. We've had several people come in from out of town and we're going to cover them first. Sam Pearsall who is local will come back when there is a bigger audience but at this point I am going to call on Michael Bryant who is here from Fish and Wildlife Services. Thanks to the rest of you all for coming back.

Mr. Michael Bryant: I am with the U.S. Fish and Wildlife Service and my presentation as you can see from the first slide is talking about adapting to change. I am a land manager I want to let you know first who we are as an agency, what we do, who care about what we do, what we're seeing happening on the land today, what we are feeling we are likely to see in the future on the lands that we manage and what our potential responses to that will be and that's the adaptive part of this. And who could potentially be doing that with us. National wildlife refuges are managed by the U.S. Fish and Wildlife Service, they are federal lands and so our job is to be land stewards when problems come like climate change and if we don't get up and leave we are fixed to the lands. It's the land that we manage, there are over 548 national wildlife refuges in America and there are eleven in North Carolina. We consider land as a community of life and to us is what an eco system is. Wildlife lands and the perpetuation of diverse and abundant wildlife to us are essential to the quality of American life that we are public servants. So we owe folks hard work, integrity, fairness and a voice in protection of their natural resources which are entrusted to us to conserve. We are not a hands off agency, we manage as necessary and if the management we do on our lands range from simple preservation to very active manipulations of the habitat and the plant and animal communities in order to achieve our particular mission. And that involves any number of management practices that I can point to a little later in the presentation and we always welcome and feel that it is essential that we have partnerships for the mission of the Fish and Wildlife Service starts out with the words working with others. Who cares about refuge? Well in 2006 in relation to the issue of global warming, defenders of wildlife came out with a report called Refuges at Risk and they identified what they felt were the ten most endangered national wildlife refuges in the nation out of those more than 500 refuges and from this particular slide you can see that in North Carolina, Alligator River National Wildlife Refuge amongst all the refuges in the system is the one they've identified at risk due to climate change.

In North Carolina in the Coastal Plains there are ten of the eleven wildlife refuges, one is in the Piedmont. Those ten as you see in the red cluster in the lower Coastal Plains in the northern half of the Coastal Plains of North Carolina. On the satellite image you can see where those refuges are located. I manage six of the nine refuges that are entirely within North Carolina. I agree there are some swamps which is in the upper left of that slide is managed out of a different regional office in the northeast because more than half of that refuge is in Virginia. But you can see from this particular slide as I'm coming down closer and closer to where the refuges are and where the issues are attended to climate change as it affects these lands that we manage. There is an awful lot of water where ever there is this land that we manage, it is part of the landscape as a dominant feature in the landscape and will affect this landscape significantly.

One of the refuges I manage is Pea Island National Wildlife Refuge and this is Oregon Inlet and this starts to speak to what we see happening today and what we've seen happening to

one particular refuge and then I'll speak later about Alligator River National Wildlife Refuge. And why I start with this one is the Atlantic Ocean, that big body of salty water sitting there and its few inlands into the estuarine system, the sound system will affect all of those lands inside that barrier island system as that barrier island system changes. As you turn and start going south the way one of the migratory birds that we manage for on Pea Island, you start to see from the air, one how narrow this landscape is, how dominated it is by water and if you look at all the tan sand that is sand moving as a natural course of the coastal process that work in this landscape as sea-level rises, as storms come and if we have more storms and they are more intense, we will see more of this.

Now from a National Wildlife Refuge standpoint and from a wildlife habitat standpoint, when the ocean feeds sand up and over this island that is not necessarily a bad thing, that is creating habitat, that's restoring habitat. Often where you have a natural process and you can allow it to dominate that landscape its sometimes very beneficial to the wildlife that we are trying to manage for. This refuge established 70 years ago was nearly 6,000 acres in size, today it is less than 5,000 acres in size. It didn't have a highway through it until the 1950's it didn't have a bridge to it until the 1960's. With highway and bridge and a landscape that is in constant motion you can perceive that it makes it much more challenging environment in which to manage for wildlife first and it also is an environment that is very challenging for the Department of Transportation to maintain infrastructure. If you look at a double set of power poles one standing in the sand near the beach and the other one starting to appear on the other side of the highway, so that is the typical progression of what is happening on that landscape from an infrastructure standpoint. Power lines are being moved to the west of course you are going to run out of land from that picture pretty soon to the west. Highway has been moved where you see these little curvy jogs, that are where the highway has been moved in the past so they are going to run out of landscape even if we allow under regulations to permit them to move the highway. But from a wildlife standpoint what we are doing here is managing for migratory birds and other species like sea turtles while this change occurs. If you are looking from the south where the refuge ends 12 miles south of Oregon Inlet, looking north you can see the interface between the National Wildlife Refuge and the community. And in 2005 this was the way it looked immediately after Hurricane Isabelle. Now again all of that sand moved across the landscape trying to get across to the sound side – in a larger storm, sand would have moved all the way across and in a few spots it did. And it will build islands on the left of this picture in the sound if you let that occur over time. In the face of development though it is very difficult for that to occur because you have to restore the highway, you have to restore and you do that by getting the sand back into the active zone where the ocean is. And there is the challenge in managing for migratory birds and other kinds of wildlife in this kind of environment.

This same spot just a month ago with this house that you can see right there – that's a house standing with beach in front of it after Hurricane Isabelle. Now go to the next picture and that house right there is that same house with far less shoreline, ocean going under during a minor low front that came through (inaudible) the Outer Banks in mid October. You can see the landscape changing rapidly, there is a house right there that fell in but this shoreline is regressing toward infrastructure that's fixed. And that is a challenge for society. Yes.

Ms. Tompkins: (Inaudible) on what term the weather was?

Mr. Bryant: It was a low pressure.

Ms. Tompkins: In October?

Mr. Bryant: In October – and typically if these last any duration and have winds above a certain speed they are called a nor'easters they didn't call it a nor'easter because it did not quite reach the nor'easter strength but it doesn't require those strengths of storm any more just duration sometimes now especially on a full moon or new moon. It gets the tide up enough to start putting it across the dune system and into the highway. Now that same house and obviously the response again I am putting it here because there is a sign for the refuge going north into the refuge. This is National Wildlife Refuge this is the first community south of it. This is a highly vulnerable spot that everyone has to consider as they adapt to this change of sea-level rising, more frequent and more intense storms and an environment that is shifting dramatically.

