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STATE of CALIFORNIA

NATURAL RESOURCES AGENCY

CALIFORNIA ENERGY COMMISSION

In the matter of:	)	Docket No. 20-LITHIUM-01
	)	
The Lithium Valley Commission	)	
	)	
	)	

Transcript of the

LITHIUM VALLEY COMMISSION MEETING

held remotely by the

California Energy Commission
Warren-Alquist State Energy Building
1516 Ninth Street
Sacramento, California 95814

Thursday, July 29, 2021

In accordance with Executive Order N-25-20 and Executive Order N-29-20, the Meeting was held via the Zoom video/audio internet and via teleconference platforms.

Reported by:
Elise Hicks

APPEARANCES

LITHIUM VALLEY COMMISSIONERS PRSENT

Steve Castaneda

Rod Colwell

Roderic Dolega

Miranda Flores

James C. Hanks

Ryan E. Kelley, Vice Chair

Arthur Lopez

Luis Olmedo

Silvia Paz, Chair

Frank Ruiz

Thomas Soto

Jonathan Weisgall

Presenters/Panelists

Rizaldo Aldas

Alex Grant

Ian Warren

Michael Whittaker

Eric Smith

Derek Benson

Jim Turner

P R O C E E D I N G S

CHAIR PAZ: Welcome everyone. We're going to be giving people a few minutes just to jump on to the Zoom meeting.

[Audio Silence]

I can see that people are joining, we're going to give them just a little more.

[Audio Silence]

So, welcome everyone to the Lithium Valley Commission Meeting. Before we get started, I will hand it over to Elisabeth de Jong. She is the Energy Commission Project Manager, and she will provide some brief housekeeping. So, Elisabeth.

MS. DE JONG: Thank you so much. Sorry about that.

Alright. Well, as you will notice, today, we are offering interpretation services for today's meeting. The Spanish Channel is intended to provide members of the public the ability to hear the entire dialogue of the Lithium Valley Commission in Spanish and in real time.

To ensure that all members of the public have access to the meeting under the Bagley-Keene, we ask that all of the Lithium Valley Commissioners select and remain on the English Channel for the entirety of the meeting, and preferably with their cameras on.

All attendees who wish to join the English Channel, please look for the small globe on the bottom of your Zoom

application and select the English Channel. Then click on original audio.

The CEC's public advisor will be speaking to inform our Spanish speaking audience about the need to select the Spanish Channel if they prefer to listen to this meeting in Spanish. There is an interpreter in the Spanish Channel, interpreting everything said in English into Spanish.

So, please be patient with us today. This is our first experience using the Zoom interpreting feature during the Lithium Valley Commission Meeting. And I'll hand it over to you, Noemi.

MS. NOEMI: [Speaking in Spanish 00:05:58 to 00:08:06]

Elisabeth, I have provided the instructions for people who wish to use the Spanish Channel. If there's anything, please let me know.

MS. DE JONG: Thank you. So, if you are joining us today via a smartphone or tablet, you may need to find the ellipses or "more" button to navigate to the interpretation services. Again, all attendees should select a channel, either English or Spanish.

If any members of the public in the Spanish Channel have questions or public comments, they will be given the same opportunity to engage in public comment throughout the agenda at the same time that the chair opens the meeting for public comment for all.

The interpreter will provide instructions to those in the Spanish Channel, to be sure that all attendees can use the raise hand feature and be called on to speak. The interpreter will assist and translate the question or public comment into English for the benefit of the commissioners and attendees in the main English Channel.

Unfortunately, the Zoom interpretation function does not work for attendees who are only joining by phone. So, our attendees on the phone will hear only the English Channel of this meeting.

So, before we get started today, I will hand it over … actually, sorry, I'm going to go ahead and go through to some administrative items for the Lithium Valley Commission.

So, this meeting is being conducted entirely via Zoom. This means that we're in separate locations and communicating only through electronic means. We are meeting in this fashion consistent with executive order N_08_21 to continue to help California responds to, recover from, and mitigate the impacts of COVID-19.

The public can participate consistent with the direction in this executive order. This meeting is being recorded as well as transcribed by the court reporter. The transcript will be posted to the electronic docket. The recording of the meeting will be available on the Lithium Valley Commission web page.

The Spanish interpretation will not be recorded or transcribed. Members of the public will be muted during the presentations, but there will be an opportunity for public comment on each agenda item and an additional opportunity for public comments towards the end of the agenda

To provide public comment, please use the raise hand feature in your Zoom application to be called on to speak. When you speak, please provide your name and affiliation. If you've called in by phone, you will need to dial *9 to raise your hand and *6 to unmute yourself. Before speaking, please say and spell your name for the court reporter.

There is also a Q&A window in the Zoom application, which you may use to type your questions. If you want to provide public comment, but are unable to raise your hand in the Zoom application or by phone, then during the public comment portion of the meeting, you may type your comment into the Q&A window so we can relay your comments.

We'll read these instructions again during the time for public comment. So, please remember to stay muted until you've been called on to speak.

We also have a chat function available for IT support. We ask that the Lithium Valley commissioners use the chat only for IT support as well. Any other comments are considered substantive to the conversation and should be made publicly and orally for the public committee plans.

Alright, so we're going to go ahead and move on to your roll call of Lithium Valley commissioners to determine a quorum. I will call your name, please respond if you're present and turn on your camera if you can.

Commissioner Steve Castaneda?

I'm just checking because I'm pretty sure he was here. Okay. Well, I do not hear a response from Commissioner Castaneda.

Commissioner Rod Colwell?

COMMISSIONER COLWELLL: Present.

MS. DE JONG: Thank you.

Commissioner Roderic Dolega?

I do not hear a response.

Commissioner Miranda Flores?

COMMISSIONER FLORES: Present.

MS. DE JONG: Great. Thank you.

Commissioner Martha Guzman Aceves?

I do not hear a response.

Commissioner James C. Hanks?

COMMISSIONER HANKS: Here.

MS. DE JONG: Thank you.

Commissioner Ryan Kelley?

Okay. Alright. Commissioner Arthur Richie Lopez?

COMMISSIONER LOPEZ: Here.

MS. DE JONG: Great, thank you. Commissioner Olmedo?

COMMISSIONER OLMEDO: Here.

MS. DE JONG: Thank you.

Chair Silvia Paz?

CHAIR PAZ: Present.

MS. DE JONG: Great. Thank you.

Commissioner Frank Ruiz?

COMMISSIONER RUIZ: Present.

MS. DE JONG: Thank you.

Commissioner Manfred Scott?

I do not hear a response.

Commissioner Tom Soto?

COMMISSIONER SOTO: Here.

MS. DE JONG: And Commissioner Weisgall?

COMMISSIONER WEISGALL: I'm here. As I said earlier, apologies. I'm traveling and managed to forget my camera, but I'm participating but no camera.

MS. DE JONG: Thank you. I see Commissioner Castaneda has hand raised.

COMMISSIONER CASTANEDA: Yeah, as you were taking roll, unfortunately, I went to activate my camera and the whole thing froze up. So, I had to reboot, so I'm here.

MS. DE JONG: Great. Thanks for clarifying, will mark you as present.

Alright. And oh, Commissioner Roderic Dolega, I see hand raised as well.

COMMISSIONER DOLEGA: Yeah, I'm here. I'm present.

MS. DE JONG: Thank you so much. Okay. Well, we have at least eight members, so we have a quorum. Also, in attendance today as Commissioner Douglas and advisors, as well as advisors from Chair Hochschild's office both from the CEC.

And I wanted to take a moment to introduce a couple of other additional CEC staff who have joined us Pam Doughman, who has a PhD in Environmental Health Science and Policy. She has been a lead author for many CEC research in Integrated Energy Policy reports.

Dr. Doughman looks forward to working with the Lithium Valley Commission to prepare its report for the legislature. And Pam, if you're on, if you'd like to go ahead and say hi.

MS. DOUGHMAN: Hi. Thank you. I look forward to working with the commission.

MS. DE JONG: Thank you so much. And one other person I'd like to take a moment to introduce is Lauren Ella, who is a summer fellow in the chair's office from Stanford.

So, Lauren, if you're there, go ahead and say hi.

MS. ELLA: Hi, I'm excited to work with the commission. Thank you.

MS. DE JONG: Great. Thank you so much. So, I'll hand the meeting back over to your Chair Paz.

CHAIR PAZ: Thank you again. Welcome, and I'm happy to be back. I couldn't join in the last meeting. But here we are.

In front of you, you see the agenda for today. We've gone through the welcome and roll call. So, we will be looking at the approval of the actual minutes, we have information items both from media and legislation, as well as any updates from the Lithium Valley commissioners.

And then we're also going to be starting our first workshop on the extraction methods for lithium. We will look over the agenda topics for the upcoming month, and then there will be a designated general public comment meeting at the end, before we adjourn.

We're going to be asking if there are any questions on the action minutes, or any discussion before we open it up to public comment, and then for a vote.

If anybody needs Elisabeth to put the action minutes on the screen, she is ready to do that, so just let us know.

Okay. I don't see anyone. Elisabeth, if we can have a public comment?

MS. DE JONG: Yes. Thank you.

So, before we move to vote the approval of the past meeting action minutes, we will open the floor to public comments relating to last meeting's action minutes. Reminder, that we will have opportunities for public comment later in the agenda as well. And that the meeting action minutes are available on the Lithium Valley Commission web page for this meeting.

So, I'm going to check and see if there's any hands raised. We'll turn first to hands raised in the Zoom application. And then if you've called in, please dial *9 to raise your hand and *6 to unmute your phone line. So, let's go ahead and see if there's any comments.

Alright, Chair Paz, I don't see any. We'll go back to vote.

CHAIR PAZ: Thank you. So, at this point, we'll entertain a motion to approve the action minutes for the June meeting.

COMMISSIONER WEISGALL: Allowed.

CHAIR PAZ: Thank you, Jonathan.

TOM: I pass.

CHAIR PAZ: Thank you, Tom.

Roll call, please.

MS. DE JONG: Thank you. So, when I call your name, please, let us know your vote of yes or no to approve the past meeting action minutes.

Commissioner Castaneda?

COMMISSIONER CASTANEDA: Yes.

MS. DE JONG: Thank you.

Commissioner Rod Colwell?

COMMISSIONER COLWELL: Yes.

MS. DE JONG: Thank you.

Commissioner Dolega?

COMMISSIONER DOLEGA: Yes.

MS. DE JONG: Thank you.

Commissioner Flores?

COMMISSIONER FLORES: Yes.

MS. DE JONG: Thank you.

Commissioner Hanks?

COMMISSIONER HANKS: Yes.

MS. DE JONG: Thank you.

Commissioner Lopez?

COMMISSIONER LOPEZ: Yes.

MS. DE JONG: Thank you.

Commissioner Olmedo?

COMMISSIONER OLMEDO: Yes.

MS. DE JONG: Thank you.

Chair Paz?

CHAIR PAZ: Abstain.

MS. DE JONG: Thank you.

Commissioner Ruiz?

COMMISSIONER RUIZ: Yes.

MS. DE JONG: Thank you.

Commissioner Soto?

COMMISSIONER SOTO: Yes.

MS. DE JONG: And Commissioner Weisgall?

COMMISSIONER WEISGALL: Yes.

MS. DE JONG: Great, thank you. The item passes with a

majority vote.

CHAIR PAZ: Thank you. So, at this point, we're going to invite Richard Rojas to give us a legislative update.

MR. ROJAS: Are you all able to see my screen?

MS. DE JONG: Yes. Thank you.

MR. ROJAS: Okay. So, this is the legislative update for July 29. In weeks past, July 14th was the deadline for policy committees to hear and release their bills. If they didn't get past the committee, there'd would be considered two-year bills or dead for this year.

July 16th, the legislature went on their summer recess and they will be gone until August 16th when they reconvene. And that does not leave much time because the end of session is actually September 10. So, it'll be two weeks between August 27th and September 10th for the fiscal committees to release their bills and on the floor.

So, there are still three bills of interest to the commission, but the first is AB 983. This is the Eduardo Garcia Bill. And this relates to workforce contracts for construction in battery manufacturing and lithium-based technology. This bill amended on June 15th and was scheduled to be heard in governance and finance committee.

And it was pulled by the author Eduardo Garcia, and because it doesn't pass that committee, is held. This is now a two-year bill, so this cannot be heard until January of next

year.

The next two bills are both Henry Stewart, SB 423, requires the energy commission to put together an assessment as part of the IBA Report. And the assessment is to assess emerging renewable energy and fund zero carbon resources that support a clean, reliable and resilient grid. And it specifically calls out that California is the global leader in solar energy and lithium-ion battery storage deployment.

And we need those increasingly and urgently to support a reliable grid. So, that is the connection to lithium.

And SB 551, also, Stern, involves the California zero emission vehicle authority. And the last version of the bill was called the California Electric Vehicle Authority that expanded to include hydrogen. So, this bill requires the authority within the governor's office to coordinate the EV charging infrastructure and fuel cell electric vehicle fueling infrastructure.

And it also calls out the responsibilities of the authorities to support and improve the battery supply chain, including the use of lithium from the Salton Sea. So, those three bills have connection with you all. I will stick the three links to the three bills in the chat after this. And that was all I had, unless you have any questions.

Thank you.

CHAIR PAZ: Now, we're going to invite the

commissioners to see if they have any updates regarding any items with respect to Lithium Valley.

Elisabeth, I know that in the last meeting, I think you probably just called on each one of us directly to see if we have any updates. We can probably do that again. And just a reminder that it's okay to pass if there's no updates at this point.

MS. DE JONG: Yes. Thank you so much. So, when I call in your name, you can go ahead and give your update. Commissioner Castaneda.

CC: None, thank you.

MS. DE JONG: Commissioner Colwell?

COMMISSIONER COLWELL: Yeah, Elisabeth, is this is the appropriate time to talk about the recent-

MS. DE JONG: Yes.

COMMISSIONER COLWELL: So, I'd like to I'm happily to report the announcement of General Motors entering into investment and long-term supply agreements with the Control Thermal Resources.

I think it's a testament to all the solvency regional Lithium Valley Commission, because what it's done is really six months of sort of negotiation has really brought about the technology, there's been this thing about technology and technology risks.

I think that it's a testament to GM to really get

through that and also a testament to the community and how they've sort of all come together on this commission among the internal and external that with GM's vision, with Mary Barra's vision to sort of source sustainable lithium. So, that was one of the big drivers and localized supply.

Rather than I think simply speaking GM's announcement has removed 30 chains from a supply chain, which traditionally would have went from maybe South America or Western Australia to Asia for processing and then sent back. So, by localizing that opportunity, it's a very intelligent move.

So, we're all full steam ahead on that. And I think sort of moving forward from what's beyond the bag of lithium, is that cathode here in Imperial Valley, is that batteries here in Imperial Valley, and that's where the discussion's really starting to go. So, I applaud the community, the commission, General Motors' vision, and it's a very exciting step for all of us. Thank you.

MS. DE JONG: Thank you very much.

Commissioner Dolega?

Okay, we might come back if we're able to get him.

And Commissioner Flores?

COMMISSIONER FLORES: No update at this time, thank you.

MS. DE JONG: Thank you.

Commissioner Hanks?

