NEVADA LEGISLATURE
JOINT INTERIM STANDING COMMITTEE ON GROWTH AND INFRASTRUCTURE

(*Nevada Revised Statutes* [NRS] 218E.320)

DRAFT MINUTES

May 29, 2024

The fourth meeting of the Joint Interim Standing Committee on Growth and Infrastructure for the 2023–2024 Interim was held on Wednesday, May 29, 2024, at 9 a.m. in Room 3138, Legislative Building, 401 South Carson Street, Carson City, Nevada. The meeting was videoconferenced to Room 4401, Grant Sawyer State Office Building, 555 East Washington Avenue, Las Vegas, Nevada.

The agenda, minutes, meeting materials, and audio or video recording of the meeting are available on the Committee's meeting page. The audio or video recording may also be found at https://www.leg.state.nv.us/Video/. Copies of the audio or video record can be obtained through the Publications Office of the Legislative Counsel Bureau (LCB) (publications@lcb.state.nv.us or 775/684-6835).

COMMITTEE MEMBERS PRESENT IN CARSON CITY:

Senator Dallas Harris, Chair
Senator Carrie A. Buck
Senator Skip Daly

COMMITTEE MEMBERS PRESENT IN LAS VEGAS:

Assemblywoman Tracy Brown-May
Assemblyman Max Carter
Assemblyman Howard Watts, Vice Chair

COMMITTEE MEMBERS ATTENDING REMOTELY:

Assemblywoman Jill Dickman
Assemblywoman Danielle Gallant

LEGISLATIVE COUNSEL BUREAU STAFF PRESENT:

Kristin Rossiter, Senior Policy Analyst, Research Division
Julianne King, Assistant Manager of Research Policy Assistants, Research Division
Cameron Newton, Deputy Legislative Counsel, Legal Division
Jessica Dummer, Senior Principal Deputy Legislative Counsel, Legal Division
Julie Waller, Principal Deputy Fiscal Analyst, Fiscal Analysis Division

Items taken out of sequence during the meeting have been placed in agenda order.
[Indicate a summary of comments.]

AGENDA ITEM I—CALL TO ORDER AND OPENING REMARKS

[Chair Harris called the meeting to order. She reviewed housekeeping measures and discussed the Committee's Solicitation of Recommendations.]

AGENDA ITEM II—PUBLIC COMMENT

[Chair Harris reviewed public testimony guidelines.]

Chair Harris:

Is there anyone here in Carson City who would like to provide public comment? Is there anyone in Las Vegas who would like to provide public comment?

Jermareon Williams, Government Affairs Manager, Western Resource Advocates:

I would like to share Western Resource Advocates' views on hydrogen and its uses in the energy sector. Hydrogen can be a pathway to accelerate the decarbonization of the energy infrastructure; however, adoption of hydrogen as fuel for power generation poses significant technical and operational challenges, such as the infrastructure investments needed to produce and transport hydrogen. These investments could have significant impacts on Nevadans. Additionally, the type of hydrogen used should not contribute to increased emissions, whether that be carbon dioxide, methane, nitrous oxide, or other greenhouse gasses or harmful emissions. Since the technology alternatives already exist for many end uses, hydrogen should be reserved for sectors that cannot be decarbonized more efficiently or cost effectively through other pathways. Given this position, the only forms of hydrogen that will generally meet this standard are green and pink hydrogen. All hydrogen should meet the three pillars adopted by the Internal Revenue Service in its proposed 45V tax credit guidance: additionality; deliverability; and hourly matching, even if hydrogen qualifies as green or pink. The use of hydrogen or expansion of related necessary infrastructure needs to be considered on a case-by-case basis. I look forward to hearing today's presentations and working with the Committee to find ways that hydrogen or better suited alternative technology can be used to help Nevada reach its statewide decarbonization goals.

Troy Arias, Owner, Arias LLC:

My family and I have been in business for over 23 years here in North Las Vegas. The registration service industry has over 80 small businesses in Reno, Carson City, and Las Vegas areas. This is a group of mostly minority women-owned businesses and almost doubled in size since 2019. We are currently licensed as document preparers by the Nevada Secretary of State (SOS), which requires a $100 document preparation licenses fee, a background check that requires fingerprints, a $50,000 bond, a State business license, and Nevada SOS local jurisdictional license, meaning city/county. We process Department of Motor Vehicle (DMV) transactions on behalf of customers. Think of it as DoorDash, but instead for DMV transactions. The industry has been in constant struggle with the DMV since October of last year. The DMV tried to completely change how they work with the industry with only a two-week notice. These changes were going to completely destroy the majority of the industry members. Through backchannel communications and help with the Latin Chamber of Commerce, we were able to push back the changes and several other deadlines on new procedures the DMV proposed over the last six months. The issue in question is one

of supply and demand. The demand of the industry's services is extremely high. We help Nevada working families with their DMV transactions. We help Nevadans with language barriers, single mothers who cannot take the day off to go to the DMV, and even Nevadans who are concerned with their immigration status in a government building, et cetera. While the DMV has only six employees in their call center answering DMV questions for the entire State, the industry has over 170 people per day answering DMV questions, not including the in-person customer service we provide for free for Nevadans coming into our offices asking about their transactions at no cost to the State. The industry provides millions of dollars of value to the State. (Agenda Item II A)

Chair Harris:

Sir, you are coming up on your two minutes if you could wrap up for me. I will also note we are going to have this topic on a later agenda for this Committee. You can submit your comments in writing, but you can also come back in August when this item is on the agenda. There are a couple of options, but please go ahead and wrap up your comments.

Mr. Arias:

My colleagues are going to finish up my statement, so I will pass it over to my next colleague.

Miriam Jimenez, Owner, Rapid Insurance:

I will continue with my partner's statement. The industry provides millions of dollars in value to the State for very little cost. The supply problem in this case is the access to DMV to process transactions is limited. In 2019, we were able to pass Assembly Bill 288, which put into law the two designated windows at each DMV metro office for industry members to process transactions. Assembly Bill 288 was almost killed with a $4.5 million fiscal note put on it by DMV, but we were able to salvage the bill through the compromise made possible by Assemblywoman Monroe-Moreno, the Committee Chair at the time, and Assemblywoman Ellen Spiegel, the bill sponsor. We are grateful for their help to this day. This bill saved a lot of small businesses and allowed these minority-owned businesses to grow over the last five years. The growth has led to new businesses entering the industry to be faced with limited access, as the two windows filled up. After the negotiations with the DMV, a new system was implemented last Monday, May 20th, to try to help these newer businesses get more access because no new resources were provided. The end result was that longstanding businesses had their access cut, and the access cut out was given to the newer businesses. We do appreciate DMV's willingness to work with the industry as they are faced with difficult problems of having limited resources. The industry is actively working on getting those issues resolved with the DMV. The industry understands the DMV's stated goal of taking everything online for their Department transformation effort; however, the industry believes it can play a role in helping solving the problem with DMV access for Nevada working families. It is clear the consumer demand in this personal service will be in the future, evidenced by the DMV building in the Silverado Ranch area. The industry together with the DMV. (Agenda Item II A)

Chair Harris:

Thank you. That is your two minutes.

Yolanda Rodriguez, Private Citizen:

I have been in business for 12 years doing the third-party service, and I will be continuing the statement. The industry goal was to work together with DMV and the Legislature to pass legislation to become licensed community partners in the same way as driving schools or other dealerships, even as AAA of California are currently offered. The cost associated with the proposal would be to pay by our industry members and would not cost anything to DMV or taxpayers. Many states, including California and Arizona, licensed third-party registration services and allowed them to process transactions inhouse. This creates a voluntary alternative solution for people to process their DMV transactions. It has been an extremely successful program and saved the State of Arizona hundreds, if not millions, of dollars. They have not needed to build any new DMV buildings for over 30 years in the Phoenix metro area. There is an effort that includes elected officials as well as the Latin Chamber of Commerce to work with DMV on this legislation for the upcoming session. We believe with a path to process transactions inhouse in the future, the industry can play a major part in helping solve the DMV issues for Nevadans. (Agenda Item II A)

Chair Harris:

The Committee has your statement, so that will be uploaded as part of today's agenda. We will be discussing this topic in August. I hope I will see you all back here then. Is there anyone else in Las Vegas who would like to provide public comment? [There was none.] We will turn it over to Broadcast and Production Services (BPS). Is there anyone on the phone lines waiting to provide public comment?

Chris Bell, Private Citizen:

As a resident of Reno and a supporter of all things towards sustainability, I make these comments regarding the bright prospects for renewable energy sources available to Nevada. We have the technology and the resources to be a carbon-free State soon. For the benefit of all residents and our descendants, we must deploy these solutions quickly. Hydrogen is undoubtedly a piece in the renewables transition; however, it entirely defeats the purpose of assisting against further climate change if it is not generated by 100 percent green electricity. Any other source of power for splitting water should not be considered or allowed. If a hydrogen facility is proposed, it also must generate its own electricity for the purpose and not use the public grid and deny the more efficient uses residents make of green electricity. Finally, this technique will be very thirsty. The water supply for hydrogen production cannot be overlooked or underestimated. I expect the Truckee River will be the most logical source for this new industry, and as such, it will be imperative to consult early on with the Truckee Meadows Water Authority (TMWA). Can a changing water supply accommodate this new demand? Thank you, Senator Spearman, for seeing the potential benefits for Nevada in green hydrogen production. Thanks to the Committee for consideration of this topic and for my opportunity to give input. (Agenda Item II B)

Bari Levinson, Volunteer, Sierra Club:

I am a retired physician and chemical engineer and a volunteer with Sierra Club. Today, I would like to review the Sierra Club position on hydrogen in our energy economy. It seems logical that hydrogen is a wonderful solution to provide clean energy and storage. Theoretically, burning it would produce water and heat. However, this is far from the truth, and problems with producing and using hydrogen are manifold. First, the only true clean way to make hydrogen is by using renewable energy, such as solar or wind, and the electrolysis process. This is called "green" hydrogen and creates no greenhouse gas emissions. Both blue and gray hydrogen are derived from methane gas, creating carbon

dioxide in the process, which is exactly what we are trying to avoid. Green hydrogen is the only environmentally acceptable form we should even consider using. Once you have the hydrogen, the only environmentally friendly way to use it is to convert that hydrogen to electricity by use of a fuel cell. However, a hydrogen fuel cell is only about 50 percent efficient, while lithium batteries are 85 to 90 percent efficient. Therefore, hydrogen fuel cells should only be used in applications in which batteries are not practical, such as in long-haul trucking. Regarding burning hydrogen and power plants, Sierra Club feels strongly that this is not a climate-friendly process. Currently, power plants can only use blends of hydrogen and methane with a maximum of maybe 30 percent hydrogen. This will still create lots of carbon dioxide. In addition, burning these blends creates much more nitrogen oxides that lead to smog and detrimental health effects compared to burning methane. It is simply not a good idea to burn hydrogen in our power plants. In summary, the Sierra Club position on hydrogen is: use only green hydrogen in limited applications for which direct renewable energy or battery technology is not suitable, and hydrogen should not be burned for power until we have technology that can accommodate 100 percent hydrogen. (Agenda Item II C)

BPS:

There are no additional callers to provide public comment at this time.

AGENDA ITEM III—APPROVAL OF THE MINUTES FOR THE MEETING ON APRIL 17, 2024

Chair Harris:

We will move on to the approval of the minutes for the meeting of April 17, 2024.

SENATOR DALY MOVED TO APPROVE THE MINUTES OF THE MEETING HELD ON APRIL 17, 2024.

VICE Chair WATTS SECONDED THE MOTION.

THE MOTION PASSED UNANIMOUSLY

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AGENDA ITEM IV—PRESENTATION ON THE 2024 INTEGRATED RESOURCE PLAN

Chair Harris:

We will now turn to a number of presentations related to the study of hydrogen and hydrogen technologies in Nevada. We will also hear a number of presentations related to energy, renewable energy, and funding. Let us go ahead and begin with the first presentation on the 2024 Integrated Resource Plan (IRP). We have representatives from NV Energy here today presenting from Las Vegas.

Ryan Bellows, Vice President, Government and External Affairs, NV Energy:

We are excited to walk you through a preview of our IRP filing we are going to be making at the end of this week. This is our IRP, so Mr. Atkins has already presented a preview to our stakeholders. There was a stakeholder briefing a week ago today, so this will be another preview in his speaking tour. (Agenda Item IV)

Ryan Atkins, Vice President, Resource Optimization, NV Energy:

My purpose is to walk you through, at a high level, the major items that are going to be included in our upcoming IRP filing, which will be made this Friday.

Our IRP process—NV Energy is required to file a full IRP at least every three years. We are able to make amendments in between those filings, but those are smaller in scope. This is a full filing, a full overhaul of our load forecast, all our resources, our demand side management plan. It is a robust filing that will be coming out. This filing is going to outline the future electric needs for the State of Nevada, a lot of the growth we are seeing throughout Nevada, and a balanced approach we believe is the best way to meet those growing needs that are going to balance affordability, reliability, and sustainability for our customers.

One of the real keys of this upcoming filing is going to be the load forecast. For a little context, the peak load our company has seen was under 8,400 megawatts. We experienced that in the summer of 2021 when Las Vegas hit an all-time record of 117 degrees. That is the highest we have seen. Our updated load forecast is showing loads of close to 10,000 megawatts by 2030, so significant growth in the next five years. That is what we have to figure out how to solve, essentially. That load forecast is somewhat conservative. We also present a high load forecast scenario in this filing. I am sure you have seen all the news articles talk to different companies. Data center growth is all over the news. There is a lot of interest, especially in the Reno area. We could see a load forecast that comes in much higher than what we are presenting, but we have to strike a balance of, what do the customers think they are going to bring to the table? What do we think is going to be realistic? How early do we need to start building out the infrastructure to ensure that customers and business can continue to come to the State of Nevada?

In addition to some of this data center load growth, obviously the electrification of the grid, specifically, electric vehicle (EV) growth—in general, the residential growth throughout the State. We have a favorable economic environment. We continue to see aggressive growth on the demand side. In order to meet this demand and ensure Nevada stays open for business on the electric side of things, we are proposing in our preferred plan four key projects on the energy supply side. Three of those are renewable. They are solar paired with battery. In total, those three projects equal 1,028 megawatts. There are 1,028 megawatts of solar resources we are proposing and 1,028 megawatts of battery storage resources that are tied to that solar. They are co-located at all those facilities. Our all-time peak was about 8,400. We are coming forth with a significant amount of new renewable resources to try to help meet that. In addition to the new growth I referenced, we are also trying to dig out of a hole we have been in for the past decade. In our filing, we call it the "open position." Essentially, this is our short position—the amount of energy we do not own that is needed in the summer to meet our peak demand. As we have come forward in previous filings, continued to request additional supply resources, a lot of that has been to catch up. Now, not only do we have to catch up, we have to meet this aggressive new growth we are seeing throughout the State. That is the purpose of coming forward with such a significant amount of resources in this filing. Those three renewable resources are all power purchase agreements. None of the three are company-owned renewable assets. In addition to these three resources, we are bringing forward two gas units that will be located at the North Valmy Generating Station in Northern Nevada. In total, these two units equal just over 400 megawatts. They quick start in capabilities. They are essentially peaking units, so they can be turned on and running at a high level in ten minutes. The nice thing about the location is that there is no new gas pipeline infrastructure that is going to be needed because a new gas lateral is already going to be constructed for the conversion of our last

coal unit at Valmy that is being converted into gas. The gas infrastructure will already be in place. We can add these two firm dispatchable units that can run any time and help to support the Northern Nevada system.

A couple of key notes about those gas units—the first is the capacity factor, or the amount the units are expected to run, is very low. In the first three years of those units' life, the capacity factor is under 15 percent, meaning it is running at less than 15 percent of what they could be running at. Beyond that, it drops down to under 10 percent starting in 2031 and beyond. That means these units are for peaking use. When we hit those 8,400 megawatt-type days when it is 117 in Vegas and 100 degrees in Reno, these can be used to help meet that need and ensure we are not relying on other States, other companies, sending power to us and hoping it arrives. The other piece is we have been working with the turbine manufacturers to ensure there is the capability for burning a hydrogen mixture. Right off the bat, these turbines are capable of burning up to a 15 percent hydrogen mixture with the goal of continuing to work with the manufacturer to reach 100 percent. The capability—if and when hydrogen supply becomes available, we have the ability to transition at a later date. With these resources in the preferred plan, if they are approved, would take our short position in 2028 and 2029 to under 500 megawatts. Historically, what we have been dealing with is an open position in excess of 2,000 megawatts. That is energy that must be bought off the open market at very high prices, and there is no guarantee it is going to be delivered within our State.

There is also discussion in the filing about future "placeholders." We do not have contracts in place yet, but we believe there is some viability to those projects in the future, and we plan to pursue those. We have these placeholders that are renewable, so additional solar and battery. We are also looking at opportunities to try and bring some out-of-state wind potentially in from Idaho based on some new transmission lines that are getting built and have some momentum throughout the western region. There will be discussion in the filing about those resources as well. That is our preferred plan—those four resources. We will also present an alternate plan for the Commission to review. That alternate plan is essentially the same, except it does not include the gas peaking units. That plan is more expensive without the gas peaking units based on the modeling results, but we present that as an alternative for the Commission to consider. We also present a no-open position plan, which means that we have no short position; we fill it with whatever resources we can. That is the third most expensive plan for customers. Fourth, we also present a low-carbon plan, which is required to meet a certain percentage reduction in carbon emissions. That is the most expensive plan of all four, largely due to a high need for additional battery resources and no ability to add a fossil. In addition to the supply resources in this filing, we will be indicating our intent to join the California Independent System Operator's (ISO) extended day-ahead market. We currently participate in what we call a real-time market. Every hour, basically the entire West works together, and our resources are optimized across a wide footprint. The next step to that is to take it to a longer term—looking, instead of next hour, now we are looking at tomorrow and the day after that and how can different states and entities pool their resources to better optimize and realize additional benefits for our customer. So, our plan is to join California's day-ahead market. We will be coming forward with a filing later this year to the Commission seeking official approval to do that, with the go-live date expected in early to mid-2027. Obviously, with the supply projects and the additional load growth, there is going to be the need for more transmission infrastructure. There are about 22 different transmission projects throughout the State that will be presented in this filing for a variety of needs and reasons at different cost levels.

We also will be bringing forth the Greenlink Nevada transmission project for continued approval with updated permitting information that came down and updated costs that have

come out of that as well. That will be in the filing. The company still believes and presents a robust portion of the filing that is dedicated to Greenlink—the reliability benefits, the renewable development benefits, and the economic benefits of why the project needs to continue to go forward. We will be bringing that forward and seeking that continued approval.

Finally, there is an entire section of this dedicated to demand-side resources, distributed resource plans, and transmission electrification. In there, there will be details on continuing and evolving those plans, continuing with the virtual power plant idea of our smart thermostat program, walking through the proposed budgets that will continue going forward behind the meter storage that will be outlined—a whole number of factors on the demand side management (DSM) that will be part of this filing as well. With that, I will see if there are questions.

Chair Harris:

We do have a couple of questions. First on my list, I have Assemblywoman Brown-May.

Assemblywoman Brown-May:

I appreciate the information. I have a couple of questions. First, you talked about data centers and the load growth and how we are already digging ourselves out of a hole we have been in for the last decade when it comes to energy purchase. Can you talk about prioritization of industry versus our residents? It is true we need to keep Nevadans working, but I am curious to know, as we look at the priority of starting new businesses or growing business we have, are we being thoughtful in the same way we would about water consumption? We are not going to start a bottling plant in Nevada because we do not have water. Are those considerations being given relative to new industry we are bringing into the State?

Mr. Atkins:

We are. We have dedicated teams working with these new large customers, these new large industries, and walking them through what realistic timelines are, what can be accomplished without compromising the integrity of other needs throughout the State. So, new residential growth, for example. We do work on that. We do keep that in mind. We also are working and continue to evolve different contractual options in place to ensure that not only the company, but its other customers are protected if any of these large customers were to be delayed or simply not show up. On the financial side of things as well, we are ensuring there is going to be appropriate protections in place for all others involved.

Assemblywoman Brown-May:

I would like to continue that conversation as we move forward, and I am interested in seeing all the detail in the IRP you are presenting. The second question is about your number four option, which is the most expensive for ratepayers—the low carbon plan. What consideration are we giving to the environment as we are putting the plans together, understanding that there are multiple priorities, energy, accessibility, and reliability being three of them? But also, if we cannot breathe and everybody has asthma, how are we utilizing the considerations for a healthy environment while we are producing energy?

Mr. Atkins:

It is a puzzle that is challenging to solve. Those three pillars I mentioned, the reliability—keeping the air conditioners running in the summer, keeping the lights on—the affordability for customers, and the sustainability, this piece you brought up—all State requirements from a renewable perspective—the renewable portfolio standards (RPS), for example, that goes to 50 percent by 2030—the generation that is being produced must come 50 percent from a renewable resource. All our plans meet that RPS requirement. That is a hard limitation we put in our model that at this time for us is nonnegotiable. In the hearings from our fifth amendment to the IRP filing, some interveners asked, "Why could we just not meet the RPS requirement?" For us, the State goal is to move forward with those. The company is working to meet those, and all our plans are required to meet that. That is our base. We must meet that. Our modeling software is going to incorporate the available renewable resources to meet that and then ensure it is the most affordable plan beyond that.

