Tetra Tech
Moderator: TBA
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OPERATOR: Good afternoon, ladies and gentlemen. It is my pleasure to now turn the floor over to Timonie Hood (ph), the Region Nine EPA. The floor is yours.

TIMONIE (ph), EPA: Welcome to the third West Coast Webinar of a three-part series on climate change, waste prevention, recovery, and disposal, organized by the Environmental Protection Agency Region Nine and 10 offices. We're happy to have you here participating.

We are also happy to be here live in Burlingame, California, with our partners, the California Resource Recovery Association, at their conference. We've got live presentations, and the participants are here as well as remote participants listening in from across the nation.

Before we introduce today's speakers, let me pass the floor over to Tommie Jean (ph) from Tetra Tech, who will go over logistics for our remote users.

TOMMIE JEAN (ph), TETRA TECH: Thanks, Timonie (ph). Hi, everyone. So as Timonie (ph) said, we have live people here in the room and we also have people over the Webinar. This is a recorded session.

For those (ph) participating remotely, the slides are going to be moved for you and the lines are muted. If you can't see the presentation, you may download them, and we will send a link to that Web site.

We welcome questions about the presentations. Please use the chat feature on the right hand side of your screen. And we have set aside 30 minutes for Q&A at the end of the event. You just type the questions into the chat box on the right.

If we don't respond to questions, we'll e-mail you a response later. If you have a slow connection, you may have a 10 second delay in seeing the slide. But there's no voice delay.

We'd also like your feedback. If you are a remote user, you're going to get a pop-up that gives you four questions to give us some feedback on the event today. You'll also get an e-mail later asking for additional feedback on today's session.

So thank you to the people in person who listened to me go through the logistics for the people on the Web.

Welcome to all of you in person. It's nice to see your faces and I have some logistics for you as well. Please go ahead and turn off your cell phones and pagers. And if you need to leave at any time, that's fine. The doors are in the back there.

You are also welcome to ask questions about the content today. And what we've done is we have prepared these little Q&A cards. They're at the end of your tables. You can grab one of those, fill it out, and when you have a question, just send it to the middle of the room, the end of your table. And again, Q&A is set aside for 30 minutes for the very end of the session. If we don't get the chance to answer your question, if you put your e-mail address in here we'll e-mail you an answer as well.

You will also receive an e-mail with a survey link to give us feedback on the presentation today as well.

So we have a sign-in sheet that we'll pass around. If you don't mind giving us your e-mail, we'd love to be able to send you some information and get your feedback.

I think those are it for the logistics. So I'm going to hand it back over to Timonie (ph) with EPA.

TIMONIE (ph): Today we have five great speakers lined up. We're going to hear more about accounting systems, modeling, and economic incentives. As I mentioned, this is the third of three Webinars. If you were not able to join us for the first two sessions, recorded sound files, transcripts, and the presentation materials are available on our Web site to download at your convenience.

Our first speaker and moderator today will be Kate KREBS (ph). Kate has been a national recycling leader who has served as the Executive Director of the National Recycling Coalition, co-founded an incredible glass recycling company, Fire and Light Originals, and served as President of the Board for Californians Against Waste.

I'm pleased to hand over the floor to Kate to introduce our other speakers and to introduce the session.

KATE KREBS (ph): Thank you. Thanks, Timonie (ph), and thanks for all of you that are here for participating in a live Webinar so that we can share the real great expertise that we have here today with folks around the country that haven't been able to get here.

After my very light introductory slides, really painting a picture of what's going on in our nation's capital, we have a terrific lineup of technical speakers that will be running through their perspectives on issues affecting climate change and the new policy that is being developed across the country.

We'll first hear from Dr. Jeffrey Morris from Sound Resource Management. Jeff will present climate change and resource management modeling tools. He's an economist from the – originally from the University of California at Berkeley. He's been on the economic faculties at University of Washington and Colorado, and is currently the principal of an economic and environmental consulting firm in the state of Washington.

Then we'll hear from Evan Edgar with Edgar and Associates. Edgar – Evan will present economic incentives, climate change, and resource management. He has more than 20 years of experience as a registered civil engineer and specializes in solid waste management, recycling, composting, and renewable energy issues.

Following Evan, we'll hear from Dr. Lisa Skumatz with Skumatz Economic Research Associates. Lisa will present reducing greenhouse gas emissions with recycling investments. She's a hands-on economist with more than 15 years experience helping communities across the country analyze practical, economic, and policy issues to reduce solid waste. She has been honored by the National Recycling Coalitions as the Recycler of the Year with their lifetime achievement award and with SWANA's (ph) integrated service award for her work that she's done.

Finally, we'll hear from Joshuah Stolaroff (ph) from the U.S. Environmental Protection Agency headquarters office in Washington, D.C. Joshuah will present materials management and greenhouse gas accounting. He's a science and technology policy fellow working for the EPA on climate change issues related to material and land management and was a post doctoral research fellow in the Climate Decision Making Center at Carnegie Melon University.

So welcome to all of our speakers.

I thought I would start first with just a real broad overview. Whether you're new to recycling or one of the old guard, a key strategy that we've always advocated to optimize recycling engagement has been the environmental benefits of recycling.

The early hay day was really, for many of us, the energy crisis that really stopped our country from moving forward in the '70s. And I know that is when I started to get into recycling. And it really opened the door to all kinds of policy conversations that we could have. It was what we really built our advocacy on. It was what we were able to articulate, both to the residents of the communities that we worked in and to the policy makers across the country.

It also opened the door to manufacturers to start utilizing secondary materials as feed stock in their manufacturing processes because of the significant energy savings that they realized from using those materials.

Advocates, such as myself, started to focus in on the demand side of sourcing recycled materials so that we would create the marketplace that we thought we needed to make recycling happen and really try to articulate how we wanted to work on a level playing field with the virgin (ph) material marketplace.

We've made progress, but now we have another singular moment that we should look at.

What mobilized us before was this picture of the mo grow (ph). And I don't know anyone that works in recycling that doesn't have a copy of it somewhere around their office. It really said something about what we needed to look to, which is where are we going to put all this stuff that we generate? And hats off to the green peace advocates that were able to get up on the barge, hang the sign that said, "Next time, try recycling."

We're at that same kind of moment right now. And clearly the energy challenges that we're facing across the country are giving us the opportunity to bring in energy and environmental benefits again to real singular kinds of conversations on how we can reduce green house gases, how we can really make the planet that we all live on sustainable.

So for us at this point in time, as recycling advocates, this it the time for us to make sure that we have the expertise we need, the tools we need, the models we need, and the knowledge we need to articulate those benefits that we've been talking about for the last 30 years in this broader conversation called Climate Change.

Right now what we're seeing, both on Capitol Hill and at state legislatures across the country, is the opportunity to really drive home what's needed to make sure that recycling comes into policy. And there's two elements that I feel are critical and important for us to make sure that we work and focus on them.

First, the environmental impacts of recycling. And I think we're going to hear quite a bit of that from Josh as he presents some of his information in working at EPA on the war (ph) model. The other aspect that's key is the protocol that we need to develop for recycling so that it fits within climate change policy. And that is something it will take experts like all of us, both here in the room and across the country, to make sure that we are mindful about all the aspects that take place within a recycling system, both upstream and downstream, and that we count those aspects and make sure that we can include those protocols within the large climate change policy.

As a coalition, I think we have to drive forward to develop those protocols so that as other elements of the climate change conversation are moving forward with their initiatives, we have the same toe hold that we need to make sure that the activities that we've been advocating for all these years are incorporated in the work that we're doing.

So these two action steps are what we must do now. First, really pay attention to what EPA is doing on recycling impacts as they tighten up the war model and make sure that any gaps that all of us have identified over the years within the articulation of those elements are captured correctly. And I look forward to what Josh is going to share with us today.

And second, make sure that we engage a credible third party to help define those protocols for recycling projects. There's a number of national NGOs (ph) that have done that type of work, whether it's World

Wildlife Fund or any of the other NGOs (ph) that are in that space so that we have the central line (ph) metrics that we need and the parameters that we really need when we test for additionality (ph).

So what is going on in Washington? And then we'll get into the technical things. First, if you're a member of CRA, you're a member of the National Recycling Coalition. And Ed Skinole (ph) as the policy director is leading great work on climate change and making sure that recycling is counted and is encouraging the other parties, including the commodities manufacturers, the advocates, and the hollers (ph) are involved in the conversation.

So make sure if you're not an NRC member and you're out there in the universe, you become one because they are really leading that charge and doing great work.

Make sure that you're watching what the Federal Trade Commission is doing. They had a workshop earlier on environmental claims that have to do with climate. They could be out in front of all of this conversation. There was great testimony that was presented through that workshop, and they are working on really the framework for being able to claim – make any claims that are associated with climate. And so that is another agency that is going to play key role.

They're also working on environmental claims for recycling for biodegradable/compostable. So that whole section of work is open right now. And the team is working on it.

The House Energy and Commerce Committee, which is led by Dingle (ph), has put out a white paper on climate change legislation design. It was released in October of 2007. That's definitely something we all should be paying attention to and reading because that is where the action will be on the House side.

And then keep track of the Senate side, which is the Warner-Lieberman bill. That came out of the Environment and Public Works Committee. That is chaired by Senator Barbara Boxer. All of you in California, keep track with your representatives. She is leading the charge to make sure that what comes out the back end is going to really be effective.

And that is also where we were able to get recycling language included in the Warner-Lieberman bill.

And then last, we will have a new administration come next year. And if you put on very narrow blinders, both of the presumptive candidates have been working on this issue of climate and the environment. And we expect to see a stellar proposal, something that we hope we can all work with once they are seated and in place.

So that administration proposal is something that we all should be looking to.

So now I'm going to turn it over to our first technical speaker, Dr. Jeff Morris.

JEFFREY MORRIS, SOUND RESOURCE MANAGEMENT: Thanks, Kate. And hello out there in the audience here live and out there in cyber space.

I'm going to talk about measuring the environmental impacts of discards management, methods, models, and results. I'm going to kind of concentrate on the models. And because of that, I've included in the material you can download an appendix which has the results of the model that we've developed to try and make up for some of the shortcomings of the other models that I'm going to talk about.

Next slide. So we're on slide 10 now for those of you on the Internet. This is simply a summary of life cycle analysis for the product and services that we consume. And I've included it because I want to make sure you understand some terminology.

When I say upstream, I'm referring to all the parts of the product supply chain that happen. They're gathering the raw materials, refining the raw materials, the manufacturing of products – the transportation of the products to the retail store, and the retail operation, all the things that happen before the customer actually gets their hands on the product.

That's the upstream. That's the one part – the first part of the life cycle of a product. The second part is the use phase. That's when the customer uses the product. And the third is the down stream. That's when the customer discards the product because they've used it up and either had leftover packaging or leftover product.

So those three aspects of the life cycle I'm going to refer to occasionally. Next slide.

And I wanted to show you a little bit about the complexity of doing life cycle analysis. This is a life cycle – only three stages of the automobile supply chain. And it simply shows that for a $20,000 car, there's a variety of inputs (ph) that are needed, engine – an engine, the steel, the parts, the plastics.

And then to make, for example, the engine, there's a variety of inputs (ph) that are needed. Again, some steel, aluminum, electricity. And then, for example, to make the steel, there's another variety of inputs (ph) that are needed.

So the supply chain of any product is basically infinite, going back a long way in space and time. And life cycle analysis attempts to deal with that in various ways in order to recognize what the environmental impacts and the energy impacts are of actually making a product.

The retail store where you buy the product is just the end of the supply chain and then you use it and then discard it.

