

Meeting Summary: Solar Panel Recycling Commission

Nov 29, 2021 12:30 pm – 2:30 pm

Attendees

DEP: Dan Clark (DC), Karen Kloo (KK), Scott Brubaker (SB), Nick Baier (NB), Nick Nader (NN), Ashia McRae (AM)

Non-DEP: Jim Entwistle (JE) -via phone, Dunbar Birnie (DB), Joseph Ferrante (JF), David Thompson (DT), Lyle Rawlings (LR), Chris Gulics (CG),

DCA: Sean Thompson (ST)

The following is a detailed summary of the discussion and is not actual word-for-word transcript. The purpose of the summary is to capture ideas expressed by the Commission members.

00:04:33.900 --> 00:04:39.910

Nader, Nicholas [DEP]

OK, so we're just going to go down this list. I believe the status of deliverables.

00:04:41.640 --> 00:04:45.020

Nader, Nicholas [DEP]

First and I guess we're gonna start with Item one B. So, I guess if Lyle has his presentation. Is that a good place to start?

00:04:57.110 --> 00:04:59.520

Lyle Rawlings

Sure, I'll be glad to and besides the presentation and this particular topic, I think it might be later in the outline, but I've been having some conversations about this with the Mid-Atlantic Solar and Storage industry Association with the other companies. They are about 50-member companies getting some feedback what they feel would be common sense solutions to the issue and then also with a national group actually North America wide called the amicus cooperative, which is the leading companies around North America. Same topic so if there's room for that I'd love to provide some feedback. Come on those conversations. So let me see if I can share my screen. All right now, you should be able to see an Excel sheet with the graph.

00:07:01.480 --> 00:07:02.080

McRae, Ashia [DEP]

We do.

00:07:02.530 --> 00:07:04.830

Lyle Rawlings

You can? OK so, in consultation with Dunbar I've been putting together a model that takes data historical data from the BPU which is a lot of detail lot of really rich and very accurate information about solar panels that have been have gone into service every year since about the year 2000, up through today and then also information from the BPU's plan. From now through the year 2030 and then further than that, from the energy master plan, which would take us up through 2050. I didn't take it as far as that, I just took it out through the year 2040 in terms of a projection, but this is a prediction of the amount of solar panels coming to the end-of-life for each year during that period. And to start with that

was what I just explained was historical data. Plus, the BPU and energy master plan plans going forward. But there's another part of it. That's kind of guesswork and that is how soon will a particular project start to throw off modules at end-of-life and by what quantities for any particular project or installation. That's guess work because there's no national database that I've been able to find. There's no one comprehensively tracking this, so I had to go based on my own company's actual experience and just anecdotal, cool evidence from other folks in the industry to come up with this graph, which is a forward-looking estimate for any particular solar project. What are sort of averaged over the whole cohort of projects in the state. What's the likely number of modules reaching end-of-life. For every year of the facility from its first year 2 up through 35 years from the time it's installed. And that's why it's kind of a guess because almost all the facilities aren't even that old yet and the years of experience. We have the data is not correct. So, consider this yeah, as a very rough estimate, but what you can see in this is that in the early part I don't know if you can see my cursor, but in the in the first 10-15 years, very small percentages of modules would reach end-of-life, and these would be defective ones that get broken and stuff like that. You can see 3 spikes where larger percentages of modules in a particular year, are likely to reach end of life and that's because most of the commercial projects and many of the residential projects are PPA contracts and so the at the end of a contract. The owner of the property usually has the option to make the solar panel owner, which is a 3rd party, remove them from the site. And so, they [property owners] don't have to [remove them from the site] at the end of a particular contract period. They may have options to renew at 5-year intervals. And the most common term for one of these PPA contracts is 20 years. But the schools and local government buildings are limited by law to 15 years and sometimes you would get projects with 25-year contract terms and that's why you see, those spikes at 15 years, 20 years, at 25 years are certain percentage of modules would come to the end of their contract in those periods. And then of course, you start to get modules that are aging out later like starting year 25 to 35. You see the bulk of the of the modules that come to end-of-life really start in the in the mid 20 years of life up through 35 years of life, and by 35 years of life, we just arbitrarily said essentially 100% of the modules would reach end of life by then. It may be, because the modules have just worn out over that period of time and are producing much less, or facilities have decided to repower with more efficient newer modules. Or like if it's on a rooftop and the roof itself may have reached the end of its life and you have to remove the modules in order to replace the roof. So, the bulk of that are the modules we're assuming will reach the end of life in that mid-20s to 35-year life. So that's the assumptions that underlie.

00:12:41.550 --> 00:12:57.820

Dunbar Birnie

So, Lyle let me interrupt and say something more about the PPA spikes. Those don't indicate that the modules are failing but that a user and owner might decide they might have efficiency.

00:12:48.390 --> 00:12:48.750

Lyle Rawlings

Yeah.

00:12:59.980 --> 00:13:13.990

Dunbar Birnie

You know everyone would want to repower with the new contract and so, so they might trade in on a better model. But still, those would go to the landfill so that's why those 3 spikes need to be there.

00:13:15.180 --> 00:13:17.130

Lyle Rawlings

That's a good point thanks Dunbar.

00:13:17.890 --> 00:13:22.920

Lyle Rawlings

Yeah, and also these spikes at the end of the PPA contracts, owners may choose to force the removal of the modules because they want a new roof. You know they may be getting leaks so the roof might be getting old and decrepit that sort of thing.

00:13:35.940 --> 00:13:56.550

Lyle Rawlings

Or have another use for the property, so these are assumptions that Dunbar had a lot of input on that we've tweaked these but there's nothing magical and then this combines with the historical BPU data and the BPU plans going forward to produce. These and these are the predictions of the actual flow of waste. From next year forward looking all the way through the year 2040 and showing how the volume of waste per year rose over time because the amount of solar panels in use the fleet around the state is growing during that time, so more and more older facilities or reaching end of life. Because of the total number of solar in the state growing. The model is expressed in 4 different measures, it's by weight, which would be tons per year. By volume which would be cubic feet. I'm sorry cubic yards of waste volume per year and then also by number of modules and by megawatts. So, this one is showing by weight, and I'll also show by volume which is going to look pretty similar. In terms of the specific numbers. I don't know folks are more interested in tons, or cubic yards, but in cubic yards. It's you know, starting from a relatively low point, just the very first modules to be installed way back in the year 2000 would be starting to age out at by next year. Anecdotally, I would say that that these early projections might be a little bit high, but it's showing something close to 2000 cubic yards per year. So that's around 6 cubic yards per day. Let's see. Yeah, it's around between 5 and 6 cubic yards per day. In the early years and then that's growing up, too from 1800 or so cubic yards. Through 2040 when you're looking at more like 17,000 cubic yards per year. If you'd like to see that in tons, it's starting out around 2500 or to 3000 tons per year in 2022 and that's growing to about you know 20,000- 26,000, no more like 28,000-29,000 tons per year in the year 2040. So, it's an issue that starting small but it's certainly not nothing even in their early years.

00:16:50.960 --> 00:16:51.530

Thompson, David

Lyle, this is David. Is this both residential and commercial industrial utility scale, right?

00:17:01.840 --> 00:17:05.800

Lyle Rawlings

Yes, that's all scales, all modules installed in the state.

00:17:02.580 --> 00:17:03.030

Thompson, David

OK. Thank you.

00:17:07.940 --> 00:17:34.270

Dunbar Birnie

So while you might swap to the page where you do the year-by-year summations because that illustrates how that histogram failure, then gets applied differently for each year. So, when we imagine some things installed in 2026, that's when that histogram starts to kick in and so, each year is offset one by one and so I think that helps unpack where these numbers come from.