COMMISSIONER HANKS: Yes, just real short. I guess as most people know, I'm centered here in Imperial Valley and my division covers the geothermal now in resource area. And I'd just like to say that there are negotiations going on for leases, also contracts being issued for site control. There are contracts being negotiated for the purchase of power and also lithium.

But it is very critical that I think as a commission that we start discussing some of the incentives. Personally, I would like to hear a discussion on developing an enterprise zone and also the importance of Assemblyman Garcia's bill, and moving it forward, come January 1st.

If we don't move on some of these important issues, I'm afraid that some of the ancillary businesses could leave our state. And our state and our region especially, really needs to benefit from the efforts being put forward in the development of lithium in our region. Thank you.

MS. DE JONG: Thank you very much. I see, it looks like Commissioner Ryan Kelley has joined, and he's actually next on the list. So, if you want to go ahead and say hello, and if you can jump right into a short update.

COMMISSIONER KELLEY: Hello. I have nothing to add. I'm in agreement with Mr. Hanks, that ancillary business should be something we discuss. And I hope that maybe at a future presentation, we could have the Business and Trade Go-Biz, be

able to speak about what efforts they're putting forward.

MS. DE JONG: Alright, great. Thank you. And let me see, Commissioner Lopez?

COMMISSIONER LOPEZ: Yeah, nothing at this time.

MS. DE JONG: Thank you.

Commissioner Olmedo?

COMMISSIONER OLMEDO: No comments at this time.

MS. DE JONG: Thank you.

Chair Paz?

CHAIR PAZ: None at this point, thank you.

MS. DE JONG: Thank you.

Commissioner Ruiz?

COMMISSIONER RUIZ: No updates at this time.

MS. DE JONG: Alright, thank you.

Commissioner Soto?

COMMISSIONER SOTO: None at this time.

CHAIR PAZ: Thank you.

And Commissioner Weisgall?

COMMISSIONER WEISGALL: Just a quick update. I think most folks know this, but the day after our last meeting, I think that was June 24. So, on June 25, the CPUC issued an order mandating that by June 1, 2026, load serving entities procure at least a thousand megawatts of generation capacity that has no onsite emissions, that has at least an 80% capacity factor, cannot be weather dependent, and does not involve

storage.

So, that pretty much narrows that procurement to geothermal, possibly biomass. I think this order is extraordinarily important for geothermal and dovetails beautifully with lithium development. As lithium development proceeds, having this additional requirement for geothermal procurement, I think will just go hand in hand with lithium development.

So, I think it's a very positive development and really congratulations to all the CPUC commissioners for having the foresight to issue this order, as well as the additional 11,500 megawatts, well, 12,000, I guess you can include the long duration storage to move forward to reach California's clean energy goals.

MS. DE JONG: Thank you. I just want to circle back if Commissioner Dolega is on?

COMMISSIONER DOLEGA: Yeah, I'm on line. Sorry about that. Had a screaming child incident. Nothing to share right now.

MS. DE JONG: Alright. Thank you.

SPANISH INTERPRETER: [Speaking in Spanish 00:30:58].

MS. DE JONG: Great. Thank you so much.

SPANISH INTERPRETER: [Speaking in Spanish 00:31:05]

MS. DE JONG: Okay. So … oh, I'm sorry. I heard someone.

CHAIR PAZ: I think we're hearing the translator.

MS. DE JONG: Noemi, I'm wondering if you could help us with that.

SPANISH INTERPRETER: [Speaking in Spanish 00:31:26]

MS. DE JONG: Alright. Well, actually, if I can … Chair Paz, I may recommend that we take a 10-minute break. That will give us an opportunity to get the presenters lined up for the upcoming item and also resolve the translation or the interpretation services.

CHAIR PAZ: Yes, does that work with everyone? 10-minute break?

PARTICIPANT: Yes.

MS. DE JONG: Okay, great. We'll come back at 2:10 then. I'm going to go ahead and pause the recording.

[Off Record from 00:32:08 to 00:43:40]

VOICEOVER: Recording in progress

MS. DE JONG: We're back, thank you everyone for your patience. We're just trying to troubleshoot as this is our first attempt at doing Spanish interpretation during the meeting. There is a Spanish Channel, if you find the interpretation globe emblem on your Zoom app and select the English or Spanish Channel, you should be able to join the meeting and hear the meeting in Spanish as well.

And we're ready to go back to kicking off the Lithium Extraction Methods Workshop. Chair Paz, if you could go ahead

and get us started.

CHAIR PAZ: Yes. Thank you. Thank you everyone for your updates. So, today, we're going to be starting with our first workshop and this one is on the topic of Lithium Extraction Methods. Let me see. I think I've lost my place with description.

So, AB 657 describes this section, it's actions that will support the further development of geothermal power that has the potential to provide the co-benefit of lithium recovery from existing and new geothermal facilities. So, the conversation will be grounded around this topic.

And we have different presenters that we're going to be starting with. They will then be followed by a panel discussion that will be moderated.

Our first speaker is Rizaldo Aldas. He will be giving us an overview of the CEC funding for geothermal lithium projects. Rizaldo?

MR. ALDAS: Thank you, Chairman Paz, and good afternoon, everyone. Again, I'm Rizaldo Aldas, I'm with the Energy Research and Development Division of the CEC. I would say that I'm lucky that we have a great lineup of speakers and experts from the industry and research institution. So, I can skip a lot of typical background introduction and just quickly go over and provide a high-level overview of our R&D projects on lithium recovery.

So, next slide, please.

I will start by framing the mineral recovery and lithium, in particular, as a key component of our geothermal research and development program. Geothermal R&D is addressing various technological gaps and needs and the economics of mineral recovery and help the state meet its clean energy goals.

Funding for geothermal activities comes from the electricity program, which is the process known as the PIER Public Interest Energy Research, and now, the EPIC or Electricity Program Investment Charge and the Geothermal Grant and Loan Program also commonly known as GRDA administered by the CEC's Renewable Energy division

Next slide, please.

So, here's a list, for example, of past projects, going back to early 2000 that explored recovery of co-products like silica and lithium. And some of these projects are foundational and provided valuable technological and business lessons.

In particular, I'm highlighting the work of Simbol on not just lithium, but also other minerals like manganese, zinc, and potassium. Simbol did several iterations to introduce seven for lithium extraction and in the process, they identified these steps that need to be addressed.

For instance, silica management and purification. Impurities in particular are significant because any product processing needs additional cost of the whole system.

And at the time, Simbol demonstrated the potential viability of a commercial plan for producing battery grade lithium carbonate.

Next slide.

Alright. So, in this slide, I'm featuring the project title Well to Wheels Lithium Design by EnergySource Minerals. This is a recently completed project from Resources Renewable under division Geothermal Grant & Loan Program. And the funding for this project was made possible through SB 1074, authored by Senator Ben Hueso.

So, in this project, ES Minerals performed detailed engineering and the design, facility confirmation, product certification and construction posting to generate an integrated engineering package with an accurate cost estimate to reduce the uncertainty around installed cost of a commercial plant.

Derek Benson of EnergySource Minerals, he is in the panel today and will be talking about their lithium activities.

Next slide, please.

Alright. Switching onto the EPIC RD&D on lithium recovery. Our current program supports two main areas.

First is on, I would call lower technology readiness level activities that is focused on improving process and technology for lithium recovery. This includes development and pilot demonstration of systems or subsystems or components to capture lithium from geothermal brine.

And the second area is more on supporting larger scale fuel demonstration. There are certain costs, the economic parameters and really, we would like to achieve cost parity, not exceeding the cost of commercial lithium production methods, which you will hear more in the next presentation.

Next slide, please.

Under the area of improving process and technology for lithium production, this featured project from Hell's Kitchen is more on pretreatment process. The first project is designing a pretreatment process based on the chemical composition of the geothermal fluids at the project site and will demonstrate its technical performance on a pilot scale. For the process, we'll remove silica and heavy metals and essentially, make the brine ready for a subsequent extraction of lithium.

The second project below, is I would say geared more towards enhancing the plant performance of geothermal including greater opportunity for flexible operation. The team is working with the Pacific Northwest National Laboratory to develop and demonstrate a new and innovative method managing silica using radical GMEPS or Geothermal Micropillar Enabled Particle Separator which separates solid particles based on their size.

I included it here because silica management is from a number of steps in lithium recovery and this has potential, I think in helping record such a step. And I think Jim Turner of Controlled Geothermal Resources is also a panelist and will be

talking more about their lithium recovery activities.

Next slide, please.

Moving on from pretreatment, our project focus on the development of sorbents from the lab through pilot scale demonstration. So, in an earlier project funded by EPIC, SRI International developed and demonstrated in the lab a new high-capacity selective sorbent which is comprised of inorganic lithium-ion sieves, and lithium-imprinted polymers.

And a part of that is developing a new eco-friendly sorbent regeneration process that leads to the direct formation of high-purity in lithium carbonate.

In a new project that we are funding with Materials Research, Materials Research is taking the next steps needed to bring that new high-capacity sorbent closer to commercial use through a pilot scale demonstration. So, their project will demonstrate and verify how new technology could lower the cost of lithium production by enabling separation with higher recovery efficiency and minimizing the cost and time.

Next slide, please.

Moving on to the deployment and demonstration project with BHER Minerals, this project will design, build and demonstrate and integrate the lithium recovery recover system at existing geothermal power facilities. The brine processing rate of at least 100 gallons per unit.

The entire system will include brine pretreatment, ion

exchange, lithium extraction, which is the core of that entire process. And the subsequent post-treatment of lithium-depleted brine.

So, there are several metrics and benefits that this project will demonstrate and examples of that are listed in this slide including the target cost of production, environmental impact minimization, freshwater usage and lithium recovery efficiency.

And Eric Smith from BHE Renewables is also in the panel and will be discussing about the other lithium project from the BHER.

Next slide, please.

So, I just want to mention that we are in the process of developing the 2021 to 2025 EPIC Investment Plan also known as EPIC 4, and we would like to propose as part of the plan for funding for lithium recovery research and development, and some of the topics that we are exploring for that plan, include continuing the development or developing ways to improve performance and cost of lithium extraction.

We are exploring economic opportunities for more cost-effective recovery of other valuable co-products or minerals. And zinc is one of the examples for that, and supporting new commercial demonstrations of mineral recovery systems.

And next slide, please.

Lastly, I would also like to add that next week on

August 4, the CEC R&D division will be holding an EPIC workshop to present a draft, set up R&D initiatives that welcomes the EPIC 2021 to 2025 Investment Plan or EPIC 4.

And that will include the lithium recovery R&D topics that I had mentioned in the previous slide. This is an opportunity to provide feedback on R&D initiatives in general and in lithium topics, in particular.

So, I would like to invite you all to participate and listen in that workshop and send your comments and suggestions. Links are provided in the slide. I think that's it, thank you. And looking forward to the continuation of the discussion.

CHAIR PAZ: Thank you. I know there'll be time for questions at the end, but if any of the commissioners have any burning question for Rizaldo? Couldn't see any.

Okay next, I want to bring up Alex Grant, and let him introduce himself.

MR. GRANT: Thanks Silvia. Okay. It's nice to be here today. Thanks to Jonathan at BHE and Elisabeth for inviting me. It's a pleasure to kind of share a broad overview of what's happening in the DLE space globally.

And to give Californians some solace in the fact that the technology development cycle that enables geothermal lithium is already decades old. So, this is a kind of positive kind of silver lining to the story, in my opinion.

Elisabeth, could you go to the next slide please?

Oh, God, I have animations. Why don't we just fill up the slide? Yeah, let's do that.

Okay. So, I'm Canadian, I did undergrad in chemical engineering and a master's in chemical engineering. I went on to co-found a technology company called Lilac Solutions, which is a lithium extraction technology company in Oakland.

And two years ago, I left to be independent and I started consulting across the lithium industry, studying all the different types of technologies used to make lithium chemicals. And a lot of my work now is also in lifecycle assessment of lithium chemical manufacturing, trying to understand the environmental impacts of extracting and processing lithium, because we have one big opportunity right now to kind of control the environmental impacts of lithium manufacturing before a whole bunch of infrastructure is built.

So, it's really exciting to me to have the opportunity to kind of help shape what that future manufacturing capacity looks like.

So, next slide, Elisabeth.

Kind of already started running into the slide, I guess. But this is just a little snapshot from my website. I publish a lot of research on lithium extraction and processing and environmental performance of making battery metals and other topics. So, I've worked on brine projects around the world, sedimentary clay projects, like those in Nevada and Europe.

I've done projects with technology companies and investors and have in the last year and a half done quite a bit of work on lifecycle assessment as well. Just to kind of set the scene and kind of give folks an understanding of who I am and what I'm doing.

So, next slide, Elisabeth.

So, I'm not a market person, I don't do cost curves and demand projections and things like this. But I just wanted to put in kind of one half-slide here just mentioning, and really just framing the fact that demand for lithium is growing exponentially. And 80% of 2030's lithium supply does not exist yet.

So, there's this tremendous opportunity to right now, shape what that supply looks like. And there's no time to wait. So, that's why it's so important to be working on these problems now.

Next slide.

A question I get some times is, is there enough with you to make all the batteries? The answer is definitely yes. There's a lot of lithium in the ocean, for example. There's a lot of lithium in geothermal brines for that matter as well.

Kind of a better question is how will we make that lithium? And geothermal lithium production is just one process route from natural resource to battery chemical of many. And a couple of that I'll talk about at a super high level here today.

But what I want to share on this slide is the idea that historically, really only the highest concentration, highest purity lithium resources were developed to serve legacy markets. And as we grow the lithium industry by 5x in the next nine years, we're going to have to start developing resources that contain higher impurities and lower concentrations, which require more energy and more reagents to process, and fundamentally different technologies such as direct lithium extraction which is being used at the Salton Sea.

Next slide.

So, just kind of super high level on lithium natural resources, geothermal brines are just one of many potential natural resources to make lithium chemicals from including other types of brines like oilfields, salars, theoretically, the ocean, waste streams.

There are a number of different pegmatite or hard rock natural resources that are being developed and mined commercially today, like Spodumene, Petalite, Lepidolite, Zinnwaldite, and sedimentary clays, which are fundamentally different from hard rock. They're more like dirt instead of like crystals. And they're processed differently.

Those are the types of resources you may have heard about at Thacker Passin Northern Nevada or the clays that Tesla appears to be developing in Central Nevada with a salt extraction process, which is very interesting. So, I share this

kind of as background to show that geothermal brines are just one type of resource, very compelling type. But there are certainly many other options.

Next slide.

I kind of have more to look at later. But really, the take away here is that all of these different types of resources can be processed in very different ways. And that is really due to the thermodynamics and the nature of those resources. And even within the same resource, there are many different ways to make a lithium chemical from it, with different cost structures, different environmental impacts, using different technologies, et cetera.

Next slide.

Also, we need to kind of look at later, but like I was mentioning as demand is growing rapidly, people have started developing natural resources with lower concentrations at higher impurity profiles. And that has led to the CO2 intensity of making battery chemicals actually increasing as demand increases as we start developing these kinds of less desirable resources.

So, it's absolutely critical that we implement new technology to kind of circumvent the CO2 emissions of other environmental impacts, which could be incurred if that new technology is not deployed.