Vice Chair Watts:

Thank you both for the presentation. I have a couple of questions. You discussed the transmission, that there are about 22 projects. I was wondering if you could give more indication of what those projects are, the scope of what they are. And then, related to Greenlink, there has been some previous regulatory and legislation related to the Greenlink project. Could you give us more detail on what is coming back in the IRP related to Greenlink? I know there have been cost estimates previously. If you could give us additional information on the transmission components.

Mr. Atkins:

Starting on the Greenlink piece of it—you are right; that is an already approved project. We got approval from the Commission. That involves the Greenlink North segment running east to west across Northern Nevada, and the Greenlink West segment running north to south from the Reno area down to Las Vegas. We have gotten more into the details, the construction, the permitting. There certainly have been changes that have come about that have necessitated changes, whether it is the route itself or the type of towers that must be used. There are updates that are impacting the costs. In addition, inflationary pressures, whether it is on material—steel, aluminum, et cetera—and labor. When this project was approved in 2019, these were costs that were based on 2018 and 2019 figures, pre-Coronavirus Pandemic of 2019 (COVID-19), pre-extreme inflation. It is bringing this back, informing the Commission that we have looked at alternatives. This is still the best option from a cost perspective and from a benefits perspective, but we want to present the change in the routing in the path, in the materials, and in the cost and want to ensure the Commission feels it is still a prudent project moving forward at those updated costs. The timing has not changed; it is those updates that are going to be brought forward. There is some analysis of alternatives. There are comparisons to other transmission projects, other inflationary issues, that have been seen across the industry within the United States—trying to paint that picture that unfortunately, this was unavoidable from a cost perspective, and there are no additional costs that are being incorporated into the project that could be left out. For the smaller projects, it is the large load pockets within the State, connecting some of these new transit supply resources to the grid. The projects for these large customers we are talking about, getting everything set up and ready to handle that on the system. I do not have the list in front of me, but every one will be outlined in the filing.

Vice Chair Watts:

Following up on that, recently the Federal Energy Regulatory Commission (FERC) issued an order related to transmission—I think it was order 1920. That came out relatively recently. I am wondering to what extent that was factored into this plan, or is that going to be something that is going to be factored in on a going-forward basis when looking at transmission projects and specifically, our grid-enhancing technologies and reconductoring things that were looked at in the development of the transmission aspects for this plan?

Mr. Atkins:

The recent orders that have come out will be included in future filings. Our transmission team—anything that has been officially put out, made public, would have been incorporated in the planning process, but anything that recent would be for future filings. We have been working on this for 9 to 12 months. A lot of that process has started well before this came out.

Vice Chair Watts:

Moving on to the gas plants. Can you talk about how that was split up between the proposal and the fifth amendment which was approved? And then the components that are proposed in this Plan and the difference in when the already-approved portion would come online versus these new proposed peakers?

Mr. Atkins:

In the fifth amendment, the "refuel project," as we call it—the intent of that was to ensure we could retire the last of our coal plants in the State and do that by the end of 2025, which was the goal of not only the company, but the Commission. That refuel process is scheduled to start in the fourth quarter of 2025. There are two units. The first coal unit will come offline, and they will begin the refuel process of that unit. Once complete, the refueled unit that can run on natural gas will come up, and the second coal unit will come offline in the first quarter of 2026, and then that refuel process will be completed. By the second quarter of 2026, both units should be completely running on natural gas, and our company will be divested of all coal generation at that time. These plants would be coming online for summer of 2028. That aligns with—if you are familiar with the WRAP, the Western Resource Adequacy Program—it is a region-wide resource adequacy effort bringing all states and utilities together in the west to enhance reliability for the region. Our first binding season, as they call it, is summer of 2028, so we are trying to get resources online in time. You must come to the table balanced. You must have enough resources to participate. That aligns with that summer of 2028 time frame. That would be the schedule.

Vice Chair Watts:

I look forward to reviewing the filing, and I am interested particularly in the battery alternative. I understand there is a cost differential there, but I am glad that is brought forward as an alternative, as something that does not involve additional fossil fuel generation. You mentioned leaning in and continuing to develop the virtual power plant options. I am aware of the smart thermostat program. Are you looking at expanding that into other things like smart technology to manage EV charging or potentially managing water heaters? Are there other elements you are looking into to expand the overall impact of virtual power plants or that load management?

Mr. Atkins:

I will caveat this. I am not the expert on that specific area, and I am likely going to defer most of this to the filing, but the answer is yes, there is discussion of that. Vehicle to grid, for example, is a big component going forward and something we are going to be focused on. There is that and looking to expand smart thermostats to the commercial space—all of that. We are looking to grow, and a lot of that is outlined in this full component of the filing. I do not have all the answers, and I do not want to dig a hole and give you something incorrect.

Vice Chair Watts:

I understand we are keeping it high level. I can follow up offline with other staff about that. Can you discuss how this Plan has complied with the provisions of AB 524 from last session? You mentioned one of those provisions, which is the fully closing the open position alternative, which sounds like was on the higher end on the cost analysis. We have other provisions that were not directly related to the Plan, but there is stakeholder engagement. If you could talk about how the development of this Plan has taken into consideration the aspects from that bill.

Mr. Atkins:

A big focus of that bill was on stakeholder involvement and limiting or eliminating the use of amendments in the IRP process. On the first piece of it, we have done our best—this came late in the process—to try to be more engaged than ever with our stakeholders. We did hold a public consumer session, and we held two additional stakeholder briefings between then and the filing. The first one was a high-level, here is what we are working on, here is the load forecast. The last one, which was last week, talked exactly about what we are talking about—the specific resources we requested, everything that is going to be in that filing. In addition, my team and I have had a number of one-on-one discussions with different interested parties that had questions about the process, whether it be our modeling process or what the plans are going to look like. We have worked to start to build and improve those relationships with stakeholders. From a future amendment perspective, you see by the sheer amount of capacity we are requesting, we are trying to look long term. We are trying to plan holistically, so we do not have to come in with the number of amendments we have seen in the past. We have talked with stakeholders about this. If there is an opportunity for a renewable purchase power agreement, for example, that could fill in one of these placeholders we have named in the future, and we need to come in and get approval for that. Could that necessitate an amendment? Potentially. We have received general support if that is the narrow scope of that, but our plan was to come in with enough resources, with an up-to-date load forecast, where this is looking far out, where we do not have to come in with the number of amendments we have in the past.

Assemblywoman Gallant:

You have mentioned affordability multiple times. What does that look like, moving 50 percent to renewable energy? It requires a lot of infrastructure. You have discussed you are going to be making some changes. What does that affordability look like for the consumer, and how is it measured? Also in terms of what the median income is, is that being factored in it all?

Mr. Atkins:

Two points on that. We will continue to see rates decreasing through the balance of this year, which is going to help that affordability piece of it. Within this filing, we have enhancements, more analysis, on the rate impacts of the projects. We have the rate impacts of the DSM plan. We did try to be more transparent on what the rate impacts are to customers on the plan. On that one, it is very in-depth, and I do not want to misspeak. I would say within the filing though, there is going to be discussion on what the rate impacts to customers look like based on the plans and the projects.

Mr. Bellows:

I would add a couple things in response to that question. I think one of the things Mr. Atkins talked through is that as we add resources that are available to us, that lessens the number of market purchases we make. We were here a couple of months ago when we talked about rates increasing over the last year. We are tied specifically to those market purchases we had to make, so this will put us in a position to drive affordability and stability for customers as we bring on these resources. The second thing I would note is that it is a balance between affordability, reliability, and sustainability. I think one of the big sustainability pieces that makes it more affordable is the Inflation Reduction Act (IRA) that was passed. These renewable projects that are being brought on, customers will see every penny of those tax savings that will be passed on, so those are significant savings that make these projects pencil out.

Chair Harris:

Any additional questions? Not seeing any. Thank you, Mr. Bellows, Mr. Atkins, for giving us that overview.

AGENDA ITEM V—PRESENTATION AND OVERVIEW OF SENATE BILL 451 FROM THE 2023 LEGISLATIVE SESSION

Chair Harris:

We will move on to the next item on our agenda, which is a presentation and overview of SB 451 from the 2023 Legislative Session. We will have our Committee Policy Analyst, Ms. Kristen Rossiter, give that presentation. However, as we begin this presentation on SB 451, I would like to take a moment to acknowledge the presentations we hear today will serve to study hydrogen as required by SB 451. At our meeting today, we are fortunate enough to have the expertise of a variety of industry leaders, scientists, and educators, as well as representatives of organizations dedicated to protecting our environment—all here to share their knowledge and areas of focus and concern related to hydrogen in Nevada. In addition to the presentations made today, there are many additional resources and items submitted for the Committee's consideration on the meeting webpage, which have been uploaded for review and will be incorporated as part of this study. I encourage everyone to review these materials. With that, Ms. Rossiter, please proceed whenever you are ready.

Ms. Rossiter:

In summary, SB 451 directs the Joint Interim Standing Committee on Growth and Infrastructure to conduct a study during the legislative interim concerning the production and storage of hydrogen, the use of stored hydrogen as a potential energy resource in Nevada, and the development of hydrogen technologies. The bill was sponsored by Senator Spearman and cosponsored by Senators Hammond, Hansen, and Stone and was

heard by the Senate Committee on Growth and Infrastructure and by the Assembly Committee on Ways and Means. Senate Bill 451 was approved in the Assembly with a vote of 42 in favor and none opposed. In the Senate, the bill was approved with 21 in favor and none opposed.

As identified in the bill, the Committee is to report the study results, including any recommendations for legislation to the Director of the LCB for transmittal to the next legislative session on or before January 1, 2025. In conducting the study, the Committee shall consult with and solicit input from the Nevada System of Higher Education (NSHE), the National Renewable Energy Laboratory (NREL), existing energy industries in Nevada, developers of clean energy, nongovernmental organizations that focus on energy conservation, utilities that provide gas and electric services, and professionals with expertise regarding the use of hydrogen and stored hydrogen and the development of hydrogen technologies.

The study must include, without limitation: a review of opportunities for students enrolled in an institution within NSHE to study subjects concerning hydrogen, including the process for the production and storage of hydrogen and any methods and technology used in such a process and hydrogen technologies; and an assessment of the feasibility of using hydrogen as an energy resource in Nevada including, without limitation, consideration of: the potential for hydrogen and stored hydrogen to enable the operation of zero-emission light and medium-duty vehicles as well as other modes of transportation identified in the bill; the potential for using wastewater and wastewater treatment facilities for the production of hydrogen; methods for incentivizing the use of hydrogen and stored hydrogen as energy resources in Nevada; economic and regulatory barriers to the implementation of hydrogen and stored hydrogen as energy resources, including whether policies incentivizing the production and storage of hydrogen as energy resources and hydrogen technologies are comparable to policies incentivizing the production of other energy resources and applicable technologies in Nevada; opportunities for federal and nongovernmental grants that may be available for the purposes of producing and storing hydrogen in Nevada; the potential for using hydrogen micro grids, stored hydrogen microgrids, and hydrogen coupled with distributed energy resources to strengthen the resilience of the electric power grid; the impact of hydrogen production on water resources; the impact of limited water resources on the production of hydrogen and its potential as an energy resource; and the long-term impact of various methods of hydrogen production on the air, water, and other natural resources and the potential for hydrogen to assist with decarbonization efforts in Nevada.

Finally, to complete the study, the Committee may enter into a contract or other agreement with the University of Nevada, Reno (UNR), the University of Nevada, Las Vegas (UNLV), or the Desert Research Institute (DRI) to gather data concerning the feasibility of hydrogen and stored hydrogen as energy resources and produce a cost-benefit analysis of hydrogen as an energy resource. This concludes a summary overview presentation on SB 451. (Agenda Item V A-1)

[Ms. Rossiter also submitted supplemental information for the record. (Agenda Item V A-2)]

Chair Harris:

Thank you. We will now jump into the substance. We will move on to a presentation and update on the virtual round table discussions that were held outside of this Committee related to hydrogen that will be done by the bill's sponsor, Senator Pat Spearman.

AGENDA ITEM VI—PRESENTATION AND UPDATE ON VIRTUAL ROUNDTABLE DISCUSSIONS RELATED TO HYDROGEN

Chair Harris:

Senator Spearman, go ahead and begin whenever you are ready.

Senator Pat Spearman, Senate District 1:

Thank you, Chair Harris. I would like to thank you for the opportunity to present the findings of our virtual roundtables. Many of you know my interest in advancing renewable energy opportunities in Nevada as part of the global effort to reduce greenhouse gasses, or GHG. My interest and passion were developed during my time as a doctoral student, and my doctoral research focused on global energy policies. The passion was expanded when I was selected to attend the NREL's Executive Energy Leadership Academy. Throughout my time in service in the Nevada Legislature, I have been interested in playing an active role in advancing and promoting clean, renewable, and alternative energy sources. I might also add that underlying all the passion and the interest in this is the time I spent in the military. Most notably, my last assignment at the Pentagon where we were engaged in two wars: one in Iraq and the other in Afghanistan. The statistics are staggering, but it is not the statistics that fuel my passion; it is the names, the faces, and the families behind those. Six out of every ten deaths in Iraq and Afghanistan were related to fueling, guarding, or transporting energy, so my passion is about speaking for those who cannot speak for themselves and for the families who, for every year hereafter, will always have an empty seat at the table because we were not willing to explore and expand our opportunities in renewable energy.

By expanding the use of solar, geothermal, and electric power technologies, the great potential for hydrogen technologies is becoming clearer every day. In order to explore the potential use of hydrogen in Nevada, I sponsored SB 451 during the last legislative session, which requires the Joint Interim Standing Committee on Growth and Infrastructure to conduct the study concerning the development of hydrogen technologies and the use of stored hydrogen as a potential energy resource in our State. As a sponsor of SB 451, it was my goal to bring about inclusion and create opportunities for interested groups to participate in this study, as well as bring forward any policy recommendations to this Committee. For this reason, I hosted two virtual roundtable discussions this spring. These virtual roundtable discussions brought together individuals and organizations concerned with the potential use of hydrogen in Nevada to begin identifying issues for the Committee to consider. I would like to share that invitations for this meeting were sent out to individuals and organizations who expressed interest both in support of and opposition to SB 451 during the 2023 Legislative Session. The first roundtable was held February 15, 2024, and was attended by more than 40 individuals. The second roundtable was held on May 21, 2024, and had over 30 people in attendance. I have submitted a summary memo to the Committee that provides an overview of both virtual roundtable discussions. (Agenda Item VI A-1) Key questions asked included, is hydrogen a viable energy source for the RPS? What are the reasons to support hydrogen development? What are the reasons to oppose hydrogen development? Key discussion points raised included solar energy and an increase in electrification are two primary components of our renewable energy portfolio that exists today, but they are not enough to meet our State's renewable energy needs. Natural gas is renewable, but it is produced outside of Nevada, and we are subject to cost increases because we do not here in Nevada have an indigenous-based load. Supply chain issues can affect renewable energy resources, and diversification is important. Hydrogen provides an opportunity to create jobs and spur economic development. Hydrogen is a key resource for decarbonization. The terms clean and green hydrogen are important to define.

Environmental concerns and water usage related to hydrogen need to be considered. It is important to look at the desired end uses of hydrogen and their applications. Additional infrastructure may be needed in order to advance hydrogen technologies, and hydrogen needs to be developed safely and may not easily replace other energy resources. Finally, participants were made aware of the Committee meeting today and were asked to share any written comments or recommendations for future discussion and to submit them to the Committee website for consideration.

The development of hydrogen as an energy resource represents a real opportunity to diversify our energy portfolio. It taps an underutilized resource and presents clear opportunities to reduce carbon emissions. I am confident the presentations you will hear today will raise awareness of these opportunities. However, as highlighted in the discussions held at the virtual roundtables, there are many varied interests and opportunities when it comes to hydrogen development, and it will be important for any policies and legislation to reflect this. As I conclude my remarks, and in order to highlight the potential of hydrogen, I would like to highlight an exhibit I have uploaded as part of my presentation. (Agenda Item VI A-2) This will share with you an overview of how hydrogen fuel cell technology has evolved into commercial applications following the initial use of fuel cell technology for NASA's Moon Shot initiative. Many of you here today may not have been present to hear the words, "One small step for mankind and one giant step for humanity" or something like that in 1969 when we went to the moon. Here is a portion of an article published in January of 2024 giving insight to the genesis of hydrogen technology and commerce. I highlight this because it is important for us to understand that hydrogen, contrary to some opinions, is not new technology. I quote:

> When NASA started investing in fuel cell technology in the 1960s, the rest of the world was still content to be powered by fossil fuels. The simple imperative that drove NASA to explore new ways to generate and store energy was the crushing cost of launching mass into space: somewhere in the order of $10,000 per pound. NASA's interest in fuel sales had nothing to do with alternative energy—we didn't have any alternative," said John Scott, NASA's principal technologist for power and energy storage. "We had to make them work in order to fly the Mission."

Another article from *POWER: News and Technology for the Global Energy Industry*:

> The Daesan hydrogen fuel cell power plant is a near-zero-waste operation, according to Hanwha Energy. The fuel cells generate up to 120,000 metric tons of water vapor per year as a byproduct. This vapor is condensed and pumped back to Hanwha Total Petrochemical. Highly efficient microfilters are installed on the fuel cells to make the plant even greener.

Another article, "A green hydrogen economy for renewable energy society"—here are some highlights:

> Green hydrogen is uniquely equipped to decarbonize sectors which do not have green alternatives. A hydrogen economy is an essential secondary energy economy to realizing a majority renewable energy society. Early implementation of hydrogen will be in the current chemical synthesis market. Hydrogen will penetrate the transportation and buildings and heating sectors in the midterm transition towards 100 percent renewables. Hydrogen will be necessary seasonal storage technology in the long term.

From another article—and I found these articles, and I can submit the links for the Committee to be posted as well. I got these from Google Scholar, which is a website that hosts academic presentations of research that have been conducted. According to a recent report by *Deloitte*, the market for green hydrogen is projected to be worth $1.4 trillion by 2050 with decisive climate action potentially making green hydrogen cost competitive within a decade. Moreover, such action could lead to the creation of around 2 million jobs globally each year between 2030 and 2050.

From a study on public acceptance of hydrogen portfolio standards for renewable energy expansion, here is a comparative analysis of hydrogen production mix plans:

> The Korean government introduced the world's first Hydrogen Portfolio Standard (HPS) into the energy market... Although the public accepted HPS itself, they preferred a higher proportion of fuel cell generation when the fuel cell was operated through clean hydrogen (blue/green hydrogen). Specifically, the marginal willingness to pay values for a 10 percent increase in fuel cell generation when changing from gray hydrogen to blue hydrogen or green hydrogen were estimated to be, in U.S. dollars, $1.94 and $2.97 respectively. Further, the acceptance of green hydrogen-based HPS rises along with the expansion in the HFC [hydrogen fuel cell] generation share. Thus, to expand the fuel cell generation in the national energy mix, transition to a clean hydrogen-based energy system should be attached.

I would also like to end this by saying in Korea, as we speak right now, there is a hydrogen fuel cell plant that is located in Seosan in Korea. My first tour was in Daegu. This is a little north of Daegu, and it is a little south of Pyeongtaek, which means that it lies in an area that is like many of the rural areas we have here in Nevada. That plant generates enough power to power 160,000 Korean homes. Last week, I was in Canada for the National Conference of State Legislatures (NCSL) Energy Supply Task Force meeting, and we toured a hydrogen plant facility. They are doing remarkable things with respect to carbon capture. In March, I was able to visit a hydrogen plant in Germany as part of the Aspen Institute research team. They, too, are doing phenomenal things with hydrogen. I do not have any illusions that this will be something we will jump into 100 percent, but I would like to say the hard work of the Committee, both those people who were for implementing hydrogen or using hydrogen and those who were opposed—we met somewhere in the middle and had a recommendation: let us start with transportation because there is absolutely no lithium battery big enough to charge or to power an over-the-road vehicle.

Finally, in 2022 and 2023, the Federal Bureau of Investigation (FBI) has shown us statistically that there has been a surge in attacks on our grid, so unless we are willing to look at other resources in terms of renewable energy, we will always put ourselves at risk for people who want to take down the grid. Christmas Day of 2022—the folks in Washington were trying to repair the grid because someone took it out with a BB gun. The interest in looking at hydrogen as one of those renewable energy resources is because we cannot build a grid big enough to power all of the electrical items or entities we are now sponsoring. We are pushing EVs. Everybody has a cellphone; everybody has a tablet; everybody has a computer. We have lights and TVs. If we do not look at other ways to find resources so we can power this, we will continue to lean solely on one aspect. At that time, we make ourselves as vulnerable to the bad folks that do not like us as we were in 1973. Many of you here may not remember that. Maybe you have read about it, but in 1973 when Arab Petroleum Exporting Countries (OAPEC) decided they were not going to give us all of the oil we needed. My interest in making sure we look at this realistically and academically is, number one, we owe it to all service members who are constantly being put in harm's way to protect our way of life. Number two, we have to make sure we are looking at all possible

resources for renewable energy so we can meet that standard of 50 percent by 2030. I also believe that if we do not look at expanding and using hydrogen in some form of clean and renewable energy, we will rue the day we did not do that. With that, I will stand for questions, and there are people that are a lot smarter than I am here that will answer the technical questions that I cannot answer. But I stand for questions in terms of what the virtual roundtables did, what we hope to happen, and what I hope will happen in the next legislative session.