Slide 12 here shows life cycle impact categories. In life cycle analysis, we don't only talk about climate change. So there are other environmental impacts that are important, and that's one of the reasons also that we developed our model because that one environmental impact is not the only one. And because if we focus only on that one environmental impact, we will end up at the same dead end bad place that we ended up from focusing only on the financial bottom line.

So I sometimes say, "Can a Cyclops see 3-D?" This is a multi-dimensional problem. The environment is multi-criteria, multi-dimensional, and any one dimension focus of it will make erroneous conclusions.

And just to indicate what some of the other impact categories are, there's climate change. There's three human health impact categories, particulates come from the criteria pollutants, toxics, and carcinogens. There's toxics that impact our ecosystems called – impact categories called ecosystems toxicity. There's acid rain, acidification. There's waterway over nitrification called nitrification (ph).

There's global ozone depletion, ground level smog formation, habitat disruption, biodiversity, and ecosystems services degradation and resource depletion. So all these things are dealt with in a full life cycle analysis, and all of them ought to be dealt with whenever you're considering what to do with your discards.

So now let me talk a little bit about some of the available models. The first one up here is the clean air climate protection model that the International Communities for Sustainability organizations put out in which many local governments used to do their climate action or climate inventories, climate carbon dioxide, carbon inventories.

The second model is the USCPA's waste reduction model, or called One (ph) that many of you are probably used to – to evaluate what the impact is on global warming. Various choices you might make for managing your discards.

The third one is – was developed over a five year, almost 10 years now, period of time. It's called Municipal Solid Waste Decision Support tool. It's still not publicly available, but Research Triangle

Institute at Research Triangle Park back in North Carolina has it. And it deals with not only global warming impacts but a number of other pollutants also in a complicated model that includes the ability to optimize on one or more different criteria.

So you could optimize on climate change or you could optimize on your criteria air pollutants or you could optimize on the bottom – financial bottom line.

So that's a complicated model, and it hasn't been released, I think, in part because of its complexity and users have had some difficulties learning how to deal with it.

The fourth model up here is the Carnegie Melon Economic Input Output Life Cycle Assessment model. It's available for free on the Internet. The Internet address is up there. It's maintained by the Green Design Institute at Carnegie Melon University.

And its attribute is that it has all the toxics release inventory emissions that happen across the life cycle supply chain for any particular product embedded in it so that you can get not just green house gases or not just criteria air pollutants. You can get all 500 – approximately 500 toxics release inventory pollutants, the emissions of those associated with whatever product you might be thinking of purchasing.

Then I've listed up here one that's used widely, I think, by the leads (ph) people and for green building BEES, Building for Environmental and Economic Sustainability from the National Institute of Standards and Technology. It's called bees. And if you type in BEES on Google, you'll get this.

This model will give you the environmental impacts, again, across the supply chain of a variety of building materials you might use for a particular purpose; for example, metal framing materials rather than wooden framing materials, or concrete versus fiberglass or something like that.

The next one that's listed up here is US EPA's tracing tool, tool for the reduction and assessment of chemical and other environmental impacts. And this is a life cycle analysis tool that also includes the characterization factors that allow you to aggregate the various toxins and reach (ph) inventory, for example, the 500 pollutants or so, 500 or so pollutants, that you have into something like a single number or a few numbers so that you can communicate with that better.

You can imagine what would happen if you went to your city council and said, "OK. Well here's a life cycle analysis and here's the 500 different graphs showing which emissions are higher or lower if you pick activity A or activity B." Their eyes would roll and they'd ignore you.

So just like in climate change, we have characterization factors to aggregate carbon dioxide and methane and sulfur hexafluoride and nitrous oxide and chlorofluorocarbons into one number of carbon equivalents or carbon dioxide equivalents. We can do that also for all the other impact categories. And Tracy (ph) has that kind of waiting scheme embedded in it.

Then the next one is a tool that we felt compelled to develop because of some of the shortcomings of the other models, which I'll talk about in a little bit. And we don't have any name for it other than right now it's called the U.S. Environmental Benefits Calculator, Medcal (ph).

And actually, recycling coalition has a calculator that I think mainly gives energy and global warming outputs. The national recycling – the Northeast Recycling Council also has a calculator that I think also gives energy and global warming outputs. Doesn't talk about the other environmental impacts.

And then the last one is something I'll come back to, the Consumer Environmental Index, which we developed for our Washington State Department of Ecology. Next slide.

So now I want to list a variety of issues with the various models. And I think rather than being specific about particular models, I might occasionally say something. But since I'm the only one here and the other model representings aren't here, I felt it would be unfair to just single them out and say, "OK, this model is wasted because of that."

But let me indicate what some of the problems are and where we felt compelled to develop our model. The first one is that there's no upstream impacts in some models. And for discards management, 75 to 95 – 75 to 90 percent of the story of environmental impact is upstream. It's making a product out of virgin materials instead of recycled materials.

So if you ignore the upstream, you've already ignored 10, you know 75 to 90 percent of the story. And this was a problem when we did the inventory for Seattle Public Utilities using the premier climate protection model because at the Seattle Public Utilities, we wanted to think about, "Well, what should we spend in terms of money for various programs," and we wanted to think about you know spending money on recycling or spending money on a landfill or spending money on composting.

And to make that decision without looking at the upstream meant we would have ignored 75 to 90 percent of the story. So that particular method of accounting for greenhouse gases seems to me to be seriously deficient. It's as if as an economist we only looked at the cost of the product that you buy and – or we were looking at the cost of the products you buy and we only looked at the cost of the retail store.

That way (ph) you know all of the costs that it took to make the product. So I think that that's a serious deficiency that we need to deal with in terms of our green house gas accounting methods.

And as a friend of mine at Carnegie Melon, Scott Matthews, has quipped, this is the toe print versus the foot print methodology. And we need to know what the foot print is. The toe print is like you know you got your toe in the water. We need to know the whole boot if you're going to get in the water.

The second issue with some of these – with some of the models is that they – and I've already mentioned this – they cover only a single environmental impact. Everybody's focused on global warming, so many models focus only on global warming. There's 10 or 15 other environmental impacts equally as important that we need to look at.

And when panels of experts get together and talk about how to rate the different environmental impacts, the most I've ever seen them give climate change would be about 40 percent rate. So again, you're reading a big part of the story if you don't have a model that tells you what the impacts are across these other environmental categories.

The third problem is that there's often no capital equipment impacts included in the life cycle assessments that are included in the models.

The fourth one is a particularly serious one for discards management. There's no upstream composting impact, or very little upstream composting impact. And one of the benefits of composting is that billing too many soils (ph) means that you don't have to use synthetic fertilizers and you don't have to use as much pesticides.

So when you begin to take into account the not producing the synthetic fertilizers and the pesticides and what those impacts are of not using the synthetic fertilizers and the pesticides, synthetic fertilizers and yet (ph) nitrous oxide, for example, is one big climate change impact. Pesticides are nasty when they run off into ecosystems, toxic ecosystems. Toxicity is one of their big impacts.

Synthetic fertilizers have excess nitrogen that usually runs off because they're using you know too much too fast in nitrogen applied to the gardens or the farms or the lawns. And so it runs off into the waterways and that produces nitrification (ph), another environmental impact that's important to keep track of.

A fifth issue with the various models is the energy offsets. It's a big deal what you decide to credit as an offset for your – for your energy that you produce from the energy production disposal methods. So whether you're burning the materials or whether you're landfilling them and gathering the methane, if the energy production that you're offsetting, if you think it's a coal plant, you get a lot more credit than if you think it's natural gas. And if you think it's a removal energy, you don't get any credit, green house gas credit.

So it's a big deal what you decide is the offset. And in particular, the one model uses is fossil fuel. The average fossil fuel is offset. The decision support tool uses the average mix across the country for its offset. And we've decided in some projects we've done for Keane (ph) County and other places, in talking with the providers of electricity that the offset is really natural gas.

That's the marginal source of energy. That's the peaking source of energy combined cycle natural gas carbon turbines (ph). So if you use that as an offset and then bringing materials with that (ph), that's good because what you're offsetting is a clean – is a clean source of energy, relatively clean.

Coal is relatively dirty. Garbage is relatively dirty. Natural gas is relatively clean. If you burn garbage to offset natural gas you know it doesn't look as good as if you're burning garbage to offset coal. And what you're really doing is when you burn garbage in either a waste energy facility or a gasification producer, synthetic gas and you burn that, it's still burning garbage, you're offsetting.

And say you're offsetting coal. That looks a lot better than if you're really offsetting natural gas which is what we think is the real story.

A sixth point is whether it's based on a process LCA or an input/output LCA. In that automobile supply chain I showed you, a lot of life cycle analysis tries to go to the manufacturers and look at what they use as inputs and then go to the manufacturers of those inputs and look at them.

And I talked about the infinite supply chain. So you can usually only go back three or four stages in the supply chain with the process LCA. And input/output LCA, on the other hand, can go all the way through the supply chain, through the magic of econometricians and mathematics. But normally you can go all the way through the supply chain.

So that's an important issue to know which models are doing what there.

And number seven is the – a lot of our emissions data is not current as (ph) small sample emissions. This applies to any models. We have buildings full – we have a country full of accountants measuring the financial impacts of things. We have very few people keeping track of the actual emissions that are happening in the plant that's next door to you in the facility, whether it's a discards management facility or a manufacturing facility.

We have very few people actually measuring the emissions on a day to day basis like we measured the pennies for dollars and cents across the revenues (ph) for those facilities. And as a result, we are looking through a glass darkly when we look at the emissions.

And so you need to be very careful and conscious of this degree of uncertainty that you have about what the environmental impact is of any particular process you're studying.

The eighth problem is that we aggregate – I already mentioned this. We aggregate emissions only for the client change impact. We should aggregate emissions for all 10 or 15 environmental impacts so that we can tell the full story.

The ninth one, not user friendly models, very complex. I mentioned a little bit about that before. Number 10, even if you roll them up into the different environmental impact categories, there's been no particular method developed that's really great for comparing environmental impacts, like if climate change goes up and human health toxics goes down, well, what do you say.

And then if carcinogens goes up, that's method A, and then on method B, green house gases go down, toxics go up and carcinogens go down, what do you say to your decision makers? A lot of people have no idea, and these models don't give you much help.

And finally, the characterization factors to aggregate our toxics and carcinogens and so forth are in flux because there's wide disagreement about what the metals impacts are when metals, arsenic and cadmium and lead and copper and on and on in relation to the environment.

Next slide. So now I'm on slide 15. What time am I – what time am I doing? Oh, OK. Thanks.

So this is some of the additional data we've used in the calculators that we've developed. EPA and AP42 emissions data, which is a good source of emissions to look at when you're doing some of these environmental impact studies of discard management.

Our Washington Department of Ecology has seen (ph) studies for Washington State has vehicle and home fuel air emissions. So the use of cars and the use of fuels in your home, it's important to take that into account. And then books and peer-reviewed articles. And those are listed in the appendix to the – they're listed in the references to this presentation which you can download.

Next slide. So now I just wanted to give a couple of examples of the outputs of our calculator to show you what the impacts are and to illustrate some of these points.

The first one is this is definitions of turns on the graph. So if you look at it, you can see it. It's – and if you don't, don't get it when I go through it, you can go back to this. I better not spend time reading them right now. But this is basically what the types of facilities and types of discard management streams I'm looking at are.