Next slide.

So, this is just really quickly, one quick example of

two evaporative brine projects in South America, one in Chile and one in Argentina.

The one on the left has been operating for about 25 years in Chile using pure evaporation. So, no direct lithium extraction technology, similar to what's being used in the Salton Sea.

On the right, more reagent-intense processes, and more energy are being used to remove impurities from the brine to make lithium chemicals. As more brines like that are developed, these kind of environmental impact questions become more and more significant and geothermal brines essentially become more competitive as costs and impacts go up elsewhere.

Next slide.

So, Enter DLE. So, I've already mentioned it but direct lithium extraction is a way of processing brine, natural resources, which are high-salt content waters found in nature. Using a selective site on an engineering material to remove lithium from that solution without the need to remove the water and impurities, not all of the impurities necessarily.

DLE has been used in Argentina for two decades already, a particular type of DLE, which I'll talk about in a second. And that approach has been kind of copied and modified by a couple of different folks in China.

So, today, there are between 5 and 10 different brine operations in Shanghai, in Western China, which use this type of

approach to make lithium chemicals. And that's operating today. That's not a science project. It does not require already funding. It is literally making lithium chemicals today.

So, yeah, I really wanna emphasize DLE is not new. We're able to learn a lot from these projects, both the main one in Argentina and the ones in China, and we can deploy some of those learnings on the Salton Sea in some circumstances.

I think I have some silly animations again, Elisabeth. If you want to fast forward five.

I just thought I shared a slide from Livent's sustainability report from 2020, where they talk about their extraction process.

So, until only very recently, not very many people understood that they were actually using DLE technology in Argentina already. And as of 2019, they started publishing about it in their sustainability report.

So, you'll hear it from project developers and technology developers that their technology increases lithium recovery, reduces land footprint, potentially reduces water footprint, removes the need to evaporate water from brine, et cetera.

It's really critical to realize that some of these advantages have already been realized in Argentina for years. And this has already really had commercial attraction. Recently BMW signed the off-state contract with Livent for five years and

they specifically mentioned their technical approach to extraction as a reason why they gave Livent that contract.

So, kind of intuitively, in the minds of laypeople and also in the minds of lithium buyers and OEMs, this is a more sustainable and desirable approach to make lithium chemicals from brines.

Next slide.

So, just kind of just to initiate any outsiders here, there are three main types of direct lithium extraction technologies; adsorption, ion exchange, and solvent extraction.

Livent and most of the operators in China use adsorption. And there are a number of kind of different technologies in development that are looking to use ion exchange, solvent attraction and some other less promising approaches which I won't talk about too much because I don't want to go too far deep into the technical weeds.

But I share this slide just to just emphasize that just as there are many different ways to make lithium chemicals from natural resources, many different ways to make lithium chemicals from brines, even geothermal brines, there are many types of DLE. I'm tracking, I think, over 70 in development and operation today. So, it's a very colorful and global space that goes way beyond just geothermal brines in California.

Next slide.

Yeah, so before I kind of hand off to Ian, I wanted to

share this slide too just to kind of start framing the geothermal context. So, geothermal brines are a very different type of brine from the types of brines that were processed in Argentina and Chile. For the most part … do you want to go one more click further, Elisabeth?

The vast majority of the brines that are producing lithium chemicals today are in that box of temperature and pressures, so they are low pressure and low temperature resources. Geothermal brines are of course, totally different, very high temperature and potentially high pressure in some cases when it's delivered to the lithium extraction process.

So, these different thermodynamic conditions, the high temperature, the high-pressure lead to different chemistry because it leads to different types of materials being dissolved in the brine from the geology underground.

So, so though DLE has been used for decades in Argentina, I want to emphasize that geothermal brines are quite different and require specific and kind of unique processing to make them amenable to lithium extraction. And I think that when Rizaldo was talking about some of the programs the CEC has funded in the past, that's to some extent reflected in what the CEC has already been kind of helping people work on.

Next slide.

That’s it from me. So, I am very find-able on the internet. Please reach out if you have any questions, I'm happy

to chat. I'm happy to help the CEC and the California government kind of understand the lithium opportunity and understand the needs of these developers. And I really wish everyone the best. I hope that all these projects get built because every 20, 30, 40,000 ton per year project that can be built in Salton Sea is a giant open-pit somewhere else that doesn't have to get built.

So, that's a really exciting and important prospect. So, yeah, that's it for me.

CHAIR PAZ: Thank you. Again, if any of the commissioners at any point have any questions, you can raise your hands. Otherwise, we will have a Q&A section at the end, after the panel discussion.

And we're going to be giving out just a short break while the next presenter gets settled, a quick break for the interpreters to switch. So, Elisabeth, just let us know when you're ready.

MS. DE JONG: Thank you. And this should only be about 30 seconds. So, please stay seated, we'll be with you in a minute.

[Off Record 01:08:47 to 01:09:30]

MS. DE JONG: So, we will now invite Ian Warren. Again, they will introduce themselves.

MR. WARREN: Okay, hi everyone, I'm Ian Warren, I'm a Senior Geoscientist at the National Renewable Energy Lab. And

apologies in advance that I don't have a nice picture like Alex does. I'm going to turn off my camera just to preserve some bandwidth, so I don't have any issues.

This project … one little thing I want to do -- in the chat, I just posted a link to a technoeconomic analysis lithium extraction from geothermal brines report that was completed late last year, and that's sort of where this presentation is evolving from.

Next slide, please.

MS. DE JONG: And if I could just really quickly interject, that the report is also available on the Lithium Valley Commission docket, and in the resources document posted on the Lithium Valley Commission web page. Thank you.

MR. WARREN: So, thanks again, Alex, for kind of setting the stage. The figures you're looking at here is a lot of colored dots to relay the lithium concentrations in geothermal fluids. Most importantly, the Salton Sea geothermal fluids have some of the highest concentrations out of that very broad occurrence of lithium in geothermal brines.

And if you look at the histogram, that figure -- apologies for some of the small numbers. But over on the right-hand side, it's 20 to 400 milligrams per kilogram, the sampled fluids. And it's a very small portion of geothermal fluids that have been sampled and stated in the US, so it makes the Salton Sea really, really important place to consider lithium

extraction.

Salton Sea resource, there are several numbers out there. One is that there's potentially 15 million metric tons of lithium to be recovered. It might be recovered at rates as high as 600,000 metric tons of lithium carbonate equivalent per year.

And just to put that sort of goal into perspective, if took sort of the modest concentration of say 200 milligrams per kilogram lithium in the fluid, and you looked at the 2019 throughput of all the Salton Sea power plants, there was about 127,750 metric tons of lithium carbonate equivalent if you had quantitatively removed up lithium. So, quite an impressive resource.

Next slide, please.

So, Alex pointed out that direct lithium extraction technology has been around and actually working on a commercial level for a couple of decades. People have been thinking about extracting lithium and other elements from geothermal fluids for quite a long time.

You know, as early as the 1960s, they were thinking about it in New Zealand and at the Salton Sea, where we have such high concentrations. There was serious effort beginning to be put towards the possibility of extracting metals and including lithium and other compounds.

In the s70s and 80s, the US Bureau of Mines got

involved with funding research very much focused on precious and base metals.

In the 80s and 90s, industry began getting involved with Dow Chemical Company and they began sort of what is looking to be one of the favored direct lithium extraction technologies with their focus on developing novel iron exchange materials.

In the 90s and 2000s, some really important things took place, notably Simbol had pilot tests at EnergySource in CalEnergy facilities.

And by the 2010s we had players like EnergySource, Controlled Thermal Resources, Berkshire Hathaway, and others beginning to think about how to pursue lithium extraction commercially.

And then today, we've got CEC funded projects that were discussed earlier, and that’s sort of really pushing us to the next level of where this needs to go and with proper focus at Salton Sea where we have the highest lithium concentrations.

Next slide, please.

So, DOE has been supportive of extraction of lithium from geothermal resources for quite a while. They were along with CEC, they were part of funding the supported Simbol pilot plants. You know, some very important work came out of that focused on advances in silica management, the actual lithium extraction, purification concentration, and then conversion into final products for sale.

They achieved 95% extraction of the lithium using lithium aluminum, double hydroxide chloride materials. That sort of was something that grew out of that earlier work that became the Dow Chemical. And at the end of the day, they claimed 90% yield and they had a concentrated lithium chloride stream that they were able to turn into a purified final product.

Unfortunately, that project ran into what seems to have been business difficulties. And it seems like they had technical success and the process itself was likely or potentially economically successful, but there were other issues that sort of led to the end of Simbol.

There was ongoing funding that included again, some focus on novel ion exchange resins and processes. CEC was also involved in those later rounds. And so, there's been some support more recently from DOE and CEC that's continuing. And that's obviously important to get us where we need to be.

Next slide, please.

So, I am not a chemical engineer like Alex, I'm a mere geoscientist, but don't want to get into the weeds of all the different things that might be done, but there’s quite a bit of direct lithium extraction technologies that might be applied to the extraction of lithium from geothermal brines.

The Stringfellow and Dobson, 2021 is a great report. They get into the details of a lot of these processes. But at

the end of the day, any of these things are … the research is really pushing towards improved sorbent selectivity, improved tolerance for interfering ions. That's the impurities that travel along in the fluid that you want to get out so you can make your final high-purity product. And then just making that extracted lithium that much pure and products that are converted to.

And then the direct lithium extraction processes, companies that are out there (and I'll get to that in the next slide) -- they're looking at adsorption, ion exchange, and solvent extraction processes to extract lithium from brines.

Next slide, please.

So, this is a table -- again, this all comes out of a technoeconomic analysis of lithium extraction from geothermal brines. And one of the foremost challenges with that was that there's not really a commercial baseline and there's very limited public data to give you details about costs and technology and performance.

That said, we were able to look at public companies that are listed on public exchanges that have rules about reporting on projects. And so, a range of brine types are being advanced towards commerciality, hopefully for these companies. And so, it was reporting from these companies that really drove the technoeconomic analysis.

In addition to that, modeling by Ventura et al, is the

far-left column for Salton Sea, that was driven by some modeling and some experimental work. And then scaling that up to see what a commercial endeavor might look like.

So, the takeaway from this is that we have to be aware that this is coming from companies that are by their nature promotional. So, they might be a bit overly optimistic, but the estimated costs for extraction of lithium from these range of brines not just geothermal -- ranged from about $3,200 up to about $4,300 per metric ton, lithium carbonate equivalent.

And it's important to point out that it's typical for the industry, but they are basically taking the OPEX and dividing it by the metric tons produced per year. And so, there's a missing cost piece in there, generally that relates to financing costs.

And so, we need to keep in mind that this is really sort of what the OPEX cost of the metric ton is. And any live commercial project is likely to have a component of additional costs just related to however the financing is organized, and then additional other things including marketing, transport, and taxes.

So, there's a few other things that may not be captured in these costs. So, these are really about the process and what it takes to get the lithium product produced at the end of the day.

And just down there in the lower right-hand corner,

this week, or at least earlier this week, spot costs of lithium carbonate were $14,000 per metric time. So, based on what these companies had done, and so anywhere from models to bench tests up to what's been called mini pilot tests, what they're telling the investment community is that they can likely produce a metric time of lithium carbonate at a cost that makes them competitive in the current marketplace.

Next slide, please.

So, the important thing about the Salton Sea is not only that we have a fluid that has concentrated lithium, but it's an incredibly, incredible good geothermal resource. In 2020, greater than 120 metric tons of fluid were produced through the power plants producing greater 2.9-gigawatt hours of electricity. And that might be able to be doubled or more if all the resource was exploited.

So, if you can go ahead and take advantage of geothermal power plants and adding on, or building geothermal power plant along with lithium extraction together, that provides power for processing. Alex mentioned the thermodynamic challenges, the power production takes care of quite a bit of that because you get heat rejection through the power process, and you also are dropping it down to a much lower pressure for the power production process.

And I put this figure, and it’s a very simple schematic of power production process at Salton Sea. And you can notice

that there are crystallizers, there are clarifiers, there's a filter press. All those things are components that clean the fluid and actually make it a little bit better for the start and beginning of the lithium extraction process.

So, it makes quite a bit of sense to take Salton Sea fluid to make geothermal power. And then before you reinject that fluid, that's the stream from which you can extract the lithium. And I mentioned that at the bottom, you might want to do a standalone as well.

Next slide.

You anticipated me perfectly. I didn't even have to ask. Yeah, there.

So, another issue with trying to do a technoeconomic analysis is the way … this was funded by the Geothermal Technologies Office. And the way the project was set up, we weren't going to be doing complicated chemical engineering and process models. We were really just going to be looking at what was out there in the world and sort of putting a snapshot together where things stand.

And we're not picking sides. We're not saying this is better or this is work. But for a detailed Salton Sea lithium extraction example, EnergySource's patent application documents actually have some of the most detail. And so, that's what I'm going to show here.

And there's many ways you can get the lithium out of

the geothermal brine, and I'm just presenting this one as one that comes with lots of details and also public statements from EnergySource. They're ready to go. So, it looks like a good one to use an exact example.

And I'm not going to get into all the details, but you'll look at that figure, there's lots of steps. There's lots of little numbers. That's all a lot of detailed information about the steps of the process that you could find in the patent document.

But what it really comes down to is you have a fluid at the tail end of power production. Then you move on to the direct lithium extraction process. As I mentioned in the previous slide, you already have some amount of removal of impurities and preparation of the fluid at the tail end of the power process that makes it better to move on to the lithium extraction.

The first thing they've got to do is they have to remove more silica, more iron, more zinc, more manganese before they then send that fluid into their sort of direct lithium extraction process that will show details on the next slide.

But they can produce the lithium fluoride stream with greater 90% the lithium from the raw brine and with greater than 99.5% of the impurities removed.

Even at that point, there then has to be further polishing of that fluid to remove calcium magnesium. There's a

reverse osmosis process that further concentrates lithium, then there's evaporation to remove some water. Again, more with the concentration. Then they've now got a highly concentrated, very pure lithium stream.

They do a first round of lithium carbonate precipitation, but then they redissolve it to remove yet more impurities before they recrystallize and finish with a high purity lithium carbonate product.

Anybody who's a chemical engineer and wants to get the details to those patent documents, have lots of that. And we're a great resource to just be able to sort of say here's the process that people are talking about and have confidence in. And here are a bit of details we can pull out.

Next slide, please.

So, this is sort of, again, the patent documents have a lot of great details for anyone who's interested in chemical engineering and process engineering. And I just wanted to show it here again, you know as an example, that has sort of the most detail out there in the public sphere.

But one of the novel things that EnergySource did is they are continuously cycling adsorption beds and the fluids continually coming in and the process is sitting there running all the time. The high concentrated lithium chloride fluid comes in, it is then going through the absorbent, and there's a stripping solution that removes it and sends it on through the

rest of the polishing steps that we saw on the previous slide.

But at the end of the day, the process is taking the lithium chloride stream, concentrating it by 10 to 20 times. And 99.9% of the impurities have been removed.

Next slide, please.

So, the Salton Sea is a potentially massive lithium resource. The number recorded here is 15 million metric tons. A variety of processes can be adapted to extract the lithium from geothermal brine. We looked in detail or a little bit of detail at a process that EnergySource described in their patent application documents.