Chair Harris:

Thank you, Senator Spearman. Are there any questions from Committee Members? Senator, not seeing any, we will go ahead and turn it over to some of our other presenters for the day.

[Senator Spearman submitted a list of links to articles regarding hydrogen for the record (Agenda Item VI A-2).]

AGENDA ITEM VII—PRESENTATION ON THE HYDROGEN LANDSCAPE IN NEVADA

Chair Harris:

I will invite Ms. Bekemohammadi to present to us. Go ahead and start whenever you are ready.

Roxana Bekemohammadi, Founder and Executive Director, United States Hydrogen Alliance (USHA):

I will be discussing the hydrogen landscape in the Silver State, and I would love to address any of the questions you may have especially brought up from our previous presenters as well. I have a chemical engineering background and can speak to the technical aspects of this technology.

First off, the USHA is a hydrogen business trade association that is focused on spurring hydrogen adoption across the U.S., state by state. We like working with policymakers on a state-by-state basis on the advantages of hydrogen, ensuring we have as many harmonized policies as possible across all 50 states. We believe hydrogen can spur great decarbonization across the country. I want to also state that Southwest Gas and Ballard Power Systems have been actively working in the State in deploying hydrogen technologies and decarbonizing activities in the State. (Agenda Item VII A-1)

All of us have a great task of moving away from fossil fuels, becoming architects of this new energy system as well as transportation. What is difficult is, from a physics perspective, fossil fuels are quite magical. It is hard to replace it. There is no silver bullet to replace it unfortunately, so we do need to architect by looking at the puzzle pieces that it is going to take to create reliable and sustainable energy and transportation systems. As such, there was a recent McKinsey report that came out that stated that by 2050, hydrogen can meet 14 percent of the global energy demand, generate almost $1 trillion dollars per year, support about 3.5 million jobs, reduce carbon emissions by 16 percent, and reduce nitrogen oxides (NOx) emissions by 36 percent. Now, this is on a global scale, and we are also seeing the fact that hydrogen is a significant puzzle piece and the way we need to move forward as a nation. We are replacing incumbent technologies that utilize fossil fuels.

This is so important that the U.S. Department of Energy (DOE) actually identified what they call H2@Scale. They looked at all the different ways hydrogen can decarbonize the electricity grid, help promote more renewables coming onto the grid by serving as a long-term energy storage medium as well as a clean energy generation tool, in addition to decarbonizing industrial processes and our transportation sectors. That is why in the Bipartisan Infrastructure Law (BIL), there was $9.5 billion that was allotted for hydrogen, with $7 billion of that $9.5 billion going to clean hydrogen hubs. There were seven regional hubs that were awarded. Unfortunately, Nevada's application was not awarded. However, I would like to say that what is known as the Southwest Clean Hydrogen Innovation Network (SHINe) application, which was an application that was done in conjunction with this State as well as Arizona, brought together public, private, and tribal organizations to produce, deliver, and store hydrogen. We also have Southwest Gas that worked with UNLV to study how hydrogen blending into the natural gas system could help reduce carbon emissions. We highly suggest the State continues to support this effort. Even though the application did not win, we do believe there are activities that are still occurring that can be supported. This was a year-and-a-half long endeavor to put this application together. The stakeholders are working closely together, and we highly suggest that they are supporting policies that help promote this hydrogen ecosystem that can be developed in the State.

The federal administration has identified hydrogen, especially these clean hydrogen hubs, as a means to help support the country reducing by half greenhouse gas emissions from 2005 levels by 2030, as well as achieving 100 percent carbon pollution-free electricity by 2035. Hydrogen can serve in multiple roles. You can learn more about the hydrogen hubs via a fact sheet our organization has put together. (Agenda Item VII A-2)

We want to discuss hydrogen production. There are resources we can leverage, as well as biomass and biogas we can leverage, to produce clean hydrogen and even renewable hydrogen. Throughout this process, hydrogen can be stored for long durations—seasons at a time—and currently, batteries can only store those electrons for about four hours or so, but we can store hydrogen for seasons. We can then utilize that hydrogen to produce electricity again when there is demand, or we can feed industrial and transportation systems.

There are 21 ways to produce hydrogen. We believe every single region has its own special resources. Geothermal is a fantastic one, as well as biomass to produce hydrogen, so you are not limited. I am sure every State has more than one or two ways to produce hydrogen—so there is flexibility. I have mentioned before that hydrogen can serve as a long duration storage medium. When we have intermittent power and no way of curtailing those electrons, essentially it limits the amount of intermittent power sources you can bring onto the grid. With hydrogen, we can see a higher penetration of solar and wind on the grid.

Talking about production and local production—Air Liquide has built its North Las Vegas hydrogen production plant, which is the largest plant in the entire world. It produces 30 tons of liquid hydrogen per day, which fuels up to 40,000 light duty fuel cell electric vehicles (EVs). From my understanding, all the hydrogen being produced in North Las Vegas has been accounted for. That is a reflection of the demand for hydrogen in the U.S.

We also see hydrogen being utilized in the decarbonization of the natural gas system, specifically hydrogen blending into the natural gas system. Dominion Energy is experimenting with this currently in the State of Utah. Northwest Natural is experimenting with this in Portland, Oregon; specifically, using modern hydrogen's pyrolysis system where there is actually no carbon dioxide produced. The only carbon that is produced is solid

carbon that is used to decarbonize asphalt. We also have Southwest Gas, who has a pilot program where they are testing out hydrogen blending up to 5 percent.

Fuel cells, which utilize hydrogen, are electrochemical devices; these are the same things that are in fuel cell EVs. They are used for power generation, but they can also be used for resiliency for the grid. We are seeing massive disruption on the grid across the U.S. because of natural disasters, as well as other potentially harmful situations we do not talk enough about, like cybersecurity. Fuel cells have been a dependable backup power generation tool for the U.S. and were instrumental during Hurricane Sandy.

Hydrogen has also played a role in freight decarbonization. It is also playing a role in the heavy-duty application, like I mentioned before. The argument for me is—are we on the path to replacing diesel, bunker fuel, and jet fuel in a timeline that is acceptable for people, especially in disadvantaged communities today? Hydrogen and hydrogen fuel cells can do that now. We can deploy the long-haul trucks that are necessary to clean up our air and to reduce particulate matter. We can deploy that in the air, in off-road equipment, and in maritime applications.

We also see hydrogen fuel cells on the roads in the great State. We see the Regional Transportation Commission (RTC) deploying buses in Las Vegas. They have ordered 60 fuel cell buses. We also have buses that are being deployed in Reno; they are going to have eight by the end of 2024. These are powered by Ballard Power Systems, which is why I mentioned them before. This is going to be critical for the communities to have zero-emission buses operating in their communities. If you talk to any transit provider—and I am sure you can have this conversation with RTC—a fuel cell electric bus is a one-for-one replacement to a diesel bus, or a Compressed Natural Gas (CNG) bus. That is critical. I want to mention before I make this comment that every single fuel cell EV—fuel cells are electrochemical devices; they are like batteries except the fuel is held outside—all of them are hybridized with batteries. Because of the physics associated with batteries, it is impossible to have that one-for-one replacement. That is why my question to everyone is, do we want to replace diesel, bunker fuel, and jet fuel? Hydrogen is the way to do that, especially in the heavy-duty transport sector. I thank you all for your work in architecting the new energy and transportation systems in the State. I would love to answer any questions.

Chair Harris:

Committee Members, do we have any questions on this agenda item? [There were none.] Thank you for joining us today. We will go ahead and close out that agenda item.

[Ms. Bekemohammadi submitted a fact sheet on hydrogen terms to know for the record. (Agenda Item VII A-3)]

AGENDA ITEM VIII—PRESENTATION ON CONSIDERATIONS IN HYDROGEN DECISION-MAKING

Chair Harris:

I will go ahead and turn it over to you now, Mr. Chung, to begin your presentation whenever you are ready.

Mark Chung, Group Manager, Mobility Infrastructure and Impact Analysis Group, NREL:

Thank you, Senator Harris and Committee Members, for having me here today. My Group has a long name, but half of that team represents hydrogen system analysis—techno-economic analysis, specifically. My presentation today will cover hydrogen. Today we will talk about hydrogen considerations. I think a lot of the speakers before me covered really well the considerations to think about when adopting hydrogen as a potential decarbonization tool. (Agenda Item VIII A-1)

Today, the topics I am going to cover are end use applications, production and energy source considerations, infrastructure, cost and economic viability, and then to a lesser extent, the environmental and social considerations. I am not going to go over this in tremendous detail. As a couple of speakers pointed out to earlier, hydrogen is indeed a useful decarbonization tool; however, it may not be the appropriate tool in every situation. Here is a simple tree diagram to understand the decision-making process at a qualitative level—how to consider hydrogen for your end use application. This can be reviewed in your free time.

Next, we will talk about end use applications and what to consider when considering hydrogen for deployments. The key question here is, what are the alternatives? Direct electrification, in some instances, may be more viable or more economic. Electrofuels (e-fuels), biofuels, or other alternatives may also be available and more economic compared to hydrogen. Other alternatives—when you are looking at transport, industrial and chemical industries, and agriculture—these same questions can be asked across any demands, so careful consideration ought to be taken into account to assess the opportunities.

This shows a study we did at NREL a couple years ago called H2@Scale. Hydrogen can be produced from a variety of sources—renewable energies in particular—nuclear and/or fossil fuels that can be used inside the grid or can be stored in the middle via a short duration or even long duration of energy storage applications. It can also be transmitted to end use via gas infrastructure. Hydrogen can be applied to a variety of demand uses: transportation; synthetic fuels; upgrading of oil and biomass; ammonia and fertilizer; et cetera. This diagram shows the diversity of end use applications and the diversity of production sources that are applicable to hydrogen.

Many talk about hydrogen as being a Swiss army knife because of the multiple ways it can be produced, stored, and consumed. Yes, this is true, but at the end of the day, would you build a house with it? The only reason we have this image here is to make the point that hydrogen is useful on a case-by-case basis. You must carefully select which cases will make the most sense for hydrogen.

When we look at demand for hydrogen, this image shows the different waves of demand we see occurring over the long term. This comes from the Hydrogen and Fuel Cell Technologies Office's National Hydrogen Strategy Reports. The most advanced technologies, or the highest tier technologies, today can use hydrogen for things like forklifts, transit buses, off-road vehicles, heavy-duty trucks, ammonia, and refining. As technologies increase over time, we hope to see broader adoption of hydrogen across these other waves of demand. For example, sustainable aviation fields and steel production in the second wave and then possibly further down the road, industrial heat and blending, container ships, cement production, et cetera. The main point here is to show the variety of end uses that hydrogen can serve and possibly the different time frames we should consider deploying hydrogen, depending on the end use and the maturity of that technology.

To wrap up this demand section, hydrogen and its alternatives have limited niche applications, and they cannot compete with some near-term market alternatives. Evaluation of these alternatives will help ensure market viability in the immediate term to make sure projects are profitable and economic. The last key consideration here for end use projects is proximity and access to end users to justify the investment in infrastructure. As mentioned many times before, hydrogen is a light molecule and so inherently, it is going to be difficult and costly to transport long distances. It can be done; it is done today in pipelines, in gaseous tube trailers and liquid trucks, but transportation costs are a key consideration when deploying hydrogen technologies.

Next, I will talk about production and energy source considerations. This shows how people generally talk about hydrogen in regard to colors. The color scheme is useful, but here we are showing the different sources that hydrogen can be produced from and the modes of production. Anything from white production, which is naturally occurring hydrogen in geologic formations, to green hydrogen, which I think is a topic or focus for today—renewable energy-powered electrolysis—to fossil technologies, natural gas or steam methane reforming (SMR), and then blue technologies, steam reforming with carbon capture to capture the emissions from that production source. However, we do not like to talk about colors; we are engineers, so we talk numbers.

This graph on the X axis shows the life cycle carbon emissions in terms of kilograms of carbon dioxide per kilogram of hydrogen. On the Y axis is your production cost in terms of U.S. dollars per kilogram of hydrogen produced. On the right-hand side, we see this brown rectangle. Coal gasification without Carbon Capture and Storage (CCS) produces a high amount of emissions, anywhere from 17 to 30 kilograms of carbon per kilogram of hydrogen. As you work your way to the left-hand side, you have SMR without CCS—that is using natural gas reforming without carbon capture—produces between 10 to 17 kilograms of carbon per kilogram of hydrogen produced. Then you get into your less intensive processes. You have SMR with carbon capture. You have biomass with and without carbon capture. You have methane pyrolysis, which is heating up methane to very high temperatures and breaking the methane up into carbon and hydrogen. You have your electrolysis—producing that by splitting water that you need to be coupled with solar, wind, or nuclear. What is key here is these dotted lines show the willingness to pay from different industries. The dotted black line at the top is heavy-duty road transportation. Currently, we estimate that to adopt hydrogen in long-haul heavy-duty fuel cell trucks, the costs that people are willing to pay today will be somewhere between $4 to $5 or even $6 per kilogram at most. If we work our way down to different applications, we have aviation and maritime fuels. Their willingness to pay is about $3 per kilogram. Ammonia and steel, which is about $2. Lastly industrial heat, if you are using hydrogen to produce heat, that may be the lowest value product there, less than $2 per kilogram. This is meant to show the different carbon emissions of the different production processes that can be employed when producing hydrogen versus their cost versus the willingness to pay. This gives you a sense for the viability of a certain production process with its end use. However, this does not show transportation costs, and we will get into that later on.

Another key consideration for hydrogen production technologies is the supply chain. On the left-hand side, you have your upstream component of hydrogen—your production, whether it is proton exchange membrane (PEM) electrolysis, alkaline, solid oxide, SMR, autothermal reforming (ATR), et cetera. Then you have your midstream component, which is your transportation. Transportation by pipe—you need to think about compressors, liquefiers, storage tanks, tube trailers. Lastly on your downstream side, you have things to consider like refueling stations, whether gaseous or liquid, and then clean ammonia, for example. On the right-hand side, you have your different supply chain vulnerabilities. Red or orange are

your higher risk level supply chain areas, and then your green areas are where there is a low supply chain risk. I will draw your attention to a couple key areas. In the second column, we have domestic subcomponent supply base. You will notice it is red for PEM electrolysis—we currently do not have gigawatts scale electrolysis for PEM production, which may pose a risk if a lot of production is going into service soon, posing supply chain problems in the immediate term. Secondly, the column to the right in the third column—domestic equipment manufacturing capacity for alkaline electrolysis. The U.S. is not a major alkaline electrolysis manufacturer; that capability mostly belongs to China today. Lastly, this column on the left-hand side, point A, a lot of these bars are yellow—global raw materials. The key components that go into electrolysis units are also at risk. Our supply chain is not mature enough today to accommodate massive adoption. However, that is slowly changing.

To highlight the key areas to consider if adopting hydrogen technologies, what supply chain risk you might want to consider when deploying these projects, as these risks could pose problems to either procuring these materials or driving up the cost of these projects in the immediate term—key takeaways here—hydrogen is a flexible and potentially zero carbon emissions energy carrier, but it depends on the production pathway, its transport storage, and end use of application. Colors are used often, but I think to be on the same page, we should start talking about emissions in terms of kilograms of carbon emitted per kilogram of hydrogen produced. Lastly, availability, reliability, and sustainability of energy sources is critical for project viability in the long term.

Now let us talk about infrastructure considerations. This shows the different methods in which hydrogen can be stored. On the left-hand side, you have physical-based storage mechanisms. The first is geologic storage. That is literally underground or subsurface solar caverns typically, where hydrogen can be stored in very large quantities. This is done today—it is done in the natural gas business today, and it is done in the hydrogen business today as well. Working our way to the right, we have above-ground devices, compressed gas, or high-pressure cylinders, cold or cryo compressed cylinders, and liquid hydrogen. I want to make a point here that the most cost-effective way to store hydrogen in bulk is going to be your geologic or subsurface storage of hydrogen. When you get to your above-ground applications, the costs start to rise significantly. When considering your end use, storage is certainly going to be a piece of that. Scale will be important to make hydrogen economic in the longer term. Deploying these technologies, we have to consider about the scale of technology being used and what storage application might be most appropriate to reduce costs. On the right-hand side are material-based approaches. I will not cover this today, as these are relatively low technology readiness level (TRL) technologies and also quite expensive at the moment. But research and development is occurring at NREL and other places to help bring these costs down and make hydrogen more easily deployable when geologic storage is not available.

This shows your major transportation modes of hydrogen. You have gaseous cylinders that are transported behind a truck. You have liquid hydrogen, which is also in a large container where hydrogen is subcooled to a very low temperature to be transported longer distances, and of course, you have pipelines. On the x-axis, you have distance in terms of miles, and on the Y axis, you have volume of hydrogen in terms of tons per day. The key takeaway here is that when you move up this y-axis and it gets to higher volumes of hydrogen—50 tons per day and higher—pipelines typically tend to make more sense in terms of economies of scale. If you look at the bottom half of this graph—gaseous tube trailers, which are highly pressurized, or liquid tube trailers may be more economic, depending on the distance you have to travel to deliver that hydrogen as well as the volume. If you are looking at volumes as low as 1 to 10 or 15 tons per day, gaseous tube trailers are used; that is what is

frequently used today for short distances, low volume. But if you have to go long distances and low volume, liquid tube trailers generally tend to be favored.

Key considerations for infrastructure—development of hydrogen infrastructure can be costly, but it is also critical to achieving decarbonization goals. Lastly, centralized hubs provide an opportunity to optimize this and minimize the required infrastructure needed to be put in place to optimize deployment and delivery of hydrogen to end users.

Now we will talk briefly about costs and economic viability. When you consider costs, NREL has developed a suite of tools that is publicly available for folks to use to assess their project economics. I am going to highlight one tool here—H2FAST. This is our flagship financial analysis model; it is used to assess the financial viability of your project. Costs such as your capital costs and operational costs are important, and it would go into this model to help understand your net present value (NPV), rate of return, and economic parameters that any investor would consider. This helps determine economic viability. What is not noted in here is market demand. This is a financial analysis tool, but if you want to understand economic viability, having a firm offtake end user who is willing to pay for the hydrogen you are producing and transporting is extremely important as part of this process.

Lastly, market dynamics—regulatory rules are changing; risk has to be adjusted. What are your pricing risks? What are the macro-factors that might impact that? Then credit worthiness of your off taker. How credit worthy or financially viable are they to be able to continue to pay for the offtake of your hydrogen? Lastly, as we talked about earlier, supply chain risks or other considerations. A way to consider financial analysis for your projects, and NREL has a variety of tools to help with this.

What I did not talk about was costs. Economies of scale are extremely important. When we are looking at pipeline delivery, your cost on a dollar per kilogram of hydrogen is important for pipelines that can range from anywhere as low as 50 cents a kilogram to $1 per kilogram. When you look at liquid tube trailers, they are roughly $3 to $4 per kilogram. And then your gaseous tube trailers were somewhere between $3 to $5 a kilogram. This shows you the range of delivery cost you might expect for your hydrogen project.

Willingness to pay has been talked about a little in the past presentations, and this is a very important component. What we have here is a demand curve for a couple of different expected demand applications and their willingness to pay in dollars per kilogram of hydrogen. On the left-hand side is $0 to $5 per kilogram. We estimate that medium and heavy-duty vehicles are willing to pay somewhere between $4 to $5 per kilogram for your hydrogen. This is relatively high TRL technology. There are vehicles in service today, both medium and heavy duty—they could take the hydrogen. The question is, can you produce a fuel and transport it at a low enough cost that they are willing to pay for it? I will not go over these other demand sectors, but you can see their willingness to pay starts to drop as you work your way to the right-hand side. Your end user must be considered when you are financially planning your projects and assessing its viability.

Environmental aspects—there are a few things to mention here. Carbon emissions should be considered. Clearly, your mode of production will drive how many emissions you are producing. Hydrogen does have a global warming potential of roughly a little over ten, so it has ten times CO_2 global warming potential, which is important to know because hydrogen can easily leak in facilities if not properly abated or mitigated. Life cycle analysis—you have to do proper life cycle analysis on your projects. Land use and access—make sure that land use is being properly allocated to hydrogen projects and there may not be a better land use for that plot of land. Water usage is of concern; electrolysis consumes about four gallons of

water per kilogram of hydrogen produced. If hydrogen has scales being deployed in Nevada, and water is a scarce resource, this should be given careful consideration. Someone asked earlier about wastewater treatments for hydrogen production. Treating of wastewater for direct production of hydrogen is not technology that I am aware of today. However, there is a process known as anaerobic digestion of wastewater, which produces essentially renewable methane or renewable natural gas. This gas can then be used to produce hydrogen via a gas reforming process, but the gas that gets produced from this process tends to be very high cost, although the total life cycle emissions of it could be zero or close to negative at the end of the day. As far as technologies are concerned on wastewater treatments in production of hydrogen, that is the most advanced technology that I know of today. Lastly, there is waste and then sustainability as key considerations for hydrogen projects.

