Please stand by for realtime captions.

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Good afternoon. Welcome to today's webinar called benefits and cost of Maine's national climate solutions. I am a resource specialist for the conservation services support center and I will be your host. We will get started with a presentation in just a moment. But first a few logistical items. This webinar is being recorded. Everybody is in listen only mode and the audio is broadcast through the speakers. We want you to part a site so please type questions and comments into the Q&A pod. You can submit questions and comments throughout the presentation however, westerns will be answered at the end during the question and answer session. If you are having audio challenges, note the relay captioning link in the link pod. The captions open in a browser window and you can follow along with comments. In the handout pod you will find a copy of the presentation that you can download. Please note note that this is in the handouts. For best webinar viewing you will require a strong connection. If you wish to make adjustments to your view of the webinar you can make the music the options in the screen share window. If you choose to mute, you will need to have her your cursor at the top of the window to return to normal view. Unit to be in that so you can see the Q&A pod. Today's pod provides continuing education units. To end earned CEUs, you step two in the open conservation webinar window to complete a posttest cut into your credentials and receive a certificate by email. We will send your CEUs certificate on your behalf in about 30 days. Please submit your conservation planner CEUs to meet your local certification requirements. We encourage everybody to complete that evaluation., Putting the webinar provides the opportunity to learn about the system and you can submit optional comments. When rating the webinar please focus on the technical training divided the by the presentation of what you learned by participating. The on demand recording will be available from the webinar webpage at the science and technology library by early next week. I want to take a moment to remind participants that during the information provided is for information only. There is no guarantee of the product by the U.S. Department of agriculture door does its indicates -- of comparable products that are not named. It with that, we will now begin. I am pleased to start the webinar and turn it over to our webinar. Erin is the coordinator of the USDA Northeast climate group. You may now begin Erin.

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Thank you. And welcome to you all. This is the Northeast climate hub webinar series. We are very pleased that you chose to join us. As we are getting started we have some polling questions for your. We want to know a little bit about who you are and where you are from. Kindly fill out these polling questions will giving this introduction. This webinar series is supported by the USDA natural resources conservation service and by the U.S. DA climate hub. The climate hubs are national networks created as a collaboration of USDA agencies working in partnership with other federal, state and local governments. Land grant institutions and private organizations as well. The Northeast tub covers 12 states from West Virginia to Maine and includes DC. Our mission with the U.S. DA is to develop and deliver knowledge and practical information on climate adaptation and litigation for farmers and land managers. With the aim to support decision-making related to the impact of climate change. The webinar today is putting the spotlight on cost and benefits of the natural climate solution in Maine. This is part two of a part two series. Yesterday we discussed benefits and solutions with a focus on agriculture. This webinar was recorded and will be archived on climate webinar.net. Check out that site for other hub webinars that you may find informative. Today, we present benefits and costs of natural climate solutions but with a focus on forestry. The USDA climate hub is a collaborator on this project and the alliance grant which is the basis for the webinar topic. I am honored to introduce our presenters today. If you have questions, while presenters are speaking, please type them into the Q&A box. I will be monitoring that box and I will read them out at the end as time allows. Today, we have Adam and Dr.

Erin Simons-Legaard presenting on natural planet solutions. Doctor Adam Daigneault is Professor of forced economics at the school of Forest resources. Unlike me, he thought it was a good idea to do his schooling in central Ohio. He has a BA from Denison University and MS and PhD at Ohio State. All in environmental and economics. He has a knack for turning farm and forest into numbers and coming up with ways to analyze how changes in management can improve environmental, social and economic outcomes. Adam enjoys adventures in the hills of central Maine. Dr. Erin Simons-Legaard is a research assistant professor of Forest landscape at the University of Maine. She received her PhD in wildlife ecology from the University of Maine and has since developed a research program that brings together remote-sensing, landscape modeling and wildlife ecology. To better understand working in complex adaptive system. Welcome Adam and Erin. We are excited to hear you have to share with us. It is now time for the presentation. Take it away.