I don't want to say that that was what their final choice of process was. That's just from the patent document. I wouldn't be surprised if there were some things that added to the efficiency of the process by the time they finally get done.

Interestingly, and this was handed to by Alex, any lithium extraction operation is going to be unique and it may even be that it has to be unique between projects. They're all in the Salton Sea, and just intersecting and getting different parts of the reservoir, or they are having different sort of conditions at the tail end of their power production process.

But the end of the day, it's going to be fluid, physical and chemical properties that dictate what's going to be the best direct lithium extraction technology to apply.

And if that is not your own technology, there's going

to be a question of availability and cost of that technology, which may tend to make you favor one or the other. Rather than it being a pure pick, the absolute best technology, it may be that the business case is slightly second best, is the best choice.

The public information we were able to find related to a range of direct lithium extraction from brines projects, makes it look like $4,000 per metric ton of lithium carbonated equivalent as achievable. Again, in all those examples, there are likely some finance costs, some tax costs, and maybe a few other things that need to be thought about in the full business case.

The performance and cost data that come from demonstrations are going to be crucial to really seeing how quickly we can get to commercial operations. And fortunately, we've got CEC backing some of that right now at Salton Sea. I think there's one more slide, but I'm done. Thanks a lot.

And again, there's one slide in there and at the very tail end slide, they just listed the web address for technoeconomic analysis report that is both in the chat. And then also, in the items that Elisabeth mentioned.

CHAIR PAZ: Thank you for your presentation.

So, now, we'll be moving on to our panel conversation and it will be moderated by Michael Whittaker. So, Michael, if you're ready.

MR. WHITTAKER: I am. Yeah, thank you very much for the opportunity. I'm excited to be hosting this panel discussion. I don't want to make this all about me. This is about the panelists from these companies who are going to tell us all about their technologies and their opportunities. I just want to take a brief moment to introduce myself and tell you a little about who I am and why I'm here.

And so, thank you Chair Paz, for the introduction and I appreciate the technical introduction by Rizaldo, Alex and Ian, who have laid a great sort of groundwork for understanding why it is that we're hoping to extract lithium from geothermal resources, how we can go about doing that, and the prospects for the resource.

I'm Mike Whittaker. I'm from the Lithium Resource Research and Innovation Center, which is a center that obviously focuses on lithium resources at Lawrence Berkeley National Laboratory.

Next slide, please.

So, we're really powering the resource-to-recharge revolution. Our motivation is really the urgency and needing this massive amount of lithium that we'll need in the near future as Alex talked about to meet the demand for electric vehicle batteries and beyond. And we also see this great opportunity. So, I think that's why a lot of us are here because there's a lot of opportunity.

And so, LiRRIC is really interested in sort of discovering technology breakthroughs, providing environmental leadership, and how those solutions are deployed in getting new technology solutions from the laboratory out into the world quickly.

Next slide, please. This is animated. You can go ahead and animate through this, please, Elisabeth. Yeah, perfect.

So, just briefly about Lawrence Berkeley National Lab, we've got Diverse Fundamental Research, including Earth and Environmental Sciences research that look at things like why does lithium become concentrated in certain parts of the earth's crust, and what are the various environmental and climactic forces that drive lithium distributions.

We also have the National Alliance for Water Innovation, which is a clean water hub. And so, we have this sort of overlap between folks who are interested in clean water, wastewater, treatment, and remediation, reverse osmosis for drinking water and things like that. And obviously, a lot of those issues are very germane to the Salton Sea region.

And of course, we also have Battery and Research Technology. We've got Hands-on Training in user facilities where we do the fundamental science that we pursue. And then we also have opportunities for Technology Transfer work to take that research and convert it into technologies that you'll see.

And I'll go into a little bit of detail about some of those opportunities that particularly relate to technologies in the Salton Sea region.

And also, I'd just like to call out some industrial partnerships that we have. We do have ongoing projects with Berkshire Hathaway Energy and Controlled Thermal Resources, two of our panelists here in our panel discussion today. And some of that funding was provided by the California Energy Commission.

Next slide, please.

Ian alluded to this during his presentation, but we have published two different reports that are directly relevant to the topics at hand today. These are by Will Stringfellow and Pat Dobson. The first of which is Technology for Lithium Extraction in the Context of Hybrid Geothermal Power.

This document and other documents are all available at our website, which is down there at the bottom. It's www.lirric.lbl.gov/publications. All of this can be found there. And of course, this PowerPoint presentation itself will be posted later on, so that you can find this after the panel discussion.

But we also -- and by we, I mean, Pat and Will have published a retrospective and all of the studies concerning extraction of lithium and elements for geothermal brines that were funded by the Department of Energy.

So, again, I'll just mention, we have received funding from the CEC and the Department of Energy to do analysis and development of some of these projects and also funding from Lawrence Berkeley National Lab for our center and for collaborations with UC Davis.

Next slide, please.

So, this collaboration with UC Davis in particular, I just want to talk very briefly about so the Lithium Resource Research and Innovation Center has a unique opportunity here, we think, based on a partnership with Alissa Kendall's group at UC Davis.

And so, her group actually has experience with lithium battery recycling analysis, a technoeconomic analysis of recycling of the batteries that would ultimately be made from lithium produced in the Salton Sea and elsewhere.

And they have experienced supporting AB 2832. The implementation of that bill is essentially moving towards and promoting a hundred percent battery reuse or recycling. So, it's relevant to the topics at hand today. It's also just sort of pragmatically a similar process to the process by which we'll be writing the report pursuant to AB 1657 to the Lithium Valley Commission.

And so, Alissa Kendall's group has experience doing this type of thing. And so, we're partnering with them to do some research of our own that's specific to actually the Lithium

Valley Commission and Salton Sea.

What we'd like to do is just understand from a local perspective some of the issues that have been raised by the discussions that occur in these meetings themselves and use that information to inform a lifecycle assessment and analysis of the technologies that are being implemented here in the Salton Sea.

And so, I think this will help strike a balance between sort of the global perspectives and the broader perspectives about lithium markets and lithium separation, things that Alex Grant talked about. And it will also provide I think a local perspective that we use to help inform how things move forward.

So, we've gone through and looked at the transcripts for all these things and identified emerging themes. The biggest one of course is employment. We've heard a lot about in these meetings.

But I would encourage everybody, if you can hear my voice right now, please go to www.lirric.lbl.gov/lvc, sign up to take our survey. We want to hear from you. We want to hear from all of the stakeholders here in the Lithium Valley and use that information to really inform sort of a quantitative framework for how we can assess what we're doing here.

Next slide, please.

So, now what you've all been waiting for, the panel discussion. We're talking about safe environmental methods and standards for lithium extraction from geothermal brines and how

this compares to other methods for deriving lithium.

And so, our panelists today will be giving presentations, 10 minutes each, from Berkshire Hathaway Energy, EnergySource, and then Controlled Thermal Resources. And the questions that will be covered during these presentations are what are your technology? What are your waste streams, specifically waste streams related to the extraction of lithium from the brine? And what is the status of your development?

Following those presentations, I'll be moderating a 20-minute discussion with some questions posed to our panelists, and then we'll have 20 minutes for the commissioners to ask questions themselves of the panelists.

So, just a quick reminder, this topic number five is subtopic number five on lithium extraction itself. It's just one of eight subtopics. And so, there are obviously a lot of interesting themes that we can touch on here, but this is the first of many conversations.

So, we're going to stay confined specifically to lithium extraction, and there will be time in future meetings where we can go into environmental impacts and economic impacts and all of these other things.

So, with that, that concludes my presentation. And I think our first speaker will be Eric Smith from Berkshire Hathaway Energy.

I think you're muted, Eric

MR. SMITH: Can you hear me now?

MR. WHITTAKER: Okay, yes, I can hear you.

MR. SMITH: Thank you. Good afternoon everyone. I'm Eric Smith, Vice President of Lithium Development at BHE Renewables.

First off, I'd like to thank the commission for inviting me to speak about our lithium project. One thing I want to point out is I apologize in advance for my nasal voice, as I'm just coming off a bad cold. So, if there's anything that I need to repeat, please don't hesitate to let me know. So, let's go ahead and get right into it by talking about our technology.

So, currently, we have two key technical challenges for lithium recovery and production in the Salton Sea known geothermal resource area, which I'm just going to call them brine from here on now.

The first one is that there are significant quantities and minerals other than lithium dissolved in the brine. In fact, over a quarter of the brine is composed of dissolved minerals. Besides lithium, of course, there's minerals such as iron, zinc, manganese, and many, many others.

And second, is keeping the temperature of the brine, which can get up to 700 degrees Fahrenheit in some locations, high enough during the process to keep, or at the very least, minimize the dissolved minerals that I mentioned before from precipitating into solids.

This is especially important because if those minerals precipitate into solids, that creates not just waste product, but also potential impurities in the lithium product. So, how are we addressing those challenges?

We're addressing those challenges and de-risking our project by first working on two small scale demonstration projects. Our first demonstration project is going to recover the lithium from the brine. And the second demonstration project will take the recovered lithium and produce lithium hydroxide monohydrate, which I'm just going to call lithium hydroxide from here on out.

So, our first demonstration project is partially funded by a Matching Grant from the California Energy Commission to demonstrate that we can recover lithium from the brine safely, cost-effectively and of course, in an environmentally responsible way, and Rizaldo touched on that a little bit earlier.

The second project has a Matching Grant from the US Department of Energy. So, in these two demonstration projects will go together. So, we'll start the first one, which is recovering the lithium from the brine.

Our lithium recovery technology keeps the dissolved minerals suspended in the brine after the lithium is recovered so the brine can be safely reinjected back into the reservoir to minimize solid waste.

This technology utilizes an ion exchange process that accounts for the unique composition of the Salton Sea geothermal brine. Our technology has been tested and proven effective and efficient in a variety of potential operating environments that we would see in the brine. We will continue to test the supports and validate the technology and potentially, find ways to make the process more efficient.

So, we'll then talk about our second project. Our lithium hydroxide project utilizes proprietary electrochemical processes to convert the final product from our first project into lithium hydroxide. One thing I want to point out is -- and Alex had touched on this a little bit earlier, is that the requirements for impurity of lithium hydroxide are pretty high.

So, to test our process, we'll be testing for impurities of our lithium hydroxide parts per billion; not million, billion with a B. Imagine that. For some impurities, even just one part per million may not be acceptable with some battery manufacturers. So, this is what we need to achieve.

Before I move on, I just wanted to explain a little bit why BHE Renewables is pursuing lithium hydroxide when lithium carbonate has historically been the lithium compound in lithium-ion batteries. Lithium carbonate synthesizes with metals used by batteries at a higher temperature.

Nickel, a metal that manufacturers are using more of because of its potential positive impact on battery performance

can potentially cause damage to the battery once synthesized at higher temperatures. Lithium hydroxide synthesizes with nickel conversely at lower temperatures and carbonate.

So, what does that mean? It means that the batteries should last longer and therefore, the more sustainable resource.

So, we'll talk about our waste streams. At the existing geothermal plants, our process utilizes existing imminent wells which have also been called production wells and outlet, which is also called injection wells. No exclusive lithium well streams back to the reservoir are required for our project. Minimizing the number of wells required for lithium production, reducing our potential project footprint.

Many wells will have to be drove exclusively for our lithium project at our existing geothermal plants. One strength that we have as we move forward with this process is that fortunately, we have already drilled our 25 production wells and 26 injection wells that we've been operating for about 35 years. That means that we have the basic infrastructure in place that has been in place for decades. Therefore, we believe that we have a great understanding of the brine and the reservoir.

This will also be helpful in advancing our timelines for our commercial **development.** As I mentioned a few minutes ago, to tie back to the earlier discussion about the technology, getting the dissolved solids suspended in the brine is essential to minimizing solid waste products. And one thing I also want

to point out is for our process, the our pH level of the outlet stream will be similar to the inlet stream, of course.

Next slide, please.

So, let me close my presentation by updating you all about the status of our demonstration projects. To reiterate my earlier point, we have the infrastructure for drilling and geothermal energy in place with our existing geothermal operations. The beginning stage of our first demonstration project is underway and is still on track for an end-service timeframe of spring 2022.

Engineering for the second demonstration project is in full swing and still on track as well.

One of the things that we have discussed before in the commission meetings previously is that we're taking the approach that we're crawling before we are walking. We believe that the technology that we're working on has not been approved on a commercial scale and these demonstration facilities serve to de-risk that.

We will be using our demonstration facilities to learn any potential lessons before our commercial operations. So, I will stop here. Michael, back to you. Thank you.

MR. WHITTAKER: Alright, thank you very much, Eric. Our next presentation is going to be from Derek Benson from EnergySource Minerals.

MR. BENSON: Great. thank you. And thanks to the

commission. Hopefully, you guys can hear me okay.

So, again, Derek Benson, COO of EnergySource Minerals.

Kinda of mindful of time, I put together a few slides to kind of give you a quick overview of where we are with the charter from the group, talk a little bit about the technology, but also some of the environmental aspects here.

So, I guess just jump right in, foreground pictures the Featherstone Plant and that's the host facility for us for our mineral recovery. So, that's been operating going on nine years now.

So, next slide.

So, a quick overview. The mineral recovery project, we refer to it as Project ATLiS, nominally a 20,000 ton per annum lithium hydroxide facility. The potential there for manganese and zinc co-products. We have done a lot of engineering, a lot of pilot work over the years. And I guess always give a shout out to the CEC for the engineering grant that we got a few years ago.

And right now, what we anticipate is a commercial operation beginning in 2024. And that would mean we go into construction in early 2022. Again, leveraging a lot of the infrastructure in place by the power facility, including the oilfield, the power lines, as well as you pointed out in one of the earlier discussions, the thermal plant does a great job of reducing the temperature and pressure of that brine and make it

manageable for mineral recovery.

And of course, when you look at our project in California compared to where lithium is sourced today, I think you're looking at a project with low to no sovereign risk, geopolitical risks. So, when you talk about the resiliency of supply chains, I think between the trade disputes and the COVID and Suez Canal blockage, I think we all appreciate how fragile some of this is. So, resiliency is important. And I think for the US market, particularly going forward and markets in the West, broadly having some new suppliers is preferential.

Next slide.

So, EnergySource Minerals is a project development company at its heart, but we ended up out of necessity kind of coupling into the technology space a bit. But I think one of the things as a project developer, the focus is to de-risk the project, make it financeable.

And there are a lot of lessons learned that got incorporated into our approach. These lessons are from the lithium industry at large, they are from the Salton Sea location specifically from the 1980s to today. There are there plenty of lessons out there.

Obviously, de-risking is aided in well field that's been operating for nine years. So, leveraging those operations again, very key.

Part of what we wanted to do though, is leverage a lot

of what we call state of the industry techniques. But with the geothermal brine, there were a couple elements that needed to be bespoke and that needed to be more efficient than what we saw as a product offering. So, we brought those to the market as part of the Project ATLiS program.

They leverage existing technologies, but modified them to fit the need. But we have vendors that are helping us in a lot of elements of this project. And that'll certainly aid when we get into the contractual elements. It's certainly good to have their support and their experience in the effort.