The speakers prior to me covered a lot of these other considerations we are talking about. I will end my presentation there and see if there are any questions.

Chair Harris:

Thank you. Committee Members, do we have any questions for Mr. Chung? Senator Daly.

Senator Daly:

Just a quick question on the pipeline application. I know there is a whole network across the country everywhere of pipeline for various use from jet fuel, natural gas, oil, et cetera. Is there a capability at some point to transition to use hydrogen, or would you have to build a whole separate pipeline? Or can you use one source and then switch to another? I do not know what those capabilities are, but I know there is a lot of pipe in the ground.

Mr. Chung:

Yes, that is an excellent question and very relevant. There are millions of miles of pipeline in the ground today to transport fuels. Natural gas is one area we are looking to today—how to use or leverage existing natural gas high-pressure transmission pipelines to transmit hydrogen. There are many problems associated with that. I will not get into the technical details, but in short, it can be done. It will be very costly and should be considered on a case-by-case basis. It depends on the operating pressures on the pipeline, the steel that is in the ground, and the compressors that are being used to move that gas down the pipeline. There is a standard out there called a ASME B31.12; that is typically the standard used to build pipelines that transmit pure hydrogen. That is the top-of-the-line standard. If you want to transmit gas—a blended mixture of hydrogen with your natural gas—we recommend meeting this standard, which basically says if your steel grade is not up to the spec, it will need to be replaced with this exact spec of pipeline to meet certain standards. It can be done. Now we have a tool that helps people assess the opportunities to do that, but it could be costly depending on the factors that get involved. It is an active area of research that everyone is looking into right now. We do not have any strong answers one way or the other, other than it could be done—you have to study it on a case-by-case basis. I am sorry that is not a definitive answer, but I hope that gives a little color as to where we are on the possibility of using existing infrastructure.

Senator Daly:

Understood. It is not a matter of realigning the existing pipe to try to lower that cost; it is what pressure will the pipe take, and if you do not have the proper steel, it is not going to work.

Mr. Chung:

Yes, proper steel. How much compression power is needed? If you put a light fuel in the pipeline, if your pressure power is going to increase, that will increase power requirements and possibly emissions. The shape of your pipeline—are there defects in the pipeline? Are there cracks in the pipeline? How was it welded? You have to understand all these components of the actual pipeline that is in the ground today to assess the possibility of failure of that pipeline. The last thing you want is for that pipeline to fail. An explosion would be very costly for every stakeholder. Yes, you have to assess it on an individual basis. And, how much volume you are putting through there? If you are using it at a low-capacity utilization factor, that is another consideration to take into account as well. A large array of factors that may be too technical for this conversation, but there are frameworks out there to assess this.

Senator Daly:

Nothing is ever as simple as it seems. Thank you.

Chair Harris:

Any additional questions from Committee Members either in Las Vegas or online? Not seeing any, we will go ahead and close out Item VIII. Thank you for being with us today, Mr. Chung.

[Mr. Chung submitted links to supplemental information on considerations in hydrogen decision-making for the record. (Agenda Item VIII A-2)]

AGENDA ITEM IX—PRESENTATION ON HYDROGEN PRODUCTION: EDUCATION AND RESEARCH

Chair Harris:

We will open up a presentation on hydrogen production, education and research. We have representatives from NSHE, UNLV; UNR; and DRI.

David Hatchett, Ph.D., Interim Vice President, Executive Director of Research Infrastructure, and Professor, UNLV:

I am also an electrochemist by training, so this is near and dear to my heart. I am presenting on behalf of my colleagues to make it more streamlined, and then we will take any questions as a group. We were asked to put this together and to talk about what is going on within NSHE in terms of hydrogen production, education, and research. We have heard people talk about gray, blue, and green hydrogen. I will not reiterate that, but there are obviously multiple ways to produce hydrogen. We are not taking sides on how it should be produced. We are looking at the education research aspects of it and how we can support whatever industry the State of Nevada looks to adopt and the current industries that exist. (Agenda Item IX)

Our past and current hydrogen research is based on funding and when funding goes in and out, which has happened for hydrogen research quite often. You will have pockets of research that happen at the institutions—and this highlights that—but when it goes out of funding, then people move to different areas. There is no cohesive effort in terms of hydrogen research at our institutions; there are pockets of research going on.
Clean hydrogen initiatives we know of in Las Vegas to give you an idea of where we have

contributed—we were part of SHINe; unfortunately, it was not funded. We are also part of a National Science Foundation (NSF) Engine which is funded on sustainability, renewable energy, carbon sequestration, and the impacts on water—also a type-one proposal with UNR that is on lithium ion batteries and the economy associated with that. There are hydrogen fuel cell buses deployed by the RTC. We know that UNLV and Southwest Gas are partnering on mixing hydrogen with natural gas and looking at that as a source of energy. We also have heard about Air Liquide today providing 30 metric tons of hydrogen daily as a resource.

One of the areas we have worked in—specifically my colleague, Dr. Kelley—is in hydrogen and transportation and looking at those challenges, meaning you have a hydrogen source, but you lack stations for filling vehicles. Vehicle sales and leases are far behind battery EVs. There is an insufficient network of refueling that would exist for this transportation push. Research needs—what would be sufficient for Nevadans? Geographical location of stations must be considered. Where are we going to fuel up? Are they on a well-traveled route? Key barriers—we know they all exist: lack of convenient network stations; reliability of existing stations; and a sparse network. Limited empirical research in Nevada—most of the existing research is coming from elsewhere in the world, and specifically in the U.S., California seems to be the lead. These are all issues that must be addressed—and as institutions of higher learning, we are equipped to do that—but we are looking for the State to say this is a priority, so we can invest with you.

Hydrogen programs and education—I will not say they do not exist. They do exist, but they exist in peripheral space with other curriculum that are being taught. For example, renewable energy—there are hydrogen components of that that we teach, but it is limited right now to individual faculty within NSHE and their graduate students. It is not coordinated across NSHE in any way. If the State says this is a priority and this is something we need to do, we certainly can do that. There are no dedicated courses, though, currently for hydrogen and hydrogen technologies that are offered. We would ask what sort of skills, training, and expertise would be required of students that we could help to support the industry and State in this regard.

Why clean hydrogen? There are environmental benefits, energy efficiency, versatility and flexibility, energy security and independence. You have heard about strategic materials and supply chain issues; those are real. If we do not have the materials to produce and store hydrogen, then we are not going to be able to do that efficiently. Technological advancements and economic opportunities—as you can see from Air Liquide relocating the largest hydrogen production facility they have to Southern Nevada. These are all reasons why you would do it.

Then you can ask, why not? I think that is what the Committee is trying to get at—what are the benefits? What are the risks? High production costs and energy intensity in producing hydrogen is obviously one of the issues. Infrastructure challenges—when I say infrastructure, you have heard about pipelines, you have heard about how would you transport it. These are real infrastructure costs. It is going to require not only State investment, but it is going to require federal investment in infrastructure to be more universal across the U.S. It is not that only one State can do this alone. We must have buy-in by the federal government in support of that. Safety concerns that have been brought up—flammability, explosiveness, handling and storage risks—those are all real. Environmental and resource concerns—how you produce hydrogen matters. If you are producing more carbon than you are eliminating in the cycle, then it is not a benefit. You have to be concerned about how you produce it. Technological and economic viability—this will compete with other technologies because right now it costs more. That is all there is to

it. The bottom line for most consumers is cost. They understand climate change, and they understand these are real things, but their bottom line is, can I afford to heat and cool my house and use electricity?

When we talk about green hydrogen for Nevada—and I will let others go into the specific details—but for us, when we look at it as people who do research in this area, there are three major topics that have to be addressed and acknowledged, and they are: (1) it requires water if you are going to produce it cleanly; (2) renewable electricity; and (3) you have to have point-of-use. You must be able to use it, because if you try to store it, there are costs to even the storage of hydrogen. It is not a simple thing. What I want the Committee to know is that as an institution of higher learning, we are in tune with the shift that we have to work with industry and community, and we have to address real needs. Research for research alone is not necessarily the net benefit; the net benefit is that there is a positive outcome that solves real problems. Thank you for your time. That ends our presentation, and the three of us will take any questions you have.

Chair Harris:

Committee Members, do we have any questions for our institutions of higher learning? Assemblywoman Gallant, please.

Assemblywoman Gallant:

Thank you, Chair. We have listened to hours' worth of presentations on hydrogen. The one thing it keeps coming down to is that the clean hydrogen, so to speak, needs water. How does it solve a problem in Nevada when water is an issue in Nevada?

Dr. Hatchett:

I think you touch on a point that has been touched on by a lot of people. I think water is a scarce commodity and to produce hydrogen responsibly, you have to weigh the benefits with the water use you are talking about. I think the quote from the NREL presenter was for every 1 kilogram, you use 4 kilograms of water. You are going to use a valuable resource that is a commodity in the State if you want to produce hydrogen—green hydrogen.

Assemblywoman Gallant:

It does not sound like it is viable in Nevada.

Dr. Hatchett:

I do not take sides. I have not done the cost-benefit analysis across the board. I know that water is a valuable commodity in this State, so we must take that into consideration.

Chair Harris:

Do we have any questions from our Committee Members in Las Vegas?

Sean McKenna, Ph.D., Executive Director, DRI:

Chair Harris, can I add to that response?

Chair Harris:

Absolutely. Please go ahead, and then we will go to Las Vegas.

Dr. McKenna:

I wanted to add on the water question. Nevada has 256 hydrographic basins. Many of those are over-allocated or at allocation. I wanted to put into the record that both DRI and the U.S. Geological Survey (USGS) in the State Engineer's Office are working now on a remapping and a recalculation of water budgets for those basins. It may turn out that there are some basins that do have available water. We will have to wait and see if those are located in areas of renewable energy production. Are they located close to a potential market for hydrogen? Those are all questions that have not been answered. I think it would do well by the State of Nevada to have a study that looks at the intersection of renewable energy, available water, and markets for the region.

Chair Harris:

Thank you. I will go ahead and turn it over to Assemblywoman Brown-May for a couple of questions.

Assemblywoman Brown-May:

Thank you, Mr. Hatchett, for your presentation. I appreciate the details. You said you are looking for the State to say that hydrogen is a priority for us to continue to invest in additional research. You have done a good job collectively with "why clean hydrogen" and "why not hydrogen," so we have a balanced approach to look at. Should we invest further in exploring hydrogen? Obviously, that is why we are here today—to get a lot of very good information that is not biased but driven by scientists and research institutes. I am curious to know—NSHE, UNR, DRI, UNLV—are you all investing in further research within your institutions to be able to assist the State with further guidance and perhaps that cost-benefit analysis? As educators, are you in a position to further educate us as lawmakers with regard to the positives and negatives as we continue to pursue hydrogen?

Dr. Hatchett:

The answer I would say is yes. We are working in the space, but it is not a cohesive effort. Each institution has individuals that work in the space. Now, what has changed the energy landscape and how universities are working are the NSF engines that we are a part of? That is to say, what is the best way to minimize carbon impacts? That could include hydrogen. If the State says this is where we are going, we would be partners in that, absolutely. We can easily produce educational components that go along with that and provide them to our students. We do indirectly in terms of renewable energy courses and certificates right now. It is easy for us to adapt to, are we going to have a hydrogen economy in the State of Nevada? The only thing I would add to that is that it is not only going to take the State of Nevada's investment; it is going to take federal investment. This is huge; it is a huge cost to think about transitioning to hydrogen as an energy source. You have heard many of those reasons today, and I am sure you will hear more. The nice thing about institutions of higher learning is we can get at complex problems because nobody tells us we cannot. We do research in that space to try to get through some of these tough problems. The three of us together put this together; it shows you we can be interdisciplinary, and we can work together to solve these kinds of complex problems. I would say we are ready to help answer any questions you might have in the future.

Assemblywoman Brown-May:

I appreciate that, and I look forward to continuing the conversation. Then following up on the water concerns, I have had the opportunity to attend the National Conference with the Senator relative to this issue. Hydrogen can be a good solution. We have to be responsible. While it is water-intensive to manufacture, that does not preclude Nevada from perhaps being a utilizer of that while we may not be a producer of that. I want throw that out there as we talk about what part hydrogen plays in the overall transition in how we produce and utilize energy.

Dr. Hatchett:

I would say you have industry here now producing. It is here, and it is producing a lot of hydrogen. The question is, how do you best utilize it? How do you transport it? You have heard all of this. How do you provide it as a fuel source; for example, for the vehicles that we are talking about—large trucks, et cetera. Those are the questions that are not resolved and have to be resolved to be able to truly deploy this as a resource in the State. How are we going to fuel those vehicles? I would say if it is only the State of Nevada, then we are missing out; it has to be more of a national scale.

Chair Harris:

Any additional questions or comments for our presenters here? Not seeing any, thank you all for your presentation and for coming together and keeping it short and succinct. We will go ahead and close out Item IX.

AGENDA ITEM X—PRESENTATION ON HYDROGEN ENERGY NEVADA: BUILDING A SUSTAINABLE LOW-CARBON SOCIETY

Chair Harris:

I have a quick note on the presentation on hydrogen energy in Nevada: building a sustainable low-carbon society. That was going to be a presentation by Air Liquide. Unfortunately, they are not able to present today; however, their presentation materials will remain part of the study taking place today and are online for Committee Members to review. (Agenda Item X)

AGENDA ITEM XI—PRESENTATION ON HYDROGEN-RELATED INITIATIVES AT THE REGIONAL TRANSPORTATION COMMISSION OF SOUTHERN NEVADA

Chair Harris:

We will go straight to a presentation on hydrogen-related initiatives at the RTC of Southern Nevada.

David Swallow, P.E., Deputy Chief Executive Officer (CEO), RTC of Southern Nevada:

To start off, nice to see all the presentations today and receive this information. I think it speaks well to the efforts of the RTC of Southern Nevada. I want to give a high-level overview of what we are doing in terms of hydrogen and incorporating hydrogen fuel into our overall transit system. (Agenda Item XI) To start that off, looking at our transit system for the Southern Nevada area, you can see a map representing the different jurisdictions

including the county, the cities. I also see Nellis Air Force Base on there. The urbanized area is about 400 square miles, and we cover that with 39 fixed routes for our regular scheduled bus service. We also have a paratransit service area that goes three-quarters of a mile from each fixed route, covering nearly that whole urbanized area. We complement that with other specialized services, such as our Game Day Express. We have what is known as RTC OnDemand. This is more emulating Uber or Lyft, but for transit. It is currently deployed in the southwest part of the Las Vegas Valley near Mountain's Edge, Southern Highlands, even over into West Henderson.

Overall, our current fixed route system serves about 50 million passenger trips per year, about 150,000 per day. We have nearly 3,700 bus stops throughout the system. It covers nearly 400 square miles. Our fleet has nearly 900 vehicles split roughly in half between our paratransit and specialized services fleet and then our regular fixed route fleet. Our specialized services fleet, in particular paratransit, is for people who are physically or cognitively not able to access the regular bus system. We provide door-to-door service for those folks. We also have specialized services, such as for seniors as well as Veteran medical services. In addition to that, we have similar vehicles we use for our OnDemand service in the southwest part of the Valley. Together, our paratransit and OnDemand fleet is nearly 100 percent hydrogen. We have about 20 vehicles that have to run on gas, and that comes from supply chain issues, not being able to get regular CNG vehicles recently.

Going over to our fixed route, where we have regularly scheduled bus service—we do have 40 double-deck buses in the fleet that we operate primarily along the Las Vegas Strip. We also provide the Game Day Express. We have about 250 60-foot articulated or bendy buses that serve most of our 24-hour routes and the high-demand bus routes in the system. We have about 160 40-foot buses that complement the 60-foot to serve the other routes throughout the system and cover a lot of the overnights. Late last year, we introduced four 40-foot buses that have a battery electric power train. These have been operating on a handful of routes throughout the system. Fall of last year, we started running our first hydrogen fuel cell electric buses. We have currently two 40-foots operating in Las Vegas. We have another 11 that are going to be delivered between mid and late 2024, and another 15 on order that will be delivered in mid to late 2025 to serve the Maryland Parkway Bus Rapid Transit route.

We were able to procure the buses with federal grants through the Low or No Emission Grant Program, as well as bus and bus facilities grants. We also have our hydrogen fueling station that is in development. Our temporary station is where we have gasses, hydrogen shipped to our main bus maintenance facility at Sunset and Decatur. You can see the hydrogen fuel cell electric bus to the left of the fueling trailers. We have gaseous hydrogen delivered to the site fairly frequently. In the meantime, we do have a liquid hydrogen fueling facility that is in development, currently under construction. We also have the fueling equipment we anticipate receiving by the end of 2024 and having it start operations in early 2025. That will be able to fuel up to 15 buses. Granted, we could fuel more buses throughout a 24-hour period, but we say 15. It is between our fueling hours that are typically between 10 p.m. and 4 a.m. every day. With that, we are also looking to expand the liquid hydrogen fueling to provide more capacity with the fueling as well as add some redundancy in case there is any repair and maintenance that needs to be done on one of the fuel systems.

A key component was also to ensure that besides our bus operators, our mechanics and other RTC staff that are managing the program are trained on the different aspects of hydrogen and how to handle it safely. The other thing was to bring in first responders, the community, all the local fire departments, to come in and get trained on how the hydrogen fueling process works—the sensors we have in place to notify us of any leakage, our

emergency response procedures, and things like that. I failed to mention that nearly our whole—aside from the double-deck buses—our fixed route fleet, the 40-foot and 60-foot buses, run on natural gas. This was a decision we made nearly a dozen years ago when our annual fuel bill for diesel was close to $20 million per year. We had since began migrating our fleet to 100 percent CNG for our paratransit and specialized services fleet, as well as nearly 80 percent of our fixed route fleet today.

When you look at hydrogen for RTC of Southern Nevada specifically, one is the vehicle availability and cost concerns. If you compare our diesel and natural gas-powered vehicles to battery electric and hydrogen fuel cell in particular—for example, a 60-foot bus. If natural gas-powered costs about $1 million to $1.2 million per bus, for hydrogen fuel cell buses, it is nearly double that, up to about $1.9 million per bus.

Likewise, on fuel availability and cost—because we do not have the liquid hydrogen fueling systems in place, but they are under construction—we are using gaseous hydrogen, which comes in at a little higher cost when it comes to the volume that is delivered, delivery costs, the rental fees for the equipment. A lot of those costs will go away as we migrate over to liquid, but that availability is dependent on the market. Thankfully, Air Liquide is located in town, and I am doing a shout out to them that hopefully they are competitive on pricing because we will go to bid on that like we did for the gaseous hydrogen.

When you look at fueling and charging infrastructure that we are putting in place for battery electric buses and hydrogen fueling, we have to be cognizant of the infrastructure requirements, particularly for power delivery to our main bus maintenance facilities. We thankfully had plenty of capacity for what we are doing right now, but as we look to transition the fleet further in the future, we need to be cognizant of those offsite infrastructure requirements and the costs associated with them.

There is talk about our range limitations, and frankly, for RTC of Southern Nevada, we run our buses hard. Our buses typically will be out doing 250 to 350 miles a day, even being out longer than 24 hours before they come back to the yard to get clean, fueled, and sent back out. When you look at battery electric buses, I think we are comfortable with a 150-mile range, but that limits what are called "blocks" that we assign those buses to, the routes they serve in any given day. Our blocks are typically in the 250-to-300-mile range. We have the buses assigned on the shorter routes, but when you look at the flexibility, hydrogen definitely has a lot more flexibility when compared to battery electric and is comparable to natural gas. We are comfortable having our current battery electric buses on blocks that will go 300 to 350 miles in a day. It is good to see a comparable range and not have that range anxiety or have to worry about doing offsite fueling outside of the bus maintenance yards.

Finally, the environmental considerations—there has been a lot of talk about how hydrogen is sourced and produced. When we are making these decisions, we are looking at the impacts on the community, and in particular, when it comes to air quality directly adjacent to our bus routes, it was a decision we made a while ago to migrate away from diesel to natural gas, reducing the air pollutants. As we go towards battery electric and hydrogen fuel cell electric, you see those direct emissions of air pollutants go down considerably, and we think that is important for our community going forward. With that, I would direct everybody to the RTC's website for more information, www.rtcsnv.com. I would be happy to answer any questions.

Chair Harris:

Committee Members, do we have any questions? Senator Daly.

Senator Daly:

I wanted to understand the range a little better. You said hydrogen is going to go a longer range. It is the same concerns people have with EVs all the way across the board—how far can I go? Where can I get refueled? How long does it take? Everybody knows their car and regular fuel. But on your application where you have your fueling station—I know there are not hydrogen stations all over the place either, but we will maybe get there as well. Your range is better. You can go further based on the hydrogen than you can on the electric. I do not know how the cost compares or if there is a miles per gallon (MPG) comparison to make. Electric vehicles, I believe, are more efficient in that regard, but it comes down to the range on that. Hydrogen works well for you guys as far as coming to the range, better than gas or diesel.