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Thank you, Erin, for that introduction. It is great to be here again. Today we are talking about forestry. I am going to assume that some of you, based on your responses to you are profession and location were here for the talk yesterday but along with that, there are plenty of new people so, the structure of the talk today, I will go over introductions as far as what are natural climate solutions and how they are relevant to what we are thinking of when it comes to climate change mitigation and then, how do we estimate these various benefits and costs from these different practices. I will pass it over to my colleague, Dr. Erin Simons-Legaard, who will go over in more detail how we actually estimate the carbon and biomass in wildlife related impacts from undertaking these various practices before having it handed back to me to do a wrap-up and so one. So, with that, let's go on this journey. So, what exactly are natural planet solutions. It is a new buzzword for saying any action that conserves, restores or improves the use of managements of force, wetlands, grasslands and agricultural lands while simultaneously increasing carbon storage or avoiding greenhouse gas emissions. So, we are thinking about three things. We can protect for us and prevent them from being converted to alternative uses. We can manage timberland better so improving the amount of carbon and timber stock on that LAN or, you can restore a forest and that means take area that used to be planted or might have low stocking and basically making those forests richer and more well-stocked. So, in the general context of this, this recent paper that was led by researchers at the nature curve Conservancy, it is estimated that within the United States caught natural climate solutions have the potential to remove 21% of the carbon pollution. That is equivalent of removing all of the cars and trucks from the road and then some. So, they have done a U.S. level analysis. It is believed that roughly 50 56% of the amount of emissions reductions that we can achieve on a natural basis can be done through the forest sector. So, it is basically the largest chunk of ecosystems that you might consider on a national level. But, agriculture, forests, the level of sequestration really varies depending on what you measure. At the global level we hear about deforestation in the tropics and how it can lead to annual emissions. And that coupled with livestock, nitrous oxide emissions and etc. results in one quarter of all the annual emissions around the world coming from the agriculture and forestry sector. In the United States, basically, we have roughly 10% of total emissions are coming from agriculture but also, the net increase in forest stocks on a year by year basis, there is the potential to sequester 11% of the total emissions being produced from industrial, commercial, residential and agricultural sectors. In balance, the land-use sector is what you might call carbon neutral. So the amount of emissions coming from agriculture are sequestered by the uptake of carbon in our force. Maine has a dramatically different look at things. There is small agriculture highly dependent on fossil fuels for heating and transportation. So, as a result, most emissions are coming from the energy sector and because we are heavily forested and the amount of growth that our forests incur every year, that is much larger than the amount of carbon and woods removed from the four so we are offsetting or removing 70% of the greenhouse admissions coming from fossil fuels, agriculture and etc. by the growth of the forests on a year-by-year basis. To get a better