Recycling, composting, anaerobic – aerobic composting. Waste energy means waste energy of the massed burn type (ph), or sometimes called advanced thermal (ph) recycling, gasification paralysis (ph) that uses so-called conversion technologies for turning our waste discards into energy sources, and then landfills. And the assumption is a 75 percent recovery rate for the methane, for the landfill gases. And there's dispute here because between 20 and 95 percent, gas engineers (ph) let's say (ph) 90 to 95.

We have certain people that have studied it and they might say 20. We ask operators of landfills and they might say 50. So the UPA1 (ph) model is defaulting at 75 and so I'm using that for these calculations and graphs I'm about to show you.

Next slide. So now on slide 17, this just illustrates the point that 75 to 90 percent of the story is upstream. This shows what energy it takes to make recycled – make products out of recycled materials versus virgin materials. And the bars are pretty clear.

Next slide. And then this is to show what happens when you add in the collection systems and the material recovery facilities and the hauling distances to markets. Just so you have something in the back of your mind, to haul a ton mile – to haul a ton a mile in a tractor trailer truck takes between one tenth and 15 hundredths of a pound of carbon dioxide. So that's between one tenth and 15 hundredths, 0.1, 0.15.

So transportation is the minimus (ph) here. It's the upstream that counts. And so when people criticize recyclings, we get (ph) recycling because it puts extra trucks on the road, if they're talking about climate change, that's just not true. That's not true. You can take a material – so a tenth of a pound of green house gases you can take a thousand miles and you've used 100 miles of green house gases.

And the differential in the next slide you'll see is a couple of tons between recycling and disposal methods. So transportation, collection processing is not the issue. The upstream is the issue. It's the upstreams throughput. As you know, we used to say, it's the economy stupid (ph).

So go to the next slide. This is the one that shows the difference between CO2 emissions, between recycled and virgin. And of course there you can see – and this is in tons per ton of material – so you can see the light green bars go up to two times and the dark green bars are down substantially below that.

So there's a ton or two or three or four or seven or eight tons of green house gas savings by making materials – products out of recycled materials. In other words, aluminum cans be shipped at minimum (ph) back several times before – in a tractor trailer or on a train or a rocket ship and – before you'd use up the virgin savings, the virgin offsets, of making aluminum cans out of recycled materials.

Next slide. And this just shows, again, adding in the collection systems and so forth. And the interesting thing here is often when people talk about getting energy out of our waste materials, they forget that a lot of our waste materials are simply fossil fuels. Plastic and rubber is a fossil fuel. So you burn plastics and rubbers, rubber, that's a fossil fuel emission.

When you're making a calculation of how much green house gases you save by getting energy from your discards, don't forget those discards are, in many cases, fossil fuels and so you're actually adding to the green house gas flow (ph) in the environment by burning them.

Next slide. Now on slide 21, this just shows the same sorts of results for composting. Go to the next slide. This is the same scale as the recycling slide. And in slide 22 this is blown up so you can really see the difference.

And this starts to show you some of the things that are important about composting that we've added into our model; carbon sequestration, the offset of fertilizer, synthetic fertilizers and pesticides. And when you do that, you get a significant greenhouse gas savings from composting.

This slide also shows effective carbon storage. So for example, when you cut down a tree, the tree sequesters carbon until it's cut down. But if you do anything with the wood, the carbon that was sequestered is still stored. Now, if you make it into paper, you lose about half of that carbon because you – for some kinds of paper, maybe 15 percent for other kinds of paper.

But this carbon is still in the paper. So as long as you have the paper or the furniture or the wood framing (ph) member, that carbon is still stored so it hasn't been released into the environment. You put that piece of wood in the landfill, it continues to be stored.

If you burn it or turn it into an energy source, that carbon is released. So you need to somehow be able to release the stored carbon into apparently your disposal options of landfill or waste energy or gasification or paralysis (ph) against recycling and composting or against each other.

We need to keep track of what's still stored, what's been released, because the environment does not care whether it was an anti phogenic (ph) or a biogenic source of CO2. If there's more CO2 in the air in one method than the other, there's more CO2 in the air. End of story.

So you need to know about storage. And we've taken that into account.

So this shows how landfills, in the case of yard debris and paper, stuff that's got a lot of carbon stored in it and doesn't degrade very fast in a landfill doesn't emit a lot of methane, a big (ph) waste of energy, degasification (ph). That's important.

Food scraps, the other way around. There's not much carbon stored in food scraps and it emits a lot of methane right away, even if you're collecting 75 percent. If you burn it, you emit less green house gases.

So it's not a super one-sided story, but you need to look at this in a complex way. Next slide.

This just shows for a particular – the same sort of thing. And in the appendix, there's all the other environmental impacts, seven of them at least, that I talked about. So you can look at those. So go to the next slide.

And the next slide I just want to show one. You go to – go ahead to 20. We're at 25. And now nitrification (ph). So here's an interesting thing to look at, in newspaper and cardboard, notice the virgin versus recycled content product difference isn't very much because making – making paper products out of recycled paper you need a – for example, be at the (ph) newspaper, you wash and repulp sort of (ph) the emissions into the waterways in terms of nitrogen turns the substances are about the same for virgin versus recycled. This is one of the few instances like that.

And show the next slide. Go ahead to the next slide, too. That simply shows that newspaper has a net release of nitrified (ph) substances because of the DAP (ph) operations. So recycling in terms of nitrification (ph) of newspaper is not as good as the other methods of handling it, again, the exception to the rule that in general recycling and composting are better.

And then for composting, this shows the offset of fertilizers, the fact that the nitrous oxide – I'm sorry, the nitrogen is not running off if you use compost instead of fertilizers. So the nitrification (ph) bar plunges off to the negative zone for composting.

Next slide. And then this is just an example of wood waste management options. And it's just to show the difference between substituting for fuel, natural gas fuel and substituting for coal and the difference between landfill getting energy from the waste and versus just flaring (ph) it.

An internal combustion engine that we used to convert landfill gases to energy is not a clean item. It's got some emissions just like your car engine. It's an internal combustion engine.

So in some aspects – in this case green house gases – so what you get from actually turning the landfill gases into energy is not such a big deal. You may as well just flatten (ph), especially given the capital investment you have to make. And if you – that's if you're substituting for natural gases.

And then next slide. So now I just wanted also to show, OK, so what is recycling 100 percent of our materials worth? And so how do you decide what recycling is worth? We've had people say it's not worth anything. We've had people say it's the only thing we ought to be do (ph).

So here's a couple of comparatives based on this Washington consumer environmental index that we've developed. Casting (ph) 100 percent of household curbside recycling materials – that's just the standard curbside materials – is equal to a 60 percent cut. In vehicle fuel and oil use, it's equal to 10 percent cut. In household electricity, it's equal to 100 percent cut in meat and dairy consumption.

Next slide is, OK, what about composting? Composting is more materials but they have less of an environmental benefit. And that's partly because we haven't really done a good job of figuring out what the – what happens to carbon in the soil when we use compost and how it builds. And we might actually sequester more carbon.

But it's equivalent – 100 percent of household composting is equivalent to a 30 percent cut in household fuel and oil use, a five percent cut in electricity use, and a 50 percent – or a 50 percent cut in meat and dairy consumption.

To put that in perspective, the average Washington State consumer generates 20 metric tons of carbon dioxide equivalents in a year from their purchases and use in discards.

This – these four things together, recycling everything and composting everything, cutting your gas and energy usage by maybe 25 to 50 percent and cutting your meat and dairy consumptions significantly might be able to reduce that down by 10 or 15 or 20 percent.

When we talk about 90 percent reduction being the goal it's because the world's oceans and soils (ph) can absorb about two metric tons – in other words, one tenth of what the average Washington State household produces.

So that's one way to judge what the worth of recycling and composting is. Another way is to put prices on the emissions.

Next slide. And I'm just going to finish up quick here. Here's the prices. I don't have time to go into this, but it's in references. This is evaluations of the various environmental impacts that are included in our model.

And then next slide, which is slide 32, this is what the environmental value is of various kinds of recyclables. And you can see, for example, aluminum cans it's almost $1,500, the environmental benefits of reducing the emissions by using recycled instead of virgin.

And the other materials are equally large, not quite that large but in the $300 or $400 or down to $50 per glass and compostables is $50 to $100.

Next slide. And just to compare those numbers to what the market price is for these materials are, this is in the Pacific Northwest. Right now we're at about $140 a ton for the average curb – mix of curbside recyclables. And if you mix those environmental values for the various materials down by their share of curbside collection, they're worth in environmental benefits more than $140.

So the environmental benefit is equal to or greater than the current market value. And just think how much recycling you can do if you could get twice as much revenue as you currently get. And that's, in fact, the social benefit of recycling that we ought to be making our decisions based on, not just the market value that we can get and avoid the disposal cost.

That's the end of my talk. And thank you very much.

EVAN EDGAR, EDGAR AND ASSOCIATES: Hello. My name is Evan Edgar. I'm not going to talk about the economic benefit. He did a great job with Dr. Morris. I'm going to talk about the policy benefit.

I'm a lobbyist in California, about AB32 (ph) and what's going on with the air board (ph). That's going to an OAS (ph) board and how do we play carbonopoly (ph). And it is a game that we could lose.

And about carbonopoly, page 37, we have to pass go and collect 200 tons of mandated commercial recycling, stay in a landfill jail. We have to promote the Community Chest of green house benefit, take a chance on bio diesel like sell (ph) ethanol, use compost in Marvin Gardens, and turn the company green and dream about carbon credits on Broadway and Park Place.

But it's not really a game. It's more like double jeopardy at times, believe me.

And I'm going to talk about some direct emissions like what does it mean to the local garbage and recycling company? What does it mean to your home town? What does it mean to the system?

And on a statewide level, we have to reduce 30 percent from a sentence (ph) as usual by 20/20. But from today's baseline, from '02 to '04, which is a baseline that we are doing today, it's only a 10 percent reduction.

So if we do business as usual, it's 30 percent. But from today, it's only 10 percent. And the institute of local government is a combination of like California league of cities and the California counties. They got together to form one of the best practices (ph) on reducing the carbon foot print of the collection companies.

And what is your carbon foot print? What can we do today? What's real? What's in front of us? And you can't manage what you don't measure.

On slide 39 I drew (ph) the lingo that I use in Sacramento on the four As and the four Fs of climate change. First, we have assessment, and I'll talk about that. And then we have action – I'm talking early action is what we should be doing now. Additionality is a buzz word, and who gets the carbon credits on assignment.

On a recycling system, the four Fs are what are the fleets, the direct emissions from the fleets? What are the facilities, the indirect emissions? What about the feed stocks being recycled, which are the avoided indirect emissions? And what are the feature of carbon credits?

And when we talk about emissions, direct, indirect, and avoidance, it goes scope one, two, and three in priority because you have to actually reduce the direct emissions first and then indirect emissions and avoid an indirect are the last on everybody's list. And fortunately, that's why we're here today.

On slide number 40, I talked about the carbon foot print reduction for the California Salt Lake (ph) system, what we can do on here for the typical curbside collector with a mert (ph). You're making 50 percent. Where are you at today?

And first of all, you have to baseline your early action. On case studies, we can baseline from the – back to '01 about. So some time along the way on green house gas inventory, you have to baseline it.

And what we're finding out, about 90 percent of the direct emissions are from the fleet use, from the fleets equip (ph) material, 10 percent are indirect from the offices. What we're finding out, what Jeff pointed out, was about you know 80 to 20 tons (ph) were carbon negative due to avoided and direct emissions. And that's a big number. And recycling is everywhere within a scoping plan with regards to what's going on with all aspects of the AB32 (ph) climate change scoping (ph) plan.

But how do you get our arms around being carbon negative? You know how do we account for it?