Mr. Swallow:

I would say it is comparable to CNG in terms of the range. For perspective, our observations are showing somewhere between—and keep in mind when we operate buses, we are stopping generally every quarter of a mile, opening all the doors, letting people on and off. You are not going to see the same type of fuel efficiency that you might expect if you are driving your car on the freeway. That being said, when we look at natural gas, our buses range from 2.3 to nearly 3.5 MPG equivalent on natural gas. When we look at hydrogen, we are in the area of about 5 to 11 miles per kilogram—nearly comparable or even double that what we are seeing on natural gas. There is a lot of nuance to that, but it does provide when you look at having somewhere between 35 to 55 kilograms of hydrogen on board a bus, we get good range to be able to cover the mileage we are assigning those buses to on a daily basis, comparable to natural gas. With battery electric, we are not seeing that same—I cannot speak to the mileage efficiency of the battery electric, but overall, we are comfortable operating those buses within 100 to 150 miles per day. Keep in mind that the charging on the battery electric buses takes much more time compared to hydrogen fueling, which is comparable to natural gas fueling.

Senator Daly:

I knew it was not exactly apples to apples on that; I was trying to understand the advantages and disadvantages. Everybody knows it takes longer to recharge the battery, and they are working on that as well. I was trying to get the cost and then the energy use for each application. I know it is more than you can go into now, but thank you for the answer.

Mr. Swallow:

I could offer a couple figures. Right now, our cost of natural gas is about $2 per gallon gas equivalent. For hydrogen, the commodity price is about $12 per kilogram; you are getting over twice the mileage per kilogram compared to natural gas. There is that little calculation in there, but that is for gaseous hydrogen, and then you have to add in the cost of delivery and the equipment rental. I cannot speak to those numbers at the moment, but we do expect as we move to liquid hydrogen that the commodity price will come down per kilogram and we will not have the equipment rental costs we do today. We still will have the delivery cost, and we will put it out on to the market to see what bids we get.

Chair Harris:

Do we have any additional questions from Committee Members? Not seeing any. Thank you, Mr. Swallow. We will go ahead and close out Item XI.

AGENDA ITEM XII—PRESENTATION ON HYDROGEN AND ALTERNATIVE FUELS IN PUBLIC TRANSIT

Chair Harris:

We will open up a presentation on hydrogen and alternate fuels in public transit.

Paul Nelson, Government Affairs Officer, RTC of Washoe County:

Good morning, Chair Harris and the Committee. Thank you for having us here to speak to you about what we are doing in Washoe County at RTC. We are proud of what we have been doing in terms of fuel efficiency and alternative sources. We had a goal originally of having a 100 percent alternative fuel fleet by 2035, and we actually accomplished that in 2022, 13 years ahead of schedule. About two-thirds of our fleet is hybrid. The other one-third is all electric. In addition to that, we are about to start up with our hydrogen fuel cell buses. We also operate our paratransit and microtransit on CNG. We are happy with where we are at in terms of alternative fuels. We have seen ridership growth over the last 22 months on our fixed-route system. Over the last 12 months, we have provided 5.2 million rides. We are happy with the growth in our ridership because every person that rides the bus is one less person that is driving on the road. That is less congestion and less air pollution. I will turn it over now to our Director of Public Transportation Operations, Jim Gee, and he will do the presentation.

Jim Gee, Director of Public Transportation and Operations, RTC of Washoe County:

For background information on RTC, we have four core services: RTC RIDE, which is our traditional fixed-route service, carries a little over 15,000 passengers a day with 20 routes and 68 vehicles; RTC ACCESS, which is our paratransit service, or service specifically for the disabled; FlexRIDE is our microtransit service which is currently operating in four zones, primarily in the suburban Reno and Sparks area. We also have a significant van pool program that is a top-ten van pool in the country. Last time we looked, we were number seven ahead of Salt Lake City. We are proud of our transit service. All modes of transportation, public transit, in Reno are growing. As Mr. Nelson mentioned, we have 22 straight months of growth. We look forward to continuing to serve the Reno/Sparks area in Washoe County. (Agenda Item XII)

In terms of our facilities, we have a fixed-route facility, Villanova. That has a mixture of hybrid vehicles and battery electric buses. At our Sutro Facility, which is the paratransit site, that has a combination of CNG vehicles, a small amount of gasoline vehicles, and is the current site of our hydrogen fueling station. Then we have transit centers around the area that we also have for charging opportunities for battery electric buses.

At RTC Washoe, we have a long history of promoting innovation with our services—innovation in terms of the types of service we provide and innovation in terms of the fuels and energy we use for the propulsion systems. As such, we were early adopters of battery electric buses, with our first four vehicles now being 11 years old, which is getting up there in public transit, then two other orders of vehicles over the last several years. That history of battery electric has shown us—in terms of pros—that you do have lower power costs, you have lower-than-expected maintenance costs, zero emissions, a lot of health benefits, and the traditional things you think about in terms of battery electric. However, there are also some negatives to battery EVs. What we have found is the scalability is a challenge. Every time you buy a battery electric bus, you have to increase your charging infrastructure to support that vehicle. You have supply chain issues. Right now, there is only one manufacturer of battery electric buses that is currently active in the industry, so parts

delivery and parts availability is a significant challenge for us. As Mr. Swallow mentioned, there are range issues. Right now, with our different generations of battery electric buses, we basically allocate 100 miles per bus in a day. We believe we can confidently deliver 100 miles for the bus before it has to charge and come back to the garage. Your traditional diesel bus or hybrid bus is about 300 to 350 miles, so what that means for us is we have to build schedules not around the range of the bus; we have to adjust those schedules based on whether the route is on a hill because hills limit the battery capacity. You have to adjust the schedule depending on the weather. In cold weather, they get less range than in warm weather. Ultimately, what we wind up doing is building our schedules around the range of the bus as opposed to the needs of our customers. That is counter to our mission of providing the best public transit service we can to our region. That is one of the primary reasons why we are now looking towards hydrogen. We do believe that battery electric buses will continue to have a role at RTC Washoe. We have the equipment. We have the infrastructure. There are certain short routes where battery electric buses do make sense. However, because of scalability, fueling time, and especially because of the range of the vehicle, we see, moving forward, hydrogen being a significant part of our fleet, complemented with battery EVs.

In terms of where we are at today, we were fortunate recipients of two federal Low or No Emission Grants that have funded two vehicles we have in Reno already and that have funded a fueling facility that is currently under construction and an augmented virtual reality training program for our mechanics, so we can teach them how to properly maintain our vehicles. Right now, our facility is planned to be located where our paratransit facility is, which is a little counter than what we would normally do. Our fixed-route facility is located underneath an interstate bridge, so CNG and Hydrogen were not viable fueling options for us given that location.

Here are our partners we are using in terms of creating our hydrogen program. New Flyer is a dominant bus manufacturer. We see Ballard Power Systems—a big name in Hydrogen. Air Products would be the fueler. Marathon would be the facility construction. We have an all-star team in terms of making hydrogen work in Reno. The first vehicles are here already. We are in the process of temporarily fueling them now, training our drivers, training our mechanics, with the permanent fueling facility to be under contract later this year. Long term, we will be looking at relocating our fixed-route facility, so it is no longer underneath an interstate bridge to give us a little more flexibility in the future in terms of how we address our fleet. Moving forward, we see a blend of hydrogen and EVs, with that blend being primarily hydrogen because of the limitations of the battery electric side. With that, I would be happy to answer any questions you may have about RTC Washoe.

Chair Harris:

Committee Members, any questions here? [There were none.] Thank you for being with us. We will go ahead and close out Item XII.

AGENDA ITEM XIII—PRESENTATION ON NEVADA'S PATH TO CLEAN ENERGY: EMPHASIZING THOUGHTFUL HYDROGEN INTEGRATION

[This agenda item was taken out of order.]

Chair Harris:

Please begin when you are ready.

Christi Cabrera-Georgeson, Deputy Director, Nevada Conservation League (NCL):

I am here today to discuss our views and past advocacy on hydrogen and our vision on achieving the State's clean energy goals. I will then turn it over to my colleagues at the Environmental Defense Fund (EDF) to go into additional detail on the considerations we believe you should keep in mind when it comes to hydrogen. In respect of the Committee's time, we have collaborated on this presentation; however, various other environmental organizations share similar concerns and views as ours, as you heard in the public comment this morning. At NCL, we are dedicated to advocating for the conservation and enhancement of Nevada's environment, including championing clean energy initiatives that ensure a sustainable future for our State. We have a long history—over two decades—of working in our State to promote conservation and clean energy policies, making our involvement in today's discussion on hydrogen both relevant and vital. (Agenda Item XIII A-1)

During the 2023 Legislative Session, NCL was actively involved in several bills relating to hydrogen. We collaborated with organizations such as EDF and other experts to ensure thoughtful considerations for each bill. While hydrogen has potential as an alternative energy source, NCL continues to emphasize the need for a cautious and informed implementation, particularly regarding how it is produced and utilized.

Before that, I want to run through some of Nevada's clean energy progress and goals. Nevada is committed to reducing greenhouse gas reduction. In 2019, the Legislature passed a bill to reduce Nevada's greenhouse gas emissions to 28 percent below 2005 levels by 2025, 45 percent by 2030, and zero or near zero by 2050. We are currently not on track to meet any of those goals—missing the 2025 target by 3.5 percent and the 2030 target by 17.2 percent. Additionally, the State has strong clean energy goals. Nevada first passed its RPS in 2001 with a goal of less than 1 percent from renewable energy sources. We have come a long way since then. In 2019, the Legislature unanimously approved an RPS of 50 percent by 2030, with a goal of 100 percent by 2050. Nevada is rich in solar and geothermal resources. In fact, we are rated number one in the nation for solar potential and currently rated number two for installed geothermal capacity. This is why we must continue to prioritize reducing reliance on imported fossil fuels like natural gas, whose price volatility has impacted Nevadans—and we have seen that in a lot of our rates over the last couple of years.

At NCL, we are also focusing on energy efficiency and expanding electric transportation infrastructure, which are key components of our clean energy transition. We know shifting towards more renewable energy plus robust energy efficiency efforts mean low, stable bills for customers. Additionally, Nevada has federal support and opportunities to boost energy efficiency and clean energy across our State. The federal government's clean energy plan created through the IRA and Infrastructure Investment and Jobs Act offers substantial support for accelerating the transition to clean energy while also addressing the climate crisis, creating good-paying jobs, and providing relief for families in their energy bills. With an abundance of clean energy resources, Nevada should prioritize pursuing funding with proven energy technologies, such as solar, geothermal, and battery storage.

In conclusion, NCL believes that leveraging our local resources and federal support to strengthen Nevada's clean energy framework. We should ensure all new clean energy technologies like hydrogen are a beneficial addition to our existing energy mix and do not substitute one fossil fuel for another. To discuss hydrogen in greater depth, I will now turn it over to our colleagues at the EDF.

Ben Bryce, Senior Manager, State Affairs Southwest, EDF:

I appreciate the invitation to participate in this Committee as we confront the climate crisis in Nevada and difficult questions, including hydrogen's role as a new energy source. We want to specifically talk about ways to ensure that hydrogen production, transportation, and use does not exacerbate the problems it was intended to solve. I am an attorney by training, which means my degree is not in economics or science, so I have brought along my colleague, Morgan Rote, who is the Director of U.S. Climate at the EDF. Ms. Rote helps to shape EDF's climate policies and priorities. Her focuses and expertise are in hydrogen, carbon pricing, clean energy innovation, quantifying the benefits of climate action, and a just transition for communities and the workforce. She has a master's in International Economics from John Hopkins University and a bachelor's in Economics from Rhodes College. I will turn the remainder of our time to her.

Morgan Rote, U.S. Climate Director, EDF:

I would like to thank Chair Harris, Vice Chair Watts, and Members of the Committee for inviting me to present today. We at EDF believe that clean hydrogen is a promising climate solution for hard-to-evade sectors; but it matters how it is produced, managed, and used. It can be clean, but it is not inherently climate neutral.

Today, more than 90 percent of hydrogen is produced from natural gas or coal, without anything to abate the carbon dioxide emissions. The Department of Energy has set a goal of shifting this production to cleaner forms of hydrogen—either blue hydrogen, which comes from the same fossil fuels but with carbon capture in place; or green hydrogen, which comes from renewable energy. The costs of these two forms, particularly green, are still much higher than gray hydrogen today. Several federal policies, including the Production Tax Credit (PTC) or 45V and the Regional Clean Hydrogen Hubs (H2Hubs) program are designed to bring the cost down to be cost competitive with gray. Even among these cleaner options, the climate impacts can vary greatly depending on several factors.

Environmental Defense Fund released our second peer-reviewed paper on this topic, which discusses many of the elements listed in this slide, including the sourcing of electricity, particularly for green hydrogen; carbon capture and sequestration rates and methane emissions, which is relevant for blue hydrogen; hydrogen emissions, which is relevant for both forms; and the end use, which is relevant regardless of the production method. I will go into each of these in more detail.

First is where electricity comes from. Hydrogen production and use is a relatively energy-intensive process. For example, for green hydrogen, you are using electricity to split a water molecule, then isolating and compressing it, then burning it or combusting it or combining it with oxygen again to recreate electricity. This process is three to seven times as energy intensive as direct electrification, depending on the end use application. Like other energy-intensive processes, this has the potential to put a lot of strain on the grid. We are seeing this right now with artificial intelligence, crypto mining, data centers, et cetera. The same thing can happen with green hydrogen. Even if green hydrogen is specifically relying on renewable resources, it could still be diverting those existing resources that are needed elsewhere, causing the grid to backfill with fossil fuel generation. This could cause emissions to skyrocket. Green hydrogen projects could have five times the emissions of today's gas-based hydrogen or gray hydrogen.

The three pillars were designed to avoid this outcome of indirect grid emissions. This framework illustrated here was included in the draft hydrogen production tax credit rule,

and it exists in the European Union as well. It requires electrolyzers—this is green hydrogen—to rely on clean energy that is incremental or new, that is hourly matched so that it is available during the hours it is used, and that it is located nearby so that it is physically deliverable with no transmission constraints in place. There are several benefits to this framework. It ensures that hydrogen is truly clean. It delivers benefits to the power sector by encouraging investment in batteries and transmission and other grid solutions. It prevents investment in assets that are not sustainable in the long run after the tax credit expires, and it encourages investment in U.S.-manufactured equipment which are more advanced and flexible machines relative to their Chinese counterparts. That is why it is so important to adhere to the three pillars when sourcing green hydrogen projects.

Next, I will talk about blue hydrogen. Here the things that matter the most are the carbon capture and sequestration rates and methane emissions. The carbon capture rate is highly important. We believe that producers should be targeting 95 percent carbon capture when it comes to blue hydrogen, but that has yet to be achieved in the real world. It is important that in climate impact calculations, which are also known as life cycle assessments (LCAs), that those reflect the actual capture rates, not the nameplate capabilities or what the machine claims it can do. It is also important that the captured carbon is fully sequestered in geologic storage projects. We are targeting an expected leakage rate of no more than 1 percent over 1,000 years. The other thing that matters immensely for blue hydrogen projects is the rate of methane emissions. Methane is the main component of natural gas. We know it leaks significantly from the existing natural gas infrastructure. Emissions depend on the basin, operational practices, and infrastructure, but we have a lot of measurement data, and we know that it varies greatly on a regional basis.

Our EDF methane team has summarized the methane emissions rates with a sampling of different basins. These are all conservative values. For example, we have removed the wells that are producing only oil. You will see they are lower for parts of the Marcellus Basin, for example, and they are higher for basins like the Permian and the Uinta Basin. However, the number currently used in the federal production tax credit—they are using what is known as a Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies (GREET) model—it is a single national average. We know that number is an underestimate of the true national average, and it is not including the regional variation you can see in this graph. This all translates directly into greenhouse gas intensity, or the overall climate impact. This matters greatly. You might think you are between 2 to 3 kilograms of carbon dioxide per kilogram of hydrogen, which means you are eligible for certain policy incentives. If you are sourcing from the Uinta Basin, your climate impact is more than double that. These blue hydrogen projects have long lifetimes, and they bring a unique set of challenges with them, such as NOx emissions, which can cause serious respiratory diseases. It is important we do not accidentally incentivize more of these types of projects than we should, thinking they are cleaner than they are. Instead, we need to be accounting for the actual emissions by using basin-specific rates.

Next, I will talk about hydrogen emissions themselves. This is an issue that matters for both green and blue hydrogen. The hydrogen molecule itself has significant warming potential. It acts as an indirect greenhouse gas, where it does not directly trap heat like carbon dioxide and methane does, but it increases the concentration of other greenhouse gasses in the atmosphere. Because of this, it has a significant warming impact, which has been confirmed by many sources including the International Energy Agency (IEA) and the Intergovernmental Panel on Climate Change (IPCC).

Like methane, its warming impact tends to be short-lived. It has 30 to 40 times the warming impact of carbon dioxide in the first 20 years, which then diminishes over time.

But this means that looking at 100-year time frames, as we tend to do in policy and analysis, will totally obscure the impact of both hydrogen and methane. You can also see the methane line in this graph which also peaks in the near term. We need to be looking at both near- and long-term horizons when making policy and investment decisions. The problem for us in this context comes from the fact that hydrogen also leaks a lot. It is a very small molecule, and it is leakier than methane. It is also often released intentionally through venting and purging, which can release up to 20 percent of the overall emissions.

Combining all these factors of hydrogen, warming potential, and methane emissions, our team at EDF looked at the true climate impact of hydrogen relative to fossil fuels. We explored a scenario where we avoided 11 kilograms of fossil fuels for every 1 kilogram of hydrogen deployed. For green hydrogen, we varied the hydrogen emissions rate from 1 to 10 percent. We took the leakage assumption from the low estimate to the potentially high estimate of 10 percent. For blue hydrogen, we vary both the hydrogen emissions rate and the methane emissions rate, and there we used 1 percent as the low and 3 percent as the high.

The horizontal line in the middle of this chart means that hydrogen has the same impact as fossil fuels. Anything below that is better, it is closer to zero emissions, and anything above that is worse for the climate. You can see the climate impacts vary greatly under these conditions. In the near term, blue hydrogen can be either 80 percent better for the climate or it can be 40 percent worse for the climate than what it is replacing. Green hydrogen can go from yielding 100 percent climate benefits, achieving zero emissions to 50 percent of those benefits. That still matters a lot since we are trying to decarbonize as much and as fast as possible. Paying attention to all these details matters a lot if we truly want to make clean hydrogen and maximize its benefits.

Last, I will talk about end use. This applies to all forms of hydrogen regardless of how it is produced. One of the best things about hydrogen is it is flexibility. It can be used in a lot of different applications in a lot of different forms. But the climate, as well as the community impacts of hydrogen, vary a lot based on those things. Questions to pay attention to when you are considering end uses—Is there a better alternative available? On the left, you will see that there are better alternatives available. On the right, you will see that hydrogen is unique in its capabilities. In general, if it can be electrified, it should be. That is more energy efficient, and it will cost ratepayers less money. The second question I would ask is what are the air quality and other public health impacts of hydrogen? For example, hydrogen releases NOx when it is combusted, and that happens in industrial settings or combustion engines, for example. We need to be aware of that potential risk and mitigate it. Another example is that ammonia can be toxic if it is not handled properly, which may matter in the shipping context, for example. The last question I would ask is, what are the opportunities for leakage? We know this can undermine the climate impacts of hydrogen, and it can also cause major safety concerns. For example, natural gas pipes cannot safely handle high blends of hydrogen. The more you move hydrogen around through a distributed network, the more chance it has of leaking. Given all those factors, the use cases that currently stand out as the highest value for us are: replacing the existing use cases of hydrogen, which tends to be fertilizer production and refining; acting as a feedstock for steel and chemical production; providing high temperature, industrial heat; and powering heavy-duty forms of transportation like ships, aircraft, and heavy-duty vehicles.

My last slide is to summarize a few different recommendations. I will quickly recap what we have talked about before, and these are things to keep in mind when making hydrogen policy and investment decisions. It is important to uphold the three pillars for green hydrogen. We need to be utilizing actual carbon capture and sequestration rates, not just

the nameplate numbers. We need to accurately account for methane leakage, including basin-specific numbers. We should be including hydrogen emissions in our climate impact assessments, as well as requiring leakage prevention plans. The United Kingdom recently introduced this into their hydrogen strategy which offers sort of an interesting precedent of a geography or locality starting to require producers to think about this proactively. Next is that we should be calculating both the near- and long-term warming impacts of hydrogen. We should be regulating the greenhouse gas and the air pollution associated with hydrogen production management and use. Right now, hydrogen production is largely unregulated, which is why EDF and its partners have released a petition to the Environmental Protection Agency (EPA) to regulate hydrogen production facilities, and EPA will be opening an information-gathering docket on this shortly. That should also be happening at the State and regional level as well. Lastly, we should be delivering hydrogen to the highest value end uses and not where the market is dictating people's willingness to pay. Thank you for having me, and I am happy to take any questions.