idea of that, I would like to see show trends over the last 30 years. The way to interpret it interpret this is the greenhouse gases, the gross greenhouse gases. And we are averaging roughly about 18 million tons of carbon dioxide per year since 2010. With that, as I noted, for us can remove 70% of those greenhouse gases and that shows the net increase in carbon in Maine on a year-by-year basis and about 12 million-13 million tons are being removed on a year-by-year basis. To pick the green line, and net out the red line, the gases are somewhere along 5 million-600 metric tons per year. So the net divided by the green line gets it such that forests are moving 70% of the greenhouse emissions. So they are important part of the overall carbon footprint. That being said, we have some ambitious climate change mitigation requirements. And that is indicating that, through a couple of legislative and executive order actions, we have a goal of producing greenhouse gas emissions by 45% and by 80% by 2050. So, with that, those greenhouse gas emissions are only included in the green line. They also have the goal of being carbon neutral or net zero by 2045. So, we are trying to get at this blue line to be net zero by 2045. So we are well on the way there but, it is highly dependent on where the future of the forest may go. Just because there is a lot of sequestering it does not mean that it will sequester in the future without additional intervention. Antivirus the focus of the talk that is understand the dynamics behind that and what different types of practices we might consider putting in place to help Maine achieve this 2045 net zero goal. So, how exactly do we estimate the natural climate solution mitigation benefits and costs? There are three ways you could do that. You want to find a baseline or business as usual pathway. And that is what I showed in the previous slide. That is, where is the forest sequestration going and where might we go in the future? That is absent of any policy measures. The second is establishing acceptable mitigation practices. So knowing forest ecosystems in Maine within the state. And what can we expect the main Foresters and land owners to basically do on their landscape to achieve that. Third is that we need to estimate the cost of implementing these practices. And I will touch upon that in the next slide. You can come up with a lot of great ideas but until you quantify with the benefit might be or the relative cost that might accrue to achieve that, it is hard to say what direction we should emphasize forest owners to go. So we talk about estimating cost and benefits and solutions. We think about the cause that might be accrued. So, you might employ certain practices. And that could change the growth. Such that you could reduce those yields on an annual average basis. If you decide to extend rotation, or cut less would you will have an impact on the harvestable area. You will also have the potential to impact cost on the amount of carbon in those products. But there could also be maintenance associated with one of their practices you want to employ and their other environmental costs. So say, transitioning from one culture to the other, could have negative impacts to some degree on what your overall goals might be. Whether it is for habitat or water quality and etc. The benefits, the primary target is looking at sequestration and the cultural practices that we consider to be improvements. One idea for entering that is the -- you are not just looking to earn revenue through timber or a hunting lease. You are adding an additional stream to your forest portfolio. You can also have cost savings associated with managing your landscape. So, some practices might lead to cost but at the same time, certain practices are going to lead to environmental benefits. You just have to acknowledge that there could be potential trade-offs not just between timber and carbon or timber, carbon and finances that you might receive but also, the other suite of ecosystem services that the forest provides. Going back to what I noted earlier about this U.S. level study. We had estimated the potential greenhouse gas mitigation or carbon sequestration potential from six different management practices and they found the largest and offense are likely to occur through reforestation and natural forest management. Not so much about conversion. Because that is a general trend in the United States and that is that forest area is increasing. Some benefits could be accrued by fire management. And, relatively, small plantations. The key is, in terms of how it applies to the state of Maine. What we say here is not always going to be the same in the U.S. as it is across Maine. So, most studies are global in national in scale. And state level estimates can be more applicable elsewhere. So it is probably not most appropriate to take the results

that I took from the previous slide and apply that to the amount of acres you might see across the forest and landscape. Have a managed forest land in Maine and New England is much different than how land is managed in the West or the South. Practices that are covered in many of those larger studies are typically more conventional management systems. In Maine, less than 5% of the landscape or 5% of the harvests are coming through what we would define as a clear-cut type of culture. It is very much a partial cut type of management regime. In addition, there can be specific implementation barriers that are specific to the study site. So, with that, based on that knowledge, these are the practices that we will consider in this study. So we are avoiding deforestation. We are seeing upwards of 10,000 acres per year in Maine being converted to development. There is also the idea that you can do reforestation. So even though more than 85% of the main land is facing deforestation, there is a way to put that back into the forest. You can also think about what is typical in improved forest management and carbon sequestration in terms of increasing the overall stocking of the stand and we think about the landscape is shifting towards plantation-based forestry a focus on improved forest station. We are also looking at permanent set-asides and removing that from any harvesting. So with that, I just want to look at this poll. What we have talked about, and this is a rough understanding of the different systems that could be different in Maine. So, what are the most important practices that we will discussed today that will have an important impact on forest carbon within the state of Maine.

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[ Poll being conducted ] I will give another 10 seconds or so to think about this. So, basically, it is really the idea of trying to some these up across the two. What would be the top to practices that you would think, by the end of our talk are going to come out with the highest mitigation potential? What we are really seeing is if you add them up, we are saying the conversion of existing forests are going to have a high number and, it really seems to be quite mixed if you add up a lot of the other ones. We are getting roughly 30-40% sinking that the next one popping out might be extended rotation and that is very typical. And may be the lowest one is deforestation of non-forest and stands. But, overall, quite a mix between the two. So we can remove the polling question and I will move on. So, before we pass this along to Erin, we are looking at what we can expect to see from employing a number of different practices and I want to give an overview of how do we come up with the estimates that we will be showing over the next half-hour. So, the first thing is in this study, we are looking at two key components related to carbon sequestration. So we are looking at the annual change in the amount of typical amount that has the most flux within any sort of standing forest on a year by year basis. We are also going to track the amount of carbon that is stored in harvested wood products and landfills. And that is roughly % of what is removed and stored in products over a 100 year period. So for total seed we of the forest and harvest together. We talked about economic costs and benefits. So the top part gives us the physical and technical potential and we also look at the economic potential. So, with that, we want to look it four things. So we are looking at how much revenue you are going to get from a forest product. And then what is the opportunity cost. What is the change in revenue relative to business as usual. So it could be positive because you are changing a practice that gets you more biomass per unit that you were looking to measure. The third is the planting cost. So there is seedling, site prep and creation of clear-cut based practices and then finally, when you're thinking about opportunity cost associated with either resourcing land or avoiding conversion we need to account for, what with the highest and best use of that land be and therefore need to understand that you need to compensate the landowner for whatever they might be able to generate from that years. And so, total cost are the mix of opportunity plus planting plus land costs. So now I will pass it over to my colleague, Dr. Erin Simons-Legaard regarding how we come up with what is in this graph regarding aboveground growth. Take it away Erin.