On slide 41, carb (ph) did adopt a great scoping plan. Rome (ph) was burning in California when we had the drought fires (ph) due to climate change. It was 110 degrees in Sacramento, and we had the smoke-filled air. But carb (ph) actually adopted a great scoping plan.

People – they'll forget about the world is watching with regards to the RPFs (ph), or renewable fuels, if you go into lower carbon fuel standards, with regard to solar roof tops. A lot was happening in that scoping plan.

Detoxing (ph) was left at the curb, along with composting, but how do we get the recycling and composting back into a scoping plan? And one of the great policies of the low carbon fuel standard, a 10 percent reduction in carbon intensity by 2020. That's in the top four of the AB32 (ph) scoping plan for the reduction, 16.5 – 16.5 (ph) millimetric (ph) tons by 2020. That is a great opportunity for everybody.

Low carbon fuel could be B20 (ph), biodiesel. It can be E15 (ph) ethanol, LNG, CNG, hydraulic hybrid. But what Jeff pointed out, a lot of these models, you don't get into a lot of upstream from like corn ethanol. You know how do you account for that?

So there's some problems with some modeling of upstream use of ethanol.

The carb ETAC, which is an Economic Technical Advisory Committee, they're looking at commercialization of – so they can set up (ph) ethanol. So we made ethanol out of our garbage, out of organic, instead of out of corn. And that's a policy that's being pushed by the ETAC committee.

C-CARB (ph), the California actual registry (ph), made a decision that B20 (ph), E15 (ph), are biogenic resources, biogenic sources. And they don't count. So it goes back to Jeff's example, it's still carbon in the air. It can't – but as part of your carbon footprint and as a biogenic resource, it doesn't count.

So that's a big policy decision that helps people reduce their carbon foot print with low carbon fuel. And of course then we have a waste port (ph) policy of diverting 50 percent of organics by 2020.

On slide 42, it talks about what California adopted into the policy, not as a mandate or not as a regulation – which it talks about additionality, which I'll get in later. But 50 percent of the carbon – 50 percent of organics reduction by 2020 was a strategic directive. And that means over the next 13 years, we have to reduce 13 tons per year. So that's a million tons incrementally per year got to be diverted. And how do we do it?

A lot of it can go in to – on page 43, I just have some factoids about low carbon fuel. The executive order put governor had some other features in it. About 20 percent of the biofuel is going to come within California by 2010 and 40 percent by 2020.

So what California wants to be is an eco industrial complex. We've done the dot coms. We've done the military. We've done entertainment. And now we've got clean technology and that's our next horizon. And by making it in-state, we can use it in state. We don't have to haul corn from the Midwest.

So about one ton of organic waste can make about 77.5 gallons of ethanol. So just doing some math, if we get 20 percent of the in-state fuel low carbon by 2010, that's about 2.5 million gallons of organic waste could be diverted there. And then if you do 40 percent by 2020, that's about 10 million tons.

But our trade association will represent the California Refuge Removal Council learn that merf first (ph), you've got to go through merf first (ph) to get all the recyclables out on traditional recycling. It's almost like a compost first. You've got to maintain the existing infrastructure in regards to recycling composting. What's left over can then go to these other types of low carbon fuels.

And once again, the upstream green house gas benefits are not part of the current modeling.

On slide 44, I've gone through (ph) a couple of carbon foot prints for different companies, and we can do it. You know if the league of cities and CSAP (ph) says, we use their carbon foot print 10 percent by 2010 or 20 percent by 2020, they did that in version four of the Best Manager Practices.

Just looking at the typical fleet out there by doing B20 (ph) or E15 (ph), LNG, CNG, or even the hydraulic hybrid, which is coming out, which is a 40 percent reduction. There are ways that our fleet that have 90 percent of emissions can reduce our carbon footprint by a low carbon fuel choice.

On page 45 I talked about the solar roof tops. And I've been modeling different roof tops with regards to that square foot on top. You do about 650 mega – 650 kilowatts and one megawatt, about 67 percent you can use on site, and there's different power purchases agreements for 15 to 20 years you sign, there's no capital. There's always good incentives on solar right now.

But we can actually reduce our carbon footprint by you know 60 tons out (ph) – oh, about 67 percent by having that on top (ph). And of course energy efficiency is a big bang for the buck, too.

On page 46, we talked about the fleets. We can reduce this by 13 to 20 percent, facilities at six to eight percent. And on the system itself, up to 20 percent. We can do it. So as part of the – when you focus that – focus on direct emission reductions and indirect emission reduction, that's the number one and two scopes going on right now that's in front of everybody and early action. So we – by focusing on that, we can do it.

Jeff had a good factoid about the truck going out to pick up – to pick up recyclables. I modeled a typical truck that takes about one gallon of diesel to pick up 2.5 gallons of single stream (ph). If you did the math on it and ran it through that federal war (ph) model unmodified, it's a 60 to 80 times (ph) benefit for every – you know of every gallon of diesel you put out, you get 2.5 tons of commercial single stream (ph), it's 60 to 80 times (ph).

So there are a lot of good practices there where we could have a – not only lower the carbon foot print but how do we increase recycling? How do we model that?

On page 47 I get into modeling the green house gas benefits. And I call those communal benefits. Everybody benefits by doing that.

So I don't know who owns the credit and I'm going to talk about that. So we can do eight to 20 times carbon negative on avoiding indirect emissions from recycling. A lot of marvelists (ph) claim that recycling is carbon neutral. Well, if you look at the green house gas benefits, they're carbon negative.

There's a lot of good stuff there that beyond the curve that we can model. But our modeling needs updating. As Jeff pointed out, there's a lot of models. People that use California – a federal model a different way.

For our there (ph), the war (ph) model is used to promote the carbon landfill. Well, last year working with TAW (ph) and working with (INAUDIBLE).org, we killed a carbon landfill on a policy side. The signs (ph) to be there, you know the carbon and landfill had some good signs that maybe the science (ph) is there, but on a policy side, at the Air Resources Control Board and the California Energy Commission, we killed a carbon landfill because we should have no policies standard to do that.

Gary (ph), you're supposed to clap on that note there (ph). Who killed the carbon landfill? That's a good one.

So C.W. (ph) did good on that one and we did (INAUDIBLE) .org.

On page 48, I'm going to talk about the policy incentive as to – with regards to what is in a scoping plan. People have said that you know recycling is at the curb, and it was with regards to what's in there today. Very deep within appendixes that came out a couple weeks ago, there's about – you know many commercial sites (ph) is good for about 3.5 million tons of recyclables. That's inside of there. Increase of compost use is about good for 3.1 million metritons (ph) of CO2 reductions and anaerobic digestion.

But it's very deep. It's not really quantified. There's not good factoids, but it's on to be evaluated list. So down the road some time it's going to be evaluated.

What we're trying to get through the carb scoping plan as well is some type of recycling protocol in order for local governments and business to use because they keep on saying the carb scoping plan, you can't quantify it and there's no good assessment tools. So that's one thing we've been working on is making sure that we have the assessment tools. What can we do now in order to assess the benefits of recycling so we don't have to wait down the road for five or 10 years forward (ph) until (ph) some protocol is developed.

On page 49, I do talk about (INAUDIBLE) assessment tools, and what is a baseline metrics? I think that was your term I liked, and your presentation in Washington, D.C. How do we baseline our metrics? What are the factoids?

And I’ve been using the federal WARM model, and I dropped the carbon landfill aspect. We just don’t account for carbon sequestering. We use the energy mix from California that is more green than it is coal (ph).

So, we modify that federal WARM model. But we do it in a sense that, for program design. You know, how to design a program. And what’s your next program to roll out if you do mandated commercial recycling? What are the factoids?

We use it for CEQA assessment. In California and starting now, any major project, depending on how, if the attorney general sues you or not. You have to assess the greenhouse gas aspect of that project.

And starting July '09, there will be office – OPR, Office of Planning and Research in the State of California, will be putting out guidelines on how do you CEQA assessment of greenhouse gas benefits and greenhouse gas emissions.

So, we're trying to develop those tools now, so as you go through the California Environmental Quality Act, as you go through our program design, we've got factoids that we can use to highlight the benefits of recycling.

But with regards to the protocol development, that's a slippery slope. When you look at a protocol, you can infer that you're using it for carbon credits. But if you do a voluntary protocol in a voluntary market, that's great. But if you do a compliance protocol, it has a high standard. At the California Action Registry, it has some real high standards in order to develop a recycling protocol with carbon credits in mind.

That's a very important aspect, because we can spend three to five years, like they did off of the forest protocol, to determine what are the greenhouse gas benefits for carbon credits for forest. That's a long, rigorous process. And if we don't do the assessment tool first and get that in place, instead of – and do it just for assessment without the recycling protocol in mind for carbon credit, that's the way to do it now, as a phased approach.

But if we try to develop a recycling protocol with carbon credits in mind today, it can derail just doing simple assessment tools in order to get that information into the mainstream today, in order for program design and CEQA design.

Which brings me to additionally. And that was one of the things that Kate (INAUDIBLE) on, slide number 50.

What is additionally?

And this is a question for CRA membership, because you can do a couple of things on additionally. You can mandate things and push them through the system, like A.B. 939 was a supply push bill, people call it. And today – and they're asking (ph) us (ph) to wait for carbon credits have a demand pull with it with regards to having money out there twice the value of – and carbon credits could be out.

So, with regards to California, we've always been leaders. This ain't Kansas anymore, you know. We're up to – we've done 54 percent on some numerics. But if we go to 75 percent by 2020, S.B. 1020, the Padilla bill is going through committee right now and has support of a lot of folks. And it'll probably be signed. Seventy-five percent by 2020 with mandated commercial recycling.

My trade association, the haulers are supporting it. But by supporting that type of bill, which is a great concept of push more through and we can design the program with the greenhouse gas benefit, we do not pass additionally test, or the regulatory test for carbon credits.

So, people are out there hoping to get carbon credits. Well, in California, by having a higher standard, a regulatory test, a mandate or a percentage is mandated, there are no carbon credits.

And plus, it'd have to be beyond business as usual, and there's things that are called real, enforceable, permanent, transparent and independently verifiable. That would be by the California Climate Act and Registry. And it's really tough to do that.

There's another CRA policy being pushed by one of the technical councils, on GRRN (ph). Linda Christopher (ph) was 2012 ban of organics. Cool. Compost of all organics at landfills.

And if that happened, and this is a great idea, there would be no additionally. So, that's a – so, as a trade association, CRA has got to make a decision. Do you want to keep on mandating stuff and push it through, or do you don't – or have policies and just wait for some carbon credits, maybe, that could happen later.

And C-CAR (ph) is tough with regards to developing recycling protocols with regards to what is an operational area? You know, who gets assignment of the credits? It's a long list of things that you have to look at.

On page 51 of my slide presentation, you know, we look at additionally. Additionally can vary over time. (INAUDIBLE) would be other bills in California, S.B. 1020 or others, that could kill additionally. It could take three to five years to do, because it's very complex.

It's huge, complex with regards to even getting your arms around the operational area. You know, do you account for the export of recyclables overseas to China? How do you account for that? Different energy mixes?

Double counting. So, if you reduce on energy use, say, electric, the sector, the electricity sector may want to get that credit.

As part of the CARB Scoping Plan, 80 percent of the CARB Scoping Plan, of the reductions, will be regulatorily driven. That's the cap. So we're definitely capping it.

The trade – people go, oh, you're a cap and trade – we can cap 80 percent of emissions, and that's through all the different sectors. That will be regulations that'll be rolled out in '09 and 2010, and be enforceable by 2011, with the mandatory reporting and enforceable caps.