Chair Harris:

Committee Members, do we have any questions for our presenters from EDF or NCL? I do not think we do. Thank you all for coming. We will go ahead and close out that agenda item.

[Ms. Cabrera-Georgeson, Mr. Bryce, and Ms. Rote submitted the following meeting materials for the record:

- A fact sheet on the science of Hydrogen's warming effects (Agenda Item XIII A-2);
- A fact sheet on preventing and mitigating hydrogen emissions from infrastructure (Agenda Item XIII A-3);
- A fact sheet on how the three-pillar rule is essential to safely grow the U.S. clean hydrogen economy (Agenda Item XIII A-4)
- A fact sheet on how hydrogen risks are not fully addressed by the 45V Rule guidance (Agenda Item XIII A-5);
- A link to an article on climate consequences of hydrogen emissions (Agenda Item XIII A-6); and
- A link to an article on climate impacts (Agenda Item XIII A-7).]

AGENDA ITEM XIV—PRESENTATION ON GEOTHERMAL TO HYDROGEN: A DEVELOPER'S PERSPECTIVE

Chair Harris:

We will go ahead and roll right into Item XIV, which is a presentation on geothermal to hydrogen, a developer's perspective. I have with us, Mr. Matt Rosenfeld, who is the Director Technology and Innovation for Circ Energy. Mr. Rosenfeld. Go ahead and please begin whenever you are ready. Rosenfeld, please begin when you are ready. Thank you.

Matt Rosenfeld, Director, Technology and Innovation, Cyrq Energy:

Cyrq Energy is a geothermal independent power producer. We own and operate six geothermal power plants, three of which are in the State of Nevada. Our fleet is about 200 megawatts of electrical generation, and we also own and operate a regulated heating geothermal heating utility in Reno. Like a lot of renewable power companies and renewable developers, we are used to selling electrons, not molecules, but we are taking a close look at hydrogen. I have a brief presentation today, but I thought I would try to give a perspective of a company that has capital to deploy, has expertise in developing

infrastructure projects, but has not stepped into hydrogen development quite yet. We are sort of on the sidelines; we have spent a lot of time looking at this as a potential growth vertical for us—a potential new business to enter into. We see a lot of opportunity, but we also see a lot of challenges and have our reservations. I hope you find this perspective valuable, but it is a neutral one and may be a little nuanced. (Agenda Item XIV)

Like a lot of companies that are trying to bring power generation onto the grid today, Cyrq is facing very long and costly grid interconnection issues. That is, in many ways, even more challenging for geothermal companies where we are not as location agnostic as, say, solar might be—where if site A does not work, we can move to site B. We are resource constrained. There are specific areas where we have excellent geothermal resources, many of which are in Northern Nevada where we have a lot of our lease holdings. It could take five, six, or more years to get access to the grid and cost tens of millions of dollars in network upgrades, transmission lines, and substation rebuilds. These are nontrivial matters. They plague a lot of renewable projects. There is a lot of good work going on into mitigating these issues, but one potential solution or work-around we are considering is using the power and the resource and the heat locally to generate hydrogen rather than wait for a grid interconnection. We have spent a good amount of time looking at pilot-scale projects at one of our power plants in the Fallon area, which has good access to transportation there in the Interstate 80 Corridor and access to potential markets for the hydrogen; however, once again, it is grid constrained. We are limited in how much electricity we can sell, but there might be other uses of the resource. Geothermal is an obvious candidate for green hydrogen development. Not only is it a baseload resource that generates electricity 24/7 and could therefore have a high utilization rate of electrolysis equipment, but depending on the electrolysis technology you use, the heat you get from a geothermal resource can also make that electrolysis process more efficient. We can actually save electricity on generating the hydrogen.

There are a lot of great tailwinds right now in terms of the tax credits that have been made available under the IRA, certainly in exciting programs like we have heard about from both RTCs and similar programs in California where there is an uptick in adoption of fleet vehicles and heavy-duty vehicles for hydrogen. We saw great presentations earlier that addressed the willingness to pay. Coming from the electricity sector, this is seen as a real risk and a real challenge as a developer. There is a broad spectrum of use cases for hydrogen, but those use cases have a wide difference in terms of what their willingness to pay is and what the pricing we see is. We are here on the sidelines saying, where is the market price for hydrogen? Is it $1 per kilogram or is it $10 per kilogram? Or somewhere in between? When we build a power plant, we typically enter into a 20-year or 25-year fixed price or escalating price contract with a creditworthy off taker, like a utility. Most of the contracts we are seeing for hydrogen are shorter duration, three-to-five-year contracts. We have seen a few ten-year contracts. It is much harder to do real infrastructure development around shorter-term contracts. The pricing does not seem to be as stable or predictable as what we see in electricity generation. These are some real risks that we are trying to work around and wrap our heads around right now.

In terms of where we see the market today and where we think it needs to get to in order to start deploying green hydrogen facilities in our fleet or have us take a real look at investment—right now, a vast majority of the hydrogen produced is, unfortunately, produced the dirty way. It has some tie to fossil fuels that could be through SMR from natural gas or similar processes that are fairly carbon intensive. But that also means that they are cheap.

For most of the uses for hydrogen today, which are in ammonia production or industrial processes, the price point associated with a vast majority of that hydrogen demand is quite low and would not support investments from companies like Cyrq in developing green hydrogen facilities. The pricing we are seeing in the transportation sector would support investment, but those markets are still fairly nascent. I think we need to see more uplift or security to give our investors confidence that those markets will be around for the long haul, there will be growth in those markets to support that price, and there will not be some arbitrage collapse between the price point we see in the transportation sector and the price point we see for hydrogen in the industrial and agricultural sectors.

The production tax credit (PTC) is a huge incentive and boon to green hydrogen production. There are still challenges with geothermal we are hopeful will get worked out. Depending on the type of geothermal, there can be trace carbon emissions that would have to get mitigated. I want to point out there is a PTC for electricity generation as well, and it does not make up nearly as much of the economics of a project. Whenever we see an incentive become a central part of the project economics, that is a bit of a red flag—a potential high risk. We want to see government support, and we want to see incentives for early-stage projects in particular; they can be absolutely critical. But compared to an incentive like the PTC for electricity, the PTC for hydrogen makes up an enormously outsized portion of the proforma for a successful hydrogen project at this point. That is a red flag we have to be cognizant of. Not to say there are not developers who will go after those, but for us, we are a little more conservative and at a little later stage in our development thesis. What we hope to see is that existing users of hydrogen will place a premium on low-carbon hydrogen, that there will be a willingness to pay greater than what they are paying now for high-carbon hydrogen. We would like to see real growth and stability in these new use cases for hydrogen that support higher price points, improvements in technology for the transportation and storage of hydrogen, safety—preventing leaks—and alternative use cases could be for chemical production, drop in-fuel production, or the like.

In terms of what the State can do and what the State could be thinking about, we cannot be thinking about this in isolation. We are right next door to probably the largest domestic source of demand for new green hydrogen in vehicles and in other processes—not to mention a huge source of demand for hydrogen in existing industries. California is spending a lot of money, effort, and time to develop their own hydrogen economy, and they were awarded one of the hydrogen hubs from the DOE. I think any collaboration we can do with our neighbor to the west should be embraced. I think Nevada could be a critical supplier to California for hydrogen. I think we can be an exporter across the border while we build out our own hydrogen use cases here in the State.

To that, I strongly support the transportation programs that are being deployed right now in Las Vegas and in Washoe County. I think these are the first steps that have to be taken. There was a lot of talk today about CNG buses. I remember 10 to 15 years ago when those were brand new, very expensive, and high risk. Groups like the RTC would take a shot at buying one or two buses and getting all the refueling infrastructure in place. We are there now with hydrogen, and I think there is now a good template because of CNG to work off of to emulate that. Then of course, to continue conversations like this and support the research being done at the university level and keep stakeholders informed and in the loop. With that, I will open to any questions that the Committee has. Thank you for your time.

Chair Harris:

Thank you for your presentation. Our first question will come from Vice Chair Watts.

Vice Chair Watts:

Thank you, Mr. Rosenfeld, for the presentation. One thing I did not see in the considerations was water. My understanding is that geothermal tends to be a more closed-loop system with water in those processes. Obviously, electrolysis would need significant additional water sources. What is your thinking and perspective on the water needs that would be related to moving towards hydrogen production?

Mr. Rosenfeld:

Right now, the projects we are looking at are relatively small, and we do have water rights at our plants mainly for cooling towers, so these are evaporative cooling losses. We have found that we can work within our existing water rights to generate a fair amount of hydrogen without any additional water consumption. Our Patua plant, for example, which is in Hazen, has a hybrid cooling system. It has water rights for a cooling tower, but it also has an air-cooled condenser. There are ways we can modulate between those two and stay within our water rights and still produce a meaningful amount of hydrogen, albeit not on an Air Liquide-type scale. We are still talking small-scale projects. The other thing I will add on the water front is that the other thing we have looked at is, depending on the use case of the hydrogen—if it is used for stationary purposes—that water can often be reclaimed. In fact, you are transporting water very efficiently in some ways because, for every kilogram of hydrogen that you transport, you can generate about 10 kilograms of water by marrying it with the oxygen in the air along with the energy that you produce there. It is not necessarily a net consumer of water, unless you are using it in transportation, in which case, it is the water vapors that are typically released.

Vice Chair Watts:

Thank you for that. Yes, a lot of conversations about the debate between evaporative cooling and the water demands that has and mechanical cooling and the increased energy demands that has. In relation to your facilities, it makes sense how you could modulate that in order to free up additional water resources, if you were to go this way. My other question is, big picture, you mentioned the number one issue is interconnection timelines and delays and the additional costs that lays out. When I think about using renewable energy to potentially generate or create hydrogen, I think of using intermittent resources, particularly at times when they are exceeding the demand on the grid. I usually think about geothermal in particular as the baseload power we need that can offset the fossil fuel-based power generation. The high-level question I have is, if you were able to get the interconnection and regulatory hurdles reduced on the power generation side, would that lead your company to continue to focus in the power generation sector more than evaluating hydrogen generation?

Mr. Rosenfeld:

I think we have to evaluate everything. We owe it to our shareholders to do that. We are still primarily focused on power generation, and that is probably always going to remain our primary focus. But if we could add hydrogen into the mix, and if it presents a potentially higher margin end product than electricity, then it is something we need to run to ground. The challenge with using intermittent resources to do electrolysis is the electrolysis equipment is capital intensive. If you are trying to operate it with, say, solar, that has a 25 percent capacity factor. That means that 75 percent of the time, your capital that has been deployed for the electrolysis plant is sitting idle. That makes the hydrogen relatively expensive even if the electricity input is cheap. I think there are real compelling use cases there for a baseload resource, especially one that could be stranded.

Vice Chair Watts:

Thank you for that perspective.

Chair Harris:

We now have questions from Assemblyman Carter.

Assemblyman Carter:

My question ties in to what Assemblyman Watts was talking about. We are seeing more and more pushback and frustration from Nevada citizens about our natural resources being exported, primarily in the energy world. We have a desperate need for baseload generation, reliable round-the-clock generation. You mentioned at the end tying into California's hydrogen hub, and one of our big frustrations is that California sucks the sunlight out of Nevada. Do we want to see California sucking the geothermal out of Nevada when Nevada desperately needs that generation capacity? Is that being taken into account that these are Nevada resources that potentially are going to be exported and profited upon?

Mr. Rosenfeld:

It is tough on the electricity side. There is essentially an arbitrage opportunity. If you own generation here in Nevada, and the contract rate you can get with NV Energy is so many dollars per megawatt hour, and the contract rate you can get in California is 20 to 30 percent higher than that, there is a huge financial incentive to sell your power to California. That is economics. I think there are things that could be done in the State to keep that generation local. We would prefer it as a developer. It is much less complicated to sell locally than to move electricity or hydrogen around, but that also means there has to be a willingness to pay that same premium that is being put on resources like geothermal in California, because it is high-cost electricity.

Chair Harris:

Committee Members, do we have any additional questions? [There were none.] With that, we will go ahead and close out Item XIV.

AGENDA ITEM XV—PRESENTATION ON FUEL CELLS: DIVERSIFY, DECARBONIZE, AND GROW NEVADA

Chair Harris:

We will open up a presentation on Fuel Cells: Diversify, Decarbonize and Grow Nevada.

Dery Daye, Founder and President, HyMAX Development Corporation:

It is my pleasure to speak to the Committee today about fuel cells as an important step towards diversifying Nevada's transportation and energy systems, expanding the decarbonization efforts in the State, and ultimately growing Nevada's economy while stimulating the region and the country to expand the use of hydrogen. I will briefly share the reasons why I started HyMAX, but I want to jump back and talk about why hydrogen is so important and something that no one has mentioned. There are only 50 years of cheap oil on this planet left. What happens as we get closer to that time? People always think, well there has to be more oil. It takes millions of years to make oil, and we have run through it like water; that means there is not going to be oil at some point. As more countries around

the world become more first world, they use more energy, they use more oil, and everything we use is made of plastic. What is plastic made of? It is made of oil. If you think about industry, will they keep cheap oil—cheap gasoline for us? Or will they take all that petroleum to make plastic? I think that is where it happens. (Agenda Item XV)

Climate change does and will impact us all, but who addresses it and is on the front lines of climate action is rarely a colorful coalition. I remember quite a few years ago listening to a television news program and being surprised to hear the commentator say people of color and lower-income individuals often were not invested in climate change because more pressing life concerns often got in the way. I was not surprised by what he said; it is true. I was surprised because people do not say it out loud. As you can also imagine if you look at this room today, if you look at climate conferences all around the world, it is pretty monochromatic, and we have to change that.

Why me, and why did I create HyMAX? Climate change does and will impact us all; but it seems that some communities experience a greater share of the negative effects of climate change historically, without receiving an appropriate share of benefits from climate action, and we almost never receive direct financial gains based on the harms we receive.

Why me? Addressing climate change and putting together climate action cannot be left only to government, academia, the wealthy, eco groups, and big businesses. I started HyMAX because clean energy should not lead to greater inequality, even if intentions are good. Clean energy options should be for everyone. We must put spotlights on "sacrifice zones" in disadvantaged communities, along with eliminating economic blight in those areas.

Although not specifically spelled out in regulation, U.S. transportation environmental policy has been centered around battery electric for passenger vehicles and hydrogen for medium- and heavy-duty industrial vehicles. Since 2022, when California issued their zero emissions rules for new car purchases by 2035, around 11 states and the EPA have developed similar rules. What will that mean? New internal combustion engines, gasoline cars will start being phased out, and by 2035, there will not be any. What will that mean? That will mean battery electrics will be the only thing you can buy in most of this country. Battery EVs are a great step towards decarbonization, but exclusively focusing on battery EVs will leave 40 to 80 million Americans and hundreds of thousands of our fellow Nevadans out of the clean energy future. Nevada has a large tenant/renter population—42 percent by some reports—and that number is sure to be higher with recent economic conditions impacting everyone. Add to that condo and townhome property owners unable to install its chargers for one reason or another, and that number gets higher. It rises even more considering there are hundreds of thousands of people who cannot afford to pass through battery EV charging onto their electric bills. Lastly, the public charging infrastructure is spotty and very limited. Often, chargers are not installed in places where they might help underserved communities. Looking at the DOE's alternative fueling station locator website for central Las Vegas near my office in Chinatown—the larger neighborhood spanning from I-15 and West Sahara to South Dakota and Flamingo—an area heavily consisting of rental properties, and this U.S. census says has a population density of 10,000 per square mile. In that 30,000 people area, there is only one public charger outside of those chargers at dealerships along Sahara. That means that if someone is a renter, where will they go for that public charging if they have to get one? Because they have to get a battery EV because there are no internal combustion engines anymore.

New car, battery electric incentive purchase programs are heavily weighted toward buyers with garages and who generally have higher incomes. This uneven application of incentives is almost entirely driven based on living situation and the lack of a more holistic, clean energy approach. Fuel cells can promote energy equality by supporting the millions for

whom battery electric is impractical, inconvenient, or inaccessible. Fuel cell EVs electrochemically create energy from hydrogen in the cell. Filling these cars is much like gasoline. They are lighter because they do not have these huge battery packs from which the car needs to draw energy. I say they are more efficient, but others may say differently. If you can get 400 miles out of your hydrogen-powered car and only 200 miles out of your electric car, which one do you think is more efficient? Eventually, they will become cheaper to purchase, fill, and operate over battery EVs because that $1 hydrogen shot that our President has actually focused the DOE to get to will mean that a 12 kilogram car will actually cost $12 to charge. Fuel cell EVs and hydrogen dispensing offer gasoline station operators the only profitable pathway to a clean energy future. Think about the 1,000 gasoline stations we have here in Nevada. Those people cannot start magically charging EVs in their lots; many gasoline stations have only two or three parking spots. They cannot take up those two spots to charge EVs. Fuel cell EVs can power electric generation plants to create sustainable energy also in places closer to where the electricity will be used.

Fuel cell EVs also promote energy equality since battery electric charging is no longer an oversized purchase consideration, so tax credits can be used more evenly. With complementary hydrogen fueling programs in place from Toyota and Hyundai, buyers could even further reduce long-term costs of ownership significantly. These are from Hyundai's and Toyota's websites. Right now, you can buy a car in California that is a fuel cell EV, and you get $15,000 or six years of complementary fueling—whichever one comes first—at either of those, and $15,000 or three years of complementary fueling—whichever comes first—if you lease that vehicle. We could extend that to Nevada residents if we had our first hydrogen station.

Fuel cells offer a lot of ways to diversify and decarbonize Nevada. As you see here, all of these are either in pilot, and the U.S.S. Odyssey is an actual fuel cell ship that has been on, a five-year journey around this world. These things are real. They are making changes. We have to embrace them.

Nevada could be a breakout leader in hydrogen commercialization. Since I moved here nearly 20 years ago, every governor has talked about diversifying Nevada's economy. Combined with Nevada's low taxes and business-friendly regulatory schemes, businesses can benefit from transferable tax credits. As you see here, there are 11 of them built into the IRA, and that is if they can associate it with green hydrogen generation—if the State can clear the regulatory hurdles to allow them.

The market outside California and Hawaii for hydrogen and fuel cell technology suffers from the old chicken and the egg dilemma. In order to create a robust fuel cell EV car market, you must have a hydrogen filling capability. To have a hydrogen fueling capability, you must have businesses willing to invest in filling stations. To have filling stations, you must have a healthy, stable market for hydrogen and fuel cells. It goes round and round. California has had a robust fuel cell EV car market for many years. Thousands of fuel cell EVs operate on California roads right this moment—almost 60 hydrogen filling stations, multiple highly visible publicly traded businesses in the space. But still, there has been little movement to expand hydrogen fueling and establish a filling infrastructure in the next state, and the next state, to create that snowball effect that happened when we moved to battery EVs back in the last decade. I believe Nevada should be next. I also believe it will require the government to intercede to get the filling network started.

I have two proposals in this presentation. My first proposal is to commit the State's financial resources to fund 98 grants. In those 98 grants, 10 percent of the State's 987 gasoline stations to partly pay for construction costs associated with siting, installing, and developing

a hydrogen dispensing infrastructure at those 98 gasoline stations. Once the first filling station is operational, then local car dealers for Hyundai and Toyota can begin selling fuel cell EVs in Nevada. With an expanding market, other car manufacturers—Honda and BMW both have cars ready to go. We will start to see hydrogen and fuel cells as less risky if conservative Nevada can do it.

By selling hydrogen at gasoline stations, it can be taxed exactly like gasoline, and that is important in a State like ours where we use a lot of gasoline tax to pay for things, and it would use existing tax collection schemes.

Another option to decarbonize is to use fuel cells for large-scale power generation. This is cost-effective, sustainable energy and can reduce this State's reliance on natural gas to fuel the current power plants to produce the energy we all use. As you will notice in that third bullet—reduce the amount of fine dust in communities. That is something I did not know we could benefit from by moving to fuel cells. That plant is the facility in South Korea that I think Senator Spearman mentioned. That is a wonderful facility that is fuel cells. I will talk about that in my second proposal.

Clear clean energy opportunities abound in this State: geothermal; hydroelectric; solar; wind; and hydrogen—and the State is not unique in them. What makes this State perfect for generating green hydrogen is the available land and almost 90 percent of the year of sunny days. In last year's State of the State address, Governor Lombardo outlined energy independence as critical for our State.

My second proposal to decarbonize and grow our economy is to fund the appropriate State agencies so they can work with a developer and fund that developer to build a fuel cell power generation system to demonstrate and develop this capability. First, we would ensure the plant entirely uses renewables to provide power to the fuel cell plant. That unlocks those transferable tax credits I mentioned. Second, construct a 150-megawatt hydrogen fuel cell generation facility with an accompanying regenerative fuel cell—that is what an electrolyzer is—back end. That gets us back to what that South Korean Plant is—provides power for hundreds of thousands of people. To explain what I talked about rudimentarily, it is a loop system that begins with water going through electrolysis, and the electrolyzer regenerates the regenerative fuel cell to create hydrogen and oxygen which is released into the environment. The hydrogen is sent through the fuel cell, which generates electricity and water as the byproduct. The electricity is transmitted to the utility or moved to storage; the water is reclaimed and cycled back through the regenerative fuel cell to restart the process. It is a loop system. It would be infinitely sustainable, bring hundreds of construction jobs, push the limits of our understanding of this technology, create permanent high-paying jobs, stimulate innovation, and become a research magnet for our institutions of higher learning in our country in general.