Representative Underhill: Excuse me is that a community that has a name?

Mr. Bryant: Rodanthe and this is just the last picture looking all the way north into the refuge – probably the first six miles of the refuge north and the road jogging along through getting precariously close to the ocean and all of this is good wildlife habitat for a variety of migratory birds. Again for which and that is why that refuge was established in 1938 and our challenge is to continue to manage it for the benefit of wildlife and for appropriate wildlife dependent recreations and it is becoming more of a challenge obviously. I am going to jump now we've got the Atlantic here contributing salt water to a sound system. I am going to jump across the sound to Alligator River National Wildlife Refuge. Alligator River National Wildlife Refuge is most of that peninsular although 46,000 acres of that peninsular right in the middle of the square is the Department of Defense land and there are few communities (inaudible) Tarboro, East Lake and Stumpy Point that are adjacent to that national wildlife refuge. This is Roanoke Island and there is Oregon Inlet and that is where we just were on the picture. Now this landscape that Alligator River is in is made up of a variety of habitats. The Pocosin habitat is a name that predominates this but there is marsh and it's a freshwater marsh that overtime will convert to a salt marsh as the sound becomes saltier. We have low shrub pocosin, some pine soil pocosin, an Atlantic waste seeder and have Gum and Cyprus swamp all on this peninsular here as well as across Alligator River on other lands that aren't part of the refuge. That gives you a flavor for the variety of habitat sites that are there and that's what supports the abundance and diversity of wildlife that is there. Again it is the national wildlife refuge set aside for wildlife and for appropriate wildlife dependent recreation and what is happening in that landscape is this: we acquired the land with the help of conservation and nature conservancies over time. Everything in green is refuge there is the (inaudible) range – but you can see it dissected with roads. Every road there has a ditch beside it – every ditch allows water to move quickly in and out of the refuge where historically water sheet loads off of it or rained on or came in slowly across the landscape as the sound would rise and flood. When you have a distance and you let water jet into the system and also on tide events let water run out quickly it gets

fundamentally altered in the ecosystems. Underlying all of this is a very rich and broad organic soil base so there is a lot of peat soil here, a huge carbon sink and in these pictures this picture here is a ditch that has been widening all by its lonesome and it is right here near the sound with water penetrating and leaving it frequently because it is so near the sound and that water is becoming saltier by the year and it is a combination of being in proximity to the sound as well as the salinity of those waters that is killing back vegetation, decide lining the banks causing the ditch to widen and changing the vegetation community. The other picture shows an interior of this that hasn't widened over time because it hasn't been influenced by these same factors of the salt in the water and rapid intrusion and exit of water.

There has been a number of models run to show what would happen to this landscape, there is Alligator River, this is the Albemarle-Pamlico peninsula and over a course of 100 years you get a 32 inch sea-level rise. Look how much of the landscape becomes open water. So we have a vested interest in trying to understand what's going to happen. And as managers we have a bias toward action. I mean I am a land manager so I want to do something and I plan to do something and I'll do it with the best available information. And what I need to do in the face of this kind of forecast is to look for ways to make that landscape resilient to it. One is to help slow down that intrusion of that salt water and these kinds of effects with salt water coming in that changes whole vegetative communities. The biologists that work for me that have been at work in this landscape for more than 30 years can easily point to tens of thousands of acres when they started their careers that were forest that are now marsh. Through no action of our own, nothing we've done just watching it happen you have forest and stress. When a forest gets stressed it is vulnerable to things like beetle kill – this is southern pine beetle which will kill pine trees by the thousand. Now what stresses the forest can be a storm event, it can be water being too high and in this case we are seeing southern pine beetle infestations that are killing forest and we have to go in and manage that to try and prevent the spread of that. What we have in this rising sea-level scenario are changes in the vegetative communities, increase in forest health issues, and also when you have the soil exposed after the vegetation dies, a loss of carbon the soil itself and what we want to get back to is a no net loss of that soil. The soil and the water are the foundation for the ecosystem and for growing plant communities that support the wildlife population that we are all about.

What kind of adaptive management strategy should we consider and have we considered? Well one, since we are land management practitioners we have a lot of practice as we employ now and always have. We use fire, we put fire out but we also do control burn. We manage water levels, we do it primarily in impounded areas for trying to increase the food availability to water fowl in the winter. We do farming with coop farmers to increase the amount of high energy food for water fowl in the winter. So we very actively manage this landscape and now we need to know what are we going to do with our skills (inaudible) and where are we going to do it to make this landscape more resilient to this sea-level rise that is occurring. What is causing it that is not my debate, it is happening, it's measurable and it's likely to continue to happen. I as a land manager should do something to work toward resiliency in this landscape. Things like water control structure – where we can use fire and judicially we put in fire breaks and use in fires. Things like replanting plant communities – these are the kinds of strategies that we want to consider and consider where we can do it

with the help of our partners. Some of the conservation tactics can include both on refuge and adjacent to the refuge are hydrologic restorations, which we've been trying to do since this refuge was created in 1984. However, we are doing it on a boot strap style and not with a lot of general science, just our best understanding of where we should move water control circuits in to limit the amount of water penetrating the refuge and slow down the exit of water so we can get it running across the landscape again. But with more science we can figure out better places to put those water control circuits.

Now land restoration and reforestation and shoreline transition work, those are some other things we can do on the refuge to make that landscape more resilient. If it is going to erode away we want it to erode away at not an accelerated pace because of our lack of management or because of previous management. We need to do things to bring the rates to a rate that is manageable and try and influence the pace at which it happens. Something that is being considered by one of the state agencies and some of the nonprofits, putting oyster reefs adjacent to those shorelines to break down the wave action and also to create better water quality from the action of the oysters in that water adjacent to the refuge. The other thing that is very important in management is measuring – we have to measure and monitor what we are doing otherwise people will challenge us always on what we do and they should. And if I haven't got good science then it is my best guess and often I have to manage based on my best guess because again my bias is to act not just to wait and worry. I take action on the best available information I have. But working with experts and developing strategies to understand what is happening to the soil and what is happening to the plant communities will allow us to better decide where to do what and what to do.