00:17:38.320 --> 00:17:40.910

Lyle Rawlings

OK let me see if I can find it.

00:17:42.320 --> 00:17:45.080

Dunbar Birnie

It might be the first page. I'm not sure.

00:17:52.560 --> 00:17:57.590

Lyle Rawlings

Yeah, so this just I'm going to expand this as well if I can. This shows that that in any particular year, and this is a big chart. But it's starting with what was installed in the year 2000, where my cursor is. What percentages of that are really small numbers so? But they're already getting pretty old by next year. So, you can see that these are pretty small numbers just because there aren't many solar panels that were installed in that year and the same thing happens for each year. And you can see that after 2021, then is starting in 2022. These are brand new modules, so very small amounts are coming to end-of-life, and you know in 2020, like 2024 etc. So, your stuff is down all the way through the year 2040. Within the future years, the flows only get started in the year after they are. They're installed and that's why you see it kind of coming down on the slope there. So that's kind of a peek into the into the detailed numbers.

00:19:15.630 --> 00:19:24.020

Dunbar Birnie

So essentially what shows in the graphs for volume and weight and module and count are the summations at the bottom of each of those columns so.

00:19:22.550 --> 00:19:26.410

Lyle Rawlings

Yeah, that's the summary along here at the bottom.

00:19:24.660 --> 00:19:24.930

Dunbar Birnie

Yep.

00:19:27.360 --> 00:19:42.630

Lyle Rawlings

Yeah, and it also shows that we have specific numbers of installs that come out of the different programs. The first program was called the core reprogram that ended in 2011, then the S rec program, which just ended so that's just ending this year. The Tirek program, which was a transition program is just occupies a few years and then the new program that's just starting up now called the solar successor program called Susie for short and the based on in the center, called the S rec 2. That's the one starting in 2021 and moving forward with greater and greater volumes going into the future. So, the

result of all these programs and all these years, is added up and the results in these graphs, predicting how much flow we're going to get every year.

00:20:32.130 --> 00:20:42.290

Dunbar Birnie

So let me ask the question I didn't think about this before, but in those future years, where that's correct 2 incentives would be available.

00:20:42.880 --> 00:20:55.710

Dunbar Birnie

How close to tracking those numbers will the BPU end up being able to stay on track or is that really a wild guess?

00:20:57.240 --> 00:21:00.950

Lyle Rawlings

Well, it's better than a Wild Guess and in fact, I would say that the biggest wild card is politics because through 2030 at least the number of megawatts supported by the BPU per year. Is a plan right and so a future governor or future BPU president could alter that plan in the future potentially could easily get done because you know, setting a goal for a coming year. There's no obligation on the part of the BPU other than sticking for their plans, so the plane can be altered and if the plan holds then these numbers are pretty accurate. Because you can have a plan for an incentive program and failed to reach it in any given year, but the history of the solar industry is that there's just so much drive and so much enthusiasm for building solar that if anything, usually you overshoot the estimates. But overshooting probably isn't kind of happened because the new thing about this new successor program is that there's a hard limit every year. Before it was open enrollment you could build as much solar as people wanted to build that's no longer the case where we're limiting solar each year to the amount supported by this incentive.

00:22:35.420 --> 00:22:35.740

Dunbar Birnie

So, before the amounts that are planned at least in the current plan. Then you think the industry and the real estate are available to reach those limits in the next few years without problems. OK cool.

00:22:48.770 --> 00:22:49.070

Lyle Rawlings

Yeah. Like I rather open question is, are we going to start to run out of space? And we're talking about such a massive build out of renewable energy. Both solar and wind that there is a realistic possibility, though run out of rooftops and ground space. Because New Jersey is just such a crowded state. So, it is possible that we could underachieve. Probably not in the next 10 years, but after that it is showing substantial volumes of waste. You know, I think if you're a landfill operator-you think in terms of cubic yards, so I'm showing again the cubic yard amounts but, if you compared it with something like municipal solid waste. I think this would look very, very small but still if you're getting 10 years from now into the 8000 cubic yard per year territory that's pretty substantial.

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Nader, Nicholas [DEP]

OK, thank you any comments questions on this?

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Brubaker, Scott [DEP]

And I guess the obvious question is what implications this has for the goal of this council and that is to plan for the end-of-life results for these panels. Have you thought about that or come to any initial thoughts about that at this point and the analysis of this in that regard?

00:25:15.220 --> 00:25:25.030

Lyle Rawlings

Well definitely some thoughts about it and I think we're still analyzing the implications of these specific volumes.

00:25:25.840 --> 00:25:26.750

Lyle Rawlings

But, folks that I'm liaising with in the industry, both Mid-Atlantic CIA and the National Group Amicas Cooperative. We are thinking about this in terms of what are some practical solutions? And so a set of suggestions is starting to come together for the near term as technologies for more fully recycling, the parts that go into a solar panel start to mature and become more economical. What can we do in the very near future to avoid you know chaos, which is what's going on now because everybody is just making their own decisions about what? So, here's a quick snapshot if you will, or vision of perhaps what could be done in near term. There's one thing that's undeniably recyclable from solar panels and it's not high tech and that is to remove the aluminum frames. It's pretty easy to do it's not it's not real cheap. But it's reasonably economic and one feature of that is when you remove the frames. All you've got is about a quarter inch thick sheet of glass and those can stack right on top of each other with no space and no loss you know, no air space. And it greatly hacks the volume when you do that. So, a suggestion would be for the state to establish a statewide reach for a recycling that would simply take off the aluminum and recycle the aluminum. It's a high value product. So, there's definitely some offsetting value there and that could be done for instance, by doing a competitive solicitation statewide presumably private or even public landfills could respond to such a solicitation to establish a facility like that. To perform the separation of the aluminum and deal with the glass laminated product that's left. As for that what to do with that, a suggestion would be to enable it to be disposed of in a landfill, but in a dedicated section, in which the glass would be laid flat with minimum breakage. Because the more encapsulated it is the less chance there is of any kind of leachate happening or any kind of leaching of anything within the laminate so it would be to stack the glass, which will both be giving it the most compact form and they kept those accountable space and handling it carefully would minimize any potential for any leaching. Then, take the stacks and store or dispose of them in a in a dedicated section. So, these are thoughts. I think the experts in in recycling and the experts in waste handling can help refine that, but I think that's where a number of folks involves our centering of some near-term suggestions.

00:29:30.150 --> 00:29:34.420

Thompson, Sean [DCA]

A quick question: is this broken or available by geography?

00:29:36.510 --> 00:29:39.340

Lyle Rawlings

I think there is enough data that they could be done it would be pretty time consuming, but I think it's

doable using the data that the bpu has available. Because there are the Master database that they release, they release a new version every month, does have addresses and zip codes for them, so I think they could be sorted by zip code; and so, it would be a lot of work because it's a massive amount of data.

00:30:16.870 --> 00:30:19.540

Thompson, Sean [DCA]

Little bit yes, you know interesting to see you know. How it is for South Jersey versus North Jersey versus Central Jersey? In terms of citing a facility for doing this procedure.

00:30:36.320 --> 00:30:38.480

Lyle Rawlings

That's good point well, let me dig in a little further and just see how much work would be involved in doing that. Just anecdotally from my own experience, I think it's pretty well spread out throughout the state and so, if you were to cite a facility, I would think that something pretty central in the state would be the optimal. But that's just you know that's just anecdotal, and you know generally what I see.

