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STATE OF CALIFORNIA

CALIFORNIA ENERGY COMMISSION

In the matter of,	)	
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2022 Integrated Energy Policy	)	Docket No. 21-IEPR-05
Report Update	)	
(2022 IEPR Update)	)	RE: Role of Hydrogen

IEPR COMMISSIONER WORKSHOP ON
ROLE OF HYDROGEN IN CALIFORNIA'S CLEAN ENERGY FUTURE
SESSION 1

IN PERSON AND REMOTE VIA ZOOM VIRTUAL MEETING

Warren-Alquist State Energy Building
Rosenfeld Hearing Room (Hearing Room A)
1516 9th Street,
Sacramento, CA 95814
(Wheelchair Accessible)

TUESDAY, JUNE 21, 2022

10:00 A.M.

Reported By:
Peter Petty

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Commissioners Present
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California Independent System Operator (CAISO)

Mark Rothleder, Sr. Vice President and Chief Operating Officer, California ISO

Panelists

Maureen Hand, CARB
Gia Vacin, GO-Biz
Jack Chang, CPUC
Matthew Bravante, Bloomberg NEF
Louis Ting, LADWP
Yuri Freedman, SoCalGas

Public Comment

Tim Saseen
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Paul Ahern, Sesame Solar
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Maia Leroy
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P R O C E E D I N G S

June 21, 2022 10:00 A.M.

MS. RAITT: So, welcome everyone. Today, we're doing a hybrid workshop using Zoom, while also meeting in person. So, for those in the room today, the videos are the presenters and executives on the dais are being broadcast over Zoom, and everything displayed over Zoom is also being shown on screen in the room. And then in the room, we're using in-pho—— in-room microphones for sound.

All of the workshops are recorded, and recordings will be linked to the CEC's website shortly after the workshop, and a written transcript will be available in about a month. To follow along, the schedule and slide-decks have been docketed and posted on the Energy Commission's IEPR page. And so, for those in the room, we have signs with a QR code, and you can scan it with your smart phone, and it will take you right to the page with all the workshop materials.

Hardcopies of the meeting schedule and other materials are available also for in-person attendees, and we have binders with all materials at the entrance to the hearing room. And, if you'd like your own hardcopy of the presentations, just please let me or

Denise Costa know.

Today, we have a full schedule with two panels of presentations in the morning and two in the afternoon. Attendees may participate in the workshops in a variety of ways. There will be opportunities to ask questions of presenters. We'll reserve a few minutes after the panel discussion to take a few questions but may not have time to address all questions submitted.

If —— for those in the room who have a question for presenters, please write your question on one of the white index cards in the entrance to the hearing room, and then feel free to just hand it to me and I'll give it to the Q & A moderators.

And for those joining through the Zoom online platform, please just use the Q & A feature that's available to you to submit questions, and you might also upload a question that's submitted by someone else, just click the thumbs up icon to upload, and persons with the most uploads are moved to the top of the queue.

And then alternatively, attendees may make comments during the public comment period at the end of the morning or afternoon session. Please note that we will not be responding to questions during the public comment period, and comments will be limited to three minutes or less.

If you'd like to make a public comment and you are in the room, you can fill out a blue card and hand it to me. And for those on the Zoom platform, just —— you can use the raise hand icon to let us know you'd like to comment, or press star-nine if you are on the phone. We also welcome written comments, and those are due on July 12th.

And with that, I'll turn it over to Vice Chair Gunda. Thank you.

VICE CHAIR GUNDA: Thank you, Heather, for setting the stage there, and I just want to begin by welcome everybody to this workshop, and also the dais here that we have. Fritz Foo, for Commissioner McAllister, we have Commissioner Monahan, as —— as well as Mark Rothleder from CAISO joining us today. So, welcome, welcome everybody.

I want to set the stage a little bit at the top. As we get into this workshop, and —— and I begin to kind of talk about some key —— key points of agreement between most of you calling in today and —— and attending this workshop and broadly engaged in the climate change conversation in —— in California.

I think we want to begin by just acknowledging climate change is real, and it is here, and we all need

to band together to accelerate our collective action to address it. Second, to address climate change, we need to make sure we reduce the carbon emissions as quickly as we can, and there are several pathways that have been in discussion over the last five years.

One key pathway that we have broad consensus on, is electrification of large segments of the economy. And —— and while doing so, we also need to make sure we clean the electricity grid as quickly as possible. While the future will see large amounts of electrification, there are sectors that are hard to electrify, and keeping the electric grid reliable and affordable points to need for some level of clean molecules.

Even this greater interdependency, planning for gas and electric systems cannot be done in a siloed fashion anymore, and requires a comprehensive energy system planning moving forward. We all agree that much of the climate impacts will affect communities of concern disproportionately, and historically those communities did not have access to shape policy.

The clean energy transition cannot continue to come at the expense of our communities. The massive transition we are in cannot be done by any one entity and needs deep collaboration and moving forward together

requires a lot of trust building in the process and ensuring that we all have access to clear accurate data.

And that's where IEPR comes in, and CEC plays an important role. CEC has an opportunity to be a neutral venue for really thinking through ideation of topics, what the problem statements are, as well as developing some high-level consensus on where we want to go in terms of a solution matrix as other sister agencies really try to implement them.

So, moving forward, you know molecular fuels will have an important role and a big —— they've been a staple for our energy system, and they've provided us with an incredible amount of reliability. So, it makes sense that, you know, we need to think through how we transition away from the fossil molecules and the need for clean molecules, and how do we have a intentional, deliberate conversation about the role of clean molecules.

And this is where hydrogen comes in. Hydrogen is a big opportunity for the state, but also nationally and globally. We are not the only ones thinking about this. Our friends in Europe share our recognition of the climate crisis and need to decarbonize, and on the top of that, they are facing the very real geo-political risk associated with relying on fossil fuels.

So, Europe is making massive investments in hydrogen. Japan, another nation that we collaborate very closely in California, is committed to a decarbonized future, and one that faces energy challenges similar to ours, and is massively investing in a hydrogen economy.

And as all —— all of us are tracking, the federal government is also investing in hydrogen, presenting opportunities to states across the country to propose the establishment of hydrogen hubs. California has a major opportunity here, and I look forward to comments from Commissioner Monahan.

This IEPR workshop is meant to be an opportunity for us to engage in a public process, to discuss in a public setting the uncertainties and the opportunities that exist for hydrogen in California. We won't solve all of it today in this workshop, but my hope is that we spend time together to identify the key actions the Energy Commission and the state should take to ensure the investments we do make in hydrogen yield the best outcome for the state.

There are a lot of questions we could set up. There's a lot of objectives. But here's a couple things, I think, clear action items. These could be ideas for the most impactful R&D projects, demonstration

projects, and infrastructure investments, and hopefully we get some of that today.

And, there could also be some, you know, important recognition of analytical research that is needed to move forward some of these investments. So, I'm hoping that we have some clear data today. The ultimate question is, that we are trying to discuss here, is what does hydrogen mean for California as we continue to think through clean, reliable, affordable, equitable future for all Californians.

Before I pass down to the rest of my colleagues on the dais, I just want to thank Heather —— Heather Raitt and the IEPR team, for always doing a fabulous job during these workshops. We have a number of staff that have been working on making this happen. Jane Berner, Kevin Uy, Rizaldo Aldas, Peter Chen, Jennifer Campagna, Kelly Garcia, and as always, David Erne. Thank you so much for all the work that you're moving here.

So, with that, Commissioner Monahan?

COMMISSIONER MONAHAN: Thank you, Vice Chair Gunda, and thanks also to Heather for putting on this workshop, she always does an amazing job. So, I —— I just wanted to start by talking about how California, I would argue more than any country in the world, has

invested in hydrogen for transportation. Our latest AB 8 report that Jane Berner helped pull together —— for the first time, reached out to other countries to see, well, what are you doing in this space, how much money are you putting into infrastructure, and what does that mean for deployment?

And, that outreach found that California has invested, on a per capita basis in the development of hydrogen stations, more than any country in the world. And that shows the measure of support that we, as a state, have had for hydrogen for many years. And, you know, we're —— the Fuels and Transportation Division is committed to reaching the 200-station goal that was laid out in a Governor Brown executive order.

Once we reach that goal, we will have the ability to fund up to 290 thousand fuel cell electric vehicles. That assumes that the station is up and running, but, you know, it —— the —— a number of vehicles that we should be able to support by the time we have all those stations opened is far beyond what the industry is projecting.

Industry is projecting 61 thousand fuel cell EV's at that time, and we should have the capacity to fuel 290 thousand, if those stations are running. I gotta say that the station reliability, just like with

charger reliability, I think we have work to do to ensure that the —— the —— these facilities are actually up and running.

But it is just a measure of how deeply California has supported this, and why we should be positioned extremely well to be a hydrogen hub from federal dollars flowing from the bill that we are all trying to capitalize on.

And, I want to say that, you know, we've —— we've invested in California a lot on transportation, and now we're exploring other uses of hydrogen. We're looking in it for industrial decarb, for high temperature industrial purposes, we're looking at it for long duration storage potentially. Even LADWP is looking at it for generation in conventional facilities.

So, I think there's no doubt here in the state that we are really interested in ensuring that these hard to decarbonize sectors are able to reach our state goals, and that we utilize hydrogen where it makes economic and environmental sense to be able to meet those goals.

I just returned, actually, from a trip in Norway and Denmark. They —— Norway in particular, sits right next to Russia, and I can say, I think Fritz Foo was on this journey with me. In Denmark, you know,

there's interest broadly in hydrogen in the EU from an energy security perspective. And a real need. So, as we development strategies here in California, we need to be mindful about what's happening in the global context to be able to capitalize on strategies that allow us to scale at a global level.

That will bring down prices, that will make it easier for all of us to reach our goals. And so, the more we can think about this as a partnership with other countries, the more successful we will be.

So, I will pass it on to Fritz.

MR. FOO: Hi. Good morning, everyone. Thank you, Vice Chair Gunda, and Commissioner Monahan. I'd like to begin by apologizing, Commissioner McAllister is unable to attend today. But I have been leading on hydrogen in our office, and I hope to be an able representative as we dive into the issues.

A couple of points have already been made. So, I will just highlight, you know, certainly in California, we used to describe hydrogen as having a chicken and egg problem. And, it feels like now we really just have a chicken problem, where we know the off-takers in California, whether it be transportation, potentially hydrogen or industry, and now it's really about considering how do we get enough clean, renewable

hydrogen to really power all these off-takers off the offramps.

And two things that I really wanted to highlight this morning. You know, the hydrogen has to eventually sustain itself. It cannot forever be subsidized. And so, when we think about creating a new market, a new economy, this is really a chance for us to provide input at the ground level, and really develop it to see —— and shape it as we think about labor, environmental concerns.

Two things on the economics though. One, is really thinking about co-location of hydrogen resources, and where we put them. It matters a lot. As Commissioner Monahan said, in Europe, they think very strategically about where they put their hydrogen resources so that storage and transport and off-use—— users can all benefit from it in a way that makes economic sense. And that includes now thinking about electricity rates, about natural gas rates. But also, in California we think about electrolytic hydrogen. Where do we plan to get water if we are thinking about water conservation?

And the other point that I wanted to highlight, in thinking about hydrogen development, is really the question of carbon content. And, I know

everyone loves the colors of hydrogen, it makes it easy from a public perspective, but I think there really is a need now to move towards a more analytical framework in thinking about really what is the carbon content from a lifecycle view.

And when we think about carbon content labeling, similar to maybe and RPS system, something that would enable us to identify, as we transition, what are the potential sources of hydrogen that we can use. Whether that's hydrogen potential with CCS, or in Europe, for example, they are moving straight to electrolytic hydrogen, or want to, in light of the natural gas crisis in the Ukraine.

So, really, just reemphasizing as Commissioner Monahan and Vice Chair Gunda mentioned, building a hydrogen ecosystem will definitely require partnership between utilities, industry, public regulators, and really the communities themselves. This is an opportunity much like solar, electric vehicles early on, to really think about how we grow this potential market.

And with that, I will pass it over to Mark Rothleder. Thank you.

MR. ROTHLEDER: Thank you. And, thank you Vice Chair Gunda for inviting us to this discussion.

As a system operator, we really have an

interest in, primarily, the reliability of the system. But, obviously, we're cognizant that reliability, affordability, and obviously decarbonizing the grid is an important step and journey in terms of the overall decarbonizing of the overall economy.

I think hydrogen is an interesting topic, and we look —— I look forward to the discussion here today to understand both the opportunities, the sta—— status of hydrogen, but also, the —— kind of looking forward to the opportunity of both on the supply side, how does hydrogen play a role as an alternative fuel to fossil fuels, maybe in replacing it in conventional resources. But also, as a new demand, and how that demand can be used to be used as a balancing or flexible demand to balance the system.

So, look forward to the discussion today, and look forward to seeing how we can use this going forward. Thank you very much.

VICE CHAIR GUNDA: Thank you, Commissioner Monahan, Fritz, and Mark. Wonderful comments and setting the stage. And, before I pass it back to Heather to help us start with the panels, just want to thank all the panelists for giving your time and advancing this conversation today. And all of you that are joining, I see over 200 people, I know we have

split, that we have a competition between Verde Exchange and us here. That's where Commissioner Monahan —— Commissioner McAllister is, both of us are discussion hydrogen today.

So, look forward to the rest of the discussion, and Heather, I'll pass it back to you. Thank you so much.

MS. RAITT: Alright, thank you, Vice Chair. So yes, our first panel this morning on —— is on updates on state initiatives on hydrogen. And happy to have Maureen Hand here to speak from the California Air Resources Board. So go ahead, Maureen. Thanks.

MS. HAND: Good morning. Excuse me. Thank you for inviting me to share an —— an overview of the Draft 2022 Scoping Plan.

I'm sorry, I'm hearing an echo.

(Pause)

So today, I'm hoping to give you an overview of the overall plan to achieve carbon neutrality while highlighting the role of hydrogen. Let's see if the slides come up here. There we go, okay. The next slide, please.