Some of the people that we've been working with and entities are the North Carolina Chapter of the Nature Conservancy, North Carolina Coastal Federation and there are potential partners in this exercise obviously, but this is a landscape level effect and in this landscape you have over a half million acres of conservation land, that is not all refuge. I manage six refuges they add up to about 300 thousand acres but you have state agencies that have large holdings on the Albemarle-Pamlico peninsula. You have nonprofits that have large land holdings so you have an opportunity with a landscape this size with so much land in conservation already to pilot adaptive management practices on that land in a way that could be measured and monitored and then you can learn from it and come back and say to the greater public here are ways we can manage in the face of this sea-level rise. Not just sit back and go oh my God what do I do? What we can do is make this landscape more resilient. What we can do is start to plan and look toward the future where would be the next place to consider additional conservation limits as these lands go under water because there will still be a need for land for conservation, there will still be a need for habitat for wildlife so we have the abundance. So we need to start planning for those things while we're managing (inaudible) for what is coming now. That is essentially my presentation if someone has questions I would be happy to take them.

Representative Harrison: Thank you. If I could ask what is the status of the bridge, isn't there a proposed bridge alternatives, one was a causeway and one was more of a fixed point?

Mr. Bryant: North Carolina Department of Transportation and Federal Highway Administration are concluding their National Environmental Policy Act process. Their final EIS came out last month or maybe two months ago the comment period ended last month. DOT's schedule is to go to a record of decision on that in mid December and their schedule is to let a contract for designing and building a short bridge across the Oregon Inlet next year with construction starting the year after as I understand it. So from the current preferred alternative they have is to build a short bridge next the Bonner Bridge right back to essentially where the Bonner Bridge makes land fall on Pea Island now and then over time their plan is to build additional bridges in the existing right-of-way as conditions warrant or demand. So in that plan if it is played out completely there would be ten miles of bridging over the 12 miles of refuge. It would exist where the road does today except the island would be moving out from under so that bridge could ultimately be in the beach base or in the surf zone of the island if the island keeps shrinking, moving and breaking from.

Representative Harrison: So the design would accommodate that migration?

Mr. Bryant: That is I think the reason for bridging. They had an engineering group come together and say what is feasible and they said well that is feasible from an engineering perspective.

Representative Harrison: Any other questions? Thank you for making the trip and next up, Sam is going to present at the next meeting, Dr. Reide Corbett and Dr. J. P. Walsh from East Carolina University (ECU). Thank you for your patience.

Dr. J. P. Walsh: Thanks for coming back after lunch. It is a pleasure to be here. I am J. P. Walsh and I'll be talking with you today along with Reide Corbett who will be up in a minute and we'll be talking about estuarine shoreline erosion and coastal hazards in North Carolina. Just to give you a little brief background about myself, I graduated from Colgate University in New York State, did a master's at Stony Brook on Long Island, did a PhD at the University of Washington and I was a post doc at Scripts Institute of Oceanography in California. I am an assistant professor at ECU. I am joint appointed between the Department of Geological Sciences and the Institute for Coastal Science Policy and basically my interest is understanding land-sea interactions and to use a variety of tools for doing that and have done work not only in North Carolina but around the world.

There are a number of reasons why we care about how climate change can impact North Carolina coast. Obviously one of the key reasons is that North Carolina much of eastern North Carolina is very low lying and that is what this map on the wall shows. The areas in red are an elevation less than two feet. Also coastal North Carolina is obviously an important economic engine for this state. Additionally there are critical sensitive habitats that occupy this coast as Michael Bryant just talked about. In particular we are going to be talking about estuaries some today. Estuaries are coastal water bodies where fresh water and salt water meet and mix so they typically have a brackish salinity. Why do we want to plan for climate change and coastal hazards in North Carolina? Well obviously as I've already said, it could be that coast is a critical economic engine in particular the tourism and fisheries industries are very important and can be impacted by climate change. Visitors to coastal counties spent over 2.5 billion in 2007 and which is a significant percent of the

tourism dollars coming into the state. Obviously some changes can have some major impacts on the infrastructure and so we need to plan responsibly so that we deal for the potential changes. Shown here is just a figure showing a perspective view of North Carolina and on it I've indicated some of the coastal hazards effecting North Carolina, the first four indicate some of the basic ones that kind of occur across the landscape. Shoreline erosion, storm surge, water quality deterioration and inundation by sea-level rise are things that are sort of ongoing across North Carolina. There are two other specific hazards that I'll be talking a little bit about today, over wash and inlet opening potential which are risk to the Outer Banks specifically.

Something of course to realize is that the risk to coastal hazards and to sea-level rise, in particular, are getting worse, not only because of sea-level rise but also because of population growth. Right now the coastal counties are home to almost a million people, a million North Carolinians and then the last three decades some coastal counties have experienced 75 to 150 percent population growth, so very impressive growth rates. Some of the work I'll be talking about today by researchers at ECU was basically supported with cooperative work between the U.S. Geological Survey (USGS) and others at the University of North Carolina and other universities. There was a major initiative to understand the ecological impacts of sea-level rise which was supported by NOVA and then support from the National Science Foundation, from the UNC systems, the Renaissance Computing Institute in North Carolina and ECU itself has provided additional support for some of the work. We use a variety of tools we go out into the fields and take cores and use geophysical methods to map and look at the geology and the processes affecting the system and then we tend to process that with a variety of computer software etc. I will not get into those details.