00:31:09.380 --> 00:31:20.460

McRae, Ashia [DEP]

With regards to storing panels in specialized areas at like landfills and things like that. You might want to pull Nick B. in on that because how does that impact enforcing the compliance on it ? How do we know they doing it the right way in the specialized area?

00:31:29.320 --> 00:31:32.490

McRae, Ashia [DEP]

How is that going to impact the operations such as enforcement, compliance, and permitting with regard to these specialized storage spaces for that kind of material?

00:31:42.270 --> 00:32:05.560

Lyle Rawlings

Speaking of that one other suggestion was once a facility like that can be established or it could be more than one with somebody who would want to look at these flows and match them up with 10 as single landfill handle it or would you want to have a North or South in a central one but once established I think the industry would be willing to say make it mandatory that when a facility is being decommissioned or even broken or failed modules being decommissioned that they are required to send them to these special facilities. In terms of monitoring the facility, if it's landfills-they are already pretty closely monitored by the DEP so I would think that checking on them would be not too onerous, but it wouldn't be my job so I'm probably not the right one to render an opinion.

00:32:58.930 --> 00:33:12.710

Lyle Rawlings

But you know exceptions do happen at landfills and so this could just be an item added to the list of them to inspect but it would be pretty simple thing-they're just removing aluminum and I don't know, if they're doing that, they're not going to throw away the aluminum because it's valuable. It's a good income stream.

00:33:22.180 --> 00:33:24.970

McRae, Ashia [DEP]

That is going to lead to my next question. So, we spend a lot of lot of time where we talk about that it's really expensive and hard to disassemble and does this option of being able to disassemble the aluminum portion of it does this kind of address the situation of the difficult disassembly and the lack of profits available to recyclers for when they are able to disassemble it then and can't make no money off of it. Will this solution or suggestion of taking that aluminum off of it and just storing that other part would that help to alleviate that issue and help raise a profit for recyclers that do it?

00:34:12.510 --> 00:34:27.160

Lyle Rawlings

We could say raise the profit or decrease the cost of disposal on it. I think it would do that. But I think we have on the Commission people in the business and recently, I would think that because you're doing a relatively inexpensive operation in producing a pretty valuable product that this will be one of the least cost weights of handling the problem, but you know the guys can give you a better answer than me.

00:34:53.220 --> 00:35:23.850

Chris Gulics (PSE&G) (Guest)

Hello one question I think we still have to overcome the determination of how we're characterizing that panel, as waste right. So, from the standpoint of hazardous waste versus non-hazardous waste that's still a big question out there that I've probably impact. Some of that. But I do agree with you, that integrated aluminum panel is one of the more difficult aspects of the manufacturing process. Even some of the vendors I speak with are very interested in getting into recycling hopefully once we get some regulatory changes that makes it easier for them. That is one of the dilemmas. They have they they've explained to me that the process is you know? The term they use is just messy in order to use the existing equipment. They have from other D manufacturing processes to adapt it to that, so it will take some retooling of their equipment that I guess in a sense, they're not really willing to spend the dollars to invest in right now until there's some more incentive to do so where they see the outcome. And I think the data you presented is excellent and you know, one question. I have about that. Too is that there is a factor of what panels are coming out from like storm events and other related incidents of malfunction and there's got to be a percentage and I don't know what that will be if there's any guests of what that could be as especially as we start to see more extreme weather events come through our areas and we increased the more you know arrays and rooftop units. It's bound more and more will be coming out of service prematurely from age.

00:36:28.450 --> 00:36:41.310

Lyle Rawlings

That's a really good point and that was taken into account. I'm going to go back to the to the service life histogram if I find it.

00:36:41.600 --> 00:36:50.600

Lyle Rawlings

Yes, we did take that into account. Fortunately, it seems like those numbers may be pretty small. All solar arrays are designed to a design wind speed that is a pretty high wind speed typically around 100 mph wind so even during Hurricane Sandy. Only a very small percentages of modules were destroyed by

that extreme weather pretty well. Even though it is really like small percentages it does take that into account and going back to what you were saying before it's a really good point Chris that if one specialized equipment specific to taking the aluminum frame off of a module, it'd be hard the way it stands now for anybody to invest in those and that's part of the reason to designate a statewide, facility or facilities because then if they can count on a flow of modules that is substantial enough to justify buying that equipment. Module frames generally come in 2 types depending on how they're joined at the corners; and once that corner join is broken it can just be pulled off very easily. They just come right off. So, the one type is the corner joints are held together by screws and the other is the press fitting. The press fitting-to do it quickly you would want a machine that can just pull them apart. The corners and for the screwed in ones. It may be better to just use manual labor to back out the screws with screw guns and then they just come right apart. But you know more and more we see the best things or best scene and we would want a facility that is guaranteed that flow of models to be able to afford a machine fast.

00:39:00.930 --> 00:39:02.060

Chris Gulics (PSE&G) (Guest)

Yeah makes sense thank you.

00:39:03.920 --> 00:39:07.990

Nader, Nicholas [DEP]

Very good and Lyle could you send this document this spreadsheet too?

00:39:08.900 --> 00:39:11.210

Nader, Nicholas [DEP]

To Ashia please.

00:39:11.310 --> 00:39:12.970

Lyle Rawlings

Yeah, yes, I sure will.

00:39:13.790 --> 00:39:14.310

Nader, Nicholas [DEP]

Thank you.

00:39:15.550 --> 00:39:20.990

Lyle Rawlings

Certainly interested in hearing any comments or suggestions about it.

00:39:16.250 --> 00:39:16.780

Nader, Nicholas [DEP]

OK.

00:39:21.780 --> 00:39:43.860

Nader, Nicholas [DEP]

OK, one quick question. There's the cubic yards. What we were looking at in terms of cubic yards like in the previous diagram. We were looking at what? What are those numbers based on? What assumptions that current trends the number of current sales subways or solar panels or what are they?

00:39:47.150 --> 00:40:02.640

Lyle Rawlings

I'll show you how that got built up so from the histogram and then the data on the bpu programs that are shown here we calculate the total volume in in megawatts and then we, we have to turn that first into the number of modules, so on. That data goes into another sheet. That gives us the number of modules and use both BPU data and industry data on how big the modules are on average. In each year's modules getting physically bigger and they've also began getting more efficient over time. So that that gives us number of modules and then we look at the trends in the BPU data and in industry data on how big each module is and then that combined gives us the volume in cubic yards.

00:40:54.770 --> 00:40:55.170

Nader, Nicholas [DEP]

Very good.

00:40:54.970 --> 00:40:55.260

Lyle Rawlings

I'm gonna have to go back and check to be honest. I think we I did assume in this one that the frames would be removed and so this volume would be much larger if the frames were not removed.

00:41:13.640 --> 00:41:17.030

Nader, Nicholas [DEP]

OK alright thank you. So, should we move on?

00:41:16.250 --> 00:41:19.600

Lyle Rawlings

Yeah, and I'll check on check on that assumption in and let us know when I send this out whether that's true.

00:41:28.110 --> 00:41:55.910

Thompson, David

Hello, it's David again, yeah, thank you for putting this together. There's a lot of excellent data. I guess my question is my sense of these problems is always banned and maybe I'm wrong, but that this is more of a consumer based or a residential based problem in that you know the consumer. The resident is going to have less ability to deal with these at the end of life, then say a large company would. We were in at least in my case, at Panasonic. We're pretty much set up to deal with our own generated waste and not involve you know a local waste. Our local recycling facility in that process, I guess. What I wanted to see is if you have any ability or just thoughts on the percentage of these volumes that would be residential generated as opposed to commercial or industrial or utility.