In closing, I want to emphasize the importance of an all-of-the-above approach toward building a lower carbon future. I showed a glimpse at how diversified transportation and energy mixture rooted in decarbonization, not only electrification, could grow Nevada and provide economic opportunities for its people. Consistent with the Nevada way, I will never give up, never give in, and never stop dreaming about decarbonizing, diversifying, and growing Nevada.

Chair Harris:

Thank you for that presentation. I will go ahead and ask Committee Members at this time if they have any questions for you. I do not see any, but I did want to turn it over to Vice Chair Watts for a short statement.

Vice Chair Watts:

Mr. Day, I wanted to commend you on your presentation. You did well for your first presentation in front of us, and it is always nice to hear from a constituent. Thank you.

Chair Harris:

With that, we will go ahead and close out Item XV.

AGENDA ITEM XVI—PRESENTATION ON FUELING A SUSTAINABLE FUTURE

Chair Harris:

We will open up a presentation on fueling a sustainable future.

Scott Leedom, Director, Public Affairs, Southwest Gas:

Good afternoon, Madam Chair, Members of the Committee. I appreciate the opportunity to present today. I want to say thank you to Senator Spearman for shepherding this piece of legislation through the process. I also want to say thank you to Chair Harris, who we both know spends a lot of time in our office talking about this bill last session and getting it through, so I want to say thank you to you and other Members of the Committee who helped get this done. I have enjoyed the discussion so far and hope to add a little more to it today.

James Stein, Manager, Energy Solutions, Southwest Gas:

Southwest Gas sees hydrogen as a versatile zero emission fuel which can be used to assist in decarbonization, especially in those difficult market sectors. With that said, Southwest Gas has partnered with Gas Technologies Institute (GTI) and Utilization Technology Development (UTD) to do a hydrogen blending project in Southern Nevada. This project is being funded by 14 other utilities. There are other partners as well, including the Air Conditioning, Heating and Refrigeration Institute, the Association of Home Appliance Manufacturers—lots of folks involved in this. Ultimately, it will be a blend of natural gas and hydrogen—up to 5 percent—based on about 30 different appliances. It should run about three to four years. The University of Nevada, Las Vegas is also a partner in this project with Southwest Gas. The University of Nevada, Las Vegas Center for Energy Research is a team we have worked closely with over the years to get to this point. They have a lot of different opportunities there, and I will touch on and some of the experience that UNLV has shared with us in their past. In this picture, you will see the electrolyzer which UNLV helped us get together for this project. It is a small electrolyzer creating 2 kilograms of hydrogen per day. From there, it will go into a holding tank where it will be blended and distributed within our emergency response facility in Southern Nevada. On the picture of the emergency response facility, there is a hut that has roughly three spaces in it where we will be doing our testing. That is where the blended hydrogen will be going. (Agenda Item XVI)

This partnership with GTI will give us the ability to measure performance emissions efficiency, operating parameters, and allow best practices for our field technicians. We specialize in natural gas; we have not dealt a lot with hydrogen. This will be an opportunity for our folks to do testing as well as how to react in different situations. We also will be working with a lot of different trade allies, builders, appliance manufacturers, code officials, and utility commissions on this one.

The next project we are working on is an advanced fueling station. We have partnered with the following companies: BayoTech, who is an SMR company; Sapphire Gas Solutions, who

is a transportation company that can move hydrogen as well as CNG via tube trailers; and Lancer Energy, who is here in attendance today and provides the engineering, procurement, and construction of these facilities. This specific project—we are looking at doing three within our service territory, two of which will fall in Nevada. We are looking at one in Southern Nevada and one in Northern Nevada. This will tie the ports—the port of Los Angeles, port of Long Beach, and other ports on the I-15 corridor, as well as the I-80 Corridor—to be able to fuel hydrogen long-range trucks. We are excited about this project. These advanced fueling stations will have a CNG station utilizing renewable natural gas as well as a hydrogen fueling station which we ran through the SMR technology that BayoTech will bring to the table, and then Sapphire will be able to transport the CNG as well as the hydrogen for local and other uses. We have done due diligence. We have met with RTC of Southern Nevada and talked to them about their hydrogen buses. We think there is an opportunity to be a backup source for them to fuel those buses when needed, when their supply maybe is not readily available. We have spoken with Amazon as well; Amazon is currently using hydrogen on their forklifts at some of their centers. There is opportunity for hydrogen delivery we see with this station. The last component of this is education, and we did not list them, but an Advanced Fuel Vehicle Institute (AFVI) has plans to team up with this group as well to do training on hydrogen vehicle and hydrogen stations. They are well-versed in the CNG world. They have been doing CNG training for a long time, and they plan to do hydrogen on this project.

A lot of discussion on water today. I do not need to dig into that, but I do want to emphasize that water is used within the electrolysis process as well as the SMR process. I think the big difference is within SMR, the steam—you are going to lose some of the water to evaporation, but it is roughly only half of the water usage you will see. Through our discussions and working with other folks such as the Southern Nevada Water Authority, we are not in a position to be utilizing water and sending it out of State. Bottling water is not something we are going to look at. From what we understand, large electrolysis plants are one that we are going to have to take a look at, because in my own words, I like to say water is worth more than gold in our State.

The next project we are working on at Southwest Gas is the California joint hydrogen application. This is a project we are working on to provide a pathway to establish hydrogen blending in California. We will be looking at policy; cost recovery; and demonstration, program, and technical reviews. Here are the partners we are working with in this application to the California Public Utilities Commission (CPUC).

This lays out the scope of the project—the blending, system integrity, system reliability, and additional research. It is a long, thought-out process we are working on. Some of the other utilities that are partnering with us include Southern California Gas Company (SoCalGas), San Diego Gas and Electric (SDG&E), as well as Pacific Gas and Electric Company (PG&E) and their projects. They range from high-pressure steel, which has been brought up today—how hydrogen reacts within those high-pressure steel lines. There will be some studying done on that. With PG&E, there is a distribution study being done. At SDG&E and SoCalGas as well.

What Southwest Gas is doing within that project is looking at a small section of our pipeline in Truckee, California. One of the opportunities there for us—it is the coldest place in the State of California. We see an opportunity to test an electrolyzer and hydrogen blending within that territory. Some of the details of that project we are looking at, we will do anywhere from a 5 to 20 percent blend in that cold climate. It will serve 18 customers, including our Southwest Gas operations facility, to be served. We are looking at roughly a four-and-a-half year project from start to finish that is proposed to be filed with the CPUC later this year, if not early next year.

Chair Harris:

Committee Members, do you have any questions for Southwest Gas? [There were none.] Thank you for being here. We will close Item XVI.

AGENDA ITEM XVII—PRESENTATION ON HYDROGEN USES FOR UTILITIES

Chair Harris:

We will welcome back our energy utility, NV Energy, for a presentation on hydrogen uses for utilities a bit more generally. Go ahead and begin when you are ready.

Chris Dancy, Senior Project Manager, Renewables and Origination, NV Energy:

Hello Committee. Thank you for having us here. We are here today to talk to you about the uses we see for hydrogen in the utility sector. As a brief overview on NV Energy—we have operated in the State for over 100 years. We service around 46,000 square miles throughout the State and about 90 percent of the State's population. We also are proud to serve around 1.5 million customers and an annual tourist population of 54 million. Our current employee base is around 2,500 people, and all of us are extremely passionate about the well-being of the State and minimizing our environmental impact by serving the 54 million tourists and our customers in the State. Hydrogen is a great way to help mitigate impacts. (Agenda Item XVII)

Our dedication to renewables is longstanding. We executed our first power purchase agreement well ahead of the RPS. We executed our first geothermal contract in 1987. In 2023, we achieved nearly 40 percent of our power produced through renewable sources, exceeding the RPS by 10 percent. We are well on our way to meeting the 50 percent requirement by 2030 and are targeting net-zero carbon by 2050. The current portfolio consists of 59 large scale geothermal, solar, solar plus storage, hydroelectric, wind, and biomass power generation.

There are many applications for hydrogen in the utility sector. Microgrids are one application we are looking at. However, thinking about areas for improvement that could have the largest impact, right now the focus is not necessarily on microgrids; it is more along dealing with the issues with the duck curve we are generally aware of and the seasonality that comes with intermittent resources. A brief review on how hydrogen could help with the duck curve problem is we could use excess solar—renewable energy that is generated in the morning and the demand is not there—utilize that excess electricity to produce hydrogen, and then burn that hydrogen in the evenings when demand has increased, the need is there for the additional power, and the sun is starting to set.

From a seasonal perspective—this year has been a good example where the temperatures have been generally milder. The air conditioning units are not cranking like they typically are; however, it has also remained very sunny. Our solar generation has been successful. Some of the benefits hydrogen can provide is we could take that excess solar generation during the spring and fall, store it in the form of hydrogen, and then utilize it during the summer or the winter when it is generally less sunny.

Our units today are able to process hydrogen. We produce around 4.5 gigawatts of power from natural gas today. In order to meet the 2050 carbon-free goal, we will need to be able to supplement or completely eliminate natural gas with hydrogen fuel for our thermal units. Today, general combustion turbines can burn approximately 10 to 20 percent hydrogen by volume in its feedstock. We are looking to improve the technology so we can process

100 percent hydrogen by 2050. Our current F-Class fleet of turbines are able to operate on a 10 percent mix of hydrogen, with some of the newer units that are coming online able to operate at 50 percent hydrogen.

There are many promising benefits for hydrogen, but there still are areas for improvement. Overall, for us, cost is an area of concern. Natural gas is around $2 a kilogram and hydrogen is $8-plus per kilogram. With the higher energy costs we have been facing, we feel that it would be difficult under the current economics to supplement natural gas with hydrogen because those additional costs would be pushed to rate payers. Our goal is to continue to track the technology that would enable lower-cost production of hydrogen. Electrolysis technology is constantly improving. Also, the hydrogen turbine technology is constantly improving, and material science is helping with the overall efficiency of the production of hydrogen through the cathodes and anodes that are utilized in the electrolysis process.

Storage and distribution is also an area where improvement is required. The geology in Nevada is generally very fractured, making it difficult to store large volumes of hydrogen. Hydrogen is a slippery little proton; you would not be able to inject it underground in Nevada like you can in other areas like Utah where there are salt domes. In order to store large volumes of hydrogen, which would be needed to mitigate the seasonal intermittency issues with renewables, we would need to look to new sources of technologies. An example is basically a big bladder that you could put underground to store the hydrogen. However, as a utility, we generally are risk averse, and we do not want to be serial number one for company-owned resources. We are willing to support the development of new technologies and storage solutions; however, from an ownership perspective, we would like to see an example commercially operating. Also, generally, the overall development of the industry and the associated infrastructure with hydrogen is important. You need to have a certain amount of critical mass in terms of users and suppliers and ability to move the protons from A to B to have an overall economically beneficial industry. Having said that, there are additional technological improvements needed. Hydrogen is a great solution for storage in the utility and power space, and we are excited to see how the industry progresses.

Chair Harris:

Vice chair Watts has a question.

Vice Chair Watts:

Thank you for the presentation. We have heard some earlier presentations about the potential for fuel cells as a storage methodology. We also heard earlier about the energy lost through the process of, particularly with electrolysis, using that as a method to generate hydrogen and then using that in combustion. Could you speak a little more from your company's perspective? We heard a lot about the potential for this to displace gas usage in your current or forthcoming combustion generation facilities, but could you talk about why you are looking at that versus potentially a fuel cell application? Are there any considerations or concerns around particularly using local energy generation resources to produce hydrogen and then combust it when we would essentially be losing energy throughout that process?

Mr. Dancy:

Pairing electrolysis with existing thermal units seems to be more of a drop-in replacement. You are able to utilize existing infrastructure that Nevada rate payers have spent a lot of

money to build. Hydrogen fuel cells is a strong solution; however, we would need to look at the overall cost of hydrogen fuel cells versus comparing that with electrolysis and utilizing existing infrastructure. It would boil down to economics. Also, hydrogen fuel sales at scale—we like the example we saw in South Korea, and we will have to take a little closer look at that. That is new.

Vice Chair Watts:

I appreciate that. My personal perspective is that we would focus our efforts on using that electricity directly on use cases where possible instead of transitioning it all the way to a combustible fuel in our generating units, which requires significant amounts of that fuel. I appreciate you looking into that more. I am guessing the reason we have not seen fuel cell technology grow as an energy storage medium is because it is not cost-competitive with lithium-ion battery storage. We will see where things go.

Chair Harris:

I have invited Southwest Gas back up to the table, and I was hoping that both utilities could touch upon integrating hydrogen into the existing utility infrastructure. I will start here up North with Southwest Gas.

Mr. Stein, Previously Identified:

That was what was in our presentation. We are looking at the opportunity to blend natural gas within our system. At our emergency response facility in Southern Nevada, we will take that blend up to 5 percent, maybe even up to 20 percent; we will mix hydrogen with natural gas and run it through our pipeline to see how it reacts. That is what we are doing at Southwest Gas. We are monitoring other utilities across the country to see what they are doing. Dominion in Utah is doing something very similar. Northwest Natural—a lot of the other utilities across the country, at least natural gas utilities, are doing blending projects to test that. That is what the CPUC filing we are looking at doing will do for the State of California as well.

Chair Harris:

Before I go down to NV energy, I want to make sure—at this time, no one is looking at pumping, let us say, 100 percent of hydrogen fuel through existing gas infrastructure, right?

Mr. Stein:

Not that we are seeing anywhere right now. There are tests being done on very specific closed systems that are not going out to the public at this point. Everything is very limited to small percentages to learn and grow from that and then take that up higher to further decarbonize our systems.

Chair Harris:

Do you know what changes would be needed to the existing infrastructure to be able to accommodate, let us say, a higher percentage of hydrogen and a lower percentage of natural gas in that mix, or are we still trying to figure that out as we do this testing?

Mr. Stein:

I think that is what we are working through as we go down this road, and that is not my expertise. I do not want to speak on that. The one thing I can say is at least within the State of Nevada, our system is much newer than many natural gas systems across the country. A lot of our pipe is up to date and much newer. It can handle, in our opinion, a higher percentage, but that is what these tests are being done across the country for us to learn from.

Chair Harris:

Thank you. Mr. Dancy, anything to add from the electric utility perspective?

Mr. Dancy:

I will echo Mr. Stein; we are also tracking the natural gas's utility and the blending of hydrogen. We agree that a crawl-walk-run approach should be taken. Hydrogen is colorless, odorless, and highly flammable. Understanding how to deal with the safety of it once you integrate it in a natural gas pipeline will be crucial to being able to deploy it. We are looking at the slower approach but like the idea of blending up and determining how well it works.

Chair Harris:

Thank you. Committee Members, any additional questions for either NV Energy or Southwest Gas? [There were none.]

AGENDA ITEM XVIII—UPDATE ON THE NEVADA CLEAN ENERGY FUND, SOLAR FOR ALL, AND OTHER FEDERAL FUNDS

Chair Harris:

We will move on to an update on the Nevada Clean Energy Fund (NCEF), Solar for All, and other federal funds.

Kirsten Stasio, CEO, NCEF:

Thank you, Chair Harris, Vice Chair Watts, and Members of the Committee, for having me here today. As you may recall, I presented in January to the Committee about how NCEF is working to bring federal clean energy funds into the State to benefit Nevadans. I specifically talked about and highlighted a $7.7 million Clean School Bus Grant that we were awarded from the EPA to deploy over 25 electric school buses with Nevada school districts. Since then, I am excited to say we have secured another $156 million federal grant for the Nevada Solar for All program that I am going to talk about today. A little departure from the hydrogen theme, but I am going to talk about it given our focus on federal clean energy funds. Towards the end, I will give an overview of the federal hydrogen funds that are available. (Agenda Item XVIII A-1)

A reminder on who we are—NCEF was established by State legislation in 2017 by SB 407, and we are established as a nonprofit organization to accelerate investments in clean energy projects in a way that reduces energy costs, creates high-quality jobs, improves the standard of living for Nevadans, and addresses climate change. Nevada Clean Energy Fund serves as the State's green bank, which is an institutional model successfully implemented in over a dozen U.S. States. As the State's Green Bank, we are playing an important role and focused on building the State's capacity to access and implement federal clean energy

funds, with a particular focus on low-income and historically underserved communities and markets that have struggled in particular to access funding to implement clean energy projects and access those benefits.

You are all aware that the opportunity before us with the federal clean energy funds that are becoming available is unlike one we have ever seen before. We have hundreds of billions of federal funds available to implement long-lasting and impactful programs in this State from the BIL and the IRA primarily. They are designed to help us bring down our energy costs and live in a healthier environment and climate. With this in mind, NCEF is implementing programs that provide financial and technical assistance to a wide range of stakeholders in the State, including households directly, affordable housing stakeholders, local businesses, schools, contractors, tribes, local governments, and others, so they can implement clean energy measures that can range from building energy efficiency, clean vehicles, and solar and energy storage projects. As an example and a reminder about our electric school bus program, earlier this year, we were awarded a $7.7 million grant from EPA under its Clean School Bus Program. We are going to be passing the vast majority of these funds directly to school districts. We are working with nine school districts across the State to replace more than 25 aging diesel buses with electric ones. We partnered with NV Energy and the Nevada Division of Environmental Protection on this grant as well, so we can stack additional sources of funds with the Clean School Bus grant to bring these school buses to the school districts at no cost. We are also bringing in other sources of funds like federal tax credits as well, and in rural areas are looking at USDA funding, so we can achieve this goal of no cost for the school districts. Not only are they getting a free bus, but these electric school buses are also reducing fuel and maintenance costs by about $15,000 annually per bus. They make the air our children breathe safer and free of harmful diesel air pollution that can cause asthma and other respiratory illnesses.

A little more context on this grant opportunity—a couple of years ago when I first started at NCEF, one of the first programs I worked on was helping several school districts apply for the predecessor to this funding opportunity, the EPA Clean School Bus Rebate Program, where multiple school districts applied individually. Clark County was successful in winning the lottery for those rebate funds, but several of the school districts in the rural areas were unsuccessful. When the next round for this grant funding opportunity came out, we recognized the opportunity for the NCEF to apply as a third-party applicant on behalf of multiple school districts to secure those funds for our school districts. We presented this incentive stacking opportunity. That collaborative approach that we took, as well as this catalytic leveraging approach to stacking multiple sources of funds, including utility and leftover Volkswagen settlement funds, was compelling to the EPA, and it is one of the reasons why were successful in securing those funds. I give that as context because that is the same approach that we took for our Solar for All program.

Last month, EPA announced a $156 million Solar for All award for the NCEF to support solar projects that benefit low-income households. Low-income households in particular are often left behind in the clean energy transition due to a lack of funding and technical assistance to access these funds. Yet, they are the ones that need the solar benefits the most, typically experiencing the highest energy cost burdens. We saw Solar for All as a significant opportunity for Nevada and for our low-income households. We worked with many stakeholders across Nevada on our application. We received letters of support from over 70 different entities and individuals. We worked with State and local governments, with tribes, with affordable housing developers, labor community groups, and members of Nevada's congressional delegation, to name a few. Our application was very successful—Nevada's $156 million award was the highest per capita award of any State in terms of eligible population for these funds—that is, low-income and disadvantaged communities. We

received the same award amount—EPA made effectively one award per State and territory, they made 60 awards. We received the same award amount as Florida, Illinois. and Pennsylvania. With these funds, we are going to be launching low-income solar programs for single-family homes, for affordable multifamily housing, as well as for community solar projects.

Across these programs, it is a federal requirement that any household benefiting from these funds has to experience at least a 20 percent savings on their utility bill. We are being very diligent about baking in this guaranteed savings as well as consumer protections into our program design. Also across the programs, we are designing our funding support to leverage additional funding from federal tax credits; in particular, the Section 48 tax credit that can cover 30 to up to 70 percent of the cost of a solar project. We are going to be administering funds as a combination of rebates and a bridge loan to enable recipients of those funds to stack those tax credits with our Solar for All funds. In that way, we can turn our $156 million grant award into twice that over the course of the five-year period of performance of the grant.

For our single-family programs, we are going to have two different options: an ownership option for households that have that capacity, but also a lease option for households that do not. For multifamily affordable housing, we are working with regional housing authorities and Nevada's major affordable housing developers to identify opportunities to put solar on affordable housing and pass those benefits to the tenants. I flagged in January—there is one challenge that could inhibit equitable access to the benefits of these programs to low-income communities. In particular, current Nevada statute prohibits Nevadans who live in individually metered multifamily buildings from being able to benefit from solar on the rooftop of their building. Senate Bill 448 in 2021 remedied this for master metered multifamily buildings but not for individually metered buildings. I look forward to working with all of you and relevant stakeholders to identify and advance good policy solutions this upcoming legislative session to overcome that barrier.