As we all in the room are well aware that climate is changing and it is causing other environmental consequences and that is really what I will be focusing on here today and Reide will talk about as well. Shown here is the global average surface temperature and you can see that rise significantly since 1950 and then we can also see the global average rise in sea-level which is a significant consequence of climate change. Some other consequences that I just want to mention are changes in storm frequency and intensity which I will briefly talk about. Of course droughts, floods, land habitat, land and habitat losses which might be induced by either of these processes that I've mentioned. Of course with ecological effects such as fish kills or other ecological changes Michael just mentioned things like pine beetle infestation and there certainly are others in the marine setting that are a problem. And of course these things can have significant economic impacts in terms of land loss not just loss of property, direct impacts to infrastructure as well as some indirect things like impact on fisheries and the economies that the fisheries support.

Some work that researchers at ECU have been working with people around the country in particular from the University of Pennsylvania has been trying to document the rate of sea-level rise in North Carolina. One common approach is to use tide gauge records but tide gauges in North Carolina have been sort of only around for a short period of time and therefore can't really be used to look at sea-level rise and so we need to use the geologic record to do that. Basically, I will not get into the details, but they use the shells of organisms that live in the sediments and then from that record we can construct what the

sea-level curve looked like and that's just what is plotted here. This is a plot of wealth at sea-level and then time is on the x axis. And what you can basically see is that rate of sea-level rise has increased dramatically in the last several hundred years. I guess you all are familiar with the global warming hockey stick curve – well Dan Horton and Reide Corbett and others have talked about how we might similarly see a hockey stick curve for sea-level rise and it does appear that we have that occur in North Carolina.

Storms are a critical sort of perforation to the system and the sea-level should mention a sort of chronic process. It is slow and steady and it is hard to sometimes understand what the potential impacts of sea-level rise are. Storms are sort of the (inaudible) acute event that really drives the point home that we are living in a dynamic system. This is just a shot of Hurricane Katrina – some of the satellite imagery that shows this moving ashore. We've obviously also had major hurricanes impact the North Carolina coast – the work that has been done recently suggest that there will be more frequent intense hurricanes. In the upper right hand corner is a graph of the number of cap 4, 5 storms as is predicted to increase with time. I don't want to get into the science of storms or sea-level rise too much other than just to emphasize that these are sort of critical consequences of global warming.

One of the great things about North Carolina is we have an impressive amount of intellectual capital in this state. We have expertise on a great number of key things that we need to know to really understand how to respond or to adapt to climate change and shown on the right is a bunch of the logos from all the players involved looking at various aspects of coastal dynamics in North Carolina. This is meant to be sort of a (inaudible) way side to mention an initiative that some of us at East Carolina have been working on is a website or what we call the North Carolina Coastal Hazards Decision Portal which is a website where we are trying to bring together some researcher information on coastal hazards including sea-level rise. This website will include a brief review of the coastal hazard information as well as provide publicly available information like hazard mitigation plans, also we will give tools. So number two is to create tools to enable the public to understand and view some of the hazard information in a frame work that they are used to and then also to provide for Reide's brief explanation and understanding of some of the natural science and social science aspects of these hazards. I'll give some examples just to let you understand a little bit more of what I'm talking about. Shown here is just a snap shot from the web page actually one of the handouts that you received gives you the website location, a little brief news release, we've had a few articles written about the website and have gotten some good attention in the press recently. So I encourage you to go visit that at your own time.

I want to give you one example of one thing that is featured on this website and a real hazard facing North Carolina that we've done some work on. Inlet opening potential is a real hazard we've talked about earlier, we showed some pictures of (inaudible) area – well as some of you might be aware during Hurricane Isabelle in 2003 we had an inlet that opened on Hatteras Island which is what is shown here. The Army Corp came in quickly and closed up this inlet but the fact is the Outer Banks are a narrow strip of sand that is very much because of the limited sand supply and the energetic coastal environment is at risk to future inlet openings. Shown here is a map of the active inlets those are indicated in red along the Outer Banks and yellow are the historic ones. They were not opened all at once but give you an idea that in the past we certainly have had inlets in much of the Outer

Banks. Stan Riggs and others have shown that very large percentage of the Outer Banks at one time was occupied by an inlet. So one thing we have done to sort of quantify the potential risk to inlet opening is just to use some lighter which is elevation data that was collected as part of the state flood plain mapping effort. We used that to quantify some aspects basically the volume of the Outer Banks and then from that information we can identify risk areas along the Outer Banks and that is what is shown in this figure. Note in this figure the area where we have low volume which is the graph off to the right. Right here is where we had an inlet opened during Hurricane Isabel in 2003. So it is a very simple approach to identify risk areas along the Outer Banks. When we take this approach and apply it along the Outer Banks we can identify the very high potential areas and you will notice in red on the right here are areas that are very high potential for opening inlets and the black circles indicate where we've actually had inlets within the last century. So it is sort of an approach of predicting possible inlet opening places and works fairly well.

So we've created this data set and now what we've done to share this with the public is we bought this into something that many of you are probably familiar with. Google map which provides a nice background data set of aerial photographs and a user can go zoom in and zoom out, they can find their house, they can find their favorite beach and look at the potential inlet openings along the coastline. This is one example of the tool that is available at this site. There has also been some other socio-economic work looking at inlet opening potential and this is also available on the site. Some work by Hans Volgleson at ECU calculated what the cost per day for having an inlet open at the different sites indicated on the map and the cost basically using some simple assumptions range from a million to five million dollars per day. So there are some significant economic ramifications of the inlet openings. One important reality that we hope to keep the reality of storms and sea-level rise in the forefront of people's minds and so we created another tool to sort of allow people to understand the impact. Other than what's shown here is just for loading up images of past hurricane impacts and people can go and look at what happened during hurricanes of the past to allow us not to forget. Another tool that has been worked on, I'll just mention briefly, is ocean erosion. Shown here is a graph of it – the Division of Coastal Management has worked hard to map our ocean shorelines and from those mappings that we've determined ocean shoreline erosion rates and those are the basics of set back policies along the Outer Banks. What we've done is taken those data and sort of projected the rates to allow people to understand where erosion might occur in the future. This is a big leap of faith I'll admit but allows people to sort of put the erosion in some perspective of the home owner along the Outer Banks. We also intend to look at how recent ocean shoreline rates might compare with those historically. This is something that obviously we need to deal with and understand particularly as sea-level rises. We certainly anticipate that the shoreline erosion rates both in our ocean and in our estuarine areas will change with time and Reide will talk a little bit more about estuarine erosion in a second.