00:42:28.520 --> 00:42:52.060

Lyle Rawlings

We sure do. The the data is so excellent and so detailed because the fact that every project happens because there's an incentive that is provided by the state and by the bpu. So, we have a rich amount of data on every single project that's ever been done in this state and so the direct answer to your question about residential, I would have to run the numbers over time, but it would be around 30 to 35% of the of the megawatts would be residential and residential modules are a little bit smaller than commercial ones. So, we're probably somewhere around 30% in terms of volume for residential and you're bringing

up a good point that the residential tracking it and enforcing a requirement that it be disposed of at this designated facility is going to be challenging for the residential sector because there's already about 140,000 of these homes that have solar on them, but the good news is that the BPU has this database that has the name and address and I don't know if they have phone numbers but anyway, name and address for every single one of those so they could do a mass mailing and say Mister homeowner or Mrs. Homeowner, you are required when your modules reach end of life to dispose of them in this designated facility and I would imagine that. There are likely to be some ancillary businesses that would crop up. They would go around and haul them away for you to that facility. But you know, we can reach people—whether we can enforce 240,000 homes that's another question.

00:44:28.960 --> 00:44:30.660

Thompson, Sean [DCA]

You raise it interesting.

00:44:29.000 --> 00:44:30.270

Thompson, David

OK, yeah, thank you for that.

00:44:32.700 --> 00:44:36.550

Thompson, Sean [DCA]

I guess point here, so if the contract expires, the homeowner, who if there are any issues, who do they contact?

00:44:48.640 --> 00:44:58.290

Lyle Rawlings

Well, I don't really know the answer to that question to be honest with you. This is new enough that there isn't a whole lot of that that has happened yet. They may be able to contract between a homeowner or building owner or landowner at all scales between them and a 3rd party owner so those contracts are between 2 parties so they can say anything. So, it's going to be hard to find out what typically those contracts say. But in my experience, they typically say that if you're at the end of the contract and the property owner at that time wants it to be removed, it will be the responsibility of the 3rd party owner to do so. So, the 3rd party owners are easier to keep track of them. They are fewer in number. So, you know they would be the ones regulated. Now if the if the property owner then chooses to continue operating it at the end of contract, which most of them probably will then it'll be their responsibility. Then, there's the about 35% of all the solar in the state that is not 3rd party where the property owner also owns the panels and also in that case, it would be their responsibility to dispose of them properly.

00:46:31.290 --> 00:46:50.360

Dunbar Birnie

So my guess partly would be there, if you were one of those residential owners. Then the first person you might call would be the company that you hired to put them in right and it's a help and there would then be a cost for removal.

00:46:31.470 --> 00:46:32.010

Thompson, Sean [DCA]

So it's good.

00:46:43.560 --> 00:46:44.290

Lyle Rawlings

I would say yes.

00:46:50.990 --> 00:46:55.260

Dunbar Birnie

And so those same companies would then know where to take it once we figure out where that is.

00:46:56.360 --> 00:46:56.720

Lyle Rawlings

True.

00:46:57.740 --> 00:46:58.120

Lyle Rawlings

Yep.

00:46:58.000 --> 00:47:03.980

Dunbar Birnie

There might be also a category of roofing companies so if you're going to be if your roof fails and that impacts a solar array, then the roofing companies would be the disassemblers and might need to know the same information.

00:47:13.200 --> 00:47:30.740

Lyle Rawlings

Yeah, and what I'm hearing anecdotally from the companies in these two industry associations is often what happens is the homeowners will call up a solar company. You know they'll just look in the phone book or whatever and call up a solar company and say can you come and remove these for me?

00:47:32.210 --> 00:47:55.780

Thompson, David

This is David, I agree. I think it's unlikely that you know a homeowner would try to remove these panels himself or herself from their roof and would call in some expertise. You have both you know the fact that they're electrically connected and may still generate power and be dangerous plus you do as a homeowner myself. I wouldn't want to do anything that would you know risk the I guess the integrity of my roofing?

00:47:56.800 --> 00:48:26.500

Lyle Rawlings

Sure and not only that but handling these is not easy for you know the typical homeowner. They're heavy you know they can weigh anywhere from 45 to 65 pounds and they're big and bulky and hard to hold and if you're a homeowner are you gonna take a rickety ladder up there and try to haul those things down a ladder yourself? Probably not, and so the guys that are in the profession of hauling them up there and fastening them are well positioned to unfasten them and hold down? They have the equipment that training etc.?

00:48:34.530 --> 00:48:57.960

Thompson, David

Protection. So, I guess what I'm what I'm thinking is, I don't see a likely scenario, where a good number

or large number of homegrown homeowners would try to remove them from the roof themselves and dispose of them. There would be some sort of professional you know trained intermediary involved and it would be reasonably easy to inform them and help train them what to do.

00:49:00.520 --> 00:49:01.240

Lyle Rawlings

Yeah, true.

00:49:00.730 --> 00:49:09.940

McRae, Ashia [DEP]

At our last meeting with when Joe was here. Joe gave us a PowerPoint presentation where he broke down. He gave a breakdown of the ownership and in his breakdown, he says that 3rd party ownership is 62% of the installed capacity right now and purchase upon installation is 38% of the installed capacity. He [Joe F.] breaks it down on who has to do what in each one of these instances. I don't know if that helps to answer the question that you're asking right now, but he did give us a PowerPoint and he obtained his information from BPU too that is broken down in spreadsheet format. I believe that this is in the library. If it's not, give me a few days and I'll have it added into the library, but it does give a little bit of an explanation of the variances of each category type.

00:50:12.890 --> 00:50:21.030

Lyle Rawlings

That's excellent and I'll share in terms of who's responsible for what was that, according to BPU rules?

00:50:23.190 --> 00:50:26.270

McRae, Ashia [DEP]

That is, according to the agreement type. So, it's for the 3rd party ownership. I'm not sure if I'm understanding it correctly. I'm going through it so quickly and let's see here impact on their side. OK so I'm not sure what's meant here, but the title of the slide is called the impact when recycling or disposal for leases. It says that the repair and maintenance is up to the lesser. The upgrades are up to the lesser the sale of the property that can be negotiated for unforeseen events that can be negotiated and if there's been a change of law that can be negotiated. For tax equity owner, from in service date until target, yeah, I'm not sure what that means but maybe you guys understand that.

00:51:28.090 --> 00:51:29.700

Lyle Rawlings

Looks like you've answered my question. So, he's talking about obligations that are contractual obligations as opposed to state impose obligations. I think what we what we will be talking about would be some state regulation or laws or requirements that would...

00:51:54.980 --> 00:51:56.290

McRae, Ashia [DEP]

Supersede this? Take precedence over this?

00:52:00.220 --> 00:52:02.060

Lyle Rawlings

I think so or contracts going there that are entered into in the future would have to comply with law and law would supersede any contractual requirements that already exist. So, if it's not spelled out in the

contract or it is. If you say all of this has to go to designated facilities. Then everybody would have to comply?

00:52:29.730 --> 00:52:36.540

McRae, Ashia [DEP]

And if any contract law or language contradicts law, the contract is unenforceable, and law supersedes it.

00:52:39.920 --> 00:52:45.190

Nader, Nicholas [DEP]

OK, Ashia can we go back to the agenda, please? Thank you.

00:52:47.110 --> 00:52:49.560

Brubaker, Scott [DEP]

I have a question for Lyle and I am not suggesting this but I'm just inquiring Lyle, as you discussed and this is where I actually thought you were going when you talked about some kind of facility to receive these things that anyone in the group even suggest that there be an opportunity to temporarily store these panels until the day when the technology caught up and could actually recycle them—was that part of this discussion at all?