Scoping plans are actionable plans to lay out a cost effective and technologically feasible path to ensure that we meet the statewide greenhouse gas

reduction targets. There are a number of requirements, such as minimizing leakage, facilitating subnational and national collaboration, and supporting cost effective and flexible compliance.

Next slide.

Direction on scoping plan goals and objectives is informed by statutes and executive orders. After each scoping plan is adopted, CARB and other state agencies start the process of reviewing and updating related programs, or developing new programs to align with outcomes that are identified in the scoping plan. Aligning these programs relies on multiple provisions across CARB and other state agencies to take action based on their established goals and authority.

Next slide, please.

As our goals have grown to include carbon neutrality, we have expanded the scope to include all sources and all sinks. The circle on the left represents California's greenhouse gas emissions from the AB 32 greenhouse gas inventoried sources, which we continue to ratchet down through air quality and climate policies.

Our natural and working lands can be a greenhouse gas source or sink, as indicated by the plus and minus signs. The state's separate Natural and

Working Lands Inventory allows us to track the greenhouse gas emissions and sequestration on natural and working lands over time. Beyond nature-based solutions, there are technological carbon dioxide removal options, such as direct air capture of CO2, coupled with permanent underground storage, that can remove emissions from the ambient air.

So, once we have a sense of the greenhouse gas emission mitigation from our sources, and the potential role of our natural and working lands, we can begin to think about how to compensate for any remaining emissions in order to reach carbon neutrality.

Next slide.

We assessed alternative fuels and technologies to reduce our reliance on fossil fuels, and that results in the AB 32 GHG inventory scenario of carbon neutrality by 2045. We also conducted groundbreaking modeling of our natural and working lands to understand how carbon stocks change under different management activities. And we have a scenario that represents those activities.

So, most of the presentation today is focused on emissions from energy use, but you can find much more detail and information about the natural and working lands carbon stocks in the draft scoping plan.

Next slide.

The reference scenario reflects emission reductions from the AB 32 greenhouse gas inventory sources that are anticipated based on existing policies, where it's a business-as-usual scenario. The proposed scenario achieves emissions reductions 40 percent below 1990 levels earlier than 2030, and it is also on a trajectory to reduce emissions 80 percent below 1990 levels by 2050.

The scoping plans identifies the fuels and technologies that transition us away from fossil fuels in every energy end use throughout the economy as quickly as possible. We can reduce the demand for gasoline and diesel by deploying zero emissions vehicles at a rapid rate while also reducing vehicle miles traveled.

The transition to ZEVS reduces our need for liquid petroleum in California. Today, refineries in California produce nearly all of the gasoline and diesel consumed in the state. And as the demand for these fuels declines, the refining capacity contracts. It's important that the reduced supply is coordinated with reduced demand to avoid shortages or creating a need to import fuels form out of state.

Decarbonizing buildings and industrial energy supply relies primarily on shifting natural gas use to

electricity, or to alternative fuels like hydrogen and biomethane.

Hydrogen may be supplied through —— to industrial facilities via dedicated pipelines, and it can also be blended into the natural gas pipeline to meet building energy demands. Because electricity becomes a primary alternative energy source, for vehicles, buildings, and industrial manufacturing, it's critical that renewables and other zero emission technologies are utilized as much as possible.

And finally, there are greenhouse gas emissions that do result —— that do not result from fossil fuel combustion, such as methane emissions from landfills and dairies, or hydrofluorocarbons that are used as refrigerants. And we need to reduce these emissions as much as possible.

Next slide.

So, here's an example of the transition away from fossil fuels for the transportation sector. Liquid petroleum fuels, like gasoline and diesel, are the primary fossil fuels. Battery electric and hydrogen fuel-cell vehicles, or ZEVS, are the alternatives to industrial combustion engine vehicles. Hydrogen fuel cells could provide power —— or could power a range of vehicles, including aviation, ocean-going vessels,

freight and passenger rail, as well as on road cars and trucks.

If all light-duty vehicle sales are ZEV by 2035, then as internal combustion engine vehicles reach their end of life, they'll be replaced with ZEVS, such that by 2045, nearly all light duty vehicles on California roads will be ZEVS. The pace of transition is slower for medium and heavy-duty vehicles while the technology develops, but a few internal combustion vehicles remain in 2045.

So, as you can see, electricity and hydrogen provide increasing shares of transportation fuel demand. In the scoping plan, hydrogen production grows 60 times from 2022 levels to meet energy demand in transportation, building, and industrial sectors.

Next slide.

Electricity is the primary alternative to fossil fuels in transportation industry and building because it can be produced with low greenhouse gas emissions. And our need for clean electricity grows, as you can see here.

We need to increase wind and solar electricity generation to reduce greenhouse gas emissions in our current electricity supply, as well as the increased demand that enables us to reduce fossil fuel combustion

in other sectors. In the scoping plan, we estimate that annual solar installation rates of seven gigawatts per year are needed over the next two decades. And this exceeds the historic installation rate of less than three gigawatts per year.

It's important to note that the estimated electricity demand shown here does not include energy to produce hydrogen. If we assume that all of the hydrogen needed in 2045 is produced from solar PV with electrolysis, we would need over 40 gigawatts of additional solar capacity. So, we need to keep options open for other methods to produce zero carbon hydrogen at the scale that we need, because it will not be possible to install this additional renewable energy instantaneously.

Facilitating this growth of clean electricity generation rapidly, while maintaining system reliability is essential to achieving our greenhouse gas reduction targets in a cost-effective manner.

Next slide, please.

So, even with rapid replacement of vehicles, appliances, and industrial equipment in the proposed scenario, in 2045, there are remaining emissions of about 100 million metric tons carbon dioxide equivalent. Some of these emissions result from continued reliance

on fossil fuels, many of these emissions result from non-energy uses, such as hydrofluorocarbons, and methane from landfills or livestock. Many of these non-energy emissions will persist. So, to achieve carbon neutrality, carbon dioxide removal will be needed to compensate for these emissions.

Next slide.

Excuse me. Carbon capture and storage, or CCS, has been around for a long time. CCS is located at a facility, and captures carbon directly associated with fuel combustion. Carbon dioxide removal, on the other hand, is a newer concept. This is carbon dioxide removal from the ambient air. There are two general types of carbon dioxide removal. Nature based, and mechanical.

The natural and working lands modelling that is described in the scoping plan is the most comprehensive scientific asse— effort to include these lands int the state's carbon strategy. Mechanical CDR refers to technologies that can be applied to capture carbon dioxide from the atmosphere. Direct air capture and bio energy with CCS are the primary options in development today. So, forest or agricultural waste that results from natural and working lands management practices may be gasified to produce hydrogen. And when

paired with CCS, this hydrogen production could be net negative.

Next slide.

Our modeling shows that lands are projected to be a net source of emissions through 2045 and indicates that a probable decrease in carbon stocks —— indicates a probable decrease in carbon stocks into the future. The modeling also indicates that immediate and aggressive action can reduce the environmental impacts of climate change that would occur in the absence of such actions. But we will need to rely on mechanical CDR to achieve carbon neutrality by 2045.

Next slide.

In order to transition every economic sector away from fossil fuels, a significant investment in alternative fuels, vehicles, appliances, and associated infrastructure will be needed. We estimate an incremental investment of $27 billion in 2045. And note that investment in new equipment or stock can be partially offset by savings when the alternative, like zero emission vehicles, reduces fuel expenditures and achieves greater efficiency.

Next slide.

Employment in California is expected to grow over the next decades with millions of new jobs. As a

result of the substantial investment to reduce greenhouse gas emissions and achieve carbon neutrality, this projected growth in the overall workforce will slow somewhat, about 120 thousand jobs, in 2045 relative to the reference scenario.

We show similar results for the gross state product in the draft scoping plan. However, the proposed scenario does provide a solid foundation for continued economic growth while achieving the transition away from fossil fuels.

Next slide.

Fossil fuel combustion is a primary driver of poor air quality, and reducing reliance on fossil fuels leads to reductions in emissions such as particulate matter, nitrogen oxides, and reactive organic gasses. These air pollutants and others that form in the atmosphere are linked to health effects such as increased hospital admissions, emergency room visits, and premature mortality. The proposed scenario is estimated to equate to about $10 million in avoided incidents of health effects in 2045.

Next slide.

As I mentioned, the draft scoping plan is available for review and public comment now. We will present the proposed scenario to the board later this

week. And, over the summer, we will continue workshops and community engagement, and will present the final scoping plan to the board for adoption in the fall.

Next slide.

Thank you, for the opportunity to share the overview of the scoping plan with you today. I do want to just suggest that we do have a public —— public comment docket open through the end of this week, through Friday, June 24th, and we do welcome comments on the scoping plan. So, thank you, Heather.

MS. RAITT: Thank you so much, Maureen. So, our next presenter is Gia Vacin from GO-Biz, and I'm sorry, Gia, if I just mispronounced your name.

MS. VACIN: No problem.

MR. RAITT: Go ahead.

MS. VACIN: No problem. Good morning, Commissioners and participants. Today, I am going to share some background on the federal hydrogen hub opportunity, and —— and some of the coordination efforts that we've been undertaking to put forth a winning proposal for California.

Next slide, please.

So, for those that aren't familiar, I just wanted to spend a moment on the bigger picture federal hydrogen opportunity here. So, the bipartisan

infrastructure law was signed into law November 15th of last year, and it included $9.5 billion for clean hydrogen. And within this, eight billion is earmarked for at least four regional clean hydrogen hubs, which I'll talk about in more detail in the coming slides.

The goal is to reduce the cost of clean hydrogen to two dollars per kilogram by 2026, setting us on the path to achieve DOE's Hydrogen Shot. And it requires a national hydrogen strategy and roadmap to be developed, which is under way.

Next, please.

So, as I mentioned, the Hydrogen Shot on the previous slide, just wanted to note that it's a DOE initiative that was launched in June of last year. And it aims to reduce the cost of clean hydrogen by 80 percent to one dollar per kilogram in the next decade, or I guess nine years from now.

Next.

So, to go in to just a little bit more detail, I mentioned the eight billion over five years for at least four regional clean hydrogen hubs. This will be a competitive application process, and you know, stepping back, big picture, this is a really exciting opportunity for —— to, you know, to leverage and expand California's push to carbon neutrality, and to accelerate the

hydrogen market in helping achieve our state's goals.

In California, we will focus on hydrogen produced from renewables. Probably no big surprise to —— to this group, and our —— and our end uses will be focused on electric power, industrial uses, and transportation, kind of as the initial areas. The —— the bipartisan infrastructure law also outlines a focus on environment and economic benefits for underrepresented communities, and high job quality creation. So, very much in line with California's focus there as well.

Next.

And, California is positioned well to win a hub. In June of 2021, DOE released a request for information around its Hydrogen Shot goal, and this graphic was produced by DOE from the result, and it shows the regional clusters and geographic factors around the country. And it's significant that California is the only state that's called out separately. California is where the early market is, and as Commissioner Monahan mentioned, you know, we've been investing in hydrogen for a long time. And —— and have really demonstrated leadership in that area.

I want to remind us that we do need national market. We need the national market to succeed, and

though in many ways the —— the national market needs California to —— to succeed. So, there are many eyes on us, and I think some high expectations.

We have a lot of advantages. Excuse me. Our stakeholder community is broad and engaged and very experienced. We have a robust policy environment, and we have the biggest early market potential.

Next.

So, we have some target outcomes from this hubs investment. With regard to time, this federal money will accelerate our transition to zero carbon transportation and —— and energy systems. With regard to money, it's a —— we're aiming to have a financially self-sustaining and expanding low carbon hydrogen market here in California. And we hear from industry that California is really the only place that this is truly possible when you think about renewable hydrogen.

And finally, an innovation outcome that this —— that our hub here in the state will continue to foster innovation and accelerate global adoption of renewable hydrogen. And something that isn't on this slide, but definitely worth mentioning, is that an —— an essential underpinning of these outcomes is also equity, community needs and interests, and workforce considerations.

Next.

So, as we heard from Maureen, in May, CARB released its draft scoping plan update, and hydrogen is all over the doc—— all over the document, particularly in the hard to decarbonize sectors. So, we pulled some of those pieces into this table here, and you can read through it, I won't go through it here. But, if you recall, those darker blue headers are the same use categories that we highlighted in the Hub's overview of some of the different end uses that —— that the Department of Energy is expecting, and where we will focus California's ener—— attention and energy, no pun intended.

And then, of course there's a cross—— crosscutting all of these is hydrogen as energy storage. And so, utilizing excess renewable energy, and thinking about long duration storage opportunities. So, a lot of our thinking about how we'll put together an application will map back to some of these elements in the scoping plan that we see here.

Next, please.

So, we've developed five key principles for the hubs. I'll just read through them quickly. Prioritizing renewable hydrogen, or green hydrogen. I think in the LA region that's definitely electrolytic,

in, you know, I think going to Fritz's comments thinking about how we're thinking about this going forward would be important, and how we're defining these different things and definitions.

Two, investing in —— in the energy system and taking a multi-sectoral approach. Three, public policy enabling these early markets and —— and utilizing private capital to really scale them and get them to a self-sustaining market. Prioritizing the hardest to abate sectors with the biggest emissions profiles while focusing on creating economically sustainable markets will be key. And a focus on communities with the largest pollution burden.

Next, please.

With regard to our application principles, we have a —— a few here. So, it will be one application that's mapped back to our stat's goals and principles, as I've outlined in previous slides, with local input and support and, you know, it's really these —— this hub's opportunity is really about implementation. And so, obviously the efforts on the ground and the local connection is going to be —— is going to be key to all of this.

And, we did —— earlier this month, the

Department of Energy released an —— a Notice of Intent, and they did actually clarify that there is expectation that it will be a single applicant coming from —— you know, they don't want five applications from California. So, that underscored what we were thinking already.