Last I just want to mention and give you an example of a sea hazard that potentially will get worse with sea-level rise, climate change will not only cause sea-level to rise but may increase the number of intense storms. Katrina obviously provides an impressive example of what a major storm can do. The state of North Carolina needs to be prepared for the arrival of a major hurricane. It is not a question of if one will hit us it is a matter of when. We need to basically adapt and prepare a plan for the future not just what to do immediately

in terms of how to evacuate and how to respond but also once we have a major event how do we deal with the infrastructure and the property that is destroyed. Do we rebuild in places that are identified as being dynamic and dangerous? Sea-level rise of course is going to magnify the impact of these events because again we are talking about a very low elevation with low (inaudible) and when we have a storm the coastal areas of North Carolina are particularly vulnerable.

I just want to show you some images of what happened to a barrier island in response to Hurricane Katrina. What I'm showing here is some (inaudible) data that is laser detection in ranging and is basically a tool that we fly from a plane that sends out lasers to the ground. And from that we can get the elevation of the ground and basically what is colored brown in this image is a barrier island and what is colored red and green are houses and that is what I've indicated. This was data that was collected it was from Salty Islands, Alabama and it was collected pre Hurricane Ivan. I should acknowledge the USGS for these data. So this is post Hurricane Ivan – Ivan was a major hurricane that made land fall in this area. There were a few houses that were lost in response to this event. I will not bother pointing those out but what happened is this is after Hurricane Katrina and as you can see we lost much of the structures across this barrier island. Just to send this picture home a little bit, this is the aerial photograph from that exact area, so obviously major hurricanes can have a real dramatic impact on barrier islands and we need to be aware of this potential risk. I do want to highlight here that Salty Island has different characteristics from the Outer Banks. The susceptibility surge is different but there certainly are tremendous risks to the Outer Banks to a major hurricane as well as the rest of the coast of North Carolina I should point out.

Just to give you a larger perspective I was showing you one area – this red in the top figure indicates houses that were lost. Also I want to point out that the red indicates erosion of the barrier island and the green indicates deposition. As Michael pointed out in the previous talk this process is a very natural process and it is how barrier islands respond to rising sea-level in storms and this is a natural process that it is going to do this. Unfortunately, we have a lot of infrastructure on the way but we need to be aware that this is something that is going to happen and be prepared for it.

Now I am going to pass this talk over to Reide Corbett.

Dr. Reide Corbett: This is a quick introduction. Again, my name is Reide Corbett – like JP I am an associate professor at East Carolina University in the Department of Geological Sciences. My background is actually in chemical oceanography and I do a lot of work nutrients and sediments dynamics primarily in North Carolina but also around the globe. You have already seen this image and I start with this image, what I am actually going to talk about is estuarine erosion, but I start with image clearly Mike and I have spent hours on our website. Because it really demonstrates the impact of sea-level rise on the ocean front it is very easy to see the Atlantic Ocean encroaching along our barrier islands. Michael had mentioned that the one house that was falling into the ocean - this is a very common site and this is the sort of images we see during major hurricanes and after major nor'easters. This is very common along the Outer Banks. And again the same image that Michael showed earlier where those hopeless romantics in the recent movie Nights in Rodanthe, that is that romantic house that is now being taken over by the Atlantic. Certainly our

coasts are being encroached by the Atlantic but (inaudible) way into that with the idea that when we think about our coast line along North Carolina many of us think about the ocean front. The fact is that the majority of our coast line is actually found along the estuarine shoreline. Although much of the Atlantic front is what we think about when we think about coast lines. It is somewhere between four to twelve thousand miles of shoreline that makes up our estuarine shoreline. We have very little understanding of how that shoreline is changing in the near future associated with sea-level rise and associated with much of the climate change and much of the global warming that is expected in the near future. I start with a few images of what the shoreline looks like, the different types of shoreline along the estuaries and these have been mapped out fairly early in the 70s and 80s by Stan Riggs. Trying to get an idea of how these shorelines are changing in the face of sea-level rise and so I am going to show you four different images of the different types of shoreline. This is a low sediment bank and each one of these you will note that it is fairly easy to get an idea that these shorelines are retreating. You will see ghost forest (image C), you will see some dead trees of ghost forest (image A), you see an agricultural land affected by these rows are being cut into by the estuary. Here is a high sediment bank. These obviously eroded very quickly and fairly dramatically during major storm surges that we can have and happened in Hurricane Isabel along the Chowan River where we lost up to 100 feet of one particular bank during that one storm.

Swamp Forest shorelines along fresh water systems - again you see a ghost forest in that top image and some of the most critical habitat are marsh environments or marsh platform in the saltier regions of the estuary. And again critical for the ecology of the system are fisheries, are shrimp or crabs and our other fisheries in the state. The key for water quality sustaining decent water quality in our estuaries, these are systems that are being lost fairly rapidly and that is what I will try to demonstrate today. The other interesting thing in our state and around the Atlantic and Gulf Coast is our shorelines are being bulk headed at a fairly rapid rate. The structuring and hardened structures are being put up fairly quickly within the estuarine environment with very little guidance of what can and can't be placed along the shoreline. This is an area that I think we really need to keep our eye on and do something about fairly quick so that we don't end up with potentially a very large bathtub that is going to be filling up with hardened structures along the entire shoreline. I show here a few images primarily from the Neuse River estuary where we have done most of our work. This is out a little further north within the system along Roanoke Island again showing some of the filling and hardening and of wetlands basically lost of some of this critical habitat and the associated development that comes along with some of the loss.