And lastly, I'll just point out, we've had early engagement with the end-users for years now. The product whether it's carbonate or hydroxide, the specs are getting tighter. And as we designed our process, we wanted to make sure that we kept our eye on what that target is. Cause it's a slightly moving target and want to make sure that the product spec was ultimately going to meet the needs of the customer.

Next slide.

So, this is just meant to give you a sense that this did not happen overnight. We have been working on this project since 2016. We've been doing a lot of engineering, a lot of pilot, a lot of process validation, and ultimately, the vendor selection that we did in '18 completed our pilots in late 1920. And a lot of engineering in the middle of that program led to a feasibility study. We did a bottoms-up costing with the

contractor to get those estimates in place.

And I'll talk a bit in a second, but we've made product, both carbonate and hydroxide that's met spec. And that gives us the comfort in both the engineering, the process numbers, the mass energy balance, the construction cost estimates. So, we have a great deal of confidence in the numbers we present and that we can execute on those.

Again, timing-wise, look to be in construction early next year and operationally in early 2024. So, I think Project ATLiS really does represent one of the most advanced lithium projects in development, and we're getting close to that transition over into construction.

Next slide.

So, if you folks have previously kind of talked about the process overall, it's a lot of unit operations to get the finished product. But the key to this process is a technology that we refer to internally, ILiAD. It’s an integrated lithium adsorption distortion approach. We consider this to be sort of at a technology readiness level of eight.

And so, we're deploying it currently in a few areas. It leans on technology and hardware that's deployed elsewhere, but again, we modified it to fit our need. It's a different process for lithium, but we do two things in one step with this unit operation.

We concentrate the lithium in our case about 12-fold

while simultaneously removing the sodium calcium potassium species that we do not want in the final product stream. So, we get about a 99.9% rejection of those monovalent salts and again, a 10 to 12x concentration of lithium in one step.

So, what this affords us is a great lithium recovery rate in terms of percent of lithium recovered. We have a low capital and a low operating cost for the separation. And of course, with this hardware and with the inherent benefits of some of the geothermal heat, very small environmental footprint.

Next slide.

So, one of the things we've been doing, I mentioned we've been doing a number of pilots over the years and running extensively on geothermal fluid, but we've been running on a number of alternative brines as well over the years. And we've gained some significant market acceptance with the approach.

And so, we are currently deploying a number of pilots, both in North America and South America. Photos at the right would show one of our smaller units and then the slightly larger one and it's factory acceptance test running at about 100 GPM.

So, these are built as you can tell, and being deployed currently. So, as we advance Project ATLiS here in California, we're also advancing the core ILiAD technology globally. And so, for us, it's been quite exciting.

To give you a sense, the Project ATLiS, I caught them in the slides here, you see a five by one configuration. What

we do to get to that full commercial scale is put in a number of these units in parallel. They're bigger, they're 1,500 gallons per minute. But it's the same process, same column heights, same configuration. So again, speaking to de-risking the platform, all of this feeds to that exercise.

Next side.

So, the last one here, in terms of speaking to what our technology is, this kind of shows you where it kind of fits in the flow sheet. It will work with any downstream process flow because what we're essentially doing is making lithium chloride stream so that can be converted to carbonate or hydroxide, will be a number of methodologies.

One of the things that I think we're particularly, you know excited about, and I think represents a real competitive advantage here is that we don't use reagents in that ILiAD unit operation. So, what that means is lower costs, lower environmental footprint, and those translate to certainly advantages in the bottom line for production.

The other thing I think important to note; this system has a very low water use relative to others. And talking about maybe one fifth to one sixth of maybe a fixed bed, comparable fix bed system, same with the absorbing inventory. So, we're talking about something that's 20 to 30% of some other approaches.

The other thing we've been doing over the years is

running long-term tests to validate the absorbent that we've made. It's a proprietary recipe, but leverages the history of absorbents and production.

And Dr. Charles Marston in our group has been in the industry for over 30 years and an expert in this field. So, we leverage a lot of that experience and what we've seen is the ability to have these absorbent materials last for years, not weeks, and not months. So, again, that testing has proven out.

And lastly, to point out, this is something that's very scalable. So, whether it's a hundred gallon per minute unit or 1,500 or 8,000 gallons a minute, we can deploy it at various sizes utilizing really the very same process and a lot of the same column geometry and configurations.

So, we're very happy with performance, and I'm very excited to be putting it out in field deployments in addition to the work that we've done here at Southern California.

Next slide.

So, I really won't spend much time here, but I think to speak to … we've completed piloting all the way through production of lithium hydroxide monohydrate as well as lithium carbonate. The table at the right just shows you kind of the spec we were targeting, which is again, fairly low in the impurities that you can see there. And we were able to achieve that in every metric.

Next slide.

So, I think the other ask was kind of what are some of the environmental attributes of the project? So, a look at ATLiS again, we commissioned an independent third party to do a life cycle assessment of our process against current state of the industry techniques looking specifically at carbon and water and land footprints.

Next slide.

So, what we did here was we took brine production and hard rock production and benchmarked ourselves. And here, this is CO2 per ton of product, and you can see Project ATLiS in green scores, very well compared to your current industry production techniques. We've taken off the names, but I think you can get a sense of the relative advantage.

Again, some of this is related to the inherent advantage of our process, and some of it is the benefit of geothermal brines being hot. So, you can leverage some of that thermal for efficiency.

Next slide.

I think this is another one that's growing in concern, and particularly as you look at South American resources from a water use standpoint. Again, Project ATLiS scores extremely favorable with respect to its water use per ton of product produced. So, we spent a lot of engineering time, both in terms of mapping out our process and validating all of those results.

But I think one of the key elements for us was the

water balance proved to have a lot of optimization that we could do. And so, that was what was the result, was a very water-efficient project at the end of the day.

Next slide.

Then lastly, this one is just sort of highlighting the land use. So, you can see, obviously, an evaporation ponds system is a huge land requirement, open pits as well. Project ATLiS doesn't really show up on the chart here.

But not only we're talking about a 30-acre facility, so very small land footprint. And in our case, it's already zoned industrial as it was done so during the permitting and construction of the Featherstone Geothermal Plant. So, the surrounding land use, farming, dart clubs, wildlife refuge, all of that continues uninterrupted.

Next slide.

And again, to put our developer hat back on, and make sure we can get a project to the financing and construction go line, is to make sure that we have a competitive offering in terms of environmental performance. Make sure you maintain cost competitiveness.

And then lastly, I think a US-based resource has some inherent advantages as we go forward. And particularly, here where we have a very strong and robust geothermal field, we've got a great resource and a great location.

So, all of those come together for us and we see its

ability to sort of execute. As a private company, we don't typically say too much, but we've been as you maybe can tell, we've been busy over the last few years and we continue to advance the project. But it has taken some time and a lot of energy. And for those that have helped and for the CEC grant and all that, we thank you.

And the next slide, if you have any questions or you want to reach out, I've provided my contact info. But look forward to the discussion, and again, appreciate the time.

MR. WHITTAKER: Thank you, Derek. Our final presentation will be from Jim Turner from Controlled Thermal Resources.

MR. TURNER: Thank you, Michael. And thank you for the opportunity to talk a little bit about our project at Salton See.

What I thought I'd do, and next slide, if you would, just introduce myself a little bit, because I'm probably the old guy on the block here, having been around the Salton Sea since the early 1990s and spending 20 years at Dow Chemical, before I came out here on loan.

Also ended up running what is now the Berkshire Hathaway operation out there, ran small, unique boutique drilling company back east, was also a senior member of EnergySource and we built their plant. And I'm now the Chief Operating Officer at Controlled Thermal Resources.

Next slide.

So, first of all, just to kind of ditto, everything that Eric Smith and Derek Benson mentioned, they talked well about the Salton Sea and its opportunity for lithium. Frankly, we're all doing something very, very similar. We're trying to get lithium out of that brine, put it into the product that's desired by the various off-takers around the world.

But the first thing I'd like to mention is the Salton Sea resource is probably one of the most, if not the most robust geothermal resource that can produce multi products in the entire world. You heard from, I believe, it was Ian, he mentioned the 600,000 tons of lithium carbonate equivalent. This resource also has a current projection of right at about 3,000 megawatts when fully developed.

And it might even be more than that as we complete the development of our resource and investigate the Northern half of this large geothermal resource. Just our area alone that we have to develop, we estimate that it will produce about half of the lithium carbonate equivalent that Ian mentioned, and about 1,100 megawatts worth of electricity at the same time.

And as both Eric and Derek mentioned, this resource has a lot of additional potential on minerals, whether it's potassium, zinc, manganese, iron, rubidium -- there is almost the entire table of elements that exist in this resource. So, it's a matter of what's being sought after and is it

economically viable to pull these materials out.

Next slide, please.

So, what are we doing? So, first of all, we have the opportunity to design a complete Greenfield Plant, including power and lithium. We don't have to worry about an existing plant that we have to bolt on to, and somehow, meet that plant's needs. We get to take our knowledge and go from the ground up on both sides.

So, what that does for us is it helps in optimizing the use of fluids like water back and forth, that helps on the use of heat. We can use some of our heat generated by steam in the lithium process. And we definitely will produce renewable electricity to run that lithium process.

As I think it was Ian or Alex mentioned, this type of technology does not use evaporation ponds. There's no tailings from an open pit mine. And in our case, we have very little almost diminimous waste. Our goal is that anything that we pull out of the brine should be a product with value. If it doesn't, we don't want to take it out.

There's no offsite liquid waste. There's very little solid waste that we would produce. And to say something that Derek mentioned, the footprint of our plant, the footprint of BHE's plants and whatnot, these are tiny in comparison to anybody else in the world. So, we all enjoy that small footprint in the small emissions that you see elsewhere.

Again, we don't feel like we're competing with each other. At least, I don't. I mean, if the entire Salton Sea development was fortunate enough to push out all the lithium, it could make the 600,000 tons per year, we're not gonna be competing. Every pound of material that, that any of us makes we'll go to market and be sold.

Derek mentioned that we're politically stable here in the United States. That's highly sought after. We're green in our case, completely from head to toe, that is also highly sought after. So, what are we doing? So, we actually have two proven technology paths to produce lithium and we settled on iron exchange.

You heard from, I think it was Ian, Dow Chemical started doing ion exchange work in the early 1980s. Actually, Dow Chemical started looking at lithium from brine as early as 1963 from what I remember. And so, there's been a lot of work around the world on how to get lithium out of brine.

A lot of different techniques. Some of them worked better than others, but the key is that you find one that gets the material out in the period that you need, that you can convert it to the final product, and it's economically acceptable. And that's what we've done.

We're a resource company. We're not a technology company. We'll leave that to others. And so, what we've done is we've assembled a team of folks that came from the Salton Sea

area that has experienced the development of all the plants that are at the Salton Sea, the ups and downs, and took that group of people, and then we said, "Okay, let's go out and find the real experts out there for the various technical components that we need to assemble for success." And that's what we've done.

Our timeline is similar in that we've done a lot of engineering, tremendous amount of engineering, a lot of environmental work, definitely a lot of sales work. I think you heard Rod earlier mentioned the GM announcement, and we're in the final phases of our engineering and permitting work. And we have our proven pathway to get all the way to whether it's lithium carbonate or lithium hydroxide.

I guess we're going to the next slide, please.

So, I'd like to mention here that we have a kind of a unique opportunity as CTR. We're in the Northern half of the geothermal field, and it's being rapidly made available by the receding shoreline of the Salton Sea. Now, the receding shoreline has some significant negative issues and in dust and pollutants, but our vision is we'll have a master-planned solution out there, probably will look like a master plan, housing development, if you will.

But the development that we need for our plants as we build them will not only take a very small footprint, but it will enable others to come out and hopefully build their developments. And maybe even use renewable electricity that we

have available, and hopefully, they'll use the lithium products that we make.

For example, cathode makers are rapidly looking to build their cathode manufacturing here in the United States, and the ultimate battery assembly plants are looking to do the same thing.

The automotive makers are starting to insist that these downstream suppliers locate here where it's politically stable and there's no better place than Imperial Valley. So, this master plan is a big deal for Imperial County because wherever anybody decides to build their plant, they're going to eliminate that dust and air pollution issue.

So, what we've done is we've let the world know that we're open for business and we'd like them to come, take a look at where they can get clean energy, they can get green lithium, and have a place with people that want jobs.

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So, just to wrap this up and to summarize, when this is fully realized, our development is fully realized, we're going to have a very significant impact on the job position of Imperial County. Our development alone will create over 2,000 jobs both direct and indirect. The economic impact here in Imperial County will be very significant, the Imperial Valley Economic Development Corporation estimated that our projects along will have greater than a $300 million direct economic

impact right here in Imperial County.

We've done a lot of work with the community. We anticipate that the Imperial County folks will help us on selecting people for potential jobs. We'll train them and all they have to do is show up. Some of the other benefits is that our clean power will go into the grid.

Everybody knows that California is going to be first to be a hundred percent renewable, clean energy, and we hope to be a big part of that. And from a US standpoint lithium production and these other minerals will be significant, positive impact on their critical materials supply here in the United States.

And that's about what I have. I don't want to repeat what has already been said, but I'd be happy to answer any questions that anybody has. Thank you, Michael.

MR. WHITTAKER: Alright. Thank you, Jim. So, that concludes our presentations from our three panelists. And so, now we're going to transition into 20 minutes of discussion.

And so, the format we have for this is I'll pose a question and I'll give all an opportunity to respond to the question if you'd like. The formal format will go in the same order as you presented. So, we'll go Eric, and then Derek, and then Jim.

If you want to interject, please feel free to do so, this is a discussion. I would only ask just make it easy on our interpreters.

So, with that, I will kick us off with the first question, which is how much lithium do you think there is? And how many years do you think you can operate on that amount of lithium? And then also please talk about how you made that assessment.

So, to start out, I'll give Eric the opportunity to respond.

MR. SMITH: Okay. So, one thing that was mentioned earlier from NREL was the estimate of 15 billion metric tons lithium carbon equivalent. We have not seen anything that necessarily disapproves that, and at our full commercial production potential, that is a resource for us that will last well over 70 years. So, for us, we believe that it is very much a sustainable resource.

And also, I know that there was a little bit of information. I can't speak to it that much, maybe some of the other panelists can speak to a little bit better than I can, is about recharging in the existing reservoir. Can the existing structure around the reservoir potentially recharge the lithium? I can't speak to that. I've heard of it, but maybe someone else can speak to it a little bit more than I can.

MR. WHITTAKER: Well, so let's go ahead and give Derek an opportunity to respond to the question, how much lithium is there? How many years can you operate? How did you make that assessment and then give you the option to follow up on Eric's

question?

MR. BENSON: Yeah, so we, we specifically look at the resource area at the Featherstone Geothermal Plant currently draws from. We've done extensive thermal modeling that goes with that. And that modeling exercise includes total dissolved solids. All of the salts that are present in that brine.

So, that's got a lot of data, a lot of operational data that feeds the model that we ran and that all informed our feasibility study. So, we took some fairly conservative assumptions around the porosity of the reservoir, around the battery limits of the production area. But I think we all recognize, it's all interconnected, there's a lot of hydraulic support across the resource.