Now, the federal money —— this says might not, it will not feed every project. But the resulting system should. And so, we want success to bring success. We're going to invest deeply in some —— in some key projects that can help show what we can do here, and what these investments can achieve, and then helping that to kind of create an environment that —— that can breed more success, rather than spreading it kind of across the state.

And, California's strongest lead story, ports and goods movement, is probably where we—— we'll have a good —— a strong focus in our application. This is very hard to abate. It's multi-sectoral. There's —— there are big emissions profiles, there's huge pollution burdens, and it's unique to California in many ways, and of course complimented by a strong power sector story. So, leveraging renewables to increased renewable penetration in the grid, and you know, using multiple sources of hydrogen to achieve all of this.

Next, please.

So, the GO-Biz team is leading the state's coordination efforts with many stakeholder groups, and in close collaboration with agencies and the governor's office. So, a little bit about where we are now.

Next please.

Last month, we published a press release announcing that California will compete for a federal hub, and our aim would be to establish environmentally and economically sustainable and expanding renewable hydrogen hub and market. And it included quotes from agency leadership and GO-Biz, CARB, CEC, CPUC, and CalSTEM.

Next, please.

GO-Biz also launched a H2Hubs collaborator form, and this is really intended to get a deeper sense of the interested stakeholder landscape. And so, for those with projects to propose, it has a section to collect basic information about that project. Tons produced or consumed, and some —— some basic information. And we're using this information to collect parties with relevant regions and workstreams and potential other partners. And so, if anyone here in the workshop is interested in participating, please feel free to add your information, the link is there on the —— on the

right-hand side.

So here is a — next please.

This is a — a snapshot as of yesterday of our dashboard of that — of that data. And, it has already more than 100 entries. So, about half of these entries, 46 of them, include a project, which is that darker blue portion on the bottom-left, a donut there. And a — and about three quarters of them include projects if you include those that have indicated that they're unsure.

And this chart on the right shows the tons of hydrogen produced in — in the left bars and consumed in the right bars. So, left being, like, blue — dark blue, dark purple, right being light blue, light purple. At the start, which is blue, and at the full buildout of the project, which is purple. And I know I went through that quickly, I'll say a little bit more about it.

The point here that I want to make is that with just these 46 projects, we're already showing 1,800 metric tons per day of hydrogen produced, and 6,200 tons per day consumed. Now, one — one of these is one massive project that's — that's indicating 5,800 tons per day consumed, so it's — it's a little more balanced than it looks here. But I wanted to put this in context a little bit more.

Next slide, please.

This is another slide from the Department of Energy, showing hydrogen and fuel cells in the US today. And, I want to draw your attention to this green bar chart on —— on the left here. It shows that of the ten million metric tons of hydrogen that's produced each year in the United States, 92 percent of it is dedicated to refining and ammonia and methanol and metals, which means that for uses like transportation and other things that we've been relying on here in California, it's this top eight percent in the other category, which equates to about 800 thousand tons per year.

Next, please.

And when we compare that with the production levels that have been entered just into our portal, these 46 projects estimate more than 80 percent of the production at full build out of what we're relying on now in the entire United States. So, even the hydrogen produced at the start in the blue there, is more than a quarter of what the US production is for, you know, the whole US is relying on right now for these kind of other uses. And we've just had this form up for about a month. So, there's strong interest in this market.

Next please.

Alright, so, seizing the hydrogen opportunity.

We must continue to create a fertile environment for market development and growth. We must continue to focus our actions on reducing the cost of renewable hydrogen. And, based on conversations that we've had, you know, GO-Biz has heard that even five to six dollars dispensed hydrogen would change the game. And flexibility is key. We need to be able to effectively respond to the market as it evolves. And, let's keep thinking outside the box, like California does so well. There will be opportunities that emerge that we're probably not even thinking about yet.

So, next slide.

In other words, let's keep thinking big. Thank you, next slide.

Appreciate your time, thank you.

MS. RAITT: Thank you, Gia, appreciate that. Next, we have two presenters from the Energy Commission staff. They'll be tag team, Rizaldo Aldas, and Jane Berner, please. Go ahead, thank you.

MR. ALDAS: Thank you. Good morning, Vice Chair Gunda, Commissioner Monahan, and everyone. So, Heather mentioned that Jane and I will be splitting the time, providing an overview of the broad efforts at CEC on hydrogen. So, I will focus on providing an overview of green hydrogen research, demonstration, and

deployment.

And before I start, I'd like to mention a couple of points there. One, is that I use the term green hydrogen, and Fritz discussed this a while ago, that you know, there are efforts that are defining renewable hydrogen, or green hydrogen, better classifying hydrogen, for example ratings of carbon intensity. We're not dealing on that. Colleagues from CPUC, and I believe from Green Hydrogen Coalition will be talking more about that. But, for our purposes in R&D, we refer to green hydrogen as being produced from renewable electricity or carbon neutral pathways.

The second point is that, as we have heard, hydrogen is not new. It's being used in a wide range of applications, with overall demand continuing to be dominated by its use from industrial feedstock. However, as we know, about 95 percent of commercially available hydrogen comes from fossil natural gas. And so, it uses a lot of incentives to green this hydrogen source to help, you know, our effort of decarbonization.

With that, can you move to the next slide, please.

So, the energy research and development is anchored on the science of innovation, and its core mission is to strategically invest funds to catalyze

change and accelerate achievement of policy goals. And we had two major sources of funding here. The Electric Program Investment Charge, and the Gas Research and Development Program. Hydrogen related efforts at ERDD, I would say is relatively new, so we don't have a lot of competing projects to feature for example.

But, it's expanding now, given the big emphasis on decarbonization. So, both the EPIC and Gas R&D Programs include initial things that evaluate and advance innovations in these sectors or investment areas, such as transportation, industrial decarbonization, power generation, energy storage, gas station, and integrity and technology to market.

Another way of looking at that is through the hydrogen supply chain. So, we had projects from production all the way to end-use and applications. And they're doing this from scientific and technical analysis to road mapping technology development, demonstration, and deployment.

Next slide, please.

So, this slide is just to show you the range of projects on our desk in Gas R&D Programs. So, between these two funding programs, CEC is investing over $45 million for active and planned hydrogen research. In production of hydrogen, we are evaluating

emerging pathways to electrolysis and non-electrolysis pathways. And this includes use of solar, and green energy to produce hydrogen, and then store and use it to support grid reliability. We're also looking at low carbon renewable hydrogen research that can use feedstock other than water.

In hydrogen blending, we are focused on assessing the feasibility of repurposing gas infrastructure for various hydrogen blends up to 100 percent. And examining potential system upgrades and associated costs.

And then in storage, we are assessing the technical and cost feasibility of geological hydrogen storage opportunities that support targeted hard-good decarbonized use spaces such as peaking power generation, and high temperature industrial processes.

And then for end use, my colleague Peter Chang will discuss the transportation research in another panel, so I'll skip that. I'll proceed to industrial applications, where we have initiatives to identify and characterize optimal co-location of industries, like clusters to share hydrogen infrastructure. We are also investigating the effects of hydrogen in end-use appliances, like identifying the impact of hydrogen and hydrogen natural gas than on existing appliances or

equipment, including operating parameters and concentrations with and without modification.

And lastly, we are conducting research on power generation and emissions control, looking at blending of hydrogen natural gas, trying to achieve at least 30 percent combined volume of blending and all the way to 100 percent, if feasible. And more importantly, we are looking at the issues of emissions, NOX emissions and developing control technologies so that hydrogen power generation, especially those located in disadvantaged communities are making sure that—— meeting the strict air quality standards.

And, next slide, please.

And lastly, there is a proposed funding for green hydrogen that's waiting up about the legislators. This is $100 million fund to advance the state of technology and demonstrate scaling of electrolyzers. Once that funding is approved, we will be moving forward with our funding of projects looking at both the onsite production and local storage, so, distributed scale of production, looking at the balance of system from production to conveyance, and onsite use.

And then, we also would like to use these funds to leverage federal funding for hydrogen R&D and regional hub, as discussed by Gia a while ago. There's

about $2 billion allocated by DOE for electrolyzer research in addition to the $8 million for the —— for the regional hub that Gia mentioned a while ago.

And lastly, we will be ready to conduct a workshop once the funding's approved to bring these projects that we are looking to fund and solicit feedback and stake—— from stakeholders and the public. With that, I will turn this over to Jane.

MS. BERNER: Thank you, Rizaldo. Good morning, everyone, I'm Jane Berner, staff in the CEC's Fuels and Transportation Division. And I'm going to provide a brief overview of what the division is doing to advance hydrogen infrastructure in California.

Next slide, please.

This slide shows a summary of investments in hydrogen infrastructure made through the Fuels and Transportation Division. These investments have largely been made through the Clean Transportation Program, established in 2007 by Assembly Bill 118. And then Assembly Bill 8 in 2013 directed the CEC to allocate $20 million annually from the Clean Transportation Program towards public hydrogen refueling stations, until there are at least 100 publicly available stations in California. The idea behind this being that these stations would enable the release of light-duty fuel

cell hydrogen electric vehicles, like the Toyota Mirai, in the California market.

Including all of the Clean Transportation Program allocations from the beginning of the program to what we expect through fiscal year 2023-24, a total of $252 million in program funds will be going towards public hydrogen stations to support STEDs. In addition, the Clean Transportation Program is supporting renewable hydrogen production projects that will produce hydrogen from renewable feedstock, and supply that hydrogen to transportation uses.

Clean Transportation Program funds are also going to hydrogen refueling infrastructure projects to support medium and heavy-duty vehicles, such as trucks and busses. Several o—— several of these projects will be discussed in more detail in the first afternoon panel today, that I'll be moderating.

These include the NorCal Zero Drayage project that received nearly $10 million in Clean Transportation Program funds from the zero-emission drayage truck and infrastructure pilot project solicitation. This solicitation was a joint effort with the California Air Resources Board, which put forth separate funds for the zero-emission trucks, while the CEC funded the corresponding infrastructure.

Also in the afternoon panel, we will hear about projects that resulted from the hydrogen fuel cell demonstrations in rail and marine applications at ports solicitation, more easily said as H2RAM. This solicitation was a joint effort between the Fuels and Transportation Division, and the Energy and Research and Development Division, with FTD providing funds for infrastructure, and ERDD supporting vehicle demonstrations.

Most recently, the Fuels and Transportation Division has supported the launch of the Energize Program. This program will support the infrastructure needs to commercial, uh, excuse me —— infrastructure needs of commercial fleets switching to zero-emission vehicles, and the program has a funding lane specific to hydrogen refueling infrastructure, which is just about to open and applications will be accepted starting June 30th, at 9:00 A.M.. And adding together the funding that has gone or is planned to go to hydrogen infrastructure projects form the Clean Transportation Program, the total is over $320 million.

Next slide, please.

I'm going to talk a little bit more about the public hydrogen refueling infrastructure that the Fuels and Transportation Division has been supporting. The

state has the executive order goal of reaching 200 hydrogen refueling stations by 2025, and the Clean Transportation Program investments are made towards that goal.

Thus far, 59 stations have opened to the public, but —— and most of them have received funding from the Clean Transportation Program, but eight have been built with only private investments. So, the figure on this slide breaks down those numbers between the stations that received public funds and those that were totally privately funded.

There's right now another 118 stations in the works, including 15 that are privately funded, and overall, we have a total planned network of 177 stations. You can see that we do have a gap towards reaching 200 stations right now, and we plan to close the gap with the forthcoming solicitation using some of the current fiscal year's general funds that have been devoted to zero-emission vehicle infrastructure.

Next slide, please.

Specifically, $27 million in general funds was allocated to closing this gap, but there's quite a lot of other funding too that can support hydrogen infrastructure. There is $690 million that we expect to have between Clean Transportation Program and general

funds for medium and heavy-duty zero emission vehicles, and infrastructure. And so, this includes support for both battery-electric and hydrogen fuel-cell technology.

Further, there are funds being put to support in-state manufacturing of zero-emission vehicles and zero-emission vehicle infrastructure. And there was a concepts workshop already held for some of this in which concepts that include manufacturing of fuel-cell vehicles and hydrogen stations were part of the concept. And there's also additional funds for fuel production that could include renewable hydrogen production plants. And these figures do not include additional funding proposed for the Zero-emission Vehicle Infrastructure Package 2.0 in the 2022-23 budget.

So, that concludes my overview of the Fuels and Transportation Division activities, and I'll hand it back to Heather.

MS. RAITT: Great, thank you so much, Jane and Rizaldo. So, next we have Jack Chang from the CPUC. So, go ahead, Jack.

MR. CHAN: Thank you. Yes, I'm a Senior Hydrogen Analyst for Energy Division at CPUC. I will provide an overview today of hydrogen related proceedings, applications, and other activities at the Commission. Staff here are focused on the

decarbonization potential, use cases, and safety considerations surrounding hydrogen development in California.

Next slide, please.

The CPUC is engaged in three general categories of hydrogen work. The first category involves studying the safety, costs, potential environmental benefits of blending hydrogen into the natural gas system. The second category analyzes Southern California Gas Company's Angeles link application, which requests permission to establish a memorandum account for the costs of performing foundational work needed to build a new hydrogen pipeline network connecting hydrogen production in Eastern California with potential hydrogen customers in the LA basin.

CPUC is also analyzing hydrogen's role in diverse initiatives such as the Self-Generation Incentive Program, the Integrated Resource Plan Proceeding, and as we just heard, the $8 billion federal Hydrogen Hubs Initiative.

Next slide, please.

So, the Commission's hydrogen blending feasibility work began with Decision 1401034, which found hydrogen to be a constituent of concern posing a

potential threat to pipeline integrity. As a result of that decision, the Commission now has an established trigger level of a tenth of a percent hydrogen in the methane stream, after which, additional testing and analysis of the gas source would be required.

Phase four of Rulemaking 1302008, requires the Commission to determine safe hydrogen injection levels, and to define renewable hydrogen for the purposes of determining what kind of hydrogen California may want to blend into the pipeline system to help meet its environmental objectives.