00:53:18.640 --> 00:53:19.990

Lyle Rawlings

Yes, absolutely, and that I think requires further research in terms of where would you find the space to do that kind of storage? I think we have to look at that a little further because we have these this data, now on the total volume that we're talking about and so we can start to look at that total volume and say, is there a way we can actually do those that doesn't involve putting them in the ground where they're inaccessible after that?

00:53:58.240 --> 00:53:58.570

Brubaker, Scott [DEP]

Right.

00:53:58.390 --> 00:54:11.680

Lyle Rawlings

The question has definitely been raised I. I think you make a really good point because it would be preferable if they could be stored so that future technology could then go back and recycle more. So, we gotta look at the practicality of doing that. I would agree that it's preferable.

00:54:17.400 --> 00:54:18.360

Brubaker, Scott [DEP]

If you have 1,000,000 tons of these things in one place somebody who's got a supply worthy of potentially investing in the technology to do something with it. It's all right there. We set up shop right

00:54:37.430 --> 00:54:49.950

Lyle Rawlings

Yeah, and I could imagine maybe a law that that somebody like Senator Smith might do that would say okay, we're gonna require going through this designated facility or facilities, we're gonna start with removing the aluminum and storing them in the most compact and safest fashion possible. Maybe we'll

find that we could store them like you were saying, and state you know the state shall undertake a study of how better technology will be incorporated in the future and provide a pathway toward getting them.

00:55:23.840 --> 00:55:31.550

Chris Gulics (PSE&G) (Guest)

Yeah, and Scott I'm not against this either. I said as before. One thing we'd have to just be cautious of is RCRA? How do we get around whether we're calling these hazardous wastes or non-hazardous waste and I know the jury still out on that discussion. But for the most part our conservative approach and some of the data we have and some of the manufacturer information suggests that many of the panels could be hazardous.

00:55:52.050 --> 00:55:55.390

Lyle Rawlings

Yeah, and I think that needs to be data driven. It would be a surprise to those in the solar industry if they were to be considered hazardous because of the fact that normally they are so well encapsulated. It's very difficult for anything to get out of this module and especially if we could establish a system where they're not ground up or crushed but rather preserved to the extent possible and laid flat that could absolutely minimize any potential for leachate.

00:56:36.600 --> 00:56:43.350

Thompson, David

Is one way to finesse this issue concern to designate them as universal waste? That would at least allow people more time to store them and allow people like E waste processors to process them before they would have to be sent to more responsible facilities for final destination.

00:56:59.620 --> 00:57:00.130

Chris Gulics (PSE&G) (Guest)

Yeah, David I think that was one of the first discussions. We probably had it at the very first meeting and I think from a lot of the industry folks that already.

00:57:02.590 --> 00:57:02.890

Thompson, David

Yeah.

00:57:10.050 --> 00:57:28.800

Chris Gulics (PSE&G) (Guest)

D manufacturing process universal waste. I think a lot of them are looking for that change and inclusion of this material to bring that this these solar panels into their operation as a as another electronic innocence. So yes, I think that would definitely help.

00:57:30.260 --> 00:57:34.410

Thompson, David

I don't know how that would handle the storage discussion, but it would at least facilitate you know more and easier management of them through the recycling process that we haven't placed now.

00:57:41.600 --> 00:57:42.370

Chris Gulics (PSE&G) (Guest)

Absolutely.

00:57:47.970 --> 00:57:48.590

Nader, Nicholas [DEP]

OK. Hi, can you Scroll down to item F?

00:57:53.170 --> 00:57:53.550

McRae, Ashia [DEP]

Yes.

00:57:53.310 --> 00:57:54.760

Nader, Nicholas [DEP]

21 F thank you.

00:58:01.450 --> 00:58:04.200

Nader, Nicholas [DEP]

OK, Chris do you have anything to share with us today?

00:58:05.160 --> 00:58:13.310

Chris Gulics (PSE&G) (Guest)

Oh no, I provided the update last meeting. I can send out the information to the group afterwards?

Absolutely.

00:58:07.870 --> 00:58:08.880

Nader, Nicholas [DEP]

You did? OK, great.

00:58:15.440 --> 00:58:45.650

Chris Gulics (PSE&G) (Guest)

And there was, I did come across, and I'll apologize now if I'm talking out of turn if this was already transmitted, but I did come across another document, another report that is essentially looking at doing a similar effort that we're looking at now, which I can share with the group after the meeting as well. It was just done in March, and it was done by the let me get the National Renewable Energy Laboratory, in cooperation with the Electric Power Research Institute and they're simply looking at the same exact thing we're looking at and includes a lot of summaries of other state laws. It includes also a write up of what we are doing in New Jersey. So, I will send this link out to the group for review.

00:59:05.430 --> 00:59:10.150

Nader, Nicholas [DEP]

OK, so we should expect a couple of documents from you.

00:59:08.610 --> 00:59:09.660

Chris Gulics (PSE&G) (Guest)

Correct.

00:59:11.340 --> 00:59:11.790

Nader, Nicholas [DEP]

Alright. Moving on. Mr. David Thompson.

00:59:23.690 --> 00:59:25.120

Thompson, David

Are we doing Sean or Dave?

00:59:29.440 --> 00:59:32.250

Nader, Nicholas [DEP]

Dave Thompson—yes.

00:59:32.310 --> 00:59:39.260

Thompson, David

Yeah, so I had requested Evelyn Butler at SEIA to put something together on this issue end-of-life solar panel management in the EU and Japan and she sent me something this morning probably about 30 minutes ago so once I've had a chance to read it. I will forward it to this group. I want to read it first.

00:59:58.140 --> 00:59:59.450

Nader, Nicholas [DEP]

OK, you want to read it first.

00:59:58.170 --> 01:00:01.350

Thompson, David

So, we should have something a couple days for you to review.

01:00:03.970 --> 01:00:06.300

Nader, Nicholas [DEP]

OK, so we should expect that in a couple of days?

01:00:06.880 --> 01:00:08.130

Thompson, David

Give me a week please.

01:00:10.290 --> 01:00:13.360

Nader, Nicholas [DEP]

OK alright I'll give you a week. OK, now, conclusions, recommendations and I think John sent us this.

01:00:33.370 --> 01:00:35.010

McRae, Ashia [DEP]

Yes, I will share.

01:00:47.450 --> 01:00:50.870

Nader, Nicholas [DEP]

What was assigned to Joe Ferrante and I'm not sure?

01:00:52.340 --> 01:00:56.710

Nader, Nicholas [DEP]

Ashia, did Joe submit all those all those items to us already?

01:00:57.030 --> 01:01:00.590

McRae, Ashia [DEP]

Yes, he sent us a PowerPoint presentation.

01:01:27.450 --> 01:01:29.810

Nader, Nicholas [DEP]

Have those been shared with everyone on the commission?

01:01:33.610 --> 01:01:34.940

McRae, Ashia [DEP]

I don't think so. I just forward that to everyone.

01:01:49.460 --> 01:01:49.770

Nader, Nicholas [DEP]

OK, I'll be ready to talk about conclusions, recommendations. Lyle at this point or is it something to talk about later.

01:02:23.730 --> 01:02:26.220

Lyle Rawlings

Sorry took me a second to come off mute. I think it may be time to start talking about that. And I think we sort of have been doing so on this call. So, I would think that the BPU should lead in terms of how to structure our decision making around recommendations. We've got a lot of ideas that have been put up by the solar industry and the recycling industry and other members of the Commission. I suppose that there needs to be a decision-making process on where we land on these recommendations. I don't know who should lead that that decision making process, but I would suspect the DEP.