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So, how do we model carbon sequestration. So we model aboveground dynamics using a force landscape model you called Linda's. It has been through a couple of revisions and he continues to have a very active user and developer community. It has been previously applied in the Northeast but those previous applications have either ignored or oversimplified timber harvesting as a factor of carbon dynamics. This model is spatially explicit. These are all modeled with spatial processes. So the extent is determined by the users. We encompass the northern half of Maine. And this contains nearly all of the commercial timberland owned by large landowners where the bulk of yearly harvesting activity is located. Our resolution was 30 meters. You will C in just a minute. So, each grid cell here was 900 square meters. And the cells are grouped into stands based on similarity of the restorative condition. The processes included harvesting, wind and climate change and specifically the impacts of climate change to tree productivity. We grossed minimum and maximum air-quality change in precipitation is expected to increase but also become more variable annually and enter annually. So, LANDIS is data hungry for input conditions. So, I drive maps from a combination of plot data from the U.S. Forest inventory program and NASA looks at that. So our area includes 1500 plots where FIA has been collecting information on a regular basis since 1999 so there is a rich data set to collect upon. It will use that for reference information when we model and map species distributions and relative abundance. And we do this for species that occur at least a 10% abundance within the study area. So that includes these 13 species that I am showing you here. There is also an example here of what the wall some for relative abundance looks like. And we use that to develop a forest type map that is then ingested by LANDIS. So, from the data and user supplied data, we estimate live aboveground carbon. These are the initial conditions upon which we can layer different forest practices to see what sort of impacts they are going to have on forest conditions into the future. As Adam said we start with the baseline scenario. So for the Landis part, to model the effects of the different practices, we started first by observing and then emulating what we saw as business as usual and will attend forest disturbance with that. And we use that to estimate the annual area harvested and that was 2010. And what we attempted to emulate, those harvest rates and patterns, we assumed that 90% of the harvest area was being removed by partial harvest and 10% by clear-cut. So if I look back at what Adam said, we have the bulk of the activity is higher. We set the minimum stand age 2 50 years and then calibrated the harvesting to maintain removal over the projection period. Allowing for a variance of 10-15%, under the assumption that, really, overall, landowners are trying to manage sustainably. So, this is our business as usual scenario. So let's take a look at the practices that we considered. So, looking at the basic outcomes and this is the business as usual scenario, this is the low admission climate scenario. This assumes that levels will stabilize rather than increase as the baseline assessment. You can see that removals, which are in the bars, mostly stayed within that 5-15% range over the course of the projection period. And they also vary by species. So we are seeing different species in the colored bars. And in the dashed line you see the live aboveground carbon and that declined between 2020 and 2100 because growth could not keep up with harvest. So, that is the baseline scenario. The different practices that we considered. We started with extending the rotation. So, we did that by increasing the eligibility criteria for stand selection for harvest. We also varied the partial harvest to clear-cut to include more clearcuts and we wanted to see if there was some benefit of carbon sequestration and other benefits to that approach. This has the incidental effect of reducing the overall footprint. We did this with and without planting within the clear-cut areas. We also increased the land held in reserve from the existing 6% that we have within the study area and then all the way up to 20%. And then finally, we looked at a mix of these practices. If you are familiar with the old Triad model, it recommends that management means that you have a certain proportion of your land in reserve and a portion that is intensively managed and then the rest is extensively managed. And then, in a few minutes, we will tell you how we manage the other components. These were not things that we dealt with within the ecological model. They came later. So, lots of lines here. But, a few key points. So, given giving every line a unique color and marker, I have stacked the legend by where the