So I am going to focus on primarily the Neuse River estuary shown there in the yellow box and this is an area where we focused the last roughly three years of some research by NOAA and some of what we are really focused on is what the rate of sea-level rise and you've seen some of that in what JP just showed with some cores that we've collected using the geological records to really evaluate what the relative sea-level rise is here in North Carolina. And some of the impacts that that might have and evaluate those impacts, how, where and why shorelines are retreating and I am not just looking at the shoreline. So where the water meets the land but also the habitat sitting right at that shoreline, we refer to it as shore zone. Whether it is that marsh or the marsh transitioning in the forest how has that changed with time? When we think about sea-level rise on any coast particularly along

the estuarine shoreline there are many things that are happening. You have for instance this is showing a marsh environment that is transitioning or migrating up that interface into a forest. That is where you get this ghost forest in that transition zone. The marsh migrating into that forest associated with the rising sea-level. At the edge of that very edge leading up to the landscape you have the erosion of the shoreline. We are looking at all of these processes that I show in this particular picture, we are looking at the shore zone migration we are looking at the incretion of a marsh and how that changes with sea-level. Many maps that you see are simply flooding maps with flooding the landscape as sea-level rises. Some landscapes like many marsh environments do keep up with sea-level rise, they may erode back but some of those marshes will also increase with time keeping up with sea-level rise. Then you have shoreline erosion. In dealing with shoreline erosion especially in these marsh environments, you have a significant loss of habitat and one critical habitat would be wetland habitat because of its functionality. Improving water quality through various filtering mechanisms obviously is critical habitat for fisheries. And what we've seen especially during Hurricane Katrina and within Louisiana recently is the importance of these marsh environments for helping and protecting the landscape behind those marshes as far as buffering storm surge. These wetland habitats are critical for many reasons.

I don't want to get into too much detail with the actual methodology but to give you some idea of what we did in order to get the data that I'm getting ready to show you. As we look at two different time periods – we looked at aerial photographs from 1958 and 1998 and essentially what you see in this particular image are those two digitized shorelines. The green line along the coast – this is just a small image of Cedar Island and the green line represents the 1958 digitized shoreline and the orange line represents the 1998 digitized shoreline. We can take that digitized line and convert that to points and essentially subtract the points to a difference. From that difference between 1958 and 1998 those 40 years we can look at erosion, we can look at incretion of land or we can look at ultimately no change on the scale of about, these are accurate within at least a foot if not better. So these are two different images showing the 1958 aerial photograph that we used and the associated digitized shoreline and the 1998 (inaudible) again aerial photograph and the digitized shorelines. We've taken those two shorelines and essentially done a difference. This is the Neuse River estuary including the Cedar Island area and what we've looked at is a 40 year change in shoreline.

I am going to focus in on just two locations Pine Knoll Shores, Cedar Island and again the focus area was primarily the Neuse River estuary but associated with some of the other work that we had going on we also looked at shoreline change in Roanoke Island. We looked at shoreline change in Pine Knoll Shores and I'll just compare some of the information from Cedar Island to Pine Knoll Shores and give you an overall figure of what we saw. Cedar Island and Pine Knoll Shores are very different systems, both sounds, fairly narrow, don't have a whole lot of area for waves to pick up. There is tidal fluctuations on a daily basis where Cedar Island you have very little tidal fluctuation, you have a very large fetch or you have a very large area where you increase winds increase waves. My focus first on Cedar Island and just kind of give you an idea of what I'm going to show you in the next several slides. The next several slides will show an aerial photograph and on that aerial photograph notice there are several different color dots that line the shoreline. Those

dots represent a rate of change along that shoreline for those 40 years. So in this case if you see a green color that's very little change – somewhere between 0 and 0.5 meters per year of change, if it is green 0 to 0.5 meters per year erosion. You see the blue color that's land gain you're creating, if you see the yellow, orange, red that is land loss, erosion. And as you move to red it's eroding much quicker. Just a quick assessment, you can see that the head lens tend to be higher in erosion. Here a lot of the area tends to be in the green so this particular area had an average shoreline erosion rate of about 0.225 meters per year. Just under a foot per year lost of land for Cedar Island.

We go to Pine Knoll Shores and the interesting thing about Pine Knoll Shores is a very short stretch that we actually looked at. If you just get the average change for that entire shoreline the actual change is 0. Very little change on average, now there is quite a bit of variability of the actual change and it ranged from some incretion as much as 2 meters per year. We were actually gaining land in this area particularly marsh to a loss of about a meter per year. Quite a bit of variability between what we are seeing within the small stretch averaging out to very little change, probably associated with the fact that we do have major tides in the system and we do have fetch for increased wave activity. If we look on a very large scale as this is the entire image of the Neuse River estuary the shoreline that we actually digitized and looked at shoreline change. And again what you see is a point every 150 feet along this shoreline. That point has been color coded based on whether you are eroding land or gaining land and again eroding is shown in the warmer colors your yellow and red. The fact is that we have great variability in erosion rate some as high as six to ten feet per year erosion along that shoreline. It varies depending on many things, fetch for one whether that shoreline has been hardened or not, what the chemistry is, what the depth profile is as you move off that shoreline. There are a lot of different parameters that can change how quickly that shoreline erodes over time. If you want to just look at some general trends you can focus in on what the trunk of the estuary looks like. So this is just reducing that data set that's just the trunk the main tributary of the Neuse River estuary.

What you see is the majority of your colors are much warmer colors. You have much more erosion along the trunk. You have higher erosion rate primarily the further you go out into the estuary, the closer to the mouth of the estuary where you have that very large fetch associated with Pamlico Sound. As you get closer to New Bern further up towards the con points of the river with the estuary notice that goes to your cooler colors, your greens and yellows. Smaller fetch not as much room for wave activities and slower erosion. We make this comparison to the main trunk of the estuary to maybe a few of the actual tributaries. So I am going to focus and just give you a couple of quick images of these three tributaries. One is the confluence of the river and the estuary right at New Bern this is a Swamp Forest environment. The one at Broad Creek just the next step down and then Cherry Point. Those are the three sites going from left to right again is the Swamp Forest at New Bern, Broad Creek and Cherry Point. Notice most of the colors in each one of those are green, very low erosion rates occurring within the tributaries especially when you compare that to the main trunk of the estuary. Now with that it is important to understand what's happening along most of the coast line, this idea of shoreline modification. When we started doing this study we were doing it primarily was aerial photographs and of course we wanted to get out in the field to kind of ground (inaudible) much of this data and when we did we noticed how important it appeared to be that shoreline hardening was becoming along our shoreline. So

we actually went out with the laptop, we went out with the GPS system and we mapped all of the hardened structures along the trunk of the Neuse River estuary. What this shows is each point represents an area where you had some modification of the estuarine shoreline. You can see the kind of laundry list of different types of modifications that we were actually looking at from a boat launch to a bridge to rip rap to ruin structures to an actual bulk head.