PG&E, SoCalGas, San Diego Gas and Electric, and SouthWest Gas Company jointly filed an application in 2020 requesting authorization to perform hydrogen blending tests in California's common carrier pipeline. The CPUC rejected the application due to what it determined was incomplete information provided by the IOU's. But, the CPUC did invite the utilities to refile their application after considering forthcoming research findings, including a CPUC commissioned report by UC Riverside on hydrogen blending that is anticipated to be finalized and released later this summer.

Last month, PG&E announced a stand-alone hydrogen blending project they called Hydrogen to Infinity, but PG&E has not yet sought approval for the

project from the CPUC. In all this work, safety will always come first and foremost when it comes to hydrogen blending, and we want to make absolute certain that anything the CPUC authorizes will not lead to unsafe outcomes.

Hydrogen has been blended into the methane stream in other states and countries, but California infrastructure is not necessarily the same as elsewhere, so we need to move forward with caution to ensure beneficial outcomes.

Next slide, please.

The CPUC is also examining an application filed by SoCalGas to establish a memorandum account the foundational work costs that I described earlier. As — you'll hear more later from SoCalGas about this project, but if the application currently pending at the CPUC is approved, the Commission would still need to decide whether to authorize the recovery of pipeline costs recorded in the memorandum accounts.

The application describes three project phases. Phase one would conduct a pre-front-end engineering and design analysis, or FEED. This phase is estimated to cost $26 million. Phase two would identify a preferred pipeline design, and conduct further design engineering and environmental studies, including a FEED

analysis, and this phase is estimated to cost $92 million. Phase three would prepare permit applications, including the application for a certificate of public means and necessity, or a CPCN. And this is estimated to cost several hundreds of millions of dollars as described in the application.

This proposed pipeline would transport independently produced green electrolytic hydrogen, produced in the desert to the basin for the purposes of power generation, power to electrify industrial uses, and transportation, at least as currently described in SoCalGas' application. Opening briefs are currently being accepted as part of this application.

Next slide, please.

CUPC is also considering hydrogen uses in three other areas. Decision 2106005 established a definition of renewable hydrogen specifically for the Self-Generation Incentive Program. That program provides financial incentives for distributed energy generation and storage, and that decision defined renewable hydrogen as that produced through non-combustion, thermal conversion of biomass, or through electrolysis using 100 percent renewable electricity.

Another area the CPU—— where the CPUC has discussed possible hydrogen use is in its Integrated

Resource Plan proceeding, which has examined how electricity generator might use hydrogen to meet the state's future energy resource needs. Ultimately, the CPUC did not require generators to use hydrogen in those resource plans, but hydrogen may be included in future IREPs, Integrated Resource Plans.

Finally, the CPUC is working with other stakeholders on California's application for Federal Bipartisan Infrastructure Plan funds, as you just heard from Gia. And, the Governor's Office of Business and Economic Development is supporting that effort.

Next slide, please.

Hydrogen is impacting a diverse and growing portfolio of CPUC work areas. We would be glad to answer any questions you might have about this work. Thank you very much.

MS. RAITT: Thank you, Jack. Commissioner, I don't know if you have any questions for our panelists?

VICE CHAIR GUNDA: Thank you, Heather. I know we have ten minutes, so we'll —— we'll try to keep as many questions as we can. So first of all, I just want to say excellent presentations. Thank you for summarizing the state of play, and the —— and the kind of broad thinking. Maureen, Gia, Rizaldo and Jack, thank you so much, as well as Jane. Thank you for your

presentation.

Couple of high-level questions. Gia, you mentioned in your presentation, you know, the underpinning of —— of equity and, you know, workforce development. Just wanted to, you know, across, you know, all our four speakers, could we just highlight, you know, the work that the state is doing in terms of community engagement, especially as it pertains to the future of hydrogen and, you know, what you see as some of the key concerns that we need to address as we move forward, along with workforce development.

MS. VACIN: Yeah, I —— I can start. Thank you for the question. Yes, I think that we —— this is a key part of the application. It's also something that DOE is highlighting as I mentioned. So, the way that we've been approaching it so far in terms of engagement is —— is working within and collaborating with the regional partners, right? So, in the —— because a lot of this is very place based, and it —— it changes, and needs are different in different places.

So, the engagement has been primarily through the efforts of those partners that are working in the regional areas. So, in Los Angeles, for example, we've been working closely with the Mayor's Office, and the

Port of LA, and as well as LADWP, and they've been working, you know, they have a motion on their own, they've been going out into the community, they've been, you know, explaining what they're intending to do with projects proposed in that area. And so, it's been pretty on the ground in that way.

Bigger picture, I think we will need to be able to —— a need that we will have, in addition to meaningfully engaging and getting feedback about what the needs are, is to be able to describe the key metrics that we will be able to measure, and how we're going to measure them in our application. I think that —— if we think about how we'll be more competitive, we'll need to do that. And so, I think that that's a lift that we —— we have ahead of us, and you know, working with the labor agency, and you know, the agencies, the other agencies, state agencies, will be —— will be key.

So, that's been our approach so far. I think that there's more opportunity for sure to have more engagement on that front.

VICE CHAIR GUNDA: Thank you, Gia. I don't know if Maureen wants to comment?

MS. HAND: Hi. Yes, I guess I don't have an awful lot to add to that. But, but certainly, as the

programs and, you know —— that are developed in support of the scoping plan —— as they're developed, community engagement is a —— a critical role, or a critical, element of those things. So, it's definitely something that we have on our radar and need to keep working at.

(Pause)

MS. BERNER: I can jump in and add that workforce development is something that the Clean Transportation Program has supported, also including things like developing curriculum for fuel cell electricity vehicle maintenance, and we expect to continue to support those kinds of initiatives.

And, I think we, like Gia mentioned, I think we're always looking for better metrics for equity when we do our solicitations, including for hydrogen refueling infrastructure. But generally, we always try to have project applicants tell us about how they're going to benefit disadvantaged communities economically, environmentally, sustainability wise, and, you know, better ways to do that is something we're always looking towards. There's a lot of different groups that we hear from in our —— in our public workshops, and increasingly community group members to, and I think the word about hydrogen is getting out there, and so that's great that we see more and more stakeholders getting involved and

we'll do what we can to continue to push that.

MR. ALDAS: Not much to add from here, but just to mention that providing equity and support to disadvantaged communities are part of our focuses there. I just want to mention maybe a couple of technical challenges that we've been hearing, particularly from environmental group, or —— and or other communities, in that there are concerns about the safety of hydrogen, leakage, global warming potential, so a lot of work I think will be needed to make sure that we address that.

Water use has come up quite a few times, the amount of water that we need to —— that will be expected to be needed, and then of course, emissions. I mentioned a while ago, particularly for you will be using hydrogen for combustion, whether it's in appliances or power generation. Emission will come up. And lastly, just the overall efficiency of the whole thing where, right now, if you talk about the process, it's a consumes a lot of electricity, you're able to keep maybe the most or the most 70 to 75 percent.

MS. VACIN: Maybe I could add just one more thing. And Rizaldo, it occurs to me, listening to my colleagues, you know, make their comments, I think that there is —— what we hear, is that there is —— there is some misunderstanding and misconception about hydrogen,

and fear, understandably, about safety, about whether it really is doing what it says it's going to do, you know, a lot of different things.

And I think from the state perspective, we have a —— a big opportunity to think about how we can provide more information, answer questions, do better engagement, and so I think every agency does that in —— in its own way, and maybe smaller ways, but if we think about transitioning our energy system and the role that hydrogen's going to play, I see that there is an opportunity for the state to take a bigger role in sort of broader understanding of hydrogen, and opportunity for people to voice their concerns, and for us to have to have great answers for them. Thank you.

VICE CHAIR GUNDA: Yeah, thank you, Gia and thanks everybody on your responses. I think there's a —— I mean, we're all doing this really well. But given one of the themes of the IEPR this year is to really advance equity as a part of the energy transition. And one of the recent workshops we heard, you know, we don't want to advance any more really, we want to achieve equity. And, you know, so it really requires a lot of active engagement with communities.

You know, given the enormity of the transition we are going through, what we don't want to find

ourselves is kind of, we —— we move forward, you know, 10-15-20 steps, and find that we're all not on the same page. So, I would really appreciate the communication and —— and trust building that hydrogen is a great opportunity for the state, and want to be able to do it as collaboratively and as collectively as we can. So, just appreciate all your work and —— and continue to ask for your advancement on that.

So, one point to David Erne and Heather as we think about writing the IEPR chapter on hydrogen, there's some excellent information that was provided by the panelists today. Thinking about a visual that could be used to really think about the overall investments of the agency and the state and hydrogen, but also looking at the policy landscape and the timeline. I think it will be just helpful places for us to think about this system wide.

(Pause)

COMMISSIONER MONAHAN: Well, I —— I want to build on the theme that Vice Chair Gunda has raised around equity, and just, you know call out this tension that exists between sticking with the colors of hydrogen, which is what the global community is doing, versus a carbon —— a pure carbon accounting, as Fritz

talked about, and as we see in the low-carbon fuel standard.

I would say that —— that this issue is, I think, where the environmental justice community, or some in the environmental justice community has raised concerns around using fossil natural gas to create hydrogen, and then capping emissions from methane, from contained animal feed operations in the Midwest. And I think that —— that tension, I want to bring that to light as something that we need to navigate as a state, and we need to really think through what our endgame is, and what are the investments that we need to get there.

I would say there's an advantage to the colors, because everybody knows what they are. Globally, everybody's using that same set of definitions, and it's —— I would just say clearer about what the processes is to actually develop that hydrogen. So, I want to call that out as something that we need to think through as a state. And especially as we move with the hydrogen hub, I saw Gia had renewable hydrogen and then green hydrogen as the —— as what it was equivalent to, and I just think —— this is an area that we want to make sure that we're doing all we can as a state to make the investments to get to where we want to

get at the end of the day.

VICE CHAIR GUNDA: Yeah, just adding to Commissioner Monahan, I think I always appreciate Commissioner Monahan's reminder on improving transparency as —— as a way to building trust. And Gia, you mentioned, you know, it's important that we understand what the questions are, and then be able to answer them as we move forward.

So, I appreciate your leadership as we develop this $2 billion plan, you know, application. I think it would be good for us to have some of those questions laid out now, and bring them to light and really thinking through what some of the answers could be, and I think —— I think a lot of us understand the difficulty of the transition and I think the least we can do is when we ask for help from other communities, just make sure they understand what they're getting in to.

So, thank you so much for your work.

COMMISSIONER MONAHAN: Yeah, and can I just emphasize —— Gia, and Go-BIZ, the Go-BIZ team has been phenomenal. I mean, this has been a really challenging process, and you guys are adeptly managing all these very committed stakeholders and it's just been really impressive to —— to watch what you've been able to accomplish, and I'm sure you're working a lot of nights

and weekends to be able to get there. Just as Maureen and the CARB team have done with the scoping plan. So just congratulations on these major efforts to move the ball forward.

MR. ROTHLEDER: Yeah, this is Mark Rothleder. I just have a quick question, and I think it was alluded to that as you get into the outer years you —— you start to see the loads increase to create the —— the green hydrogen. When do we start having to worry about, or be —— its material increase in the demand to produce the hydrogen. When does that start to get registered and be considered in the IEPR?

(Pause)

VICE CHAIR GUNDA: Maureen, do you want to respond?

COMMISSIONER MONAHAN: So, well, let's see. I guess I —— I don't have a very particular answer. We —— we —— in the Draft Scoping Plan, you know, we are looking at the endpoints in 2045 and trying to understand what the technologies are that —— that need to be there. And so, we are seeing growth in —— in all of these technologies, vehicles, and appliances, and other infrastructure. So, everything is accelerating very soon. Anyway, I —— I guess the point is that we need to

be planning for this increased electricity demand, and increased need for hydrogen. And, yeah. So —— so, it's coming.

MR. ROTHLEDER: Sorry, I do appreciate that, and I understand the —— the things like electric vehicles are kind of here and now, we're starting to see that, and we'll see the building stock coming soon. But, that's something, like you said, in a planning phase, we —— we want to get ahead of it, we don't want to be behind in terms of supporting those new loads, so.

COMMISSIONER MONAHAN: I think that's a really great question. I mean, I think we also need to think about the —— the water implications as Rizaldo highlighted. But —— but also recognize that hydrogen is a fungible fuel. Like, we probably —— we will make it here in California, and we will import it from Saudi Arabia and Australia and other places. So, it's —— it may be hard to —— to identify what the load is actually going to be in California.

VICE CHAIR GUNDA: Great points. So, just keeping on time, so I don't get in trouble with Heather, so we'll keep it moving. But I just want to say thank you all for taking the time to help us advance this conversation and get a better insight. And, as

Commissioner Monahan always does and reminds me to do, Maureen and Gia, you guys have been in the middle of some extraordinary efforts with the Scoping Plan and the hydrogen hub. Thank you so much for all the work you do, and continue to kind of move us forward as a state. And to our team at CEC. Jane, Rizaldo, just thank you for the work you do and Jack, thanks for joining us and all the CPUC's work recently. So, thanks all the way. And now, back to Heather, second panel.

MS. RAITT: Yes, thank you. Yeah, so we'll move on to our second panel. And it is on forecasts of hydrogen opportunities in an economy-wide decarbonization. And, David Erne is hear from the Energy Commission to moderate. So, go ahead, David, when you're ready.

MR. ERNE: Thank you, Heather. And, welcome everybody to our workshop. Thanks for joining us. You heard in the last panel, which was focused on state activities relative to hydrogen and its role for helping California move forward. This panel's going to be talking about forecasts. So, what is the —— what is the hydrogen market look like now and in the future, and what are some of the better strategies, or insights on strategies for this particular end uses for hydrogen.