different practices and up at the end of the century to give you a sense of the ranking. Overall, the projected trends live and aboveground carbon stock, life and aboveground carbon and metric tons varied by harvest scenario. So this is under model RCP 2.6. You can see they are all in the bottom at the black. The ones that rose to the top in terms of benefiting carbon sequestration, the planting generated the largest difference from the business as usual. So, we have those clustered there at the top you can also see the triad treatments are also there competing at the top. In the middle, we have these set-asides increasing that proportion of the land that is in reserve and these are unmanaged reserves. No touch reserves. After that you can see the extended rotation. So, we did not see a whole lot of change throughout the projection period but when we increase the rotation to 100 years, we initially saw a lot of impact but that changed over time. Then down at the bottom, with the business as usual, we see the increased clear-cut treatments without the planting. So again, that was under 2.6 that is now on the left. The same set of scenarios under the high admission scenario, the RCP a .5 which shows CO2 levels increasing and even doubling from where we are now. And the practice ranking was the same regardless of which one we modeled. But, you can see that the high admission scenario on your right had a dampening effect on forest productivity. So as things get warmer in our Region, especially the northern conifers are going to have a hard time maintaining product to the and then that plays out with increased difficulty with growth keeping up with harvest. And as I mentioned, we have considered a lot of the benefits. We have looked at a suite of services said this is just a snapshot. Here we have focused on the spruce carbon and lay succession for us to so how much forest do we have in these forest types that are within 100 years old and then the other end of the spectrum. They are associated with early regenerating spruce forest and I have given you a subset of the different practices so that top line is if we extend the rotation out to 100 years than the 10% set-aside depending on clearcutting without planting, with planting and you can see were we have, sort of a variability in terms of the trade-off associated with these different ecosystem services and practices. And this is another lens that we are bringing to the analysis so we are not being totally myopic and only focusing on carbon sequestration. All right, add up, take it away.

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All right. So, Aaron did a nice job of laying out where the trajectory of forest carbon stocks are looking to go in Maine, particularly in northern Maine, over the next 50 years. We had a comment in the chat that I want to address address now. And had to do with the question about why are we only focusing on aboveground forest carbon as well as the harvest and would product carbon. The answer there comes with understanding what is the difference between forest carbon stocks and forest carbon sequestration. The figures that are shown here are the live aboveground carbon stock. So if you went out and you measured across the landscape, what is the total amount of carbon that you see out there. When we talk about mitigation, we want to compare the amount of change in carbon stock or what we call flux to the amount of emissions that are going out of tailpipes and smokestacks. And those are measured on an annual basis. So within forest ecosystems, the stocks that change the most are going to be aboveground carbon and then those in the harvested wood products. So that is why we are focused on that. So, the next few slides I will present on sequestration so we are looking at two points along this line or three points along this line and looking at the change from one point to the other. And the difference between each of these lines and dividing that by however far we go. So, the stock is gone at any point in time and we measure how much is out there. And we look at the difference in that stock. And that is the amount that basically has been sequestered or omitted. So what is, let's take the trajectory and looking at something that is more comparable than the spaghetti graphs. So we have looked at those changes in carbon stocks and looked at them over a 20 year and a 50 year average. So that is a short-term and a medium-term look when considering approaches. So, the 20 year mean is the blue and the fifty-year Maine is the red. There is a strong benefit as far as mitigation potential but ultimately, what happens, we have a return after harvestable age and then they get cut. So these