What is interesting is if you take all of this just along the trunk and compare those areas that are hardened versus those areas that are not the table in the upper left gives you some idea of the summary of that. Roughly 30 percent of just the trunk, ok this is just the trunk of the estuary, 30 percent of that trunk has been hardened or modified in one way or another primarily by vertical structures. So that leaves only roughly 65 or 70 percent of that in its natural state – now that's just the trunk. What is interesting is you move back into these tributaries we haven't mapped that yet and although I think it should be, many of those tributaries where a lot of the development is taking place today in many of those tributaries are being bulk headed at a fairly rapid rate. This gives you some idea, this is the Oriental waterfront where you have rip rap along the entire structure and with this sort of information we can look at the differences between shoreline erosion that are occurring in areas with rip rap with bulk heads; although the studies of this was in North Carolina and are limited if not non-existent. So transition from the shoreline to the shore zone and in particular when you put up these structures what you are preventing is any change in that shoreline any ecological change in that shoreline. Michael did a good introduction to the idea that what you have occurring right now in the Alligator National Wildlife Refuge is a transition from a forest environment to a marsh environment. That's what this image is trying to show that what you typically see with sea-level rise, increased flooding, (inaudible), increased salinity, forest will typically transition into a high marsh. High marsh will transition into a low marsh and low marsh is potentially flooded. That is basically the succession of an environment of sea-level risers. And as that continues if that is allowed to continue then what you have is an ecological system that can sustain itself. You continue to have marsh environments at that water's edge both high and low marsh. Then these just keep stepping back if allowed to do that and if the slope is such that can do that those will continue to step back providing that same ecological state that same ecological function with time.

One way of thinking of this is a kind of simple carpet model where what you're doing is rolling that carpet out but at the same time as you roll that carpet out, for instance the marsh rolling up that environment, you are also giving that carpet that is rolling up behind you and that is the shoreline erosion that's occurring. So what you want is for that marsh to be able to march its way up into the forest as quickly as it is eroding away on its edge. Then there is this transition zone occurring somewhere in the center. This example is just an image showing of a marsh environment freshwater marsh, moving into a forest. That transition zone of marsh to forest. In our environment what we are seeing is several different ways that this is transitioning and there are some examples – this top one is a migrating upstream. This would be an example of Broad Creek that I showed you just a minute ago or around New Bern where you have a Swamp Forest. That Swamp Forest has become saltier and saltier is going to transition into marsh and that is going to continue to move up that tributary. Migrating overland is an area where much of what is occurring and included in the Alligator Wildlife Refuge where you have marsh moving into forest

environment and this idea of a non-migrating island an example of that would be Cedar Island. Cedar Island is eroding on all of its edges and it has no place to go so that is an environment that will most certainly be lost in the future because it has no place to migrate.

Just to give you an idea of some of this migration some actual images that I can show you between two different time periods, 1958 and 1998. I am going to show you one at this N1 north 1 little slip up at Broad Creek and I'll show you some images from Cedar Island at the very opposite end of our study area. So I'll start with this is kind of a slump forest area this is the 1958 aerial image, notice there are a couple of lines drawn on there this little squiggly line is the line between marsh and forest and then this is an actual transect where samples were collected. If I toggle between this 1958 to 1998 image you can see a significant change in that shoreline, significant erosion significant loss of marsh with no transition occurring. Basically it is just a loss of land now the water is at the forest edge. We had the opportunity to actually get out there on a small plane and take some aerial images. That's at the same exact location where you can see water is now right at the forest edge. In contrast to that this is going down to Cedar Island it is actually south side of Cedar Island on (inaudible) Road. Again, you can see this transect right here - this is a forest boundary of a very small beach and then the transition that is occurring between the 1958 and 1998 image. There are several things that are occurring here if you look at the shoreline – notice that the shoreline is retreating and there is also the marsh edge along here is migrating upland. The idea of the carpet model – this is the carpet model right here perfectly shown. I mention that these systems can also accrete with time and if you look down here there are some major geo-morphological changes that are occurring. You have a significant stream here or inlet here and you don't have much of a spit over here. If you look at the difference between the two images that stream is now gone and you have a significant spit.

When I talk about accreting versus erosion this image shows all of those things occurring within just one fairly small area, why we have significant variability in these rates. That is the actual image there in the aerial photo taken recently. The idea that these systems can step back and they will transition as sea-level rises is important and that is a natural thing to occur. The problem is when there is infrastructure that might get in the way. This is a 1983 image that I was able to pull up of Point Peter Road – this is I believe a little bit further north than this point shows. I believe it is in the Alligator River National Wildlife Refuge. What is interesting is this major transition that occurs along a canal, this is marsh environment, the red is forest environment. This really demonstrates how infrastructure a road or ditch or something along that nature can stop that natural transition that provides that same function. If you allow these environments to transition on their own then you don't lose that ecological function with time. Put a ditch, put a road or something like that in the way and all of a sudden you don't allow that transition to occur. What do we do, how do we adapt? Certainly if we are thinking about adapting to climate change adapting to sea-level, what we ultimately want to do is preserve coastal North Carolina in a functional state like allowing for that same ecological function that we have today or if we can actually improve it. So in order to be able to protect our resources not at the expense of the health or function of the natural environment and in doing so there is no doubt that this idea of an economic engine. If we do this then we can continue that coastal economic engine. In general what we found is that there is no doubt that our coast is at high risk today and certainly in the future with increased changes associated with climate change.