01:03:21.420 --> 01:03:22.710

Nader, Nicholas [DEP]

Correct I think yes.

01:03:26.240 --> 01:03:28.900

Lyle Rawlings

I mean, I would be glad to get the ball rolling with a kind of an outline and put it out there just as a starting point. If there's maybe some other people that could collaborate on starting that framework.

01:04:01.040 --> 01:04:06.670

Nader, Nicholas [DEP]

OK, does anybody have some sort of recommendations they could submit to us at this point? I know Jim already sent his recommendations like talk about depots and collection centers, I think. I only read it briefly.

Jim Entwistle on phone with McRae, Ashia [DEP]

Yeah, if everybody takes a little time to read what I submitted I think it's gonna answer some of your concerns, some of the ideas that Lyle brought up, and some of the concerns that Chris had brought up about it being considered as universal waste. There's no question. Exactly utilization. The existing network of E waste recyclers is probably the easiest way to go. And as you go through what I've submitted Karen and they asked me to fill in the blanks or add to the framework. I went into a little more detail about funding other components of what a fee would be who, would pay the fee is important to understand that in the private sector. We like to get paid for the services that we provide, and I think it's important to understand that to get industry willing to embrace this, we need to make it part of who we are, and how we function as a recycler in the state, it's just that there's a lot going on as

far as handling the material and I also feel that there's some viable downstreams to the material to keep the end-of-life processing added. This state and utilized depots, and aggregators within the state could solve this trauma. Sign up for feedback on what I submitted and please—anybody can email me directly with any questions. Thank you.

01:06:39.340 --> 01:06:40.730

Nader, Nicholas [DEP]

OK great.

01:06:41.510 --> 01:06:43.950

Kloo, Karen [DEP]

So I was thinking at the last meeting that perhaps structuring, the conclusions and recommendations in a way that Lyle's graph supports is kind of immediate action, short-term action, and long-term action. That seems to go hand in hand with what is projected to be the increase in panels needing recycling in 2025 versus 2040 so I was thinking that something that we could do immediately in keeping with a lot of our previous discussions is to have a role change to include solar panels as a universal waste and I think that accomplishes a couple of different things. We can do it quickly. It opens up the ability for existing Recyclers to kind of look into this market and see maybe even promote facilities like they are doing in California. It's great financially viable but at least people are starting to dip their toe in the water to evaluate different processes because it isn't managed as hazardous waste so I'm thinking maybe that could be an immediate action and then these other shorter-term solutions may follow, may go hand in hand, may develop from something that we think about more immediately and I think because the technology hasn't caught up and the number of panels hasn't caught up. Maybe have a long-term recommendation for continued study, long term panel of industry experts that monitor the situation and take action as the time approaches where action needs to be taken. That was again I thought I had as to how to structure the recommendations discussion. Going forward do you guys agree that that would be a practical approach for recommendations or whether there would be no need to divide it up?

01:09:40.900 --> 01:09:49.350

Lyle Rawlings

I think it is about a recommendation, but that would be my first reaction.

01:09:51.470 --> 01:10:13.860

Chris Gulics (PSE&G) (Guest)

Yeah, Karen I agree I think sure, there's a there's a great need for some short-term solutions as longer term are work through and I could tell you just selfishly from a utility standpoint, we generate 100 or so panels a month that are going out as waste and we're disposing of as hazardous waste. So, from our standpoint and I'm sure other utilities are doing something similar where they have those arrays and so forth that we install a lot on utility poles as I discussed. So, it would give us relief, not so much from a cost standpoint, but from a sustainability standpoint as well. We don't take pleasure in disposing of the panels at a hazardous waste landfill, and we think there's other valuable ways to do that and not take up space for other truly hazardous waste that should be dedicated to those types of facilities.

01:10:46.690 --> 01:10:52.890

Kloo, Karen [DEP]

Quite frankly, when in New Jersey E-waste is a universal waste and that really has paved the way for successful electronic waste recycling in the state, I think without that piece we wouldn't be recycling

nearly as many millions of pounds that we, as we currently so if we can capitalize on that kind of model. I think we're not recreating the wheel. We are just using it to pave the way for future action as a number of panels are an increase entering the recycling market.

01:11:38.670 --> 01:11:41.140

Lyle Rawlings

Now to just throw in a real quick note I think the decision making has to have a special case for the cadmium telluride modules. Fortunately, I presented a while back the volume of those is quite small but you know it's a significant difference in the potential risk from those and I think we're fortunate that many, if not most—the majority of them have been installed by PSE&G and that's good because you've got a highly responsible party who can be counted on to take great care with them.

01:12:04.640 --> 01:12:04.950

Kloo, Karen [DEP]

Right.

01:12:22.080 --> 01:12:22.550

Lyle Rawlings

But again, I have feedback from the industry and also of my own would be that I would strongly believe that those should be left intact and stored that they should not be crushed or broken in any way because those are glass modules that are extremely well encapsulated as long as they're intact. If they get accidentally broken—I still think that even an accidentally broken module should be left as intact as possible and the ones that are not broken should just be fortunately, they're also frameless. So, we don't have to worry about that. But those should be carefully stacked and stored, a small volume and that means they should be handled with special care during the uninstallation process.

01:13:33.240 --> 01:13:34.430

Nader, Nicholas [DEP]

OK, so did we miss anything? Here any of these items here? Comparison of current approach in the state of North Carolina.

01:13:51.920 --> 01:13:54.180

Nader, Nicholas [DEP]

Sean Thompson, did you have anything to share with us?

01:13:58.070 --> 01:14:02.360

Thompson, Sean [DCA]

No, regulations have not been proposed yet. I don't think they're going to meet the deadline or the time frame that's in the bill, and Illinois as I previously mentioned, the state itself is not considering regulations.

01:14:18.670 --> 01:14:19.180

Nader, Nicholas [DEP]

OK, that's simple enough. Alright so open discussion at this point. So, this is my understanding: is everybody leaning towards classifying these solar panels as universal waste and deploy solar panels—is that the general consensus here? Anybody?

01:14:56.180 --> 01:15:07.950

Lyle Rawlings

I'm probably one of the least knowledgeable about the regulation and what that means so if its universal waste does that mean in terms of disposal? In other words, what kind of facility can you put universal waste in?

01:15:15.520 --> 01:15:19.160

Nader, Nicholas [DEP]

Class D universal waste facilities where they can de-manufacture and send the parts to end markets. That's basically it.

01:15:32.490 --> 01:15:40.370

Lyle Rawlings

OK, so in other words, they can't go to a landfill or just a general storage facility—is that right?

01:15:33.030 --> 01:15:34.140

Nader, Nicholas [DEP]

So they will be. Well, I don't know if they can. If they would—some parts may end up in landfill and there's nothing that would prevent them.

01:15:57.460 --> 01:15:59.980

Lyle Rawlings

Well, I guess what I'm a little concerned about is that we're talking about two almost opposite directions that these panels could take at end-of-life. One would be to preserve its existing encapsulation to the greatest degree possible, meaning you don't shred him. You don't grind them. You just keep that big sheet of glass as intact as possible and that means you're not really doing any real recycling other than the frames. So that would be one pathway. Pathway two would be you start trying to recycle any materials within that encapsulated glass, which means that you have to start pulling it apart, smashing it, grinding it, shredding it, in order to get at what's inside. So, I think what we're recommending is the first way where you try to preserve the existing in capsulation to the greatest degree possible and do not take it apart that encapsulated glass sheet until economic recycling methodologies and technologies are available. Because that minimizes the exposure of what's inside this encapsulated laminate to the elements.