And that's a strong statement. Eighty percent will be capped. The other 20 percent is cap and trade, where they can do different types of carbon credits. And the 20 percent is, you know, that's going to be rigorous with regards to passing the CARB and C-CAR (ph) compliance test on how do you turn that – who gets the credit? What is a credit?

And that's one of my fear factors is, is that, if we try to wait to develop recycling protocols based on what could happen down the road, and not work on these models today, and put all the resources on who gets the carbon credits versus assessment today, we've got to put our time and energy by having the standardized assessment tools, so that we can model these programs.

On page 52, who gets the carbon credits? I've been at the table in Sacramento for 15 years, and if you're not at the table, you're part of the menu. At least, that's another way to look at it.

But right now, the low-carbon fuel producers are in regulation. Anything above that 10 percent carbon intensity by 2020, the fuel producers are going to get it. So, whoever makes a B-20 or the E-15, anything above that 10 percent carbon intensity, the fuel producers.

I believe that domestic manufacturers should get the carbon credit. You're making – in the state of California, you're making plastic (ph) lumber (ph). They want the carbon credits. And you're making a choice to use a recycled product.

So, I'm at the table with the biomass energy guys. They want the carbon credits with all of the wood chips you guys make. Local government, they think they want the carbon credit, because you (INAUDIBLE) the franchises, your action. You know, you guys are empowering the hauler to get it.

Some of the haulers want the carbon credits for their MERF (ph). You know, everybody wants the carbon credits, but, you know what? There may not be any carbon credits, if we don't pass the additionally test. And I don't think carbon credits are to be had.

But they are to be had, whatever benefits there are will be part of the value chain of that commodity. So, whatever that commodity is, and if there are any carbon credits to be assigned, everybody wins.

One thing they're trying to avoid in Sacramento is a turf battle, that every meeting starts out on who gets the carbon credits versus designing the program for assessment and base lining the metrics. Early action.

So, we get lost. The whole thing is lost on elbowing for carbon credits, versus doing things we should be doing now.

So, on page 53, I'd say we get a pass go and collect our recyclables. That's part of the Monopoly we were playing up there. We can do carbon footprint reductions on direct and indirect emissions. We have the factoids for that. C-CAR (ph) is a good model to model reduction of fuel use and going to B20 and E15.

The AB32 (ph) and Scoping Plan is great opportunities for industry with regards to low carbon fuel, solar rooftops, making biomass chips to send off to the biomass plant.

People have been very critical of the CARB Scoping Plan, but on a big picture, what it does is huge opportunities for our industry. Huge. Maybe less recycling at the curb, but recycling every place within a recycling, within a CARB Scoping Plan.

And what I'm saying now is, plus, we need to develop the tools today for recycling for both program design and CEQA assessment.

And do not delay early action. People are sitting around wanting to delay early action. They're delaying different programs, because they want to get carbon credits later.

Don't do that. We need it to start right now.

Thank you.

KATE KREBS (ph): Before our next speaker, I just want to remind people in the room and people, remote users on the Web, that you can ask questions. At the edge of each table are little question cards. So, please go ahead and fill those out, and pass them into the middle, and we'll collect those.

Or if you are on the Web, we would like you to go ahead and type your questions into the chat feature. And we have a Q&A session at the very end. Thanks.

LISA SKUMATZ, ECONOMIST, SKUMATZ ECONOMIC RESEARCH ASSOCIATES: I'm Lisa Skumatz, and I'll be talking about what provides the biggest bang, comparing the carbon footprint effects and the cost from recycling or diversion programs with energy efficiency program results.

In this case, I'm going to – we're going to be using – we've been using modeling work to develop policies and to look at program and portfolio development for communities. And we wanted to walk you through some of those examples.

Specifically, we're going to be looking at first, measuring the value of emissions impacts, then comparing the costs to reduce one metric ton of carbon equivalent – and I'll probably be using carbon sort of as a shortcut for that kind of term throughout this talk.

And we'll be looking at the comparison of cost-reduced carbon from different initiatives, and then also, developing some implications.

One of the things that is a really key part of – when we deliver our program, we deliver – we mean to deliver certain kinds of effects, but we also deliver a whole host of other effects. Those are omitted impacts that come from programs that we deliver.

Those programs and activities deliver direct and indirect effects, are direct effects from a recycling program might be diverting tons from a landfill. Some of our indirect effects might be the tons upstream have been alluded to before, the air and emissions impacts, and also impacts at the household level.

We see impacts delivered to the participant of the program, the deliverer of the program – that might be the solid waste agency – and to society, or as it was referred to earlier, communal impacts.

Those kinds of impacts are really important, and they're indirect and not what we usually pay attention to when we're delivering our program.

The reason I got into this kind of analysis and concern about what are these outside impacts, is because I spend about half my time working in the energy field. And in the energy field, we see a lot of these kinds of impacts.

When you're talking about what's the impact to a participant in an energy efficiency program, yes, it's more efficient lights. Or a new kind of manufacturing equipment. But there are indirect effects to them that include things like greater comfort, greater productivity and things like that.

All these things are hard to measure, but they're not impossible to measure. And they're really important.

Well, similarly, like, as we've been talking about currently, while landfill programs or diversion programs deliver savings and emissions, obviously, it's very direct also for those kinds of emissions savings coming from energy programs. And that's kind of how this go started.

One of the things that (ph), as an economist, I can't help but argue that monetizing makes a difference. We've tended to track our things in tons, tons diverted, that sort of thing.

But if we take that step to going to dollars, as well, those dollar values help for the benefits from our program, to really help people pay attention. You're not saying, oh – you're getting beyond hand (ph) wave (ph). You're getting beyond sort of the comparison of apples to oranges into something that's apples to apples, dollars to dollars.

And it allows us to figure out a better cost-benefit analysis, lets us use some information and what really, what people value, and you can market those things that people really value. You can look at a portfolio approach, trying to achieve goals. And you can go beyond sort of fluffy measurements into something – it's hard measurements, but not consistent measurement.

So, when we started looking at how are we going to go ahead looking at what kinds of omitted (ph) effects are we getting, I started – I wanted to start with a particular solid waste program. And not shockingly, I decided to pick pay-as-you-throw as an example.

Why did I want to pick pay-as-you-throw as an example? One, because we've been studying it quite a bit. But two, it has a very strong impact at the landfill. All the research that we've been doing shows that, if you put in a p program, you're going to save about 18 percent.

You're going to divert about 18 percent of the trash from the residential stream that would have gone to the landfill, and about a third of it is going to go to recycling. About a third of it is going to go to composting, and about a third of it is going to be diverted into source reduction or waste that doesn't happen in the first place.

You look at this graph, it's meant to say, you know, if commercial disposal is between 40 and 60 percent, and the remainder is residential, then you see a pretty significant cut out of the whole disposal stream from a pay-as-you-throw program.

So, that led to one reason for considering pay-as-you-throw as our first example.

These are those numbers that I just mentioned. Next slide. We're up to slide 60 now.

One of the other reasons I wanted to examine the pay-as-you-throw program is because thousands of communities have pay-as-you-throw programs. And when you're talking about something that thousands of communities have, that the impact or the analysis has direct meaning to all those thousands of communities.

So, what we did was a number of steps. We looked at – this was back in about 1999, an exploration that we did. And we did that as part of a source reduction project that we did partly for EPA. It followed on to the greenhouse gas and energy implications work that we had been doing, and we developed models starting in '94 that's been updated over time.

What we did the first step was, we looked at the quantitative effects from the pay-as-you-throw impact, and that included the population covered by the programs at that point in time, the disposal tons that that meant that were being put into a landfill, what the diversion would be from that landfill, and into recycling, composting and source reduction.

We then took EPA's WARM model. And using EPA's WARM model, we were able to estimate the emissions changes from the sort of base case, which was not pay-as-you-throw to a pay-as-you-throw case.

We then used the valuations in that energy model that I mentioned. It's called the NEBIT (ph) model. But in any case, we have a lot of information on sources, about 30 different sources for emissions values at that time, and valued the emissions.

On slide 61, we talked about that. And we used sources that were both regulatory in source as well as environmental in source, to try to get the range of what kinds of valuation might people be putting on these avoided emissions.

We, as a result, calculated metric tons reductions in a number of constituents for greenhouse gases, and valued the ones that we could find values for.

When we computed that all and backed that up to how many tons were diverted from the pay-as-you-throw program, we found that it added a premium of perhaps $1 to $6 per ton, which was a pretty conservative estimate. And we tried specifically to be conservative, and not sort of make an extreme case, but make a very valid and believable and, you know, comfortable case for what kinds of values you might be seeing.

Slide 62.

We then did an updated analysis in 2006. We did another count of how many communities had pay-as-you-throw programs, and we tried to figure out what did that mean. What were we seeing with the new values for emissions, with the new count of communities, and so on?

So, we did a new analysis, and we found that about 70 – our research showed 7,100 communities around the U.S. had pay-as-you-throw, and about 75 million of the population was covered by those programs.

We looked at the generation that was produced, and we used a number of sources for that. We used our diversion estimates of about 17 percent or 18 percent reduction, with a third to recycling, a third to composting, a third to source reduction.

And we then used the WARM model to estimate the emissions effects of that diversion, so the base case and the scenario.

Certainly, there are pros and cons to the model, as Dr. Morris pointed out. And again, I think that the numbers that are in there are conservative.

So, what we did then was, we valued the emissions that came out, and we used the values Misty Co. (ph) case in the Chicago Climate Exchange.

Next slide.

We found that there were a number of direct impacts in terms of Btu carbon equivalents, and so on.

Next slide. And the next.

And so, when we looked at values from the Chicago Climate Exchange, and also from other sources, we saw values at that time between $4 and $5.50, in that range. When we computed that all back and tried to figure out what does that mean for a premium per ton, above and beyond the landfill disposal savings, we found a premium of around $4 to $11 per ton on the landfill tip fee savings.

Now, as was mentioned before, and one of the main things I work in in the energy field is attribution and figuring out, you know, who gets to take credit for a light bulb put in place, and that sort of thing.

Attribution is a really key thing. So, who's going to get these savings? How do you figure out whether you get them, or the people upstream? It's a little bit – it's tricky.

And so, valuing landfill – valuing this tipping fee addition is not sort of the be-all and end-all of all uses of this kind of work.

So, next slide.

As I mentioned, one of the things that I do is, I work in a couple of fields. And I have, as a sense of that, I have sort of a portfolio approach, and looking at, gee, if we're trying to achieve some green goals, how do we figure out where we ought to be spending our dollar, spending our time, spending our effort.

And so, thinking about it from a portfolio point of view, you might look at this greenhouse gas emissions – yes. So, next slide. You might look at this – I think it's back one, actually. Did you pass a graph?

There should be a – you should have a pie chart back.

There. Missing? OK.

OK. Well, I'll talk about it in any case.

So, you have a U.S. gas emissions table from 2005 – thank you, thanks a lot – that shows where the greenhouse gas emissions seem to come from. And you'll see that the big bangs on here include electricity production, transportation. And when you look at waste, you see a sad little three percent slice, which is kind of small.

So, again, I was – I thought, well that's kind of depressing. Now you can go to the next slide. Thank you. I think that's depressing.

But, you know, as I mentioned, though, one of the things that I work on is energy and looking at hard-to-measure effects. And I wanted to check out and say, you know, does that graph, does that pie chart define the way we should be moving forward in policy?

Maybe not, is sort of what I wanted to find out. So, I thought I would look – and as an economist, one of the things I look for is cost effectiveness and cost benefit, and that sort of thing. And so, what I thought I would do is say, does that graph translate to policy?