additional benefits are lost over a timeframe. Just doing clearcuts with regeneration does not produce a lot of carbon footprint. Just how those stands are growing. If we can it accelerate the inputs, we can see that we are getting a lot of input just taking some land in the set-asides, this does enhance the overall is sequestration but only about one third up to one quarter that we might get from the planting. Then we look at the planting and business as usual as well as set-asides. And that is a happy medium. So we are getting somewhere upwards of 2.5 metric tons per year. So we are focusing on the 9 million acres in northern Maine but, right now, Maine is focusing around 12 million tons per year and again, we are ignoring the bottom half of the state as well and that is outside of our study area. So, with that, you might be thinking that there are concerns or the effects of what happens when you reduce harvesting. There are two ways you can think about that. One is that the local economy is largely dependent on forest industry so changing that will have impact on the economy. In addition, there is this idea of linkage and that is, if you do not cut a tree in the state of Maine, what will stopped a mill from getting it there logs from outside the study area? Or, in the Northeast, if we stop harvesting, there is still a demand for wood so what will prevent harvesting from occurring in the tropics. So you want to understand the impact on harvest volumes. What we found here is that most harvests are within 10% of what the base level lines are. The key exception being the extended rotation, particularly after focusing on that 100 year level. And that is where we can see harvest levels drop, particularly in the 20 year period. Then if we take the carbon that is being increased in the above ground. And that is the first line and then we look at the change in the amount that can be stored in wood products. And in all cases, we saw that would harvest will go down. We need to think about that when we look at net impacts. So, the a Brown is the above Brown aboveground carbon and the grain is the amount that is being produced or the relative change in harvested wood product as a result of having less harvest. So, the total carbon is a net of those. So you take the brown minus the green and that is where you get the net. So the establishing set-aside, it will have a negative impact on harvest and that will reduce the overall amount that is sequestered. Increase in clear-cut and planting, the harvest went down barely at all. In some cases it is just flat. And that is where we have that minimal leakage. The other key aspect is that is all about technical potential. But if we want to look at things that are --, this would be shifting from the conventional business as usual practices to one of these regular practices. So, looking at the really large cost, all of the opportunity cost, clear-cut not so much from that perspective but it does not have a lot of carbon. These are actually quite costly and that has to do with all of the additional cost that you face when you are doing artificial regeneration and planting relative to the more natural based approach to partial cutting and mixed species management. And of course, this is a happy medium between all of them. When they establish that aside, there are costs because you are taking product out of production. So we can take all of these figures together and you can take the amount of additional carbon being sequestered above the baseline and divided by the cost, the basic cost to achieve that and then we have a breakeven price. So that is, if you look at comparison across any mitigation process, when you look at anything, everything is measured in the dollar per ton so what we can see here is the relative cost that you may need to compensate a land owner for the amount that they are sequestering in addition to what the business as usual case might be to recognize that you may have to --. As far as other things that we are seeing, this is what we found that the average cost is $30 or more in some more conventional practices are over $50 per ton of carbon dioxide. So, I will go that take a look at these next two. So outside of the Landis model, these are costs that are related to conversion. So forest can projected to be lost in Maine and we are looking at a long 10,000 acres per year. That will shift to development. So to mitigate that loss, you may pay land owners in perpetuity. Although Maine is heavily forested there is the potential to plant trees in areas that have not been planted in --. So, and that lessens the benefits that they might get from moving into forestry. And so, collectively, those are the figures that I have appear. These are the summaries in the previous slide. So it is these clear-cut implant options that will offer the most bang for the buck. So this in light green come in around $10 per ton of

CO2. Conversion from cropland, not a lot of benefit just because there is not a lot of cropland or a lot of forest that is expected to go into cropland and then paying for avoided conversion development is believed to be quite pricey. So, given where pressures are in the state of Maine, that is quite high so that may not be the best thing to target when thinking about fixed budgets and where to focus. If you combine the best option that we can get through clearcutting and planting along with deforestation, we can roughly get into this with 400 million attic cost of $64 million and it comes out to an average cost of about $60 million per carbon 10. Over the last couple of minutes, everything that we talked about earlier was about technical potential. Estimated the cost of the technical potential. But we also need to recognize that there are barriers to implementation. And a lot of the groups that we held with key stakeholders, it was recognizing that the biggest barriers is the financial. People are willing to implement the practice if they can be compensated. There are also concerns about the lack of experience and not really knowing how to do it. In addition, the potential impact that it might have on harvest supply. So people are concerned about the negative impact on main economy. And then, we asked, what practices would you consider implementing if we could get the incentives right and by far it was commercial and precommercial settings. And that is to enhance stock as well as extending rotations and to some degree, a bit of modifying clearcuts. So, touching upon some different constraints and barriers, one thing that came out is regulation versus voluntary. Everybody says they are fine with voluntary markets. They don't want to see more regulation. They don't want to see more affects top-down coming from the state or the feds telling them how to manage their land. And a lot of people are interested in doing intermediate treatments but there is a financial constraint and when it comes to small land owners, there are technical barriers. Many noted that managing forest is not just about timber and then, in this case, carbon. It is a multi objective approach so we want to have better ideas about how this can impact multiple objectives. And Erin did a nice job of that. The fourth his public perception. So I may have found that clearcutting and planting on large amounts of land would be carbon beneficial but, many are hesitant about the clear-cut and they are noting that, the 80s into the 90s was a transition in terms of how the main forests are managed. People are not sure if those in Maine are willing to go back to that approach. And then finally, as I noted, there is this idea of focusing on supply but also maintain sequestration. So, just to summarize, the top practices that we found were a mix of harvesting as well as planting and set aside so that is that triad approach. We found that the harvest were pretty close to historical trends and as a result that will reduce leakage. And as Erin noted, there are habitat trade-offs and overall we found that many of these -- and that is pretty cheap compared to other sectors of the economy. But we will need to include technical incentives across the state. With that, I want to thank all of the collaboration funders and for Erin to funding this. And Erin Lane in that perspective. And Jen has posted a number of links associated with this webinar and Mostar related to the initiative project of which you can find a lot more detail on these projects and more on our project on site. So now, I will toss it back to Erin to moderate the last part of the webinar.