01:17:35.940 --> 01:18:06.650

Chris Gulics (PSE&G) (Guest)

I just to want to add to that. I think one of the problems we face as the generator of the panels of the waste when a panel is no longer usable. It's up to the generator to make a waste determination of how that material needs to be managed whether it's non-hazardous waste or hazardous waste and I think I agree with you. There isn't an encapsulation, but from a regulatory standpoint the requirement requires some destructive testing of that material to determine its leachability as it gets landfilled and based on some of the data we have internally performed as well as some of the manufacturer information a number of these types of panels are considered hazardous regardless of if they're damaged or undamaged, but to that extent, most of the panels we're bringing down do have cells broken there is glass damage to them. So that I just want to make it clear that regulation kind of drives how we have to look at this and how we have to manage it as the as the generator to ensure that we're in compliance and that we are not having an impact to the environment but placing these things in regular solid waste

municipal landfills versus a very highly regulated costly hazardous waste landfill. So, I just want to make sure that there are some driving rules that we need to just think about and that's where I think moving towards a universal waste category is still deeming. This hazardous waste. But it's in a universal waste category from a state standpoint where it allows the easier handling and recovering and recycling of these materials that that we have in there and so you'll be disposing of hopefully less of that material as hazardous waste than the total amount of product. You start with and Karen and Scott—chime in here anyone else from a state standpoint if I misinterpreted.

01:19:31.470 --> 01:19:32.600

Thompson, David

This is this is Dave. One comment for the state is wouldn't the universal waste rule designation facilitate the removal of the aluminum frames and then it would be a question of what the DEP would allow for final disposition? Would the DEP allow for some sort of storage while we wait for the development of technology or some other practical landfill storage since their leachability is so low?

01:20:07.130 --> 01:20:13.110

Kloo, Karen [DEP]

So, the E-waste law precludes storage of materials right, Dan?

01:20:16.070 --> 01:20:29.120

Clark, Daniel [DEP]

Yeah, for the most part I think they can store materials within the program year. Essentially within a reporting period and have to report what's in storage, but beyond that if you're storing E-waste, you can't store it for an extended period of time. Part of that comes from a number of high-profile cases especially with CRT 's—but not only with CRT 's where you've ended up with multi-million-dollar cleanups because somebody was saying they were recycling the waste and really just putting it in a bunch of trailers.

01:20:57.570 --> 01:21:02.450

Kloo, Karen [DEP]

Right and there was some other facilities in Ohio that just warehouse, right?

01:21:05.840 --> 01:21:07.280

Clark, Daniel [DEP]

Yes, that's a big one. The Closed Loop case.

01:21:07.510 --> 01:21:09.790

Kloo, Karen [DEP]

Yeah, material to the point where the property is now valueless because of the costs of disposing of materials is so high. So, I think it is kind of a clever idea to safely store it in a way to allow the recycling technology to catch up. I'm not sure from a political or regulatory standpoint the Department or legislators would be in favor of that or fear of that happening. That the materials gets stored and even if they get stored in an environmentally sound way if the recycling technology doesn't ever catch up or that property gets slated for redevelopment or the property owner walks away; and therefore, the material is no longer maintained in an environmentally sound way that there might be a reluctance to adopt that kind of approach.

01:22:28.630 --> 01:22:34.900

Dunbar Birnie

So let me make a comment. I'm obviously not well informed on the rules, but what Chris said seems pretty valid that if there is a leachability test that is already on the books, it has to be satisfied, even though we can do a better job of storing them by stacking them in many cases. I think that we have to abide by that ruling and for the CadTel case, especially.

01:23:00.100 --> 01:23:18.120

Kloo, Karen [DEP]

I think the CadTel is a different animal and would have to be managed differently. But I think what the problem with the leachability tests for the other panels is expensive and it's so expensive that people just rather assume they're hazardous than do the testing.

01:23:24.460 --> 01:23:37.750

McRae, Ashia [DEP]

I don't know if it helps any, but I remember Karen asked Tommy McGuire how does your company tell which panels are hazardous and non-hazardous he stated that they have a database. He was willing to share that information with us. Would anybody like me to reach out and ask for that information? But he said that they maintain the database over the years, and they know which ones have that bad stuff in it, and which ones don't, they know them by the model or the manufacturer. I don't know if that helps to cut down work.

01:24:03.650 --> 01:24:06.570

Thompson, David

Well, I don't know if anyone wants to follow up on that, I'd like to see that database certainly.

01:24:08.630 --> 01:24:09.060

Kloo, Karen [DEP]

Sure.

01:24:08.910 --> 01:24:18.090

Thompson, David

But there's also been some work done by the University of Arizona on characterizing the panels for TCLP testing and it suggests that if they're really handled in such a way that you get a true representative sample of what's in the panel that it's unlikely they will fail a hazardous waste test.

01:24:43.700 --> 01:25:06.020

Lyle Rawlings

I believe very strongly, and I would love to see any leachate data that's out there because I don't have access to that now. So, if there's any anyone can point me to the data or provide some but from an engineering point of view. I think it's almost certain that the more the existing encapsulation stays in place, the less potential for leachate that there is. The encapsulation is specifically meant to keep all of the elements out for a 35-year life and modules fail if that doesn't happen. So, over time they've gotten better and better at perfect encapsulation, so if they stay intact that's absolutely going to minimize actual potential for leachate and then it's just a question of if they are left intact and stored in that manner is just a matter of what kind of facility will accept them in the case of cadmium Telluride. I am also highly confident there that there there's going to be no way to recover anything but glass and

plastic out of that, if you break it open the cadmium telluride layer is only a Micron or two thick, so there's just no way to recover that material—it's just not going to happen. So, in that case in particular, I think it's imperative that those modules be left as intact as possible and then it's just a question of where you're going to put them, what regulatory type of facility can you put them in? For other modules, I think the endpoint is still the same until you can economically recover materials by tearing them apart. It's best to keep them encapsulated and keep them safe to the greatest extent possible. If the modules get broken there's still a sheet there because of the encapsulating material. So, you can still just lay them out flat and to the extent that they're intact, they remain intact. While we were talking, I just did a little figuring-based volumes. If you took all the modules that reach end of life, according to our model over the next 10 years, by the year 2030; and you were able to store them 15 feet deep or 15 feet high, depending on whether it's below ground or above ground, that turns out to be about 1.2 acres. So, it's kind of a manageable amount of area that would be required, if you could stack them that high or burying them that deep. Having protection of that amount of areas seems like it'd be a doable thing. Just so that we can have some quantities in mind.

01:28:15.330 --> 01:28:17.940

Nader, Nicholas [DEP]

OK, Dan if I can ask you a question? Do we have any assessment of California 's program so far on that managing end-of-life solar panels as universal waste—do we have any?

01:28:51.100 --> 01:28:58.270

Clark, Daniel [DEP]

I sent out the responses to the emails I had. A lot of it boils down to they're still in the first year and things won't be due until February 1st. hey don't know if anything is going out of state, and I forwarded this to everybody on 9/23. They think overall that this is increase their demand for you know their wider program has you know of like renewable energy has increased the demand for solar panels. It sounds like they just simply do not have enough data yet.

01:29:56.690 --> 01:29:58.550

Kloo, Karen [DEP]

It's too soon to tell, right?