So, next slide. I thought I would try to figure out, what do we see for delivering an equivalent amount of greenhouse gas reduction, carbon equivalent reduction, from an energy program versus a diversion program, or a recycling program?

And this is all – we were doing this sort of as we were thinking about helping some of our clients measure sort of the broader impacts of the green goals that they were approaching and trying to figure out, how do we measure that stuff.

So, next slide.

So, we have a lot of data on costs for energy efficiency programs from all around the country. We've evaluated programs from the Northeast to California, to all over the country. So, we assembled a lot of that information to figure out what kind of cost do we see per kilowatt hour to – associated with energy programs.

We used some emissions information from peer reviewed articles, but we made sure that when we were talking about peak load programs, we were using peak load marginal mix of power, and when we were talking about base load programs, we were talking about the appropriate mix of production for those base load programs.

That is, when you're talking about air conditioning, you're talking about a peak program, and you're looking at that marginal source of energy. It might be natural gas.

When you're talking about shell measures, you're talking about insulation, windows, et cetera, et cetera, you're talking about a base load thing. And that might be a base load coal plant.

So, those kinds of things are important in figuring out how many emissions you're getting from, in what levels.

So, we used different mixes of generating plants. And for the different utilities we had, you know, mix of coal versus natural gas and average ages of the generating equipment, and so on. And we used our model to figure out what – with – populated with a lot of secondary data to try to model the greenhouse gas impact and the cost.

That gave us a cost per carbon equivalent, metric ton of carbon dioxide equivalence.

Next slide.

We then looked back at the trash side, the recycling side. And we said, OK. Now, we know what it costs to deliver a pay-as-you-throw program. We know what it costs to deliver a recycling program. We've done those for many communities around the country.

And so, what do we see for those numbers? And then went through and figured out the cost per ton for delivering that program, used the WARM model effect results to figure out a conservative estimate of the diverted carbon – next slide – and came up with a table here.

And of course, there are many programs underneath this. I thought I would simplify it for this presentation to make the main point. And I pulled together averages from a whole bunch of different programs around the country. And while we have dollar per – dollar values in the underlying work, here we present it as multiples, so you get an idea of just how much difference there is between the prices – the costs – rather than getting hung up in exactly what the dollar value is.

So, what we did was, we looked at – let's look at commercial energy efficiency programs as our base. So, let's look at that. And so we said, OK, the cost for an energy efficiency program on the commercial side we're going to say is one – one unit, $1, $100. It's not terribly critical right now. So, in the last column we see that the commercial energy efficiency program costs about one unit.

If we want to deliver – if we want to reach the same carbon reduction through a residential energy efficiency program, that's going to cost us about three times as much as it does to deliver that same reduction in greenhouse gases through the commercial program.

If we looked at wind and we look at photovoltaic, we see those numbers are currently higher than the two types of energy efficiency programs – not shockingly, given that avoiding something is often cheaper than making new.

So, then we go down to the blue part. And the blue part tells us these similar kinds of numbers for curbside recycling, pay-as-you-throw. And we're working on prevention and reuse, yard waste, and we're also working on some water and transit programs – transportation programs. But this gives you an idea.

So, when we went to the curbside recycling program, we found that, actually, curbside recycling, to deliver the same kind of carbon reductions, we're seeing a cost of about two-thirds of the cost of that commercial energy efficiency program.

And we look at pay-as-you-throw, we see it's on the order of a third or less as costly as it is to deliver that cheapest, sort of, those energy efficiency programs that we're seeing delivered in the marketplace readily now.

And so, next slide, tried to illustrate that graphically.

Those two for wind and PV are cut off, so that you can actually see the costs for pay-as-you-throw and curbside recycling. They're cut off at around seven.

And so, you can see that, while there are costs for the energy efficiency programs, the gray bars, in each case the blue bars that we've put down for the recycling programs we looked at are considerably lower than the costs for the other programs.

Next slide.

There are other things to look at, too. When we're looking at energy efficiency – delivering reductions through an energy efficiency program versus a diversion or recycling program, we have a difference in speed and timing. Let's look at that. OK.

So, if you want to put in a pay-as-you-throw program, you can do that quite readily. You can put in an ordinance that says, haulers, you shall put in pay-as-you-throw, and you'll see it happen pretty quickly.

We've put in pay-as-you-throw programs in communities around the U.S., and those programs have gone in as fast as three months and routinely less than a year.

And when you put in an energy efficiency program, it's quite a lot longer. There's a process. There's, you know, delivery. There's going door-to-door – all that sort of stuff. It's quite different in timeframe.

What we found, in fact, when we've been working with some clients, one of our clients in particular found that, when they had – they'd established a greenhouse gas goal. They put together a whole bunch of programs to try to reach that – some transportation, some energy, some solid waste.

And what they found after a five-year assessment was that 40 percent of the progress they had made toward reaching their greenhouse gas goals had been made through their recycling efforts, not through their energy and other efforts.

That was not expected, when you look at that slice that tells you three percent.

Coverage is another issue. When you put in a pay-as-you-throw program, when you put in a curbside recycling program, and on and on, other types of programs, you find also that you immediately cover all the households in your area.

Everybody in your town gets to help contribute toward diverting greenhouse gases. Everybody in town gets involved. The businesses get involved when you put in a commercial program – unlike the slow buildup that you often get from energy efficiency programs, where you do a few audits, you do a few more. It takes time.

Finally, another really important point is the authority. Cities, counties – cities in particular – and towns have authority over solid waste in most communities, in most areas. They may not have invoked it, but they often have that, at least at some level through their health and safety, their police powers, et cetera.

That's not always the case for energy. Energy is routinely delivered by a third party energy utility, investor-owned or public, or whatever, but not the city or county.

And so, this is something where you have direct authority.

Retention – or, that is, how long will these savings and so on last – that's an issue that hasn't been well studied, nearly well enough studied in either energy or in recycling. So, I'm just going to leave that for now. It's something that is a real pet area, a pet peeve of mine. So, in any case.

So, if you look at – if you had gone back to that other graph – don't bother – you would have seen one column that relates to how expensive it is to implement these options. The other column you would have seen sort of relative times.

And the main message is that you have a chance to implement pay-as-you-throw and recycling and diversion programs really quickly, and in many cases more quickly than you see a lot of energy programs go in.

I wanted to mention some of the other effects beyond sort of direct effects. These results that I've pointed out are fairly conservative, and from a number of points of view, and one of them being that the methane impacts are very important. And has been mentioned before and by others, those are very front-loaded and that's really important.

Solid waste programs hit the methane, not the energy efficiency programs. They don't do so much.

One of the things that I'll show you in a slide coming up is the production effect, emissions effects that are many times more important than the disposal emissions effects. And those – that information comes from work by David Allaway from the Oregon DEQ.

And I think some of the numbers I'll show you provide even more impact. They resonate more for me than saying, OK, you saved – I will say I'm impressed by 95 percent of the energy savings, you know, for producing a new can are saved when you use recycled content. But there are some numbers that I'll show you in a second that are even – that are pretty compelling, as well.

The energy savings upstream are much more important than the landfill diversion. And I think it's really important for us not to just keep thinking about – you know, the impacts are above and beyond landfill savings.

And some of these effects have been demonstrated through (ph) some (ph) revised accounting that the EPA has been putting together.

And I'm going to defer to the next speaker, Joshuahh Stolaroff, who's really an expert on this and has updated this number, in fact, beyond the numbers that I received.

But the main message I wanted to make from this was that, if you look at what goes into a landfill, it all derives from the production of goods and materials. Under the new accounting that looks at that kind of thing and a different way of accounting for how energy and how greenhouse gas emissions are done, and the sort of accounts underneath it, you find that provision of goods and materials is as large or larger than building energies or adding transportation together, and so on.

Our little three percent slice is very likely not anything like three percent when you look at it in a new and a better and an improved way.

Next slide.

I mentioned it's important to think about, gee, if you use – if you use a recycled can to make a new can, an aluminum can, you saved 95 percent of the energy. One other way to look at it is to say, how far – when you account for that energy, how far could you be trucking your recyclables – or barging or freighting or railing, or whatever – your recyclables to a market, and still come out energy ahead?

And you look at numbers like, if you – you could truck the aluminum 121,000 miles and still come out ahead. That's how important those upstream savings are. So, that just gives you an idea of just how important that is, and it's not just about the landfill.

Next slide.

In conclusion, you can measure the effects from greenhouse gas reductions. And our preliminary work shows that you get millions of tons in savings, millions of dollars in savings, and you get some calculable premiums for the landfill diversion, sort of on top of landfill diversion amounts, to account for those emissions benefits.

But more importantly, you can also compare the cost to achieve greenhouse gas reductions from an array of programs. When you're trying to figure out in your portfolio where should you be, what should you be pushing, what should you be doing, you find that recycling is cheaper than energy conservation for some programs, and it's cheaper than renewables.

It's faster to implement. You get greater coverage. More people are affected. More people are involved. And you get – you have the authority to do it in most cases, where you don't always in some of these other important, but maybe not quite as cost-effective, options that you could be putting in.

Recycling and pay-as-you-throw and other – and presumably other programs that we're investigating, are really early big bang programs.

When you're talking about the broader economic context and you try to make the case for diversion, one of the things that we're seeing it, if you look at three percent, you find that a lot of the talk about how are we going to hit our green goals goes on without the recycling folks at the table. It often is really most involving the energy folks, the transportation folks. Those were the big parts of the pie.

But these results show that we really need to be at the table. We need to be at the table, and our programs need to be considered among the first batch that you put out and put in place.

And we shouldn't be apologizing for being at the table. They should be happy to have us there. In fact, we have information enough now to know that this should be a key part of any long-term greenhouse gas strategy.

If you're interested in the report that's under this, it's almost done, and I'd be happy to send it back to anyone who e-mails me a request for that report. Thank you very much.

JOSHUAH STOLAROFF, SCIENCE AND TECHNOLOGY FELLOW, AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE: Good afternoon. I'm Joshuah Stolaroff. I am a science and technology policy fellow with the American Association for the Advancement of Sciences. I'm working in EPA's Office of Solid Waste and Emergency Response. And I'll just do the disclaimer now that I'm not an official EPA employee, so my views are not those of the agency.

However, I have led development of a lot of estimates that I'm going to show you as part of the development of the climate change strategy for EPA's Office of Solid Waste and Emergency Response. And that office is concerned with broadly three things, which include materials management, like recycling, and most of the things we've been talking about here at this conference, and land cleanup, revitalization and reuse policies, or land recycling, if you will, and also emergency response and preparedness.

I'm going to talk just about those first two things today, though.

OK, so, slide – on slide 80, I'm showing a couple of the things that I'm going to try to convince you of today, which are that materials management and land management have a – make up a significant share of greenhouse gas emissions. And then, also that changes in materials and land management practices can make reductions in greenhouse gas emissions.

These are points that have been well made in a couple of the talks you've just heard. And if you – for those of you on the Webinar, if you've listened to the other series, like David Allaway's talk, you will understand these points already.

And I'm actually now going to try to get you to think a little bigger picture, and think of materials management as part of a larger story. And what I call that larger story is prevention-oriented approaches, but you may know them by many other different names. There's green design and life cycle analysis – sorry – green design and industrial ecology, design for environment, sustainable consumption or energy efficiency approaches.

And all of these things are really trying to do similar things, which is, you perform the same function, or, really, you meet the same human need with lower demand on resources and lower impact on the environment.