So, we look at our modeling that's done on a 20-year basis where we do have a very modest amount of depletion over that time based on the minerals that we see today and some of the operations that occur at the power plant. You don't really see much of a depletion, but we modeled it as a conservative basis. And then we'll see how that goes forward.

But ultimately, there's a there is a lot of lithium in the in the Salton Sea resource. And we'll see how the model compares once we're operational, but indications are 20 years or more, it's easily achievable here.

MR. WHITTAKER: Great. And Jim, I'll give you a chance to respond to that. How much lithium, how many years can

you operate and how did you make that assessment?

MR. TURNER: So, what we did is we chose to follow the Canadian instrument, national instrument 43101 process, and had what's called qualified personnel review on a technical scale, the geology, the solution characteristics down there to determine the amount of lithium and therefore, the number of years given a particular withdrawal rate of that lithium.

So, we only use data for lithium that's in solution, not lithium that may still be in the rock. And in doing so, we ended up with our amount of lithium as just lithium, not a particular compound, and then converted that. And that's how we ended up with our approximation of 300,000 metric tons of lithium.

We feel that we're easily in that 40, 60-year range depending on how fast or how much we take out each year. We did not include anything related to additional lithium dissolving into solution. So, we feel we're extremely conservative in our estimate. And then we only used what we could find as published data, as opposed to anecdotal data that most of us know, because we've run all these plants that are out there. So, there's a lot of data that's not published.

And again, we feel we have an extremely conservative estimate based on that.

MR. WHITTAKER: Okay, great. The next question is related to the previous question, but I just want to give you a

chance to address it explicitly since it's come up in a number of context.

Is there a danger that the resource could be depleted and maybe perhaps in light of your previous comments, is there a danger that the resource could be depleted before the sort of time window that you've estimated for your resource lifetime?

MR. TURNER: At this time, based off of everything that we have seen and have verified, of course, we don't believe that that's the case.

MR. WHITTAKER: And Derek.

MR. BENSON: Yeah, I think that's the same response is that when we do the modeling, nothing would suggest that you'd be negatively surprised with a tenure asset. No, I think the assumptions, most of the reservoir data that exists and keep in mind, there's some projects that have been out here 30 years. You know, ours has been operating nine.

The data clearly is a robust data set. So, 20 years is probably the short end of the modeling. I think Jim talked about, as well as there's some conservative assumptions you want to take at this point and try to be surprised to the positive. So, no, I think if anything, these are going to be long lived assets, not something where you have sort of a flash in the pan moment.

I think there's certainly a lot of fluid and that fluid is all bearing lithium at this point. So, I think it's a stout

resource to go forward.

MR. WHITTAKER: Great. And Jim?

MR. TURNER: So, technically, yeah, it's a mine, so it will be depleted at some point, but probably not in any of our lifetimes or the foreseeable future. We look at the change in silica concentration, because all these plants have extracted silica ever since the first one started 38 years ago. And there's no change in the amount of silica in the brine.

So, if that's any kind of an indication of depletion rate, then it says that we're going to see lithium coming out of this for probably many, many, many years, given the last 38 years of operation.

MR. WHITTAKER: Great. The next question is, again, something that's been touched on both in our introduction talks and also your talks as well. But I want to give you the chance to take this one on directly.

How much research and development is needed now on specifically the lithium extraction process from geothermal brines, or is the technology sound, and is it just a matter of demonstrating that the technology can scale up to a full-scale capacity?

MR. SMITH: For us, since we're going with the demonstration process, we believe the technology is good at a small scale, but we want to come up with -- for our demonstration plants, it's one tenth of a commercial scale. So,

even though we believe that the technology is definitely promising, we want to make sure that it is good to go before we move to the commercial stage.

MR. WHITTAKER: Great, Derek.

MR. BENSON: Yeah. So, I think you'd say we probably have a little different take. Each of our unit operations is essentially commercially deployed at the moment. The only thing that's a little bit different is the ILiAD hardware, while it's been used in other applications at full scale, the application for lithium is new, but we're talking about internals on a similar piece of hardware.

So, the technology risk isn't very high. But at the same time, we're deploying commercial demonstration units as we speak. So, for us, the technology risk has been answered. We're not looking at any more R&D.

What we will have is a continuous improvement program that's internal that we're executing. So, we're in deployment, we're moving toward construction. So, we've asked and answered the technology question to our satisfaction.

MR. WHITTAKER: Great. And Jim.

MR. TURNER: Yeah, similar response as Derek. We think the technology risk is acceptable at this point, but coming from the chemical industry, the industry as a whole won't stop developing and trying to improve on technical pathways to extract lithium from brine. And I think that's important to

remember that just because we may have a plant, EnergySource may have a plant, and BHE may have a plant that works and it has good economics today, you're always looking to improve upon that.

And it may be a small twist on today's technology. I think we're going to see by the next 10 or 15 years, a big handful of technologies that we're going to think pretty seriously about for the next generation of lithium plants that we have out here.

MR. WHITTAKER: Great. So, you've just articulated that there's no major sort of R&D challenge in general to operations. But we've also heard that none of your operations are at full scale yet. And so, if it's not the R&D, what is the most significant barrier to getting to full scale operation? Is it permitting, is it raising capital, or is it something else?

Eric, I'll let you start.

MR. SMITH: Okay. Since we are presumed a demonstration scale, we want to prove to our satisfaction that the technology can be implemented for commercial scale.

But an additional challenge and I think a lot of people would agree is making sure that our process's cost compared to other sources of lithium outside of the Imperial Valley. You know, we have a great opportunity with one of the world's most environmentally responsible methods of recovering and producing lithium.

But there are other suppliers internationally that don't prioritize ESG. And we also know that even though lithium prices are very strong today, markets are not always rational. So, we are all aware of the impending demand, but as that demand increases, so eventually, will the supply. So, making sure that … we touched a little bit on the sustainability of the lithium itself from the brine, but also, we want to make sure that our process is sustainable to market fluctuations.

MR. WHITTAKER: Great, and Derek.

MR. BENSON: Yeah. So, I go back maybe to the slide where we were talk about our development time. I think for us, what has been the major challenge is to vet this out. And we recognize this is for us, it's a geothermal-based lithium project. We are talking about serial number one.

So, you do have to take that technology, that process, do the engineering, and ultimately, make it a financeable approach so that the selection of vendors, the selection of everything in the process has been very deliberate to that. But it has taken us a while to get to this point.

But you raised like whether … permitting is a pretty prescriptive program in California. So, that for us is not a particular challenge. Because again, we leverage the zoning of the Featherstone Plant and that process that's in place. So, you obviously, need to go through the mechanics of it. And now, you're in a market where I think the financing, it's not done

until it's done, so there are risks there.

But ultimately, I think you're in a strong market for lithium demand. We're in a post-COVID moment, I hope, in terms of some stability and commodity prices for construction. But that all has to kind of work itself out. But from our standpoint, the bigger challenges maybe are just behind us, and now, we just need to do the last little push into the project finance.

MS. WHITTAKER: Great. And Jim.

MR. TURNER: Thank you, Michael. You know similar to BHE and EnergySource, we're all working very cautiously to de-risk these projects during our development stage, because as you mentioned, we don't have the first one in commercial operation yet. So, everybody's being extra careful, and that is I think the very smart route.

Put that aside, and because of my years in the chemical industry, I can tell you that California is notoriously difficult to permit. As prescriptive as it is, it is a big process. And if there's one element that is most significant in terms of a development going forward is time. So, if we can have reasonable permitting criteria that we can get through in a reasonable amount of time, that helps develop because time is money.

From a capital standpoint, COVID certainly has had its impact on capital availability. But I think at the end of the

day, the capital will flow with good research and development and a good process that you can show to the people that are going to supply that capital.

And as Derek mentioned, I agree with him; financing's not over until you sign on the dotted line and the money's in the bank. And then you're ready to go for construction.

One of the things that we've seen here in recent times, and it's not just here, it's basically global, is a material shortage of things like steel. Now that's getting better, but that prop came up as a result of COVID and we all have to deal with that so that we can get these plants built.

MS. WHITTAKER: Great. Thank you, Jim. Alright.

Next question is about co-products. And so, we heard some discussion about potential to produce co-products; zinc, manganese, potentially other minerals that are found in the brine.

Aren't your financial models reliant on the production of co-products? Are they sustained fully on the production of lithium? And sort of corelated to that, we've heard about producing things like silica. Are your financial models reliant on having particular offtake agreements in place for things like silica?

So, Eric, go ahead and take it away.

MR. SMITH: For us, the answer is no. Our focus is on lithium and each mineral will have to have its own business

case, but our lithium economics are not dependent on any other minerals.

MS. WHITTAKER: Great. Derek.

MR. BENSON: I think Eric nailed it. No, is the short answer.

MR. WHITTAKER: Great, and Jim.

MR. TURNER: I think all three of us have a laser focus on getting the lithium out. The co-products will be a bonus obviously, and as Eric mentioned, they need to stand on their own economic case. And frankly, the reason we all have the laser-like focus is because Simbol failed not because of technology, but because they did not have that laser-like focus on getting past the goal line on lithium.

MR. WHITTAKER: Great. Thank you all very much. I think we're approaching the end of our time here for the moderator discussion. And I want to open it up now to the commissioners to be able to give them time to ask their questions of our panelists.

So, what we'll do now, if any of the commissioners have questions, I'll just invite you to raise your hands and I can call on you to unmute yourself and you can ask your question of the panelists. So, I see Commissioner Olmedo has raised his hand; Commissioner, please go ahead unmute yourself and ask your question.

COMMISSIONER OLMEDO: Yeah, thank you for all the

presenters, great information. As we're tasked to put together a report, this information is going to be very useful to understand as much as possibly available to us, to the public. I think they will help us reach much better final recommendations.

My comments are something that really comes to mind, one of several questions, and I'm happy to pause at some point, let other commissioners ask theirs -- what comes to mind is you have the geothermal operations that are now going to take advantage of this secondary business. It's not dependent from my understanding and listening to the presenters.

If you have a 50-megawatt geothermal, the model of lithium production isn't dependent on that 50. In other words, it's going to have to be a standalone, ongoing mining operation. Am I understanding that correct to me, perhaps the projected demands of each operator facility?

MR. BENSON: We are in the process of determining how much our energy usage is going to be at the commercial level. So, we don't have the information at this time to make a definitive statement on that.

COMMISSIONER OLMEDO: Any of the other panelists have an answer for that?

MR. TURNER: Commissioner Olmedo, it's Jim Turner. The way we look at it and I think this is the way the other guys look at this too, is the power plant has to stand on its own two

feet and the lithium plant has to stand on its own two feet financially.

Now, they're interrelated because one provides the brine over to the other one, but financially, each has to stand on its own two feet to be a success. And that's the way Controlled Thermal Resources looks at it. And I'm sure the other two companies look at it the same way.

COMMISSIONER OLMEDO: Thank you, Jim. That came across very clear in your presentation. It hasn't come across that clear in past presentations or in the earlier two presentations. So, yeah, thank you, Jim.

It seems clear that that CTR is a resource facility and that its operation is based on a resource and energy being an additional business benefit to that business model. Would that be fair to say that that's kind of the order that I used, Jim?

MR. TURNER: Yes, I think so. Definitely the minerals are probably the big dog, if you will, and energy is the smaller, but they're both viable and they both will play a significant role, I think, in the California economy, and especially the Imperial County economy.

COMMISSIONER OLMEDO: And one more question. I have a lot of questions, but I think that maybe I can always do follow-ups. One thing that I'm probably known for is bringing up the concerns about the waste streams. And I appreciate it being brought up and how it's more invasive and open mining and other

types of methods.

There's a concern locally from some who may or may not be as familiar as all of you. But there are concerns about the seismic activity, about how much of disruption occurs in the siphoning or the production whether it's for the energy and whichever way it occurs. You know, there a lot of talks about the impurities or the sludge, the waste and how that would be handled.

Again, it was very clear in the presentation of the CTR model, being one of the focus areas of showing there was minimal amount of waste. In some of the existing facilities, I imagine that they've been around for quite a number of years, there's talk about what comes next.

Even with the technology now, if I understood correctly, there's always a forward thinking of what's the next technology model that's going to come out that may be more efficient, maybe cleaner, maybe better.

But is there any thoughts or any thoughts right now as to something for myself and the general public, how are the waste streams going to be mitigated? And I'll say this; there are concerns that even when talking about Salton Sea, there's this optimism of the decline in oil expansion of the Playa and the public health concern that exists. And those two don't seem to reconcile right now.

There's a public health concern, there's an optimism of

more open area in the known geothermal area, and the mitigation doesn't seem to be happening as quickly as we would hope. So, obviously that's one issue, but the other is the waste streams. And is there anything that you can comment to that is to how the different bus presenters are addressing that?

MR. TURNER: Yeah, so I will. Having been a part of BHE for quite a few years and have run the part of the organization and having been one of the senior leaders over at EnergySource, along with Derek and his team, I can tell you that environmental responsibility is right at the top of the list of important items on both those other companies, as well as CTR.

It has been even back in the 90s when I was running the Berkshire area out there, when I was part of EnergySource, environmental responsibility, being a good neighbor, trying to minimize or eliminate waste is always on the front page of whatever we're working on.

And not that it's easy to do. I mean, in some cases, it's difficult. But I can guarantee you that all three companies want to have a minimal waste to no waste if we can, to be the absolute best neighbor to the farmers who are out there. And that's one of one of CTR's top criteria. And I have to imagine it's the same on the other two companies that are developing out there.

We have almost daily conversations at CTR on water use reduction, not producing any waste. And in some cases, our

mandate to our employees is okay, we will not have any water discharged from our site. In other words, we don't need an NPDES permit. That was the criteria at EnergySource when I was there. They were able to fulfill that. I think BHE is in that same vein.

So, while it may appear that that level of care isn't there, I can tell you that it is and all three companies are united on being the best possible neighbor we could be out there on an environmental scale. And in fact, if you look at BHE, it's sitting right next to the Sonny Bono reserve and that's important to us that we can have that kind of a neighbor and be welcomed.

COMMISSIONER OLMEDO: Thank you, Jim. I do have other question but I'll wait, thank you.

MR. WHITTAKER: Other questions from any of the commissioners? I see, Chair Paz, please go ahead.

CHAIR PAZ: Thank you. And my questions are probably going to take a lot more time to get into and I'm assuming that's why they were not touched in detail in the presentation. So, I will start with that.

But there was information that was given to us both by Alex presentation, for example, on the different methods of direct lithium extraction, and those different methods, will probably, I'm assuming require different resources and have different levels of waste streams.

I would like to see, especially as we're putting in analysis on this topic, a lot more detail on the typical resources taken and then the waste streams that come along with them. And as it refers to our panelists, though I heard various times that there was minimal waste, minimal use of resources, that it will be beneficial for all of us to know what that threshold is. What is minimum water, how much water are we using? Are we using fresh water? Where's the water coming from?

So, those levels of details I think are going to be important again, for us to do the analysis that we're charged with doing.

MR. WHITTAKER: Any of the panelists wants to respond, we'll start with Eric, if you'd like.

MR. SMITH: No, I think it gets to that stage, it'd be good to see exactly what the commission needs in order to make an informed analysis and we'll proceed accordingly.

MR. WHITTAKER: Derek, would you like to comment?