So, we have three panelists with us today to

give us different perspectives on that topic. First is Matthew Bravante fr—— he's a US Hydrogen Analysts at Bloomberg NEF. He'll give their assessment of —— of, kind of, national aspects of hydrogen market, including technology maturity, and their assessment of the best opportunity for hydrogen in California.

Next will be Louis Ting. He's the Director of Power, Engineering and Technical Services at LADWP. And he will give an overview of the key roles for the safety for hydrogen in and beyond the LA basin. And last, we have Yuri Freedman, Senior Director of Business Development at SoCalGas. He'll give an overview of SoCalGas' clean fuel strategy, as well as demonstration projects that they have lined up to demonstrate the ability to generate, transport, and use hydrogen for different end use applications.

So, with that, I'll turn it over to Matthew Bravante for our first presentation.

(Pause)

And Matthew, we can't hear you.

MR. BRAVANTE: Sorry about that. Hello everyone, hello everyone on the Commission and everyone in the audience. My name's Matthew Bravante, and I'm a hydrogen analyst at Bloomberg NEF, which is an energy research firm within the larger Bloomoberg LP. I'm

grateful to be able to speak today, about the changing landscape of hydrogen.

The Commission's been at the forefront of so many positive changes in the energy market. And it's wonderful to see the Commission stepping up again to lead the way on development a hydrogen economy.

Next slide, please.

Today I have split my remarks into three key points. The first of which will describe the growth we are seeing in the market all around the world.

Next slide.

The trends and excitement around hydrogen can largely be explained by the graphs on the screen. On the right, you have Bloomberg's forecast of electrolyzer capital costs. For those of you that are unfamiliar with the term, electrolyzers are the key piece of equipment to turn water and electricity into hydrogen.

Electrolyzers are analogous to, like, the panel in solar panels, or the wind turbine in wind power. And in a similar fashion to how we saw these panels and turbines dramatically decline in cost over the past decade, we are expecting similar cost declines in electrolyzer technology in this upcoming decade.

This brings me to the graph on the right, which is Bloomberg's levelized cost of hydrogen

forecast. The key be here, the green bar, represents the cost of renewable hydrogen, often referred to as green hydrogen, or electrolytic hydrogen, in 2021 and 2030 in California, as it compares to blue hydrogen, or grey hydrogen, the two fossil fuel based pathways for hydrogen production. As you can see, the costs are set to come down dramatically. This cost reduction is key to unlocking hydrogen's potential in the energy system, and it's actually crucial to its success.

Next slide, please.

Now that we've established the idea of future cost-declines, let's move on to the current global market. Clean hydrogen is still quite a nascent market, measured in megawatts, which most energy markets are not measured in megawatts, they're measured in gigawatts or terawatts, although the market is growing rapidly. This year, we expect global shipments of electrolyzers to quadruple to roughly two gigawatts.

Next slide.

The expansion of the electrolyzer deliveries is coupled with the massive buildout of electrolyzer manufacturing capacity. The manufacturing market will more than double from 6.7 gigawatts to 13.5 gigawatts of electrolyzer capacity. There's over 100 gigawatts of electrolyzer projects in our global project pipeline,

and manufacturers are scaling to try and capture this future demand.

Next slide.

Now, I would like to switch gears and talk about my second key message today, which has to do with demand for hydrogen.

Next slide.

On this slide, you can see Bloomberg NEF's demand source hierarchy. At Bloomberg, we look at hydrogen as a tool for deep decarbonization. So, we structure this hierarchy in a way that will best accomplish this goal. At the top, you see sectors that need hydrogen as a chemical agent. And importantly, have no substitute for hydrogen. Following down, you'll see a group of sectors where several technologies are vying for dominance in a net-zero world. And hydrogen has some compelling characteristics to win dominance of these sectors.

And finally at the bottom, you have sectors where there is likely going to be a better net-zero carbon technology option that will be preferred to hydrogen, and hydrogen will not —— likely not be used in large quantities. Now, if the Commission takes away one point from my entire presentation, it's this: in the near-term, clean hydrogen will be scarce resource.

Understanding it as a scarce resource helps us allocate it to the right demand sources for effective decarbonization, and designing policies that incentivize this allocation will be incredibly important.

Next slide, please.

I want to explore this concept of resource scarcity through an example. On the screen, you can see an estimated value for the amount of hydrogen that California currently uses in oil refineries. These are just the refineries within the state of California, and they consume roughly 800 thousand tons of hydrogen a year.

Next slide.

To meet the demand for California oil refineries, we're going to need to build a lot of renewable power, like solar and wind, and connect that renewable power to electrolyzers to produce hydrogen. Colleagues of mine at Bloomberg do some industry leading forecasts of solar and wind builds across the US, and I borrowed their forecast for California from 2022 to 2025. I did some math, and the blue bars here represent how much hydrogen we could produce over the next four years from all the renewables available in California. As the red line shows, it would take 66 percent of all the renewables California will build cumulatively over

the next four years just to meet this demand.

I repeat, we would need to dedicate 66 percent of all the solar and wind that we will build in California for the next four years combined to meet the demand for California oil refineries. And this is just oil refining, this is not to mention all the ammonia that California consumes, or the power and gas markets that we would also like to decarbonize. Now, this is a big challenge, but it's not an impossible one. We would just need to find more renewables, which brings me to my next point on the next slide.

This chart, it's not ours, it's from —— it's from the Berkeley Lab, but it shows interconnection queues for power projects in different markets. And you can see that CAISO, or California, has about 100 gigawatts of solar and wind in the 2021 queue. Now, most of this queue would never get built, but the percentage of projects that make it out of the queue in California has fallen over the past several years.

Now, there are several challenges around land management and grid balancing, and I'm not here to say that Cal—— that can —— that hydrogen can fix all of that. I do, however, want to make the point that electrolyzers can become a source of flexible demand for renewable hydrogen on the California grid.

And electrolyzers' capital cost will fall in the future. And then, subsequently, the vast majority of the cost of the kilogram of hydrogen will just be the power cost, and it will be optimal to run these systems only in times of extremely cheap power, which California has plenty of at certain times of the day.

I make this point just to say that when we're starting to think about building a lot of hydrogen, we can do it in a way that's complimentary to renewables and can help decongest the grid. However, policy is going to be crucial to ensure the way that we build this hydrogen is complimentary and it's not a burden to the grid.

Next slide, please.

Lastly, I would just like to close with a quick word on hydrogen's use in the transportation sector. This is definitely where hydrogen got the most attention in early years, and still receives a lot of attention. At Bloomberg, we have a relatively pessimistic view of hydrogen in the road-transport market.

Looking at the data, fuel-cell ve—— excuse me —— fuel-cell vehicle sales are a drop in the ocean compared to passenger electric vehicle sales. Hydrogen could be applicable in heavy-duty vehicle markets, but

the early data is not looking favorable to that reality. On the screen, you can see model availability of battery-electric and fuel-cell electric vehicles today, and on the right, you can see the max and average range of the technologies available today.

Now, the jury is still very much out on the heavy-duty vehicle segment. But battery technology will continue to advance alongside fuel-cell technology. And batteries have a big lead right now. In terms of scaling, success begets success, and as more companies switch to battery-electric vehicles, we think we'll see more innovation in the battery space.

And this brings me to my summary points on the next slide.

So, today, I would like to take —— I would like you to take away three key points. First, is that electrolyzers are becoming cheaper and more abundant, which will lead to cheaper hydrogen. In the near term, clean hydrogen will be a scarce resource, and it should be thought of as a valuable tool for deep decarbonization, and it should only be allocated in a manner that is conscience—— conscious of its scarcity. And then lastly, hydrogen can relive interconnection challenges, and provide a higher value market for renewables competing in a low-price electricity

environment.

That's it, and I look forward to your questions. Thank you.

MR. ERNE: Thank you, Matt. We're going to hold questions until all the panelists have spoken. So, I'll move next to Louis.

MR. TING: Thank you, David. Good morning, Vice Chair Gunda, Commissioner Monahan, and esteemed colleagues. Thank you for the time for —— for me, Louis Ting here, I'm Director of Engineering and Power Technical Services. Thank you for the time.

And, as my colleague have presented previously on LA water study that we finished last March, and what investment it will take to reach our zero-carbon goals for our electric grid, and the updates on our hydrogen efforts for —— for us. Not just the high DLA partial with the Green Hydrogen Coalition, and the status of our —— the renewal of the Re-power Projects or the Intermountain Project.

Today, I want to update you all the CLA's initiative to engage a much broader stakeholder base to essentially map out pathways to further decarbonize across all sectors, especially focusing on the hard to decarbonize businesses and sectors that we —— we partner with.

Next slide, please.

So, essentially, our engagement and the collaboration are underway. And this includes — and of course that was in — as Gia mentioned, that — that we — our city council had a motion for us to go after the — the hydrogen hub effort. And this includes our state partners, our collaborators, and — and our city agencies, which I listed some of them up there, and our industrial customers. And very importantly, what's not pictured there is our local communities and our labor partners for workforce development and all the community-based organizations essentially addressing their concerns. And that's what's underway already.

As — as Fritz mentioned very well earlier, the chicken or the egg problem with hydrogen. As you can see, most of the — the pillars here, I call it, it's going to be demand. We're going to be the — the demand of hydrogen for the city. For example, the Port of Los Angeles and also the Port of Long Beach next door, it — it holds about 18 thousand drayage trucks on any given day. And that is a huge potential. Understanding Bloomberg's point about heavy-duty vehicles, but there's also other potentials right at the ports itself with their yard equipments.

So, there's a significant amount of yard equipment consuming a significant amount of —— of fossil fuel today, that may be decarbonized through hydrogen. More important, and for the future out, we believe that the —— the maritime industry could be decarbonized through green hydrogen, whether it's through ammonia, or —— or water technologies that —— that they're looking at.

On a similar fashion, the aviation industry may be coming along looking at potential decarbonization through hydrogen or green hydrogen, besides the —— the sustainable air—— airline fuels and so forth, aviation fuels. But also, within the —— the rural airport premise, there's significant amount of equipment that could be decarbonized also through green hydrogen. And more importunately the co-gen units that they have today. They —— they truly want to decarbonize through green hydrogen, just like us, with the Department of Water and Power.

What's real interesting here was the notation that they are also a —— a potential producer of hydrogen. That solves a little bit of the supply issues, supply and demand there. With their food wastes, obviously, there's technology already here today that can do that.

More importantly, sanitation had reached out

to us with regards to their recycled water potential by 2035. They want us to help them to get to the 100 percent recycled capacity. Right now, today, I believe they're around 70-75 percent capacity that they can recycle their water. So, with that said, I know Fritz also mentioned water conservation and Commissioner Monahan also mentioned water conservation. Really important to us, because we know that the 100 percent that recycles is going to be —— it's already been spoken for many times in the City of Lo—— LA.

We're looking at other agency, other water agencies potentially, and other means of storing water locally with all the local water storage efforts that we're doing, to make sure that water conservation is —— is driving a lot of the key decisions that we'll have with green hydrogen within the —— in —— based in LA.

Doesn't have —— I don't have to mention too much with our Department of Water and Power, we have four in basin plants, power plants, that use natural gas today that we're looking at how to decarbonize, and green hydrogen is definitely one of the best pathways that we've found through the LA water studies.

And, the —— our C&I customers, besides the heavy-duty trucking, we also have significant plans

within the reach of LA region, and —— and that can potentially also be decarbonized through that effort of a collaboration that we talked about here with the hub.

Next slide, please.

Real quickly, on the LA 100 Study. Just a quick recap, I know most of you have probably heard this already. But, LA 100 Study wa—— na—— partnered with National Renewable Energy Lab, essentially the conclusion is, 100 percent renewable energy is achievable through multiple pathways. To —— the key to affordability, by the time we get to 100 percent, is high building and transportation and electrification. That is shown through the models.

And the range of costs to get to 100 percent is anywhere from 57 billion to 87 billion in addition existing infrastructure obligations. For example, for reliability and for —— and resilience. There will be a significant amount of job creation through all the pathways. Approximately 9,500 jobs across all sectors, and —— and very importantly, we can achieve this by 2035, as our City Council has asked us to do.

And —— and there are common investments across all pathways to 100 percent. And, what I want to focus on today, really, is just the bottom right that says

green hydrogen. Because, the last 10 percent of the 100 percent renewable effort by 2035 is really that last 10 percent. How do we get there? And, we're looking at renewable fuel and dispatchable turbines to make sure that because of our —— our vast amount of transmission through the west, we —— we want to continue to import those renewables for our —— for —— from —— for geographic diversity purposes, but also for reliability purposes.

And —— and we definitely need the —— the reliability must runs units within the basin to —— to make our transmission more —— more reliable and also more resilient.

Next slide, please.

So, as part of our transforming our local generation, and LA 100 ha—— again, has shown that very succinctly, that we need in-basin reliable combustion generation. And not because there's not enough storage technology out there, we will have over 2,000 megawatts of in-basin and out of basin storage technology as shown with the LA 100 modeling. But we will need dispatchable, firm generation in-basin in order to import a lot of those renewables. And —— and LA 100 study also assumed all of the scenarios to have hydrogen and —— and we already talked about the hard-to-electrify

industries and —— that we have within the LA basin's reach.

So, with that, one of our efforts is that we submitted a —— we solicited requests for information back in August last year. And it was very daunting that —— how many of the existing technology and companies that are already out there throughout the world, that showed us what they can do. And —— and mainly this RFI focused on the in-basin generating stations, the four in-basin generating stations that we have. And —— and covers environmental stewardships, safety aspects, how —— how do we operate hydrogen safely, and —— and what pathways technology-wise to get to the green hydrogen. And —— I'll talk a little bit more about it.

Next slide, please.

So, here —— here are the results from this RFI. And we're about finishing all the evaluations. And the reason it took us a while, is because we —— we received 36 submittals, and these are voluminous submittals. These are not RFP's, but these are RFI's. But still, we received significant amount of information from 26 individual companies. And 20 out of those 36 —— 22 addressed multiple technology of interest.