And the advantage of all of these prevention-oriented approaches – one of the advantages – is that you tend to make emissions reductions at lower cost, and you tend to get other environmental co-benefits while you do that.

So, if you want to take these prevention-oriented approaches, one of the things that you need is what I'll call systems-oriented thinking. And that includes life cycle analysis, and it includes consumption-based accounting, which I'll talk about later.

But in understanding how materials management fits with greenhouse gas emissions and overall climate policy, it's first good to take a look at the conventional perspective.

So, on slide 84, you see the greenhouse gas emissions as they're typically portrayed, like in the U.S. greenhouse gas inventory. I call this the sectors view. And it's essentially an allocation of greenhouse gas emissions at the point they're emitted. So, if they're coming out of an electric power plant or out of a vehicle, that's which category they fall into.

And the larger story from this kind of picture is that, if you control emissions from electric power plants and from vehicles, then you really got the majority of greenhouse gas emissions. And if you include industry in there, then you're getting pretty close to the whole picture.

And this is a useful view for targeting end-of-pipe solutions, which is, if you're looking at the place where the emissions are coming out, if you change that process so they're not coming out there anymore, that's an end-of-pipe solution. And so, carbon capture and sequestration (at) electric power plants is an example of that.

But you might also consider technology substitutions or process changes, which make reductions sector-wide. So, hybrid electric vehicles can help you get at that transportation slice.

But it's not really obvious when you look at this picture where materials management or land management fall. And in particular, as we heard about the waste – which is not usually on this chart, but if it were, it would be a three percent slice – that's not really showing the activities of materials management, which, although they do reduce emissions from the waste sector – for instance, composting does that – they also reduce emissions from many other sectors. Like aluminum recycling will reduce electricity use and those emissions.

So, we tried to – we developed another perspective of greenhouse gas emissions, which I called the systems view of greenhouse gas emissions, where we looked at what systems or what applications are driving the emissions. And there are a lot of different views you could construct based on systems, but this one is chosen with land management and materials management in particular.

And the story that you get from this chart is that provision of goods and materials – and if you consider food a material, which in many ways it is – account for about, almost half of total greenhouse gas emissions.

And then, various categories associated with land management, like the emissions from clearing land for new development, which is part of the new land development slice, or the emissions from local passenger transportation, which is affected by land use, local land use planning, those are a part of land management. They make up a significant share.

And also, this faded outer ring in the pie chart, labeled the natural land sink, represents emissions absorbed by natural lands, primarily regrowing forests. And it's important to think about that as part of the overall greenhouse gas picture, because that's offsetting a significant share of our emissions at 11 percent.

So, in the next slide, I'm just – I already talked about a couple of these things. But in general, this view is the systems view. And it doesn't have to be this one. You can draw other systems views. But in general, these are useful for targeting prevention-oriented strategies, because prevention-oriented mitigation tends to reduce emissions from a bunch of different sources, but they do act on a particular system.

And so, if you take this perspective and you say, OK, land management practices and materials management practices influence a pretty large share of greenhouse gas emissions, the next question is, can changes in those practices reduce emissions?

And so, that's what we try to answer in the next analysis, where we did – oh, I'm sorry. I'm getting ahead of myself. I'll just give you a little more detail on the pie chart.

And so, to give you a flavor of what's included in each of these slices, this is a breakout of the provision of goods and materials slice. And you can see that the emissions come from a bunch of different sources.

You've got industrial sector fossil fuel combustion. There's electricity used by the industrial sector. You've got process emissions in industry like non-CO2 greenhouse gases. You've got emissions from freight moving all of the materials around from place to place, and from waste, including landfills.

And then there's an adjustment to account for some of those emissions that are in other slices. And what you end up with is close to three billion metric tons of CO2 per year that's attributable in this provision of goods in the materials slice.

And the new land development slice, which actually includes some new research – so, some of these emissions are not included in the U.S. greenhouse gas inventory – you can see that this story looks a little different. We're actually dominated by the biogenic carbon, that is, lost soil carbon, lost above-ground biomass and lost dead (ph) or (ph) net (ph) organic matter when you clear land for development.

And there's also emissions from building roads and sewers and pipelines. And adding all those things together, the emissions from clearing land, roughly 2.2 million acres per year of land in the U.S. is cleared for development, that comes out to about five percent of total emissions.

A very rough number. Maybe it's two percent, maybe it's six percent. It is a first-cut analysis.

But the point is that it's significant on this scale of our (ph) total greenhouse gas emissions, and that land development should be considered in our greenhouse gas policies.

And so, if you think about the potential for land recycling, this is sort of the maximum potential. If you most efficiently managed to reuse land instead of clearing new land for development, this is the size of the emissions slice that you'd be able to squeeze, if you will.

On the next slide, getting back to what I was saying earlier, so, this is our rough analysis of the technical potential of a bunch of different materials management mitigation opportunities.

Technical potential is just – it's a scoping analysis. It says, what happens if we did all of it? What sort ordered (ph) number are we talking about? Is it big enough to worry about?

And that's really the intention of these calculations. And most of these are based, they're extrapolations of information in the WARM model.

But going down the list here, we can see that, if you source reduced 25 percent of a whole bunch of stuff that's covered in the WARM model, including cans and plastic and consumer paper, depending on how such a huge change in materials use affects forest management, your reductions range between 30 and 100 million tons of CO2 reduction per year.

Or as sort of an alternate take on a similar change to the materials system, if you reduced packaging use overall by 50 percent, then you could make 150 million tons of CO2 reduction per year.

Again, so, this is compared with the total of 7,000. So, these things are significant on that scale. And actually, they compare with other greenhouse gas mitigation policies that are frequently discussed on the sort of national policy scale.

So, for instance, if any of you have seen the report from McKinsey and Company, titled "CO2 Emissions Reductions: How Much at What Cost?" – a very influential report where they tried to go through every sector of the economy and looked at where could you make greenhouse gas reductions between now and 2030 for costs that are reasonable. One of the sectors that they found you could get 60 million tons of reduction from building shell improvements, so, essentially, from improving the insulating capacity of buildings.

Or cellulosic biofuels, if you made those work and used them up to their economic potential, you could make 100 million tons of reduction.

So, I mean, these are things that are frequently discussed as part of climate policy, and they're on the same order as reductions that you get, or that you could potentially get, from materials management changes like recycling.

But on the other hand, these numbers are not – they're not so big compared to that three billion tons of total emissions from provision of goods and materials that we saw in the pie chart.

So, there's still a connection to be made. And this is a challenge for the recycling community, or for the materials management community more broadly, is that it's not just about recycling. If you go and recycle essentially everything you possibly and/or economically could, you're still a pretty far step from that 3,000 million tons potential.

And so, you have to think about other strategies, too, which include source reduction, changes in how, which materials are used, extending product lifetimes, service (ph) sizing (ph), all the sort of more advanced things. And those are more challenging activities to assess the potential of. And so, that's something we continue to work on, is how do we think about the more advanced materials management practices and the reductions possible from those?

But, so, it's just important to keep the perspective on both sides, that recycling matters on the scale of national greenhouse gas policy, but it's also not the whole story, if you want to think about materials management broadly.

So, another thing we're interested in for the OSWER climate strategy is, what are the effects of land management policies, in particular for us, land recycling policies, again, doing the same technical potential sort of calculations. You know, if you went out and did all of this stuff, is it big enough to matter?

And to answer those questions, we first had to figure out how much contaminated land out there is there. It's sort of the equivalent to how much material is currently going into landfills – which was not an easy question to answer.

But looking at just the databases that we have available in EPA, we find that there's about 17 million acres of contaminated land out there, which is roughly the size of West Virginia. And a lot of that is remote, sort of abandoned mining sites and things that are not what you would imagine like developing houses on.

And so, part of the question is, what can you do with urban sites to recycle them into new housing, for instance? But then, what do you do with all of these remote contaminated sites that may be lying barren after being mine scarred and have nothing growing on them? Is there something useful you can do in climate terms with those sites?

So, on the next slide, we look at – slide 92, for those of you following along – we look at some opportunities for the new land development. Of course, implied in our pie chart calculations is the potential for urban land recycling, which is in the hundreds of millions of tons.

But also, there's a lot of acres of abandoned mine lands that could be reforested. And so, a very rough estimate of the emissions you could offset by doing that is about 80 million tons per year.

And then, if you looked at all these 17 million acres of contaminated lands and took all the ones that are on solar class six and seven sites, and put utility-scale solar on them, you could – well, you could almost have enough electricity to power half of the country.

A similar story with – or a similar calculation for wind. If you took all the solar class – sorry – wind class five and six sites and put windmills on them, you could get 30 million tons of reduction by offsetting fossil, the current mix of electricity.

And then, also, as we clean up all these sites, which tends to be an energy-intensive process, if you make the cleaning process more energy efficient, there's four million tons out there to grab.

So, some of the points that I hope come from these kinds of analyses is that you need systems-oriented accounting to target prevention-oriented policies. You can't look at the conventional sector's pie chart and figure out where your prevention-oriented policies are going to be.

You have to figure out where are the systems. And then, when you look at the system and say, how do I make this system more efficient, cutting across all of the various sources that make it up, then you can figure out the scale and the benefits of those policies.

And then, you can use technical potential calculations like these. The OSWER climate strategy is slated to be public in September. And at that point, hopefully you'll be able to see the methodology for these things. But certainly, contact me if you're interested in details.

But this is a kind of process that can be applied across any scale of strategy. If you're a locality, and you're looking across your options, the first-cut analysis you can do is, well, if I went and changed all of the zoning regulations this way, what would be the technical potential reduction from that? So, the technical potential calculations are useful for scoping out potential policies.

And then, the analysis, the sort of systems-oriented pie chart can be done at a lot of different levels. It can be done for a city or for a state, or, in this case, for the country. And I'll give one example of extending this analysis.

So, the previous chart I showed included only domestic emissions, as the U.S. greenhouse gas inventory does. But you can imagine accounting for emissions based on consumption rather than production.

So, if we think about all of the goods we consume in addition to all of the activities that we do domestically, the emissions associated with those systems, and then we subtract the things that we produce that are consumed elsewhere, then you get a consumption-based accounting. And I put our analysis together with some numbers from the paper cited at the bottom there, to figure out what does this picture look like, if you include international emissions for producing goods we consume here, and then subtract out emissions from goods we export.

And what happens there is, the goods and materials emissions increase by about a third. And so, that takes up an even bigger portion of the pie now. But food emissions decrease slightly, because we export more food than we consume here. But overall emissions increase 12 percent, with an uncertainty range of four to 18 percent.

And in a sense you could say, well, you know, that's bad to do consumption-based accounting, because it looks like we emit more. But on the other hand, the advantage of this is that it puts more emissions on the table for you to reduce.

So, if you're a locality or a state, and you want to use prevention-oriented policies to reduce emissions, you need some sort of systems-based accounting to be able to see that. So, if you draw the border around your municipality and you don't have a manufacturing plant there, but you reduce emissions by recycling that reduce emissions at a manufacturing plant, that's not going to help you meet your climate reduction – you climate change emissions reduction goals.

But if you have an accounting system that's based on consumption, then those benefits of recycling will show up. And similarly, even looking at the whole country, if we have a policy that reduces emissions, say, by increased recycling of steel, but what that offsets is steel that we've imported from abroad, then those emissions reductions are not going to show up in our national reduction target.

So, there is a role of consumption-based accounting in that it puts more opportunities on the table, because a lot of these prevention-oriented strategies – again, lower costs, and have (ph) environmental co-benefits compared with end-of-pipe solutions. And the end-of-pipe solutions will always reduce emissions at the point that you're targeting.