MR. BENSON: Sure. And one of the things, I guess, to kind of weigh in with respect to we talk about impurities, we recognize that impurity management, a lot of it by volume is sodium potassium, calcium -- all of those stay … they come out of the well dissolved in the brine and they ultimately end up back in the reservoir, still dissolved in the brine.

Things that we take out, we are precipitating or recovering material very selectively, so that we do minimize the

waste and/or it's a co-product. So, the ultimate goal for the project is an efficiency from the standpoint of material inputs, because each has a cost. But from a standpoint of managing the brine to get to a point where you can extract the lithium, most of what we're looking at, are potential for co-product.

So, that's been the focus, obviously, in a 10-minute window, we can't kind of get all the way down into all the details there in terms of what we have, in terms mass balance and these kinds of things. But from a standpoint of in efficiency, in terms of energy, water, material inputs, the geothermal brine just speaking comparatively, has a number of attributes that obviously give it significant advantage.

We were talking about these processes, the kinetics are always enhanced by temperature. It's a luxury that we are awash in high temperature fluid, so you don't have to put a lot of heat into the system. That obviously saves fuel, it saves on emissions, these kinds of things.

So, in this discussion, it was a bit of a comparative analysis rather than absolute numbers. But I want to give you guys a sense, like when we talk about … there are no sludges per se; what we would remove would be generally speaking, a co-product or the actual product in the form of lithium.

The bulk of materials in terms of what is dissolved in that brine remains in that brine. And that's particularly sodium potassium and calcium in our case. We don't extract those. We

just leave it as dissolved solids in the brine.

And that re-injection is obviously, it's part of the power plant. Each power plant has a requirement to re-inject, and that provides the pressure support to the resource. It's also what makes the renewable attributes of geothermal renewable.

You put the fluid back in, as it moves across the magnetic body, that's heated up that area, it's reheated and then reused. So, those are the attributes that the minerals sort of continuing.

So, apologies, we don't have absolute numbers, but it was meant to give you some relativity to vis-a-vis existing processes.

CHAIR PAZ: Yes, I understand given the time and it was a very good overview. Just my question is, as we're getting ready to delve down and do our analysis, it will be helpful to have absolute numbers and a better understanding of what we mean when we're saying these processes and methods are environmentally responsible. What's our definition, is it environmentally responsible in comparison to A, B, and C, things of that nature.

I understand, thank you.

MR. WHITTAKER: Alright. Thank you, Chair Paz for the question. We have a hand up from Commissioner Ruiz. Please go ahead.

COMMISSIONER RUIZ: Yes, thank you all for wonderful presentations. In talking to members from the community, one of the concerns is -- and I think you have the chairperson who has mentioned that and Commissioner Olmedo as well.

In a community, in a region that is already plagued with limited water, it is a concern for a lot of people the amount of water that will be used. And I heard from most of you the use of water here will be very conservative.

But nonetheless, we've seen what this industry has done in other places in the world. And I was checking some numbers in North America, just to produce one metric ton of lithium require over almost 1.5-acre feet of water. Here, I heard numbers between 50 and 90,000 gallons.

What is the projection now? And what is the technology that will be used in order to save more water in the long run?

MR. TURNER: Commissioner Ruiz, this is Jim Turner. What we're able to do, I think because we're building from the ground up as a Greenfield Plant with an integrated design, is that we're looking at how many times we can reuse a gallon of water. And that is specifically to minimize the amount of freshwater that we need.

And that's important. We're all very serious about minimizing that use of water, but it depends on the technology. And if you remember what Alex Grant mentioned, that there's lots of different technologies out there that can be used for lithium

extraction, DLE in this case -- they all have their pluses and minuses.

And one of the mines is that to my knowledge, they all require water in some form and in some amount. And the key for us is to look at how many times we can reuse a gallon of water. And that's our method of minimizing the first water take.

MR. WHITTAKER: Eric or Derek, would you like to add anything?

MR. BENSON: Yeah, no, I guess just to respond directly, obviously we recognize, even though within the IID service territory, we are in a low desert that has water, and there is an allocation for industrial use. We certainly are attuned to that issue and try to minimize that water use.

And again, that's been a huge focus of the engineering and design effort. And why in terms of both the process designed development, the water balance was given equal time in terms of trying to do that optimization.

The numbers you cited previously by those volumes, those are orders of magnitude, I think, higher than what you'll see on the geothermal-based resource in terms of water consumption per ton of product. A lot of what the water use is for is for a rent cycle, if you will.

So, we have to do some treatment of surface water to get it up to a quality standard that's acceptable. And so, we're trying to minimize that. That has cost to do that. So,

again, water efficiency is huge. And so, again, maybe in due course, we can get you that number specifically. But the reality is it's significantly less than what you quoted.

So, again, we're trying to minimize inputs, trying to minimize costs, and that's certainly one that we recognize, it's particularly important here. It's significantly more important than in areas where you have high desert production like in South America, where they have no water use, and no water resource.

Though, a lot of projects that we're involved with, with ILiAD technology, it's a paramount issue. So, we hear you, we recognize it, and that's been front and center.

COMMISSIONER RUIZ: I agree with what Jim and Derek have said, and I'll also point out that as mentioned earlier, in Rizaldo's presentation, that one of our requirements from the California Energy Commission is making sure that we have minimized our wire usage to a 50,000 gallon per metric ton, which is 90% less than a water that's needed in South America by comparison.

MR. WHITTAKER: Great, thank you. Well, I think in the interest of time, we'll have one final question from Commissioner Flores, and then we'll move on to the next phase of the meeting. So, Commissioner Flores, please go ahead.

COMMISSIONER FLORES: Sure. I was just going back to when the presenter was talking about the reinjection of the

minerals, once they've come up and they've extracted the lithium, and then reinjected that.

And I was just wondering, I mean, although the minerals were there, they're going to be there in different concentrations. So, will this end up changing the way resources are coming back up, so the lithium that's coming back up at all, eventually? Are there any concerns with that?

MR. TURNER: Commissioner Flores, this Jim Turner. The amount of minerals that we're talking about, basically are miniscule compared to the high mineral concentration minerals that are in that brine. For example, sodium chloride, which is table salt, if I remember right, is probably about 6% and lithium is in that 2 to 300 plus parts per million. So, were many, many, many times smaller.

So, when you take out the lithium, it doesn't even change the volume of the of the leftover brine that's going back into the ground as if we were taking out the sodium chloride, which is a much bigger amount of material, if that's what we're looking for.

So, changing the brine other than under a chemical analysis, you might see that over a long period of time, that the lithium concentration might be depleted. Like we talked much earlier today, you wouldn't see a change in the chemistry.

MR. WHITTAKER: Eric or Derek, want to answer that question as well?

MR. SMITH: No, I concur with what Jim said.

MR. BENSON: Yeah, yeah. Derek here, not nothing additional. I think Jim hit it. The pilot work we've done, it shows that the brine that we take out of the ground is essentially the same, but for the depletion of the lithium fraction, which is just 250 PPM on order of magnitude. You see sodium at 60 or 70,000 parts per million.

So, just a completely different concentration of sodium and then calcium and potassium in short order, right behind, maybe 30,000 and 20,000 parts per million. So, those are the things you want to keep then just because there's so much of it and that's consistent with the reservoir that's in place.

MR. WHITTAKER: Alright. Thank you all. Thanks to the commissioners for excellent questions. Thank you to the panelists. I do see that we have a number of questions in the Q&A, and I believe that there's going to be an opportunity for public comment, which Elisabeth has just put up on the screen here. So, perfect timing for that.

In that case, I'll segue to the next segment and just thank you all for joining us and turn over the floor to Elisabeth.

MS. DE JONG: Thank you very much for that great panel. So, yes, we will be turning now to public comments.

This is for public comments regarding the Lithium Extraction Methods Workshop, the presentations and panel

discussion that we just saw. If you're joining us by Zoom on the computer, please use the raise hand feature. And if you've called in, please dial *9 to raise your hand, and then *6 to unmute your phone line.

We have the hands raised first, and then to the phones, and then the written comments. Alright. I'm seeing lots of hands raised. So, let me go ahead and start with Craig, and you should be able to unmute yourself.

Alright. Well, we'll come back to Craig if he's able to unmute. But Orlando Foote, if you're able to unmute, go ahead.

MR. FOOTE: Now, can you hear me?

MS. DE JONG: Yes.

MR. FOOTE: Oh, good. Yes, just a general question. Maybe this is a paver to go on further down the pathway. But we know that certainly there have been issues raised to the east of us in particularly in Nevada, with some of the environmental organizations relative to mining activities in general and even the lithium thing.

Has there been any discussion of the cost of remediation down the line, recognizing that this remains as a mining operation? And we know that in Hungary, mining operations are generally permitted with a reclamation component bonded in or financed.

Has there been any discussion of that in connection

with these particular projects in the context of both permitting and downline what we're going to be left with after these projects have completed their useful life?

MS. DE JONG: I'll jump in here just really quick and mentioned that in future meetings, we will be discussing and doing the same kind of deep dive on all the different topics outlined in AB 1657. So, we will be going over environmental impacts as well as permitting in future workshops. So, we encourage you to stay tuned with us, and then I'll turn and see if there's any immediate responses.

Oh, yes, Jim, I see your hand raised.

MR. TURNER: Yeah. So just to respond to Mr. Foote's question, one of the beauties of what we're all three doing is that we don't create a mine in a normal sense of a mine. It's a liquid reservoir down there.

However, in our probing process, we do put up a bond for basically tearing down the plant, returning it to earth at the end of its useful life, whenever we're finished doing work with that, just the same as the geothermal plant.

So, that's already in the mechanics or the permitting process, and since we're not a hard rock mine or a big seller mine that has these horrendously large evaporation ponds, when we're all done and we move away, it will look just like it did before we got there.

MR. FOOTE: Thanks, Jim.

MS. DE JONG: Alright, thank you. So, we'll turn to another public, and this one is for LCJA ECV office, go ahead and speak.

MS. MARIELA: This is not a particular question, this is more of just a general comment. This is Mariela Loera from Leadership Council, and I want to raise some of the concerns that we have heard from community in community meetings and as well as community forum that we held with Commissioners Frank and Luis. So, thank you both for that.

They have already raised some of these questions in this space, so thank you for doing that. We'll definitely take those answers back to community who asked them.

But I would say, the main concerns the community have expressed are around concerning the lack of just general information that has been provided to them on how those development will affect their wellbeing and the lack of just … the lack of community involvement with them.

So, they're specifically asking for the distribution of accessible educational material and more fluid conversation. So, like I would suggest like basically all of the information that has been shared in this space being translated for the general public and then shared with them would be ideal.

Some of the specific questions that they have asked and again, Commissioner Luis and Frank already said some of this, is around water use, sourcing of water, recycling of water, the

effect this will have to the land around them, especially like **at the San Andreas fault** and ground level issues. Thank you.

MS. DE JONG: Thank you very much for your comments. All right. I'm going to turn to Vijay Dhar.

MR. DHAR: Yeah, can you hear me?

MS. DE JONG: Yes.

MR. DHAR: Actually, lately there has been a lot of debate about the cell chemistries, whether the nickel and cobalt is going to be used or not and preferences not to use them. And there's a lot of news that actually Tesla recently has been moving towards the chemistries which uses iron and phosphate inertia to lithium.

So, I was wondering whether these three companies, whether they're agnostic to what the cell chemistry is, or they have to work upfront several years before to really make sure that the lithium is compatible with the cell chemistry that is going to be used, ultimately?

MS. DE JONG: I see you raise your hand, Jim.

MR. TURNER: Yep, I did. So, Mr. Dhar, we're relatively agnostic. I think that's true for the other two guys as well, in that what is being sought after is the lithium and it's the molecule that contains the lithium that will affect the chemistry. And all of our technologies are really pretty similar at the end of the day.

And if we do well, we all have the ability to change

the lithium as it's extracted from the brine into the molecule of choice that the battery maker wants. So, as that battery technology develops, and maybe they go from lithium carbonate or looking hydroxide to another form of lithium, say lithium fluoride that has a fluorine atom on it, then we all have the ability if we choose to, and it's economically viable, to change the back end once we get the lithium out.

So, the real key is being effective at getting the lithium out of the brine, then we can do virtually anything with it at that point.

MR. DHAR: Thank you.

MS. DE JONG: Right, Michael Garabedian.

MR. GARABEDIAN: Good afternoon. Thank you to Lithium Valley Commissioners. I'm wondering if you can give us in an introductory way the transmission infrastructure requirements, including routes, what's their now and ownership. I'm not raising environmental impact issues, a question about operational needs. Thank you.

MS. DE JONG: Thank you for your question. And I'm going to go ahead and jump in on that. That we encourage you to please join in next month's meeting as well as future meetings. In next month's meeting, we will be discussing and starting to break on a way of discussing infrastructure both existing and needed. So, please join us for that. I don't think we'll have the time to go into infrastructure today.

MR. GARABEDIAN: Thank you.

MS. DE JONG: So, I had a public comment from someone named Craig before, no last name -- I just want to check if you're able to unmute?

Okay. I'll go ahead to Christina Marquez.

MS. MARQUEZ: Can you hear me?

MS. DE JONG: Yes.

MS. MARQUEZ: Great, thank you. Good afternoon, commissioners. I just wanted to introduce myself. My name is Christina Marquez speaking on behalf of over 3,500 members of IBEW Local 569, the Electrical Workers Union, representing San Diego and Imperial Counties.

I really appreciate you taking the time to put together the panels and have the stakeholders speak so that the community can learn about how intricate this is. You know, being a journeyman myself, looking at some of these line diagrams and looking at the relays and the switches, as you can see, it's really complicated. And we want to make sure that people that are trained and certified, electricians are doing this work.

We actually have a new building that is scheduled to break ground soon, 10,000-foot facility in Imperial that will have the state certified electrical apprenticeship held there in Imperial. And our members have built over two gigawatts of renewable energy. And the vast majority of these clean energy projects have been built under project labor agreements.

These projects have generated good paying jobs, employing local workers, and have provided skilled training and benefits in an economically hard-hit region that includes high scoring CalEnviroScreen communities.

From a local benefits and workforce perspective, we believe the following are critical to embed in statewide initiatives or related policies. Number one, require a strong workforce and labor standards that create high quality jobs for local community members and support state-certified apprenticeship opportunities.

Number two, ensuring efforts in Imperial County compliment the ongoing work at the Salton Sea to protect public health and restore habitat. We have joined the allies in the conservation community, IID, and Imperial County to support these efforts over the years at the sea. It is vital to the health of communities and Imperial County.

And finally, number three, ensure projects are being done in a way that is environmentally responsible and safe for workers and surrounding communities. This also ties into point one; ensure proper skills and training for construction, operations, and maintenance personnel is critical to help ensure facilities are running safely.

And as you can see, coming from an apprenticeship myself, I see the need for working safe and getting things done right. And I really appreciate the statewide leadership that

you guys have provided and the opportunity to comment. Thank you.

MS. DE JONG: Thank you very much. Alright. We have another question coming from Nikola Lakic.

MR. LAKIC: Hello everyone, can you hear me?

MS. DE JONG: Yes.

MR. LAKIC: Thank you commissioners and panelists and presenters. I was very pleased to see those presentation and knowledgeable people talking.