And some of those responding industry included

turbine OEM's, safety products from —— from existing very well-established safety —— hydrogen safety companies, renewable developers, obviously, and green hydrogen —— or green ammonia producers, fuel cell manufacturers, we got consultants, project developers, and existing gas providers. So, very diverse and we're —— we're about to finish our analysis and there'll be —— hopefully we'll present it to our board and also our council very soon here.

Next slide, please.

One of the potential is —— is describing entire paths from generation with renewable energy to production of hydrogen. And also, not just the —— the path, but the process and the procedures and the type of equipment, the storage —— including storage, potential storage in-basin, and also the pipelines that gets the —— the hydrogen to our four in-basin plants, which was the scope of the RFI. And, this is the very simplistic illustration of what was included in ——in one or multiple of the R—— the proposal that we see for the RFI.

Next slide, please.

As you are very well aware of the —— the HYDEAL LA, the first effort, the first phase, partnering with Green Hydrogen Coalition, and many —— several —— many

partners within that coalition. The key focus for the phase one, and essentially, we found out that —— that green hydrogen is doable within the region in LA by 2035 within the —— the affordability making it more economic.

What phase two will —— this is HYDEAL LA 2 now. What phase two will focus on, besides looking at additional offtakes and —— and —— for ocean shipping, aviation, and heavy-duty trucking —— what really, we want to focus, and the team want to focus, is that the engagement with the local stakeholders. Underserved communities, really to identify and align the value-proposition of green hydrogen, what it can provides, and addressing their concerns, right?

And, within emphasis on equity, obviously pollution reduction, and —— and talk about job creation and most important, economic development within those regions. And so, that will be the HYDEAL LA phase two, that we're partnering with Green Hydrogen Coalition.

Next slide, please.

And, I know you —— you all heard about the IPP project, this is the Delta-Utah project that —— that Los Angeles Department of Water and Power has a DC transmission line all the way from there down to Adelanto, here, and directly connected to our AC system

of transmission. That project has —— has been —— made some significant progress. And, some of the progress that you see up on the right-hand side there, by —— in 2020, we —— we committed with the —— the IPA committed with —— the Intermountain Power Agency committed with Mitsubishi to —— to essentially, to procure the 840 megawatts of combined cycle, which replaces today's 1,800 megawatts of coal.

And by 2025, you'll be able to utilize 30 percent of green hydrogen. And by 2045, it's the target for 100 percent usage of hydrogen. And that project alone is not —— it's just part of the project for the power island. Also included, obviously, the site preparation, the switchyard expansion, but also the —— the power island EPC construction. So, all those are —— are all secure on their way. We do expect to be in commission and also tested and in-service by 2025.

What's —— what's really important and —— in the Intermountain Power Agency, but also out of the stakeholders within this project, very proud that —— that in just in this month, DOE, the Loan Program Office, has essentially —— we secured a 504 million loan through DOE, and that's one of the largest loan, I believe, that this administration has granted.

And, the picture to the left of the text there, it's an artist's rendering of what that initial 504 million will be. Essentially a phase —— the first phase. And that will include 100 meg—— metric tons of green hydrogen per day through electrolysis, two salt caverns, and each capable of storing 150 gigawatt-hours of energy. And what that picture doesn't depict and doesn't show is the underground caverns. The potential at that location is significant, and that's why it was almost a no-brainer to do clean-hydrogen capacity and firm and dispatchable capacity at that location, because of the geological formation there.

And, I will f—— and next slide, and I will conclude my presentation here. Thank you.

MR. ERNE: Thank you, Louis, appreciate your remarks and look forward to hearing more about the assessment of the RFI results as that gets concluded.

So, our last speaker is Yuri, so Yuri, you've got your slides pulled up. Would you like to begin your presentation?

MR. FREEDMAN: Hello, thank you very much, David. Good morning, everyone, and thank you for the opportunity to be here. Thank you, Vice Chair Gunda, and Commissioner Monahan for inviting us to the discussion. I'm Yuri Freedman, Senior Director of

Business Development at SoCalGas. In my role, I manage SoCalGas portfolio growth initiatives, and RD&D activities, including development of clean hydrogen infrastructure.

Next slide, please.

At SoCalGas, we are working on shaping California's 21st century energy system to update the adoption of clean energy components, such as hydrogen, renewable natural gas, fuel cells, carbon capture and storage, and others. Key milestones of our journey towards carbon neutrality including our climate commitment, clean fuels white paper, and Angeles Link announcement are depicted on this slide. And I will talk more about some of them later in the presentation.

I'd like to focus my opening remarks today on three key points. First, the role of clean hy—— molecules in achieving decarbonization. The second, the central role of hydrogen on the spectrum of these clean molecules. And the third, is the role that SoCalGas can play in achieving carbon neutrality. I'll specifically mention that two projects we are working on: Angeles Link, and H2Hydrogen Home.

Next slide, please.

To set the stage, please let me refer to analysis conducted by Bloomberg New Energy Finance, the

company of my fellow panelist, Matt. And I will direct you to the red box on the right-hand side of this chart. As you can see from this chart, in this analysis, the contribution of clean molecules and clean electrons toward meeting energy demand in a net-zero economy is approximately equal.

That means that we have to apply as much effort to adoption of clean molecules as we have applied to adoption of clean electrons, to successfully execute the energy transition. In truth, the energy system of the future will be highly integrated, where clean molecules will be supporting clean electrons working together to achieve maximum emissions reduction, while maintaining reliability and resilience.

Next slide, please.

Last October, SoCalGas published an economy-wide decarbonization analysis, detailing the role of clean fuels network to help the state reach net-zero. This analysis, which was independently reviewed and verified by academic researchers, demonstrates that clean, renewable electrons and clean gas molecules are not competitors, but in fact, compliment each other's strength.

Our work shows that the electrifica—— electrification, excuse me, combined with clean fuels

like hydrogen, and carbon management, and fuel cells, delivered the most affordable, resilient, and technologically proven path for carbon neutrality. In that, our conclusions are entirely consistent with those reached by Bloomberg New Energy Finance on a global scale, as shown earlier. Right now, I'll spend some time on why hydrogen is going to be a critical element for decarbonization.

Next slide, please.

On one hand, hydrogen is remarkably complimentary to renewables. It is now widely recognized that growth of renewable generation, the energy mix will widen the imbalance between timing of supply of power and demand for it. Not only on the intra-day basis, known as the dark curve, but also on the inter-seasonal basis. Quite simply, hydrogen is an attractive, and perhaps, the only scalable way to store this excess energy in large amounts for long periods of time.

On the other hand, as you can see on this chart, hydrogen can be deployed across a very broad range of end-use applications. In fact, it can be used in all sectors currently using natural gas. In addition, it can also be used in transportation as a fuel for fuel-cell electric vehicles, which of course

has a particular rel—— relevance in California where transportation accounts for the largest share of emissions.

We are doing exploration of global momentum and hydrogen in Europe and —— and Asia, have their peaked by environmental goals, as well as sharp prioritization of security concerns due to Russia's invasion in the Ukraine. Our European colleagues also understand that gas systems are essential to supporting continued decarbonization across the full range of energy and emissions in intensive sector. As evidenced by European Hydrogen Backbone Initiative results, within this initiative, 31 companies, 21 countries in Europe worked together to map out continent-wide hydrogen network. And amount the conclusions was the fact that more than 60 percent of that network can be build using repurposed gas pipelines.

Here at home, the Bipartisan Infrastructure Law includes $8 billion program to development regional clean hydrogen hubs across America. And the —— we believe, as Gia described, that California is in an excellent position to capitalize on this opportunity. Now, about our efforts in hydrogen.

Next slide, please.

(Pause)

Oh, thank you.

First, let me turn to large green hydrogen infrastructure project we are working on. Recently, announced our proposal to develop Angeles Link, what could be the nation's largest green hydrogen energy infrastructure system, to deliver energy, clean energy, and reliable energy to the Los Angeles basin.

The Los Angeles basin, as many of you know, is home to the largest port in the western hemisphere. And the country's largest manufacturing center, making it home to many potential green hydrogen end users. As such, we envision the Angeles Link's green hydrogen could power heavy-duty transportation, dispatchable electric generation, including what Louis covered earlier, and manufacturing in the region, reducing California's emissions, and helping accelerate achieving our climate goals. As demand for green hydrogen grows, and as the Los Angeles basin's green hydrogen economy scales up, we expect it will also include aviation, shipping, and chemical manufacturing, among others.

Next slide, please.

The next slide lays out the key elements of hydrogen value chain, beginning from renewable power to production of hydrogen by electrolysis, to transportation of hydrogen to end-users, which is what

represents Angeles Link, and ultimately, using it was, as you can see very significant emissions reduction benefits.

We identified three phases of the project as it moves forward. First, is preliminary engineering design and environmental studies. Second one is the field study. And the third one is the development of the formal —— formal application for CPCM for the potential project.

Importantly, we envision engaging stakeholders early on and maintaining this engagement for the course of developing the project. We are committed to make sure that stakeholders, environmental organizations, and the public would have a voice and a seat at the table in the Angeles Link development process, with equity at the top of our priority list.

Next slide, please.

In this context, I would like to spend a little of time to discuss the opportunity of hydrogen offers for transportation decarbonization. This slide describes complimentary to battery and fuel-cell vehicles, which, by the way, of course are both electric vehicles. And that complimentary depicted across the broad range of transportation sector, as a function of load weight and travel duration. We observed many

manufacturers recognize that, and we are satisfied to see many of them turning to producing fuel-cell battery trucks.

But what I really wanted to point out while covering this slide, is the really important point to act on. There are more than 20 thousand diesel trucks that transport containers from Ports of Los Angeles and Long Beach. These trucks are often travelling through disadvantaged communities, which results in increased air pollution and direct public health impact on people living there. Displacing these diesel trucks with fuel-cell electric trucks would constitute a major act of achieving environmental and social equity, that I believe we would be proud of our state.

Let's go to the next slide please.

In parallel with our infrastructure development efforts, we are actively engaged in multiple pilot projects related to hydrogen across the value chain, including production, transportation, and use. And today, I'd like to talk about one of them, it's the H2 Hydrogen Home.

Next slide, please.

This is our award-winning H2 Hydrogen Home. The project that aims to demonstrate how carbon-free gas made from renewable electricity can be used to fuel

clean energy systems of the future. Specifically, this project will demonstrate in real life complementarity of renewables and hydrogen by producing hydrogen by electrolysis by using carbon-free energy from an adjacent solar panel. It will demonstrate safe storage of hydrogen with storage tank, and it will demonstrate that hydrogen can be used in a fuel-cell to power eventual homes, provide the entire resiliency for multiple base with zero-emissions in the face of risks of power supply interactions. Excuse me, interruptions.

To conclude, SoCal Gas is uniquely positioned to in—— to ensure California meets their climate goals, in particular through the adoption of hydrogen. Our projects like Angeles Link and H2 Hydrogen Home will play a crucial role in building the 21st end of century energy system, providing secure, resilient and affordable access to clean energy for consumers in California, and creating an example for the US and around the world.

This concludes my presentation. Thank you once again for the opportunity to be here and discuss with you this very important topic.

(Pause)

MR. ERNE: Thank you, Yuri. So, if we could have all three of the panelists turn their video on, we

can turn to Vice Chair for questions.

VICE CHAIR GUNDA: Thank you, David. Again, excellent presentations. Just really thankful to Matt, Louis, and Yuri. I thought you all set up the context really, really well.

I have a couple of questions. Maybe just starting with Matthew, but before I go into the questions, I know on time, we were supposed to go until 12:10, so I want to keep it to that so we can have questions from the public and then we can still accommodate that.

So, Matthew mentioned, you know, just the dramatic drop in cost of hydrogen moving forward and electrolyzers. Could you just kind of lay out some reasons for that?

MR. BRAVANTE: Sure. So, I'll — can you — can you guys hear me okay?

VICE CHAIR GUNDA: Yeah, absolutely.

MR. BRAVANTE: I'll say, just from the start, the prices I was showing on the screen were for western alkaline electrolyzers. So, alkaline electrolyzers made in western nations, the US, and Europe. And the capital cost there was about, you know, 100 — or $1,200 to $1,400 per kilowatt. Where we're already seeing prices in China going forward at, you know, $200 to $300 per

kilowatt.

So, it's not so much of a can we achieve capital costs, you know, at this low price, it's, you know, what is it going to take to —— to catch up, basically. And there are, you know, some —— some lingering questions about performance and stuff related to —— to Chinese electrolyzers. But really, it's a matter of —— of scale, and a better match between supply and demand.

So, I don't know if you saw in my charts, but, in the first —— and when I was talking about projects and manufacturing capacity, there's been a massive buildout in manufacturing capacity, specifically in Europe, over the past few years. We're, you know, going to enter into a world where we're north of 10 gigawatts of electrolyzer manufacturing capacity this year. And we're still, you know, on a megawatt scale in terms of shipments.

So, we've talked to specific manufacturers in Europe that say, you know, this year, next year, they're only running their plants at 11 —— 11 percent capacity. So, there's a bit of just like, getting scale and getting a better match between supply and demand. And there's also an aspect of scaling projects. You know,

we're going to go from —— we're going to go from projects that are, you know, in the tens of megawatts to the hundreds of megawatts. We've already seen a 150 megawatt project go forward in China. I know, you know, Plug Power has plenty of large-scale electro—— electrolysis based projects going forward in the states. We see that in Australia and Europe as well. So, just the scale of the projects will help a lot as well.

Yeah, I think I'll leave it there for time.

VICE CHAIR GUNDA: Matthew, if you could also just comment on, you know, specifically for the electrolyzers. In terms of materials, you know, we are looking at supply chain issues all over, you know, kind of the industry, clean energy industry. So, I —— what is —— what is your kind of, current outlook on materials, supply chain, and you know, the confidence in the scale?

MR. BRAVANTE: Sure. Our view at BNEF, and this is a controversial and not-yet determined view in the industry. Most of the projects we track are alkaline based. I think about 80 percent of them. The largest exception, globally, is Plug Power, here in the states, and —— that —— that builds PEM electrolyzers.