So, if you're a municipality and you do have a manufacturing plant, and you use an end-of-pipe strategy to reduce emissions from that plant, it'll show up in your accounting, but the prevention-oriented strategy, not necessarily. So, that's why – or that's one reason why these things are useful.

And I hope that it's clear from this discussion that materials management, a lot of the materials management approaches, fit in this systems and prevention-oriented framework.

And that's all.

KATE KREBS (ph): So, now we're going to try this challenging way of asking questions and making sure the answers come in through the microphone. So, I've tried to sort the questions out to each speaker, so that I'll call someone up and give you a couple questions, and see how we do.

So, Jeff, why don't you come on up and we'll start.

One of the things that Jeff and I spoke of before the session started was some of the work being done in different communities. And in trying to approach community planning for recycling or composting collection infrastructure, what is the best model? I think you talked about a community up in Washington that you're working with, and trying to really encourage recycling and maybe going to biweekly.

One of the questions that came was a city in Southern California turned down a weekly yard trimmings program and decided to keep biweekly collection, based on truck emissions doubling, but only picking up half-full carts.

Did they cut their nose to spite their face in trying to be more efficient?

JEFFREY MORRIS: Yes.

KATE KREBS (ph): (INAUDIBLE). So, what do we look at?

JEFFREY MORRIS: To elaborate, you know, I said a tenth of a pound of greenhouse gases per ton per mile. That's sort of what we're looking at, versus the big number that you save by recycling or composting more.

So, if you decrease the frequency of your collection, you will decrease the amount of material you collect. If you don't come by every week, and a garbage truck comes by every week, then, when they forgot the previous week, or they have something snowy they don't want to put or keep for two weeks, they'll put it in the garbage.

So, basically, if your either recycling, or especially organics collection frequency is not the same as or more frequent than the garbage collection frequency, you'll lose some tons. And losing those tons, you don't have to lose very many of them before you've lost more greenhouse gases than you would incur by having the extra collection.

So, "yes" is the answer.

KATE KREBS (ph): Great. Thanks. I have one more for you.

Which public model shows the most advantageous benefits of recycling? And which is the most widely used?

JEFFREY MORRIS: I have no idea which is the most widely used. I think our calculators has got more benefits in it, because that's what we – that's the way we created it.

The publicly available models – you know, WARM is the only one that's really publicly available, unless you build your own, as we've done. The decision support tool is not really user-friendly and is not publicly available. You have to use it through Research Triangle Institute.

So, I don't think there is a comprehensive model out there, and that's why we developed what we have. And we give it to people if they want to use it, but we don't provide backup service for it. We don't answer a million questions, but we'll give it out to you, if you want to use it.

KATE KREBS (ph): Great. Thanks, Jeff.

Evan, come on up. We've got a couple here for you.

So, one question. You said that recycling is everywhere within the CARB Scoping Plan. Where specifically? I don't see it.

EVAN EDGAR: Recycling is collection, processing, and then the feedstocks for manufacturing. Thirty-eight percent of the emissions are transportation. And the number one aspect of the CARB Scoping Plan is to reduce direct emissions from transportation.

And one aspect is to have low carbon fuels. And in order to have a B20 E15. So, as (ph) you're out there collecting all of the material for recycling, the transportation sector is the largest greenhouse gas emitter.

I like what several (ph) at (ph) EPA said about taking a systems approach. That's what I tried to do today in my presentation, is what is a recycling systems approach? Ninety percent is transportation, 10 percent is facility energy use, and then the eight to 20 times (ph) communal benefit is the recycling of (ph) feedstock. So, that's a big part of it.

With regards to the energy use, 10 percent of your energy is from processing recyclables. So, by processing different woodchips we can make bio energy out of the woodchips. And by promoting the RPS (ph) standard (ph) have more solar rooftops, and we can promote reduction of indirect emissions through alternative energy. So, that's a big part of it.

And then, what they did (ph) leave (ph) their (ph) recycling, they have a protocol development. And that's what I've been trying to do, but it stalled out in Sacramento, because people start going for carbon credits from day one. They get in a food fight over carbon credits versus a simple assessment tool that Jeff is working on, that we're working on, and get that front and center.

So, recycling is ubiquitous throughout all sectors. And I think the systems approach that was talked by (INAUDIBLE) and (ph) Kate (ph), kind of captures that recycling is more than just recycling feedstock. It's manufacturing material overseas. They use energy, a different energy mix. It's everywhere.

So, recycling as a sector does not exist, but it is, as a system, is very prevalent.

KATE KREBS (ph): Got another one here for you. S.B. 1020 is still pending. What is the status?

EVAN EDGAR: Oh, S.B. 1020 is the Padilla bill. There's some good language out right now. It's 60 percent disposal reduction equivalency by 2015, and 75 percent by 2020.

We tried to add language, like everybody else in Sacramento, to have this preserve carbon credits. We have a mandate which is – yes (ph), we have some language. But I doubt it's going to get any air play, because everyone else is trying to preserve their carbon credits while increasing mandates.

So, I believe that S.B. 1020 will pass this year. Our trade association is supporting it. I think the governor will sign it. And I think it's a good bill.

And it kind of ties it to S.B. 1016, the Wiggins bill, that shifts the accounting system away from percentages, where people have practiced waste generation inflation. We have consumed our way to resource conservation goals on a consumption pie chart, by, again, 54 percent, because we produced 13.4 pounds per person per day in 2006, to inflate our way to 54 percent. That's a fallacy of percentages.

And what S.B. 1016 does, it has disposal-based accounting, where what goes into the ground, we're actually 6.2 pounds per person per day disposal. The rest of America is about 4.5. Europe is under three. But even with their high recycling rate in California, 54 percent, we're still very high on 6.2 pounds per person per day.

And what S.B. 1016 does is have that accounting system be the indicator of success. And we couple it with S.B. 1020, what it means is about 16 million tons of garbage will be recycled in 2020. It adds up to about 36 million metric tons of CO2, which in the CARB Scoping Plan, that would be all of the trade that's left.

The number one strategy would be 36 million metrics tons is in the CARB Scoping Plan for cap and trade. And if all what was recycled became a carbon credit, it could use up all of the – it would use up all of the trade.

KATE KREBS (ph): Great. One last question for you.

Are there other things that CRA can do to help with the work that's going on in Sacramento?

EVAN EDGAR: Yes. I was encouraged and inspired by CRA this year by hiring an executive director that can show up. I think they have a good letter campaign writing skills. We used to have CRA show up more often at the waste board or at the CARB. But I'm glad to see some letter writing campaign by Julian (ph), the president, is happening. And today was some good CORC (ph) workshops on organic aspects of it.

But I think you need to show up. You need to be present to win.

KATE KREBS (ph): Great. Thanks.

I'm going to take this question. How can individuals and organizations such as CRA most effectively influence national climate change policy? Letters, calls, donations and to who?

I think I said in my opening comments, the National Recycling Coalition is playing a great role in trying to make sure that all the parties are being heard on climate change legislation. So, be sure you're an NRC member. Watch out for those action alerts and participate, as they ask for calls for actions.

I think Barbara Boxer will continue to play a key role, as will Nancy Pelosi. They represent your state here in California. So, staying in touch with their field office is also important.

Lisa, I got some questions for you.

So, the questions are both about pay-as-you-throw. If you could quickly just talk about what exactly is pay-as-you-throw.

And the second question is, pay-as-you-throw can come in a variety of ways. Do you have a very sophisticated one in mind, such as scales on a collection truck and charging customers individually for weight? Or simply the larger the container, the higher the cost?

LISA SKUMATZ: If I can, I'd like to take one second and first elaborate on one of the earlier questions. And Jeff and I are both economists, so we both – and we're – you asked the question very narrowly, but I think that we need to look at one step about the question you asked about every-other week collection.

And yes, I think that you're absolutely right in terms of, you get a win in terms of your emissions by collecting more material. But don't forget the cost side. And I think it's really important to look at the fact that, if you go – if you collect every week, yes, you'll collect a couple of percentage points more material, has great upstream benefits and all that.

But don't forget that by going every-other week, you're saving about 40 percent of the cost for the collection program. And that may free up money for you to add a whole new stream, add a collection of other (ph) material – all kinds of things like that.

So, there are tradeoffs in economics. That's the whole sort of fun of it.

And on the emissions point of view, that box, absolutely. On the broader scale, things aren't so simple. So, anyway …

KATE KREBS (ph): Thank you.

LISA SKUMATZ: OK. You asked about defining pay-as-you-throw.

KATE KREBS (ph): What is – what is exactly …

LISA SKUMATZ: Well, pay-as-you-throw, what we're talking about here is, instead of paying a fixed bill for unlimited collection, or instead of paying for trash and potentially recycling, but trash collection through your taxes, we break that out, and instead you're ending up paying for your trash by the can, by the bag, some volume indicator.

That is going – some cities are bag or sticker systems. And that's very common in the Midwest and the Northeast. In the West we see most commonly can-based systems. So, people get issued a 30-gallon, a 60-gallon or a 90-gallon wheelie. And their bill varies, depending on how big that container is.

And so, those couple of systems are very common. Hybrid systems are another option. But in any case, those are the main systems.

I'm talking not about the garbage-by-the-pound program that we started, sort of initiated, piloted and now is being adapted by another place back in the '80s (ph). That garbage by the pound weighing on the backs of trucks, it's practical, but that's not even what I'm talking about.

I'm talking about the bag based (ph) or the can-based programs.

KATE KREBS (ph): OK. Great. Thank you.

LISA SKUMATZ: That's it?

KATE KREBS (ph): Yes.

And Josh, you had some great, thoughtful remarks. We really appreciated them.

One of the questions that came in that you touched on, that it would be great to have you talk a little bit more, is any work that's being done on source reduction and calculating in source reduction from a greenhouse gas reduction standpoint.

STOLAROFF: Well, the WARM model does include estimates for the benefits of source reduction for every material that has the benefits of recycling. And typically, source reduction is better for the environment than recycling.

And I'm sure, as we continue developing estimates for other materials and for new strategies, that we'll be looking to source reduction as part (ph) one (ph) of the primary strategies.

KATE KREBS (ph): (INAUDIBLE). I think that was (INAUDIBLE) presentation. Right?

STOLAROFF: That was just to explain what that means.

Let me grab my notes.

KATE KREBS (ph): The question is for him to explain a little bit more about the five NPL treatment technologies, and are they related to the top five contaminants?

STOLAROFF: The answer to that is, well, the NPL is the National Priorities List, so it's a list of contaminated sites.

And the top five treatment technologies are related to the top five contaminants, if you will. Or they're essentially the most energy-intensive technologies. So, if you improved those five, which account for most of the energy and most of the greenhouse gases used in the treatment, then that's where that estimate comes from.

That, along with the other estimates, will be detailed in the OSWER climate strategy when that is public in the fall.

KATE KREBS (ph): Great. Thank you.

So, those are the questions that were sent in to us. I want to turn it back over to Timonie (ph) to wrap up. But thank you, for all of you, for coming to this session right after lunch. It was very technical, but I found it very interesting and exciting, and appreciate all of the speakers and all that they did.

Thank you.

TIMONIE (ph): Thank you very much for participating in today's West Coast Webinar on accounting systems, modeling and economic incentives. Speakers, thank you very much. Your presentations were incredibly informative and useful, and we really appreciate your contributions to this exciting field.

I think we'll now close the Webinar session, but if there are people in the audience that would like to stay and ask additional questions, we have a little more time in the session.

Thanks so much.

OPERATOR: For those of you on the Web, this concludes our Webinar session. Thank you.

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