01:29:58.230 --> 01:30:02.360

Clark, Daniel [DEP]

Yeah, and if everyone wants I can re-forward this to the whole crew right now. A lot of it just boils down to the fact that a lot of it is too soon, and because there's no way of preventing the panels from leaving the state. California is treating the panels as universal waste, but they really just don't have a ton of information yet. I mean, they do have that generators can obtain information about the hazardous characteristics by either testing or getting it from the manufacturer. They don't have data on what percentage are hazardous, they must be disposed of at hazardous waste facilities; and then also in that they have a link to the final regulation text in their CFR or code of regulations rather. I think basically what it comes down to is a lot of it is just too soon to know a whole lot.

01:31:38.790 --> 01:31:41.140

Nader, Nicholas [DEP]

So, soon, yes, OK, thank you.

01:31:52.120 --> 01:32:19.800

Chris Gulics (PSE&G) (Guest)

I just wanted to go back and remind that the Legislature is what we're working towards right now is the solar panel recycling Bill and I think one thing we have to keep in mind. I think the ultimate goal of the bill was to try and facilitate recycling of the panels now. Not to say that has to be the only recommendation. I just wanted to refresh everybody's memory as to what the goal of the intent of the Commission wants.

01:32:27.000 --> 01:32:27.460

Nader, Nicholas [DEP]

OK, any other items? Any other comments?

01:32:34.530 --> 01:32:37.820

Dunbar Birnie

Well, let me let me add a bit on the recycling angle. Early in our discussion about the reuse and in some kind of a way, then I was sort of thinking that that might be just too difficult to do, but I was thinking recently that in fact because of the availability of single module. Microinverters then it wouldn't be necessary to have every module in a recycled array match each other. It's not like you'd have to have an aggregated mixture of modules to be useful and so that especially applies to these cases at the 15, 20 and 25 years where there would be a repowering event that new modules would come into place and the old modules would still be operational with another maybe 10- or 15-years life or more. But that probably isn't a business opportunity out there rather than a regulation about what we do. But we could pay lip service to that opportunity by saying recycling options might be enabled this way.

01:34:00.540 --> 01:34:00.800

Lyle Rawlings

Right, I had neglected to mention this, but a lot of the feedback that I'm getting is from people who are in the solar industry who are trying to re-purpose modules, and you know that's a good thing to encourage and may play a part in our recommendations about finding a way to encourage repurposing.

01:34:26.480 --> 01:34:35.220

Nader, Nicholas [DEP]

Would there be a market for that domestically I mean? I know some companies that are talking about shipping those used panels overseas.

01:34:36.630 --> 01:34:42.390

Nader, Nicholas [DEP]

But I mean domestically, I don't know whether homeowners would be too receptive to that idea. You know they had like a 15-year-old panel.

01:34:48.310 --> 01:35:18.470

Dunbar Birnie

So I don't think that a solar array is more of a high end product but it's subsidized obviously to some extent, but it's the people that are spending money on these are going to be thinking about the efficiency and make a choice and say ok, it's probably is better to buy more expensive, newer model and keep it rather than by an older one that might end up dying sooner so same kind of thoughts when you buy a used car, right? In so there could be a model where instead of stacking them in a partly

deconstructed state maybe the working ones. Maybe it's at a landfill site they could be powered up there and kept in service generating power on some large unused land. Although if you were doing array installations on landfills. You'd still maybe run the numbers and put new modules in so it's valid question.

01:35:55.430 --> 01:35:59.880

Kloo, Karen [DEP]

Right I think we talked a lot about re-purposing last time and I think maybe the Commission 's role in something like that would be a recommendation for some kind of tax break or tax incentive for people to donate panels to poor countries or developing countries or charities and nonprofits. I think it could be more than just lip service. I think they're its recommendations. We actually could make that be meaningful and again re-purposing is a higher order of recycling than then recycling itself, so I think that is absolutely in keeping with the goal and mission of the commission also again if we're gonna break this down into a timeline, perhaps establishing some kind of clearinghouse or tax incentive program that could be a short-term recommendation that comes from the Commission to incentivize repurposing of the panels to extend the life. And that pushes the curve that much further out. Alright, we should be mindful of the time. Nick, what do you think the next step should be and do people want to meet in December?

01:37:41.430 --> 01:37:44.800

Nader, Nicholas [DEP]

Well, I guess next step would be for us, DEP, to go over all the recommendations and put things together. I think at this point, I don't know whether you would agree to that.

01:37:54.590 --> 01:37:59.230

Kloo, Karen [DEP]

Yeah, I think we need to assemble the sections that have already been assigned to individuals and everybody should submit their written products to Ashia and that's the background, right? That's the framework and then we move on to the recommendation section. So, I'm wondering whether we should establish next meeting as everybody's goal to get their original assignments drafts in writing to Ashia; and then the following meeting talk about and maybe capture in writing some of the recommendations and whether they fit in immediate, short term, long term; and then assign those sections out to flesh them out. That way we kind of have a very rough draft of the background information and then from that, we can talk about recommendations, come up with a list, and then flush those out using the data from the original sections.

01:39:15.080 --> 01:39:18.990

Clark, Daniel [DEP]

I like that idea. I think that sounds like a logical progression.

01:39:21.180 --> 01:39:29.150

Kloo, Karen [DEP]

So does everybody think that they could have a product to DEP to Ashia by the middle of next month?

01:39:34.130 --> 01:39:37.600

Clark, Daniel [DEP]

I would figure most people, or some people might be not around Monday, December 27th so then we'd either be looking at doing Monday, December 20th or push into January.

01:39:59.790 --> 01:40:02.800

Kloo, Karen [DEP]

Does the 20th work for most or?

01:40:04.900 --> 01:40:06.050

Lyle Rawlings

Works for me.

01:40:09.200 --> 01:40:09.850

Dunbar Birnie

I can do that.

01:40:09.450 --> 01:40:11.990

Kloo, Karen [DEP]

Alright why don't we shoot for the 20th then, Ashia?

01:40:12.730 --> 01:40:13.520

Kloo, Karen [DEP]

Same time.

01:40:13.800 --> 01:40:14.700

McRae, Ashia [DEP]

Same time.

01:40:15.040 --> 01:40:15.400

Kloo, Karen [DEP]

Yeah.

01:40:34.260 --> 01:40:37.350

McRae, Ashia [DEP]

We're gonna we're gonna stay with our same 12:30 start time?

01:40:38.180 --> 01:40:41.120

Kloo, Karen [DEP]

Yeah, I think that works for everybody.

01:40:43.060 --> 01:40:49.110

Kloo, Karen [DEP]

And let's shoot to have a product into us by then, and maybe a designated note taker for next meeting so we can record all of these ideas have been discussed over the past several weeks, and put them in some kind of logical order, and then see if we can verbally reach a consensus. And assign those subtopics out to finish it up. Alright. Thank you, Nick.

01:41:33.970 --> 01:41:34.490

Nader, Nicholas [DEP]

Thank you, so we conclude now or what?

01:41:39.120 --> 01:41:42.340

Kloo, Karen [DEP]

Yeah, I think we're ready unless anybody has anything to add. OK thanks again.

01:41:44.840 --> 01:41:47.120

Dunbar Birnie

Good discussion today! Good seeing everyone!

01:41:45.440 --> 01:41:46.410

Chris Gulics (PSE&G) (Guest)

No thank you.

01:41:46.690 --> 01:41:47.020

Kloo, Karen [DEP]

Thank you.

01:41:47.740 --> 01:41:50.250

Thompson, David

Thank you all yes, I agree thank you.

01:41:47.930 --> 01:41:48.270

Kloo, Karen [DEP]

Bye-bye.

01:41:49.430 --> 01:41:51.130

Nader, Nicholas [DEP]

Bye-bye.