But, the vast majority of the projects we see going forward, especially at larger scales, are

alkaline. And they have less issues with, you know, critical materials that I think you're referencing. So, in the near-term, we don't really see that as a —— as a major issue. If —— if PEM does, you know, make up a lot of ground, and —— and get a substantial foothold in the —— in the overall race to dominate the electrolyzer market, it could become a bit of a more —— more of an issue. But in the near-term, we don't see that being —— being a huge issue.

One —— one last thing I'll make a comment of. It's been brought up a lot, this —— this concept of water scarcity. And it's not necessarily related to minerals. But, if you look at, you know, the —— a steam-methane reformer, and how much water it takes. Depending on the steam to carbon ratio you use, it's going to use about 18 to 20 kilograms per kilogram of hydrogen. Compare that to the 10 kilograms of water per kilogram of electrolytic hydrogen. You're almost cutting the hy—— water use in half by switching from a fossil-based pathway to an electrolytic based pathway.

So, when you're looking at decarbonizing industries that already use hydrogen, you're actually getting a net water saving. Which I feel like is a point that's not brought up very often. And there

obviously are concerns if you expand the footprint of hydrogen into other energy related sectors, then you need to compare that water use on an MMBQ basis, or some sort of energy basis to natural gas, oil, or whatever you're using. But, just in terms of the decarbonization problem we have right now, of decarbonizing industry that uses hydrogen, I think water is going to be less of an issue if you switch to an electrolytic pathway.

(Pause)

VICE CHAIR GUNDA: Thank you, Matt. I have so many questions for the panelists, but in an interest of time, you know, one quick question to you, Yuri, if you —— if we have. And first of all, thank you for your presentation and —— and highlighting the work that you're doing in engaging the communities ahead of time and thinking through, you know, your —— your work.

So, from a planning standpoint, are y—— is SoCalGas right now looking at, you know, we have the IRP, we have the, you know, gas planning side, how are you blending the hydrogen planning into it, and do you have any work reports that you could share with us after that would be helpful in framing how to think about planning for hydrogen?

MR. FREEDMAN: Thank you so much for those question, Vice Chair. And, I would say, again, within

the compliance of time, that we definitely are working on incorporating hydrogen to those proceedings. Angeles Link is only one of the prongs, if you will, of our effort. We believe that there is a role for new build projects, which we all know, take time. There's also a role for blending hydrogen, and are working on that as well. It was brought up earlier today.

And to that effect, we are actually working on incorporating the hydrogen as the element of analysis into the modeling into the IRP process into the IEPR. And we are definitely observing and very happy to see a tremendous shift, but, clearly more needs to be done to make sure that we are together designing this resilient and clean system. So, happy to provide more details. We have offline to give you more debrief on what we are specifically working on.

VICE CHAIR GUNDA: Thank you so much. I'll pass down to Commissioner Monahan.

COMMISSIONER MONAHAN: I wan—— I wanted to start with Louis and Yuri. I'm wondering if you are seeing, I mean, the announcements that you have made, I mean, to me they were —— they were quite striking in terms of their level of ambition and scope, vision. Are you seeing other utilities across the United States look at you for leadership and —— and make similar

announcements?

(Pause)

MR. TING: I'll go, this is Louis Ting. I —— I can go first. We have been talking to other large public power councils throughout the whole, you know, the —— as far as public power goes. And —— and there are some potentials, obviously, with the west —— western states that are looking at hydrogen hubs and looking at the —— how to connect the hubs together. And, I think that effort's going to continue.

(Pause)

MR. FREEDMAN: Perhaps, thank you, Louis. Just to add to that, first of all, I'd like to say that we clearly are as comminisher—— Commissioner mentioned, in a leadership position to a very large degree because of LADWP's steps that they've taken. The first step was Intermountain, that put hydrogen power generation on the map not as a maybe, but as a real project. As evidenced by the recent launch from the DOE, which integrates that.

And now, they're looking at replicating this in the basin. Hydrogen power generation is now becoming a reality to a very large degree, and because of what's happening here in California. Other states are looking

at us, and we have multiple gas utilities reaching out to us to try and understand how we think about that.

I will also go back and say that we observe that other countries and continents are in some ways ahead of us in thinking about hydrogen, and we are tapping to them. It's driven, often times, by energy efficiency, like in Asia and Japan, it's driven also clearly by energy security in a very good way like in Europe. And —— and it's also driven by places like Australia, which have opportunities not unlike ours, when I think about not just using hydrogen, but perhaps one day exporting that as renewables to the world. And so, we are actively collaborating with multiple utilities to ensure that we are going to be as efficient as we can in the —— addressing these challenges.

(Pause)

COMMISSIONER MONAHAN: Thank you. And I see, Fritz, do you have a question? 'Cause —— okay, go ahead.

MR. FOO: Hey, thanks for the presentations, everyone. I had a question for LADWP and SoCalGas. Really, on the idea of existing infrastructure as a way to mitigate costs, and you know, are there any, sort of, permitting challenges? So, the question for SoCalGas —— you all had mentioned 50 percent of your potential build out will be using existing infrastructure. Do you see

permitting challenges on your end?

And then similarly, with LADWP, you know, do you have a sense of how much existing infrastructure you plan to use, and do you see permitting challenges for you all as well?

MR. FREEDMAN: Thank you. And first, I would probably like to clarify a little bit to the point that you made. I don't think I've said that 50 percent of our existing infrastructure can be used for the build-out. What I alluded to is the work which was done by our colleagues in Europe, where they designed continent-wide backbone, and their conclusion by their result of about result of about two years of work was that about 60 percent, a little bit more that, of that backbone, can be built using repurposed gas pipelines. I would be happy to provide the materials that they have published with significantly more information.

We have this work ahead of us, and I think we need —— needless to say, to work together with all the public agencies, because building infrastructure, whether it's repurposing or new, it's complicated. It's complicated technically, it's complicated from the permitting and regulatory standpoint. Especially in the context of the ambitious goals that we have in this state.

So, we all need to work together, and we —— I often refer to the shared sense of urgency, which again, I observe our colleagues in Europe have today, and I think we have to match that, and that's how we're going to be successful. And I'm sorry, I don't think I've addressed the other part of your question.

MR. TING: Just to add to that. Thank you for the question, but as far as permitting and challenges and so forth, I want to frame it in a sense that, you know, every project for us is —— we have to go through CEQA, right? So, that is a challenge itself.

But. However, we successfully have gone through CEQA processes, it's just a matter of time and engaging the right stakeholders and getting all the proper work together. However, you know, even though the whole hydrogen, not green hydrogen, but —— maybe not green hydrogen, but the whole hydrogen industry is —— is a very mature industry. But, at the scale for the utility, especially for power generation, it's —— it's still very nascent and also developing technology.

So as far as permitting goes, there are two aspects, right? So, one —— one is really with the public stakeholder outreach. The other one is getting technology down so that besides meeting the BACT

requirements, but also we gotta demonstrate that it is also safe, it is also doable, but also, that the workforce development and training for our employees, it needs to be really focused on —— and besides no —— besides the fact that that permitting, it will be a challenge, we believe. As far as our —— within the in basins. In —— in Los Angeles.

MR. Foo: Thanks for answering the question.

MR. ROTHLEDER: Hi, I think this question is for Louis. To what extent the existing generation, production equipment, can be reutilized or retrofitted, or would it have to be replaced from where it's —— it's state now to support the hydrogen generation? And I guess I'm trying to —— by the way, all these presentations are really, very, very informative, and I appreciate the information. But, I'm just trying to figure out from the RFI's that you received, how much retrofit replacement would you have to do to your existing generation equipment?

MR TING: That's a great question, Mark, thank you for that. And ——and as far as existing equipment, there are some technologies that we have that the —— the OEM has indicated that there's some high potentials of —— of retrofitting the existing. So, it —— it —— the

analogy will be, kind of, re-gutting your —your automotive engine, and — and make it a completely renewable fuel vehicle.

Same thing with these type of gas turbines and some of the other turbines that we have — whether it's combined cycle, or — or simple cycle, they're all gas right now. But converting to — to hydrogen besides the OEM's, there are some other third parties that have already done, you know, hydrogen blending skids that are already being ins— put in service right now as we speak.

So, depending on the OEM's and at different levels of the maturity with hydrogen, some are more mature than others, we believe that there is a pathway to getting them retrofitted with the existing equipment. Obviously, you know, newer equipment that will be — probably be more favorable than the existing equipment, but at the end of the day, we're trying to be more efficient and — with our equipment that we have already. And that will be our preferred choices.

(Pause)

VICE CHAIR GUNDA: Thank you all.

(Pause)

Yes, just echoing there a little bit.

(Pause)

Okay, let's —— okay that's good. So, thank you, everyone for your presentations and also answering questions. This is more of a comment that I would like to just flag. You know, we had our gas transition OAIP that was launched a few weeks ago, I know Jennifer Campagna and Davie Erne, who are kind of a —— a leadership management role here on that work.

At the —— there was a question around hydrogen and leakage as an important element to think through. And I just want to flag that, Yuri especially, you know, as your work furthers, would love information that you all find on, you know, both the issue and the opportunity for mitigation whether through, you know, design of transportation, or whether it's through other areas, you know, would be really helpful to —— to kind of get talking about that, making sure we —— we keep that as an issue that we have good answers for. As a —— as a bri—— big team.

So, with that, I don't have any other questions, Yuri, unless you want to quickly respond. If not, I'm gonna take it back to Heather.

Yuri, did you want to say anything or are you good? We'll follow up.

MR. FREEDMAN: Oh, I'm here with the follow

up, I think that the topic of leakage, Vice Chair, is very important and we see it rising in —— in dialogue lately. We believe that there's a good data there to address that, and are new technology to address that.

Again, I think Louis referred to that. We are talking about using a very old and mature commodity in new ways. So, transporting of hydrogen is not new, we have to do it safely, reliably, and with minimum leakage, and we are fairly confident that this can be done, but we are doing work that effect. So, thank you for bringing this up.

VICE CHAIR GUNDA: Thank you so much. With that, I will pass it back to David, or Heather, for the Q&A.

MS. RAITT: Great, thanks. So, actually I'll pass it to Jennifer Campagna. I —— we are short on time, but maybe we can take a question or two from the attendees. Thanks. Jennifer?

VICE CHAIR GUNDA: Heather, can I just request that we create five minutes for the Q&A?

MS. RAITT: Absolutely, yes.

VICE CHAIR GUNDA: Thanks

MS. RAITT: Thanks.

MS. CAMPAGNA: Great, thank you.

(Pause)

The first question I have is from Tim Saseen from Ballard, and this question is for Matt:

"We can switch all oil refining to zero-carbon hydrogen and move the hydrogen over to transportation."

Oh, sorry about the echo.

(Pause)

Sorry about that.

(Pause)

Okay, sorry about that. Let me start over here real quick:

"We can switch all oil refining to zero-carbon hydrogen then move the hydrogen over to transportation as oil use for transportation drops. The extra 66 percent of renewables is hardly surprising. Note that California will need greater than three times its present renewable energy production to finish the 50 percent of present electrical grid demand and the extra renewables needed for 100 percent transportation decarbonization.

Did the NEF consider this, and how does the NEF see the economic tradeoff for not achieving 100 percent decarbonization without hydrogen and the resulting climate externalities?"

And the second part is:

"Did the NEF make any projections for future

fuel-cell electric vehicle prices, or only todays?"

(Pause)

MR. BRAVANTE: Thank you for the question. So, I guess to answer the last part, we did do some projections, and in the heavy-duty vehicle space, it really depends on the policy support given to hydrogen, and kind of what the learning curves do on the fuel-cell side of things. Unfortunately, I can't share that, because a lot of our work is behind a pay-wall.

But, to the —— to the previous question, and I —— yeah, I don't want my —— my presentation to be misconstrued as, you know, we're —— we're at all negative about the —— the hydrogen economy. Really, the point I wanted to get across was that in the near-term, there are an increasing amount of demands on the clean-electricity resources that California will be able to build.

And, hydrogen is going to be one of many of those resources. And, there are certain applications where hydrogen can be used as a tool for decarbonization, in which there are no other great alternatives. And oil refining is one of those. It was not the only example I would have used, it was just the example we found quick and easy data on. But you can think about all the ammonia we use in the state to grow

food. And then you can think about newer sources of demand for hydrogen. I know a lot of folks talked about ports and, you know, maybe maritime fuel, things like that. Using it as a, you know, grid balancing mechanism over long hours, or even seasonal storage.

So, there are a ton of different options, and we think, in the long term, more and more of those will be, you know, unlocked or accessible. But, in the near term, I think it's important to consider what are we using the hydrogen for? And how is that —— how is that advancing California's larger goal of getting to net-zero emissions when —— taking into consideration all the other different aspects of that pie, mainly the electrification of certain segments.

(Pause)

MS. CAMPAGNA: Thank you. Sir, do we have time for one more? Okay. Matt, this question is also for you. It's from William Hazenberg:

"Hydrogen in the industry does have the greatest demand but wants to pay the least for it. While selling to said mobility," —— I think it means maybe mobile —— "it gives the highest economic price per kilogram, so it also needs less subsidy. How do you see this?"

(Pause)

MR. BRAVANTE: It's a great question, and, you know, I've actually spoken to tons of folks in industry and asked them where they think demand will actually occur first, and a lot of folks say the power industry. The reason folks say the power industry, at least when I'm talking to them, is that the economics, and —— and in California you could make an analogous argument for the transportation industry, but the power marked in the US is broadly the only place that rewards lower carbon generation through —— through various, you know, state-wide renewable target goals, or, renewable portfolio goals.

So, those are places where you are going to get rewarded, and those are places where the economics are likely to pencil out. But, in the context of what we're talking about here today, and helping California create policy that achieves decarbonization, I think it was all the more important to —— to identify areas where decarbonization is needed, but the economics might not pencil out.