What we've tried to do is give you a breath of example of the types of hazards that we are dealing with and specifically focusing in on estuarine shoreline erosion because I think it is not very often that we are actually thinking about that edge as opposed to the ocean's edge. You've got that hand out on this new website where we're trying to get information to the public on these different hazards NCCOHAZ (EXHIBIT P) and certainly even within that website we are trying to demonstrate the importance of shoreline erosion and not just that but the changes that are occurring along our estuarine shoreline associated with hardening. Some of the recommendations, I am not sure that adaptation works for some of these bullets that we've included but some of the recommendations – what we've done at least within the Neuse River estuary, we've documented shoreline change, we've documented a digital shoreline it provides a basis for us to evaluate change in the future. Certainly if we are going to do anything in the future to evaluate what is happening we have to have some idea of what infrastructure, what's currently at risk and the best way to adapt to it and there has got to be some initiative to go out and actually do this.

Plan carefully about placement and character of new infrastructure in the coastal zone – the idea of whether or not a road is going to be placed in a certain area that is going to prevent for instance the transition of a marsh moving into a forest. What is the ecological function that might change associated with changing the infrastructure? Determine in advance how to respond once infrastructure is removed by disaster or is the end of its engineered life. The fact that we have at least on the Outer Banks we continue to try to step our roads back and in the not too distinct future they are not going to have much room for them to step back any further - the idea that we need to start planning for whether it's worth continuing to build in these few locations that we've done in the past. Create policy (inaudible) planning preparation in action, the idea of prioritizing which coastal hazards that must be funded and an appropriate level to do so.

With what we've tried to demonstrate with our shoreline erosion site we have very little information on our shoreline. Again, for the entire 4,000 and 12,000 miles of estuarine shoreline that we've looked at is one of our estuaries the Neuse River estuary and there is very little information beyond that. Whether it's an actual digitized shoreline the wet dry line, erosion rates, how much hardening, how much of the shoreline is actual hardened or the rate at which it is being hardened, structures are being placed along it. So we need to create a baseline for the state for our estuaries, evaluate the shoreline, evaluate different habitats, evaluate structure and then ultimately from that baseline we can look at change in the future. Develop an explicit policy on the management of the estuarine shoreline. What we've shown just in the news is that the tributaries along the Neuse tend to have much lower erosion rates than what is occurring along the main trunk of the Neuse. That alone should tell us something about where we should versus what we shouldn't harden. We need to be able to keep a balance in the ecological function within our estuarine systems. We need to have the same functions whether it is wetlands, sediment bank, high sediment banks – we need to have that same function across the estuary. So in order to do that we need to look at where things can transition in the future, areas that we shouldn't harden, a hardened structure especially a vertical structure or bulk head offers no habitat. It offers no transition of that habitat in the future. Create a shoreline hardened assessment across the state to guide decision making by property owners and managers. The idea here is based

on information that, for instance, what we've done in he Neuse, we can use that information to develop an assessment of where certain structures could be placed, where hardening might not create too many problems ecologically or where we by all means should not allow any hardening or try to provide better set back.

You have several hand outs, I'll mention this is "North Carolin's Coasts in Crisis" and if it does work out J. P. Walsh and Dave Corbett will be here at your next meeting to talk a little bit about this particular publication (EXHIBIT Q) and a lot of the work that's been going on within this publication dealing with particular hazards associated with climate change. I've kind of given you a summary of the shoreline erosion as well and a publication (EXHIBIT R) that will be coming out in the near future a similar publication to this kind of a glossy pub as well as information to the North Carolina Coastal Hazards site and we encourage you to visit that to get additional information on some of these hazards and I'll stop there. I appreciate your time.

Representative Harrison: Thank you. Are there any questions from the Commission members? I appreciate you making the presentation – I am sorry we are down to such few members here. Is there any other business, any comments or questions? We'll approve the minutes at next meeting which is December 9th.

Mr. Givens: For the presenters and members who are here we do produce detailed minutes and they will become a part of the records so even if there was not a large number of people here to hear your presentation it will be preserved and become a part of the record. Note it might have some impact down the road. I call your attention to the fact that the next meeting is scheduled for Tuesday, 9 December and that we have meetings scheduled in January – Tuesday 13 January and Tuesday 27 January.

Representative Harrison: I guess that is it and we are adjourned and thank you again for sticking it out.

Meeting adjourned at 3:18 pm.

Respectfully submitted,

Representative Pricey Harrison
Chairman

Thelma T. Utley
Commission Clerk

APPENDICES

Exhibit A	**Visitor Registration Sheet**
Exhibit B	**Agenda**
Exhibit C	**North Carolina Renewable Energy and Energy Efficiency Industry Census 2008**
Exhibit D	**The Center for Climate Strategies memorandum dated November 13, 2008**
Exhibit E	**Peer Review by David G. Tuerck, et al., of the Beacon Hill Institute analysis entitled "The Economics of Climate Change in Legislation in North Carolina"**
Exhibit F	**Florida Department of Environment Protection Letter**
Exhibit G	**Draft of Minutes for 10/23/07, 12/4/07, 1/16/08, 2/11/08, 3/5/08**
Exhibit H	**The Alligator River Climate Change Adaptation Pilot Project and Memo from Mike Bryant**
Exhibit I	**Assessing the Costs of Climate Change**
Exhibit J	**NC Global Warming Cornerstones**
Exhibit K	**The Greenhouse Gas Marketplace: Commercial Regulation of Climate Change Solutions**
Exhibit L	**Recommended Mitigation Options for Controlling Greenhouse Gas Emissions Final Report**
Exhibit M	**Recommended Mitigation Options for Controlling Greenhouse Gas Emissions Executive Summary**
Exhibit N	**Secondary Economic Impact Analysis of Greenhouse Gas Mitigation Options for North Carolina**
Exhibit O	**Interim Report to the Environmental Review Commission and the General Assembly of North Carolina**
Exhibit P	**NC COHAZ – ECU News Bureau**
Exhibit Q	**North Carolina's Coasts in Crisis: A Vision for the Future**
Exhibit R	**Shoreline Change in the Albemarle-Pamlico Estuarine System, North Carolina**