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Thank you, Adam and Erin. That was a fantastic presentation and series of presentations yesterday and today. We are now opening this up for questions. If you have any, please type them into the Q&A box. We should be able to answer some bow and follow-up more later. So, you mentioned, there is a question here about how clearcutting increases sequestration and if it is related to sequestration.

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Yes. It increases the sequestration and of the storage side, that contributes to that, because if you remember, when we increase the clear-cut proportion we maintain the supply. And that means, we reduce the overall harvest footprint. So the same amount was coming out. And that means that more forests was left to age. So we had that additional co-benefit of mature forest acting as additional storage.

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And you did mention regeneration pressures. What are the primary ones?

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So, climate change is going to give the northern conifers and with increasing temperatures, they will not spend optimal time in their -- range. So there production could go down.

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You mentioned a climate change plant paradigm. With that compromise the multi climate species in the Maine woods.

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Thank you, for the question, Roger. At getting back to the fact that increasing clear-cut has that benefit of leaving it more forest to age. So, it does not actually have that effect, as you might ask expect. If we were harvesting the same area but all by clear-cut, absolutely. But that is not the scenario as we designed it. We designed it to maintain supply and that means of the harvest footprint was reduced and that means that we have more mature forest on the landscape.

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Thank you, Erin. And this one is for Adam, which RCP do you see main and the United States falling with the business as usual scenario.

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So, we always have this discussion and debate. A lot of projection when you look at things globally and any sort of mitigation and continuation of existing policies are probably closer to a 2.5 that a 5.6. But then international obligations are at least locally committed to getting closer to a 2.6 target but, when it comes to a forest management perspective you need to take both into account. And that is where we need to think about, we as individuals, we only have so much influence on which trajectory we can get on and another aspect is looking at it from the adaptation sense. Work and we look at biomass increase benefits regardless of the trigger tree.

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Great. Thank you. So, you mentioned the ability of soil harvest stocks. Have you evaluated the soil harvest disturbances with this?

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We have, to some degree but not to the level that we feel like we can included in the modeling. It is a good question. There has been analysis conducted saying, basically, depending on what practice you employ, you could have plus or -10-20% on soil carbon. And as far as the carbon pool, it is a big one. It is 50% of the total stock if you look at anything from the top of the tree to several meters below the ground. So, but there is still a lot of uncertainty around that space. That being said, it comes back to the relative change across these practices. So it is shifting away from this did trail and broad-based approach and what is the relative difference in disturbance area. It is harder to say then how much of an effect that might have on soil carbon relative to the above ground impact. That is a great question. It is very complex though. Is a complex answer. Spiking thank you and thank you, both, again. We are out of time for questions but we may be able to follow up with those that did not get answers. I will hand it back now to John.

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On behalf of the USDA and the natural resources conservation centers I want to say you, to Adam and Erin for providing information about the benefit and cost of natural climate solutions forestry. And thank you, for attending the webinar. And participants, please provide your feedback about the webinar and if you would like to earn CEUs, please continue to process that. This concludes the webinar presentation.

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