I will say that, aside from the transport sector, the —— because you're comparing to a diesel fuel, but when you're comparing to natural gas for, you know, power gen, or for heating or anything, the economics for ammonia, oil refining, where you're actually using it as

a molecule rather than —— or a chemical agent rather than an energy molecule, the economics are better, because you just need to compete with the cheapest source of hydrogen. You don't need to compete with the cheapest source of energy.

But yeah, in the —— on the —— on the transport side, especially in California when you think about things like the LCFS, I mean there is a substantial economic benefit to using hydrogen within the transportation system. The point, or the question I was trying to raise is, as we start to develop a hydrogen economy with the goal to decarbonize California's entire energy system, what kind of policy should we design to help us get it there?

And, you know, in the next ten years, we project that costs are going to fall quite dramatically. So, hopefully, you know, this near-term economic sting will be less of an issue. But the question is, like, how do we get there, and what —— what sectors do we want to incentivize with policy tools to help decarbonize California?

(Pause)

MS. CAMPAGNA: Okay great, thank you. I think at this time, we are —— oh, okay. We have a question from the audience. Please introduce yourself.

MR. AHEARN: Hi. My name's Paul Ahearn, I'm with a company and manufacturer in Michigan, called Sesame Solar. And this last week, we just launched the world's first mobile —— think of a trailer —— with a deployable solar array on top. And, we create our own hydrogen fuel-cell on board. So, out of water, you actually have on the trailer, you know, with one button —— you know push of a button, with electrolyzer, we actually create that gas.

And so, I just wanted to say that —— and the reason I'm bringing this up is because as you're thinking about, you know, these incentives are coming from —— from above, from the government, and how to allocate that, and then invite the participants who might be able to, sort of, help with some of this changing, or bringing up new products, just wanted to have you think about the smaller aspects of where it could be used.

So, think of towables, maybe add that into the definition of what an electric vehicle is. And, you know, we can —— we can certainly address a lot of the socio-economic issues with our product. Our product is originally designed for disaster relief. So, placing one of these mobile offices, a mobile medical clinic, in

an austere environment, where there's not a lot of resources.

And instead of using diesel fuel as a backup when solar is not available, we, right now, alive today, and I was just in Rocklin testing it out again, we right now have that ability to do that as I speak. So, I just wanted to share that with you, and thank you very much for giving me a moment to chat about that.

(Pause)

MS. RAITT: Okay, thank you. So, if it's okay, Commissioners, we'll move on to public comment period. So, thank you, Jennifer, for that, and sorry we couldn't get to all of the comments, all the questions that were raised, so we got some good ones.

So, let's see. So, it's — so we will be taking public comment now, and we request one person per organization may comment, and the comments will be limited to three minutes per speaker. If we had — if we end up having several speak — several people wanting to comment, we may have to limit that to 1.5 minutes per speaker.

We'll start with those in the audience, I don't see any blue cards — but if anyone in the audience wanted to comment, let me know. Otherwise, we'll move on to those who are attending remotely, and use the

raise-hand feature to let us know you'd like to make a comment, or you can press star-nine if you're on the phone, and that will let us know you'd like to make a comment.

So, we will open your line, and —— and then you'll —— so let's see. So, we have, um, I am not going to be able to pronounce your name. Salim Rahemtulla? Go ahead, we will, uh——

MR. RAHEMTULLA: Great job, thank you. Yes, Salim Rahemtulla, PowerTap Hydrogen Fueling Corporation. I wanted to just comment briefly on the fact that it appeared that with all the discussion and presentations on green hydrogen, there was lack of inclusion of waste to hydrogen, where there are several technologies available that can produce hydrogen using these renewable sort of resources. Not solar and wind and water. And I wanted to make sure that that was captured in definitions of green energy. That's my comment.

MS. RAITT: Thank you. Next, we will go to Mikhael, or Mik Skvarla. Excuse my mispronunciation. Go ahead and unmute your line.

MR. SKVARLA: Hi, Michael Skvarla. Appreciate that with Salim and I, the difficulty pronouncing the names.

Thanks for having this workshop, I appreciate

the opportunity. I'm here on behalf of California Hydrogen Coalition. And while we appreciate the CEC"s commitment to 200 stations, want to bring light to the proposed plan within the Scoping Plan, which indicates, you know, needs of upwards of 3,000 stations statewide between the light, medium, and heavy-duty markets to achieve our carbon neutrality goals.

We also want to indicate that the ambition for that, and the scoping plan, will, you know, be discussed over the next several months, and we'll be filing comments there with regard to infrastructure needs and —— and I'm sure that we —— we'll —— we supply those, uh, that information to the CEC and into this IEPR docket.

Further, with regard to the conversation of —— of carbon intensity versus the color wheel. I think most folks in the industry agree that the carbon intensity is the best way to go. The Federal Bipartisan Infrastructure Legislation had a definition of clean hydrogen which includes feedstocks, some of which may not be allowable here in California, based on our goals.

However, the use of that definition does have an overlay of a two kilograms per —— two kilograms of CO2 per kilogram of hydrogen. That's roughly equivalent to CI and (INDISCERNIBLE) of about 15 or 16. The grid averages right around 80 today. And so, we have a 5x

reduction in emissions from clean hydrogen versus the grid. And I think that's a good way to go. We should probably look into a phased in standard over time, as we have with the RPS, to allow existing assets to transition. A combination of feedstock and carbon intensity is probably the highest road to take with regard to looking at standards. And there is a need for a statewide standard, having disparate definitions across the CPUC, CEC and ARB is not the best way to drive investment.

And then lastly, the Hubs present an incredible opportunity for California. We have a lot of end-use off takers, and different production pathways. Also, within the scoping plan, the transportation sector is mainly sourced from biomass and biogas, while we see the electric sector being served through electrolytic hydrogen based on those modeling results.

Obviously, models are restrictive and don't paint the whole picture of the economic outcomes, but it does indicate that we can mitigate emissions from methane, and —— and the excess biomass from ag and —— and our forests. You know, in a high value commodity like me—— like hydrogen, and the transportation sector, again across all vehicle weight classes because there will be needs.

Further, we will be submitting some comments with regards to some of the fear, uncertainty, and doubt that we've heard. I'd love some comments with regard to water consumption. It's not as big of a deal as I think folks are trying to make it out to be, especially compared to the existing energy systems that we have, with regard to refineries and —— and fossil fuel.

So, thank you.

(Pause)

MS. RAITT: Thank you. So, next is DJ Taylor. Go ahead and unmute.

(Pause)

MR. TAYLOR: Have you got me now? Okay good. Yeah, this is Donald Taylor, with Taylor Energy. We're primarily biomass to hydrogen people. So, I feel like this group has been really oriented towards the electrolyzer technology, which I like a lot and that's essentially opening up and driving this market.

But, maybe under a —— a separate —— some kind of a separate group, we need to talk more specifically about, for example, you know somebody mentioned waste to hydrogen, and you know, biomass to hydrogen, which early on, are bound to be the low-cost sources of hydrogen. They're not going to satisfy the whole market, obviously, but early on, if you look at the numbers for

hydrogen produced from natural gas, in reality, it's not much different from biomass. There's some difficulties and so on. But, the ultimate cost is nearly the same.

So I — in some ways, I feel like relying on the electrolyzer model, for example I had asked the question, well it's 40 percent utilization of that technology, is that a realistic number? And I don't think it is. I think if you're lucky to get 25 percent using the renewable low-cost power, maybe I'm wrong on that.

But, I just think we, you know, at a certain point we need to focus as we move into this, on the economics, very clearly. We're aggressive on the economics, trying to pursue that two dollar, and then a dollar a kilogram goal. But, I just think we need to be watching the economics carefully. And not this — not — make sure that biomass guys get included into this is my comment. And that's all I really have. Thank you.

MS. RAITT: Thank you for that. Next, is Sara Fitzsimon. Go ahead, Sara.

MS. FITZSIMON: Hi.

(Pause)

VICE CHAIR GUNDA: Sara, we can't hear you. I think you muted and unmuted.

MS. FITZSIMON: Okay. Are we good?

VICE CHAIR GUNDA: We can hear you now.

MS. FITZSIMON: Thank you.

VICE CHAIR GUNDA: Yup.

MS. FITZSIMON: Hi, Sara Fitzsimon from the California Hydrogen Business Council. I'm calling to comment —— well, I'd like to second the comments of Salim Rahemtulla from PowerTap, as well as Mik's comments from the CHC. I would like to add in addition, and I didn't hear the entirety of the questions from Matt on his presentation, but I would like to add that the heavy-duty fuel-cell electric vehicle trucking space is already being piloted and successfully on the road.

To claim that hydrogen fuel-cell trucks will be overpowered by battery, or at least the technologies will outweigh one or the other, it's just too early to call that. And, I think it really does get in the way of developing good policy that's sustainable and will help us meet our goals sooner.

So, I would just like to note that fuel-cell electric trucks are on the road, they're a wonderful resource in meeting our transportation needs and decarbonizing California's transportation space as well as eliminating a lot of NOX emissions and other black carbons that come from diesel fueled trucks that are on the road currently. So, if we can start including fuel-

cell electric trucks in our calculation of heavy-duty transportation space, I think that would best serve our policies. They are long-range, they don't change their performance based off of weather, they have very quick refueling time, and they're —— they're much more function —— they serve the functionality of duty cycles and goods movement far better than battery-electric vehicles do at this point.

And so, to choose one technology over another, we just ask as representatives of the hydrogen space and the OEM's, that we start talking about both technologies equally, providing equal opportunities to both technologies, because so many consumers in California would like to have the option, and not be limited to one technology over another due to policies. So, I do ask that that is emphasized in the planning and in the coordination among agencies going forward. Thank you for your time.

(Pause)

MS. RAITT: Thank you. So next is Maia Leroy. Go ahead. Could you ——

(Pause)

Go ahead and unmute on your end, Maia.

MS. LEROY: Can you hear me now?

MS. RAITT: Yes.

MS. LEROY: Okay, thank you. Hydrogen offers an opportunity to green up the hard to decarbonize sectors in the future. And today, it's already presenting itself as a widely used resource in the manufacturing industry that requires decarbonization in its own production.

Roughly 95 percent of all hydrogen produced today is done so with fossil fuels. And so, with decarbonization as the goal, we need to focus on the transition to producing all hydrogen via green electrolyzers to clean up the industries still relying on this polluting grey-hydrogen.

And then, once we've done that, then we can focus on utilizing that hydrogen on a more wide-spread scale. And when we do so, we need to ensure that it's in safe and clean applications. This would mean keeping the production site local to the site of consumption to mitigate possible transportation hazards like leakage.

And so, this might look like something, you know, like putting electrolyzers at a heavy-duty vehicle refueling stations, rather than trucking it in from another outside production site. And so, that concludes my comment, I just wanted to focus on those —— those safety precautions as well as, you know, where we can decarbonize initially near-term, versus what's

acceptable for the long-term. Thank you.

(Pause)

MS. RAITT: Great, thank you. I don't see any more hands raised, so, I think that concludes public comment. If you wanted —— oh, I'm sorry. We do have one last hand raised, and then —— So, apprenticeship coordinator, go ahead.

MR. LUCERO: Hello, everybody, my name is Dominic Lucero, L-U-C-E-R-O. I am the executive board member and committee chair for the New Endeavors Research and Development Committee, also known as NERD, representing the international brotherhood of Boilermakers.

This has been absolutely fantastic. There is one thing that is missing from these plans, and it's specific skilled and trained and language written into the framework of this transition for a just and equitable transition of the labor organizations that have been building California's infrastructure through the state's entire history. Many of these members also live in disadvantaged communities, and these labor organizations offer higher education through apprenticeship programs with no college debt.

We have to be certain that private companies do not hire low-skilled workers to build the hydrogen

infrastructure with no long-term future. The future relies on highly skilled workers with a proven safety record. We highly support the transition, but we also have to be included. Thank you.

(Pause)

MS. RAITT: Great, any —— I'll give one moment for raised hands.

(Pause)

I don't see any more raised hands, so I think we are going to conclude public comment here. And, Commissioner, if you wanted to make any quick remarks?

VICE CHAIR GUNDA: Yeah, thank you, Heather, for making sure we had all the Q&A, and the comments. So, I just want to acknowledge all in the room, for your comments. Salim, Mik, Donald, Sara, Maia, and Dominic. And, I think there's a —— a couple of pieces that you all raised that I would love to get in the docket as written comments would be really helpful. Both on the end-users, but also the opportunity for the biogas —— or the bio side of it to hydrogen and the overall negative carbon opportunity in generating the hydrogen.

So, would love to hear comments on that, but also Paul, to your comments, and Dominic's, had a chance to talk to a professor at, you know, Sac State LA, and about the importance of funding small fuel-cell/hydrogen

projects that could both be used for small level fueling, but also an opportunity for workforce training, and really the need for, you know, more programs that allow for good training, but also, you know, just jobs. So, thank you for your comments and everybody else's.

So —— so, it's a —— thank you, Ben. It's Cal State Long Beach, not Cal State LA. So, thank —— thank you so much.

So, with that, I —— any other comments from the dais? Okay, so we will split for the morning, thank you all to the panelists, we will come back at 1:30. Looking forward to the afternoon session. Wonderful discussion, thanks.

(Meeting off the record at 12:37 P.M.)

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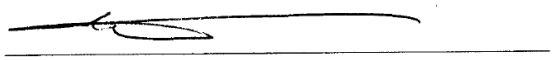

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I do hereby certify that the testimony in the foregoing hearing was taken at the time and place therein stated; that the testimony of said witnesses were transcribed by me, a certified transcriber and a disinterested person, and was under my supervision thereafter transcribed into typewriting.

And I further certify that I am not of counsel or attorney for either or any of the parties to said hearing nor in any way interested in the outcome of the cause named in said caption.

IN WITNESS WHEREOF, I have hereunto set my hand this 17th day of August, 2022.

Myra Severtson
Certified Transcriber
AAERT No. CET**D-852