I'm disappointed that I haven't been invited to make presentation myself. I'm not selected as commissioner, although it would be much better because I would have chance to make a report to the Department of Energy and EPA, but I still intend to send the report.

Anyway, the thing is my proposal for the restoration of the Salton Sea incorporates also harnessing lithium by taking it from salty water from the lake. I understand all panelists and expert talking about taking lithium from geothermal brine. That's great. We are not in conflict.

But what I am proposing is from architectural point of the view, I'm graduate engineer architect -- that taking desalinization on the lake, salty water has high density and has tendency to go to the bottom.

I'm taking that water, using in my design, geothermal power plant into boilers, producing electric energy, have

byproduct potable water and brine, which can be used for extraction of lithium radio. So, it's win-win situation.

I hope that I will be invited soon to make presentation because it incorporated … this expertise -- I saw presentations and I read the reports. Excellent! We should work together on this one.

My proposal is providing clean environment, potable water, energy, and much, much more lithium. This is in addition to production of lithium from geothermal brine. So, I'm producing lithium from brine, from Salton Sea. I'm doing desalination, and also, I'm importing sea water from Long Beach, along corridor, and from Sea of Cortez.

I have dividing lake on two sections. It's about 120 slides. It's not something for three minutes comment, definitely. Therefore, I was hoping that I would be invited from Chairman Silvia Paz or Elisabeth to make … I'm very sorry that I haven't been invited today. It's amazing stuff, you should definitely consider that.

MS. DE JONG: Thank you very much for your comments.

MR. LAKIC: Thank you.

MS. DE JONG: Danielle, you should be able to unmute.

MS. DANIELLE: Hi, good afternoon. Can you hear me?

MS. DE JONG: Yes.

MS. DOOLEY: Hi, this is Danielle Dooley with the public advocate's office at the CPUC. I had a comment and well,

probably a comment and one question for the panelists. So, on the comment issue; I think this was said by panelist Turner but I could be misremembering. And it concerns workforce development.

So, he had said earlier in the presentation that they would be able to hire locally and provide training. So, basically, my comment is maybe in the future, I would be very interested to know what types of jobs have been offered at facilities that were constructed and like local areas. And generally, what the average wage was maybe, and like the quality of the jobs and what kind of training there is just to make sure that that is also part of the conversation.

The question I had is I know in context that -- and the Geysers up in the Santa Rosa Healdsburg area, they were having trouble with water use at some point and its project, and they were able to solve at least some of that with Aqua for Recharge and water recycling.

So, I know we've talked a little bit about that, but I was wondering given the needs of the water use of just the geothermal plants in general, and also the lithium extraction, would building any of these facilities require co-locating a new either water recycling facility onsite, or one that could be shared, or will it require desalination as the previous speaker asked. So, that's my main question.

MS. DE JONG: Thank you. Jim, I see you raised your

hand.

MR. TURNER: Sure. Ms. Dooley, as we all mentioned, we've all learned about water usage. It's a precious resource not only in Imperial County, but all out west here. And we at CTR, we're looking at different waters that we can use. Some of them may require some form of desalination or cleanup. You mentioned that maybe there's a way that we could have one larger unit so to speak and we could all share. I mean, that's a possibility.

But the one thing is that BHE, EnergySource, and CTR, we're all very concerned about water. And as I mentioned, we all look to find ways to minimize the take of fresh water out of the canal supplied by IID.

There are other waters out there, but they all take different forms of cleanup if you will, or desalination, but they're all on the table until we take them off.

MS. DE JONG: Thank you very much. I see Derek Benson has raised his hand.

MR. BENSON: Yeah, no, I just wanted to chime in real quick. I think the issue in the Geysers a very different resource issue. And so, their reclamation of that water was to enhance production. I think the Salton Sea resource is a very different geological feature. It's a hydrothermal resource at its heart.

So, a little bit of apples and oranges there, not to

take anything away from what Jim just mentioned, but it's geologically a very different setting. So, we don't have that issue. We're a water rich geothermal resource. So, we won't need to replenish in that regard.

MS. DE JONG: Thank you very much, Derek. And then I'll reiterate that in a future meeting, we'll be going over environmental impact and water will be one of those topics that comes up as well. So, we encourage further participation on that same topic. Thank you.

Alright. So, I'm just going to turn to the written comments that we have in Q&A and in the chats before we close out public comments. And keeping an eye on time, we may not be able to answer some of these live, but we'll do our best.

One quick question, and Jim Turner, maybe if you are able to answer. There's a question here that says, when does CTR plan to drill a well?

MR. TURNER: Elisabeth, we plan to be … it's called spudding, starting that well-drilling late September. And we're just waiting on the final materials to be delivered so that we have all the right materials on site before we erect a drill rig. So, we're getting close. But it looks like late September is when we'll start.

MS. DE JONG: Great. Thank you so much. Alex Grant, if you wouldn't mind unmuting, I'm going to call on you for a second.

There's a comment here, but we will say it out loud as well, just to make sure that it goes on the public record. Is it possible to extract lithium from saltwater converted to fresh water in desalination plants? And I see that you responded -- if you wouldn't mind reiterating.

MR. GRANT: Is it possible to take lithium out of ocean desal concentrate? Is that the question?

MS. DE JONG: It looks like it; from salt water converted to fresh water in the desalination plants.

Mr. GRANT: So, the ocean contains around 0.2 milligrams per liter of lithium, which is very well comparing that to the Salton Sea of between 200 and 300 milligrams per liter. So, it's like three orders of magnitude, lower concentration. So, you have to move a thousand times more brine to make the same amount of lithium.

When you do desalination on ocean water, you produce a brine, actually is what they call it. That is like two to three times more concentrated than the ocean proper. So, you're only increasing the concentration of lithium by 2 to 3x, but you're still a thousand times lower concentration than a geothermal brine or any other continental brine.

And I've reviewed DLE technologies that have tried to produce lithium from the ocean directly and from desal concentrates. And I've seen some interesting information, but I would not put my money on that approach versus processing a

continental brine, certainly.

And yeah, I mean, a number of folks have tried to make potassium compounds like fertilizer from the ocean and different industrial minerals. But the problem is there's nothing really valuable in the ocean and from these desal concentrates.

So, I've probably seen at least two to three different folks telling me war stories about trying to make industrial minerals from diesel concentrates and the conclusion each time is, oh, there's actually nothing really valuable in the ocean. Which kind of makes sense if you think about how the ocean is formed. But that's another story.

So, I hope that answers the question. Continental brines for me for now.

CHAIR PAZ: Alex, if I can just interrupt a little bit, because you talk about the concentration from desalination; would that apply across the board? For example, the Salton Sea has very high concentrations of salty water, that the concentration will be less than geothermal.

MR. GRANT: My understanding is it would be significantly less. I don't know the lithium concentration in the raw Salton Sea water, but I do not understand it to be very high. So, even if you were to use reverse osmosis to desalinate the water from the actual Salton Sea proper, you would probably still have orders of magnitude lower lithium concentration. So, the geothermal brine thousands of feet below the Salton Sea is

probably a much better target.

CHAIR PAZ: Thank you.

MR. GRANT: Yep.

MS. DE JONG: Alex, if you wouldn't mind sticking around, this one might continue to you as well, but Ian Warren, see if you can join us as well. There's a comment from James Blair that both of you sort of addressed already, but we'll read it for public record.

It says, I imagine the evaporation (triple effect) step in the DLE process mentioned by EnergySource is relatively small compared to the conventional brine evaporation for lithium processing in South America. But how to account for water loss, if not also reinjected at the Salton Sea.

MR. GRANT: Yeah, I typed up a reply to that comment to help that person out. But yeah, basically when mechanical of operation like triple effective operation is used in a DLE flow sheet, the water is recycled. So, energy is being put into the system and water's essentially being taken out and reused. That is different or evaporative processes used in south America, for example, and other kind of high-grade continental brines.

In that case, the wind picks the water away with it and it is lost. It is not recovered. So, those two things may both be called evaporation because water is becoming a vapor from a liquid. They are fundamentally very different. So, it won't result in necessarily very high water use for ideally flow

sheet, for example.

MS. DE JONG: Great, thank you.

CHAIR PAZ: Elisabeth, if I can just do a time check, it's 4: 55. So, maybe if we can just read … if there are any other questions, but not the responses, thank you.

MS. DE JONG: Yes, okay. So, one question asked if anyone has patents protecting the extraction process. And at this time, our answer is that there are multiple patented processes for direct lithium extraction.

And then I think let me see, there's just a couple of more comments here.

So, one question was, would these projects be union jobs? And for that one, I will, again, reiterate that in a future workshop, we will be going over workforce developments. We encourage you to stay tuned as we get towards that.

What can you tell us? Oh, I'm sorry. I was going to reiterate the question that we already addressed earlier. Will the findings of the pilot plants be shared with the public?

So, if this is in regards to this RD&D projects that Rizaldo Aldas referred to earlier; there are public reports that are published by the CEC as a result of those grant projects. That is when the grant projects end.

And I believe that is all of the questions in the Q&A. And one thing that I just want to reiterate is that Lithium Valley Commissioners, when you write questions in the chat, we

still do want to make sure that they are on public record.

So, I'll acknowledge that Commissioner Olmedo said that there is more data needed. And we only heard about brine and not air emissions.

Commissioner Ruiz said, as with any mining or any other industry, impacts to the environment are present as minimum as they may be, can we discuss it at the next meeting and itemize these impacts, including air emissions.

And again, so we'll be going over environmental impacts as well as economic impacts in the future readings. So, luckily, I think that's the next thing on the agenda, is to assign the times for those events. So, thank you very much. I believe we've addressed all of the questions and we can move on to the next item.

CHAIR PAZ: Thank you. So, at the last meeting, there was an agreement for the topics that would be covered in the following meeting. So, we said that during the meeting in August, we will be discussing further in geothermal development; in September, market opportunities for lithium; October, economic and environmental impacts.

Today, we want continue moving forward and think of December also. There was a recommendation that we cover incentives. As you notice here in our timeline, we do not have a November meeting. So, what we want to do is have a longer December meeting to be able to cover maybe two topics.

So, I have a recommendation for us to consider that would slightly modify the October meeting incorporated into December. So, here's two parts of the proposal.

First is that in December we have a slightly longer meeting, maybe from 11 to 12 joining in to have/take care of any administrative items and updates, then have a one-hour break from 12 to 1. And then have two workshops from one to five. The first workshop could be incentives and then another workshop economic impacts.

So, we would be moving the economic topic from October to December to cover it along with incentives. And that will be the October workshop, the full two hours to focus on only environmental impacts, which many had suggested we needed to sort of make sure we had enough time to cover both environmental impacts and economic impacts.

So, I know that was a mouthful. But again, my recommendation is that we, in summary, in October only cover environmental impacts, in December, we have a longer meeting where we would be having two workshops; one on the economic impacts, another one on the incentives.

So, unless, anyone has any opposition, that's the way I would recommend we move forward, but I would like to hear from you and I see that Luis has his hand up.

MR. OLMEDO: Yeah, Madam Chair, just so I understand this; are you suggesting moving economics workshop to December,

so it's incentives and economics, and then leaving a standalone sort of agenda for environmental impacts? Do I understand that, correctly?

CHAIR PAZ: Correct.

MR. OLMEDO: I wanted to further make the recommendation that while we have in October -- and I do support the recommendation, with the caveat that I believe that economic environmental impacts are key to every element, every presentation as we've seen today. But with that, I support the recommendation.

CHAIR PAZ: Thank you. So, if there are no objections, maybe we can just solidify. We don't need to vote on it, but we can just solidify that this is the way we're moving forward. Thank you.

So, I think that was quick. So, to summarize, Elisabeth, we will be making those changes. In October, we will cover environmental impacts. In December, we will have a slightly longer meeting with a one-hour break in between the administrative items and the workshops. And in December, we will cover the topics of economic impacts and incentives.

MS. DE JONG: Thank you very much.

CHAIR PAZ: Thank you.

MS. DE JONG: Alright. So, we will move on to public comments. And I'll just reiterate this public comment period is specifically just on the previous item of future meeting

planning. And then if we have other comments still remaining, we'll go into those in the next comment period after our general public comments.

So, if anyone additional raises their hand right now, I'll call on them. And if not, we'll move on to the general public comment and address the two hands raised.

Not seeing any additional public comments. And we'll go ahead and ask Hector, who has a hand raised, you can go ahead and give your comments. Hector, are you able to unmute?

I'll try to come back to Hector. Nikola Lakic, you should be able to unmute.

MR. LAKIC: Can you hear me now?

MS. DE JONG: Yes.

Mr. LAKIC: Thanks. Just this question that was posed to Alex Grant about can we produce lithium from seawater. That's true. In order to produce one ton of lithium, you need to process 5 million tons of the seawater. So, it's not economic, it's not feasible.

But in my design, in my methodology, which I get patent for, so Mr. Alex might not know that -- I am increasing salinity. So, look, it’s hard really without illustration, but I'm producing electric energy byproduct potable water, and salty brine, which is concentrated again and again, increasing concentration.

I'm storing it in my wellbore, which is via a diameter

about five, six feet straight down two miles. So, there'll be 24 variables in one power plant. So, when it's fluid, I'm taking that out in near nearby mineral extraction building, so concentration will be enough. It's not just salty water from ocean.

I'm taking salty water from bottom of the Salton Sea -- first of all, I'm bringing from ocean, but they'll be concentrated, I'm cleaning Salton Sea and producing that brine that can be used for production of lithium, very concentrated.

We can produce much, much more -- I don't want to say much more. Let's put in addition to whatever panelists talking about harnessing lithium from geothermal brine. So, we can clean Salton Sea, we can produce potable water, we can produce lithium.

I just want to correct that, yes, it's not feasible to produce from ocean, just seas right now. But since I'm going to have concentrated brine as a byproduct, then we can do that very economically. And I would like to con contact Alex, and can I have emails of the panelists and everyone, so I can maybe send some material and hopefully, I will have a chance to speak, to make presentation in some of these meetings.

It's very, very important. It should be really … see that because bypassing it, it would be big mistake.

MS. DE JONG: Thank you, Nikola. And to address your questions, I will follow up with you via email about getting in

contact with the presenters.

MR. LAKIC: Thank you very much.

MS. DE JONG: Yeah, thank you. Okay. Let me check … I think I just want to check if Hector was able to unmute?

Okay. That looks like it all … yes, that looks like all of the comments.

I'm sorry. Okay. So, it looks like Hector is trying one more time. Let me give it another chance; Hector, are you able to unmute?

MR. HECTOR: Yes, I just had a quick question; is there a date set yet for the workforce development workshop?

MS. DE JONG: Yeah, thank you for asking. So, this time we're kind of planning three or four meetings in advance. It is not currently scheduled, but it will be for some time in the near future.

MR. HECTOR: Thank you.

MS. DE JONG: Alright, thank you Chair Paz, that is all of the public comments.

CHAIR PAZ: Thank you everyone. Our next meeting is August meeting the 26, and the meeting is now adjourned.

ATTENDEE: Thank you.

ATTENDEE: Thanks, Paz.

ATTENDEE: Thanks, Rod.

VOICEOVER: Recording stopped.

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