I talked briefly about single-family and multifamily affordable housing. For our community solar projects—community solar is critical to unlocking solar for low-income communities and in particular, renters, which make up a big portion of the population, and those renters do not necessarily have control over their roof. We plan to work with Nevada's utilities, including NV Energy and rural utilities, to build community solar projects, but given regulatory barriers to community solar in Nevada and also the emphasis from the EPA on community ownership of these assets, we are also taking an innovative approach where we work with local governments, nonprofits, tribes, and other commercial building owners who develop and host community solar projects that participate in traditional utility net metering programs. Then, NCEF uses the proceeds from the projects' financing to provide economic benefits directly to low-income households.

There is a five-year period of performance for our Solar for All grant. It began on May 1st. But like all the solar referral awardees, we are still negotiating with EPA to finalize our work plan and our grant agreement, and we will not be able to start drawing down funds until that happens, at least for significant program activities. We can hopefully start drawing down funds for the time we are spending on program design and whatnot soon. We do not expect to be able to start drawing down funds for projects until December 2024 at the earliest. In the meantime, we are working on program design. We are planning to launch guidance and applications for affordable housing developers and for community solar project hosts in the fall of this year, with applications for households released in early 2025.

That is Solar for All, and solar is an important component of the solution for reducing energy burdens for households, but so are measures like energy efficiency, weatherization, and electrification as well.

We consider it a missed opportunity if we work with a household or a building to access solar and leave energy cost saving opportunities and federal funding on the table from these other measures. That is why we continue to expand NCEF's Residential Energy Upgrade Program (RE-UP). This Program connects Nevada homeowners with financial and technical assistance for energy efficiency and clean energy upgrades in their homes that bring down their energy costs. The Program is designed to empower households to access other federal clean energy funds, like tax credits and forthcoming federal home energy rebates as well as utility incentives, by providing education and pairing that with affordable and accessible loans.

We created a one-stop shop for Nevadans to help them access and stack multiple federal and utility incentives and financing resources. This is a screenshot from the NCEF residents page that has resources for residents of all different types of income levels, not only on how to fund the projects in their home, but also how to identify vetted and licensed contractors and how to protect themselves from predatory practices. Another couple of screenshots from our residents' portion of our website—we worked with Rewiring America to develop a Nevada-specific incentive calculator where a resident household can go and input their income and their zip code and see what federal and utility incentives they qualify for. We also have our Solar for All interest form that Nevadans can fill out to get updates as we launch those programs. We are building lots of great resources to help empower Nevadans to take advantage of beneficial clean energy opportunities and access funding, in particular federal funds.

I want to take a moment to say thank you to all of you. None of this work would have been possible without the support of the Legislature. Nevada Clean Energy Fund is a relatively new organization. Although we were established by State legislation in 2017, we were not formally launched until early 2022. In July 2023, the Legislature allocated $1 million for the biennium to NCEF to build our capacity to bring in federal funds, so all of our work and accomplishments with the $156 million Solar for All award, the $8 million, the $7.7 million Clean School Bus Program, the RE-UP program—we also have partnerships with the Governor's Office of Energy to implement some formula funds from the DOE—we have a lot of initiatives we are advancing, and none of that would have been possible without the catalytic allocation from the Legislature. Thank you.

Chair Harris:

Do we have any questions for NCEF, Committee Members?

Ms. Stasio:

If it would be helpful, I could talk a little about hydrogen, but it would be a departure.

Chair Harris:

Let me see if we have any questions. It does not look like it. Since we are on a hydrogen day, feel free to give us any information you have about available hydrogen funding opportunities.

Ms. Stasio:

Given today's focus on hydrogen and our focus on bringing federal clean energy funds into the State, I will provide a brief overview of federal hydrogen funding opportunities, some of which you have already heard about today. Hopefully, this can give you perspective on the overall landscape. Before I jump in, I want to note that NCEF's founding statute allows NCEF to support hydrogen only that is sourced from renewable resources.

There are a lot of different federal funds available to support hydrogen between the BIL and the IRA. Some of the major funding sources are listed here, and I have organized them by upstream production and manufacturing and more downstream consumption and end use—we do a lot of education around the end use in Nevada—then also some cross-cutting funds as well. This list is by no means comprehensive. There are tax credits and grants available for the upstream production of hydrogen as well as the manufacturing of electrolyzers and fuel cells. You heard about the 45V tax credit, in particular. That is significant. In terms of end use, there are tax credits and grants for end uses of hydrogen; in particular, hydrogen-powered vehicles. You heard from both RTCs in Nevada earlier about how the Low and No Emissions Grant Program from the Federal Transit Administration has been a big source of funding for them to roll out those hydrogen buses, but there are also tax credits. There is an open federal funding opportunity right now from the EPA for a Clean Heavy-Duty Vehicle Program. There are lots of investments on the upstream supply that I think are going to help catalyze a significant amount of supply of hydrogen in the U.S. market paired with lots of potential end uses as well. Then you have the $7 billion Clean Hydrogen Hubs that is in the cross-cutting category from DOE that was already awarded. You can see the Hydrogen Hubs that were awarded across the U.S. here, as well as a map of the awards from the Clean Hydrogen Electrolysis, Manufacturing, and Recycling Program. These efforts and grants give us a sense of big investments in infrastructure that are going to increase the supply and general market for hydrogen across the U.S. Many of these funds have already been committed, so we know where they are going; but in the case of federal tax credits like the 45V and the end use ones—45W, 30C—those are uncapped. They are deployed based on how many projects we deploy or how much hydrogen we develop. They are going to be a significant component of the federal funding that is deployed and could ultimately dwarf the federal grant programs depending on how much is actually deployed.

I have included some resources here on federal funds for hydrogen. (Agenda Item XVIII A-2) There is a great primer from the National Governors Association. The DOE has its Hydrogen Program Plan and Hydrogen Shot Program. They have got a lot of great resources if you would like to read more. With that, I will take any questions.

Chair Harris:

Thank you. I will turn it over to Vice Chair Watts. I believe he has a statement.

Vice Chair Watts:

Thank you, Ms. Stasio, for the presentation. I wanted to take a moment to acknowledge Senator Spearman to thank you for your work, because Senator Spearman helped create the NCEF in 2017. Looking at where it is now and the results that have come about is truly incredible. I wanted to thank you for your work, Senator, and to highlight our thanks as well. We made that investment, and what a return it has been in a little less than a year. One million dollars has yielded $165 million in federal funds to the State, and it sounds like it is going to be leveraged to bring in $150 million in additional federal funding, plus leveraging additional private capital and investment. I think it is extremely exciting for

those who are going to benefit from the Solar for All program to know that it is going to bring a guaranteed 20 percent reduction in their utility bills. Those are things all of us are excited to spread the word to our constituents about, and we look forward to seeing what comes next and continuing to support and work together with you in any way possible.

Chair Harris:

I will echo those comments. Do you want to follow up?

Ms. Stasio:

Thank you, Vice Chair Watts. I echo your thanks to Senator Spearman as well.

Chair Harris:

There are no more questions or comments from Committee Members.

AGENDA ITEM XIX—PRESENTATION ON THE RECYCLING OF SOLAR PANELS

Chair Harris:

We will open up a presentation on the recycling of solar panels.

Robert Nicholson, Senior Manager, PV [photovoltaic] Recycling, Solar Energy Industries Association:

Thank you for inviting me here today to talk about solar panel recycling. We represent approximately 1,100 companies, organizations, and people across the solar industry in the U.S. (Agenda Item XIX)

About two years ago, the Association recognized that with the exponential growth of solar capacity in the United States, a day will come when we will need to address end-of-life issues for this equipment. To the Association's credit, it put resources in place and started building plans to manage this material, which we fully expect to see within five to ten years.

To provide a basis to this, currently, there are about 300 million-plus panels deployed in the U.S. with a life expectancy of 25 to 30 years. We are now seeing some with a lifetime of up to 40 years. It is important to note that 80 percent of the panels deployed in the U.S. have been deployed in the last seven years. In relative terms, what we are seeing coming out of the waste shed currently is a very small number compared to what we will see in five to ten years and beyond that.

What we have seen from a regulatory perspective, right now some of the panels that are at end of life, whether it is through use or breakage, could be considered hazardous waste under EPA's rules—the Toxicity Characteristic Leaching Procedure (TCLP) rule. The good news is going forward, manufacturers are using significantly less of the metals that would lead to that designation in most panels—that would be silver and lead. I would like to say that they are reducing those metals to produce more environmentally friendly equipment—which is true—but the fact of the matter is they are also reducing those materials to save cost, in which I applaud them on both fronts. The Environmental Protection Agency is currently considering regulating panels as a universal waste. That conversation is ongoing, and I think we will continue for another year. Right now, the State of California is the only state in the U.S. that has regulated panels as universal waste, but other areas are either implementing rules around end-of-life panels or considering rules. California, Washington,

and Niagara County in New York have implemented rules for recycling and managing end-of-life panels.

Around recycling of the panels—there is a lot of misinformation out there, so we like to try and provide background on how this happens. There are two economic models in the recycling industry. The first is what I call a "high value" model. That is the recycling of materials like copper, silver, steel, and aluminum, where simply the materials being recycled contain more value than the cost to process them. Those materials are very easy to recycle—to get recycled through local markets. Again, the yield far exceeds the cost of recovery. In that case, typically the generator of that waste gets paid for their materials. The second model is what I call the "low value" model. That typically refers to materials like electronic displays, mixed plastics, glass, solar panels, and tires. That is a situation where the cost to recycle that material exceeds the value—the yield from those materials. That is at a recycling cost to the generator of the material. Again, that is where photovoltaic (PV) recycling falls. I have heard in different parts of the country a belief that the value of an end-of-life solar panel is very high, when in fact, it is not; it contains very small amounts of materials that have value. That amount of material is getting smaller and smaller as we go forward.

Solar panels are designed and manufactured to be very resilient. The more resilient a product is, the harder it is to recycle, and that is an unfortunate fact. The cost for recycling will always present the challenge with the low quantity of recoverable materials. The chart is depicting the price of copper. Recycling costs can fluctuate with the price materials that are recovered and can create big swings in recycling costs. The other factor with solar panel recycling is the fact that 80 percent of the weight of a solar panel is simply glass, and high value markets for glass do not exist. I know municipalities struggle with markets for their glass streams all the time across the U.S. Solar panels are essentially glass. Moving forward as an industry, we need to work on increasing glass markets.

The current recycling processes in the U.S. and around the world—there are two approaches. The first approach is what I call a mechanical sort and separate. There are a number of companies in the U.S. engaged in this practice today, and that is where they use a mechanical process to sort the materials used to make the solar panel. At the end of the process, they have the aluminum separated, glass, laminate, which contains the silica and the metals, copper, lead, and silver, and then those materials can go into end markets. The second approach is a thermal approach. This is what is called *smelting* where panels are taken to a shredder, which is a very common practice here in the U.S. The materials are shredded, and then they are shipped to a smelter for metals recovery. In many cases, the glass is used in the smelting process. Personally, it is not my favorite approach, but it is a very common and popular approach for solar panels, as well as a lot of other scrap materials produced here in the U.S.

A typical processing line—you probably cannot see that image very well, but the reason why I include that in this presentation is to show that PV processing for recycling is essentially off-the-shelf equipment. There are a number of companies now in the U.S. that offer this process to any recyclers who want to engage in recycling here of PV panels. I can say that as the Recycling Manager for the Association of Washington, I am now receiving calls from equipment manufacturers that either now have new equipment or are proposing a process. I fully expect to see the availability of processing equipment to grow quickly. I should also say I probably field a call a week now from companies who are becoming engaged in solar panel recycling somewhere in the U.S. In some cases, there are existing companies that are looking to expand their capabilities to include PV recycling.

The greatest challenge is managing the glass. In the crush and separate process, it does separate and produce a very clean glass stream. With 80 percent of the panel being glass, that is quite a bit of glass. Moving glass is very expensive, which hurts the economics of recycling. It means we need to create glass markets local to where the panels are recycled. Regional markets would work best—to have regional collection points for the glass. Then certainly more work needs to be done to find markets and end uses for the glass. This is one of many projects underway right now where companies are looking to find uses for glass. This particular company has found a process to convert the glass into a chemical additive that is used in the manufacturing of concrete. For every ton of concrete or every yard of concrete, they use this additive. This glass can be used to replace that additive. If it was, there would be a massive demand. One plant would use 25,000 to 35,000 tons a year of solar panel glass. We do not endorse any particular process or approach, but there are a number of companies out there that are looking at creating new markets for solar panel glass.

I should also mention the Association strongly supports refurbishment and resale of panels into markets. That is becoming a little more challenging given the pricing of new panels. They basically get cheaper and cheaper. As new panels get cheaper and come with a warranty, it makes the economics of using a used panel a little more challenging. That does not mean there are not strong international markets for used panels, and we continue to look into those markets and see what it takes to open those channels. There is a number of companies that are looking into that as well. That is a practice we want to be very careful about because we certainly do not want to export a waste problem outside of the U.S.

A little about what we are doing as an organization—we have what we call our recycling partner process where we go out and conduct due diligence on companies that claim to do solar panel recycling. It is early, and now is the time to be doing this. We do not want the recycling industry to move in a negative direction. We want to make sure the companies that hold themselves up as solar panel recyclers have a very transparent process and do it right. We have engaged in this audit process where we do a physical site audit of recycling companies. We do a regulatory compliance review. We confirm they have adequate insurance in place. We also do a mass balance review where we look at where their materials go and better understand the downstream markets for these materials. Sham recycling is real. Sham recycling happens in all industries and all materials. Because it is so early in the process, we are going to make sure we have very strong infrastructure to manage these panels as they come out of the waste shed. As an Association, we are also very involved in policy development. We have ideas on how to ensure that in the future, we have strong infrastructure that is very compliant. We are working with states any chance we get to help them with policy development and help policy move in the right direction.

A little more specifically about our recycling partner program—we currently have ten companies that have gone through our process. I have personally visited every site to assess their process, and we now have new people on board that will assist us in doing that. We have ten currently. I fully expect another ten by the end of 2024, which will give us 20 across the country, which is a great start. Given the number of companies that have reached out to me, we could be auditing a company a week here in the U.S., but we want this to move slowly and at a very measured pace. Those ten recyclers give us a current capacity of a little over 10 million panels per year; all ten of our recycling partners are nowhere near their capacity. They still have a long way to go to get to capacity. Our organization is an approved American National Standards Institute standards developer. This year, we are developing a recycling standard that will have a recycler certification program associated with it. We are also developing a decommissioning standard to provide guidance to projects that are entering into either decommissioning planning or getting to a

decommissioning stage in the process. We will continue our recycler certification. I will also point out some of our recycling partners are located in Arizona and Texas—somewhat local to Nevada—but we are talking to two recyclers here in Nevada that we hope to add to the program by the August/September time frame. We are excited about that. Also, we are encouraging manufacturers to offer take-back programs. If you are familiar with First Solar, their headquarters is in Phoenix, Arizona. They have a take-back program where they produce thin film panels. With their program, they will take those panels back at end of life, recycle those panels, and reuse the material in their manufacturing process. I expect to see more manufacturers buy into that and certainly will help them with the development of that type of program.

This is about our national policy framework we support. We do not support extended producer responsibility because we do not think it is the right fit for a solar panel. Solar panels are designed to last 30 years. Certainly, extended producer responsibility works great for short-term products, plastic, containers, even mattresses, but for industrial equipment that lasts 30 years, maybe 40 years, it does not make a lot of sense to us. We think a better place for that work is in the decommissioning plan and decommissioning fund, which also gives local permanent authority the ability to prescribe recycling steps to make sure their interests are protected. We think it is a better place for that. It would also allow them, to a certain extent, to require reuse of those panels for panels that may be coming out of a project due to a repowering—panels that still have usable life. For the customer-owned solar, we look at the owner as having some responsibility at end of life and are working on providing drop-off site infrastructure that could be included in a maintenance contract. But to the extent possible, we want to use existing recycling resources and infrastructure for those smaller quantities. There are municipalities that have recycling centers, electronics recyclers, and scrap metal recyclers in communities throughout the U.S. We think it is a better fit to help those locations become tooled up and better equipped to manage smaller quantities of solar panels. We think the industry could do work along with the State to develop resources and help communicate to stakeholders where recycling capacity is located and how to get those panels collected in a cost-effective way. We also think any recycling requirements from a policy perspective should be forward-looking, phased in, and account for existing contractual arrangements and industry practices like decommissioning planning and decommissioning funding.

The last ask we have and that we would support in work with states is to start collecting data on the PV end-of-life materials that are coming out of the waste shed. I have many conversations with municipalities across the U.S. They have very little data; it is more anecdotal. I will hear from municipal collections locations. They will say, "Well, we get one or two panels here or there, but we do not know what is coming in our trucks going to tipping floors or landfills." Now that it is early in the industry—it is a good time to start collecting data and understanding better what those floors look like. I am happy to take whatever questions you have.

Chair Harris:

Thank you. We have a couple of questions. I will start with Senator Buck.

Senator Buck:

Do we have any solar panel manufacturing facilities in Nevada?

Mr. Nicholson:

I do not believe there is a manufacturer in Nevada.

Senator Buck:

Where do they come from then? Where are the big producers of solar panels in the Southwest?

Mr. Nicholson:

There is a panel manufacturer in the Pacific Northwest. There is a manufacturer in Arizona for solar. There are a number of foreign manufacturers that import panels into the U.S. as well.

Chair Harris:

We will go now to Vice Chair Watts.

Vice Chair Watts:

Thank you, Mr. Nicholson, for the presentation; I found it very informative. I appreciate not only understanding a little more about the process, the materials, and the challenges with those waste streams and ensuring they are not processed but actually can get repurposed and reused, as well as thinking about the different sectors we have to deal with, from the utility scale and the large companies that still retain control of those panels through leases or power purchase agreements, down to individual customer-owned rooftop panels. I would ask that you please work to send us an update once those Nevada recyclers go through your process. We would love to be made aware of that. I have heard from folks who are interested in pursuing that here, and I think it would be beneficial for all of us to know about those companies that are poised to be a part of this particular industry in the State and look forward to continuing conversations. I think this would be something for us to look into and be on the leading edge of policy as well, to try and make sure before that large influx of panels comes in from bigger projects that are decommissioning or swapping out panels, that we have some policy in place to ensure we are minimizing their entry into landfills and figuring out how we can work on some of that data collection as well. I look forward to continuing that conversation.

Mr. Nicholson:

Will do.

Chair Harris:

Committee Members, do we have any additional questions? Not seeing any. Thank you, Mr. Nicholson. We will go ahead and close out Item XIX.

AGENDA ITEM XX—PRESENTATION ON POWERING NEVADA WITH ENHANCED GEOTHERMAL

Chair Harris:

We will open up our last agenda item before public comment, which is a presentation on powering Nevada with enhanced geothermal.

Ben Serrurier, Government Affairs and Policy, Fervo Energy:

Chair, Vice Chair, Members of the Committee, thank you very much. Fervo Energy is a developer of enhanced geothermal energy projects and is a next-generation geothermal energy technology. There is a lot of application for much of the hydrogen topics you heard about earlier and the power sector applications NV Energy talked about in the very first session that kicked off this Committee hearing—lots of applicability. I will keep this concise; I recognize I am the only thing standing between you and adjournment.

I want to talk briefly about what enhanced geothermal systems (EGS) are. I want to talk about why this is different than the conventional geothermal resources you know about and that have been so successful in Nevada historically. I want to talk about Nevada's leadership with a project that Fervo brought online at the end of last year called Project Red, which is the first commercial EGS project successfully built in the world; what we are doing as an industry; bringing this technology to scale with a project in Utah; and then bringing it back to Nevada to talk about the opportunity here to power the State and the economy with clean, firm geothermal energy. (Agenda Item XX)

First talking about what EGS is and how it is different from conventional geothermal—conventional geothermal, which has been so successful in Nevada, requires a number of very specific subsurface conditions. You need high-temperature heat. You need it to be close to the surface. You need to have highly fractured rock in that subsurface so water can flow through those fractures, and you can extract the water or steam and use that to generate electricity. This has been successful in unique spots. Development of these resources has been fairly small on a per-project basis, fairly expensive to develop because they are all rather bespoke, and they carry a lot of risk because if you drill in slightly the wrong place, then you are not going to get the right specific conditions for a commercial project. However, not all of these subsurface conditions are limited to the same extent. For example, the heat is widespread in the subsurface, particularly in a State like Nevada; it is very close to the surface—makes it a great resource. However, not all the rock is sufficiently permeable to flow water steam through that formation to sweep that heat and collect it for power generation. Fervo is intentionally seeking out areas of the subsurface that are impermeable, that do not have naturally occurring fractures. We create our own fracture network in the subsurface, in the *hot, dry rock*, as it is called in the industry. We then flow water through those fractures; it picks up the heat; we cycle that to the surface and generate electricity and circle the now-cooled water back down into the subsurface to pick up more heat. This is a technology that has been on the mind of the geothermal industry since the seventies. I think that was the first time it was tried in New Mexico, but it has only been because of technology advancements spearheaded by the oil and gas industry that have unlocked the shale boom that have opened up the low-cost drilling, the fiber optic sensing, and the subsurface reservoir engineering approaches that now make it commercially valuable to basically create our own geothermal energy reservoir anywhere.

The key message to deliver here is that EGS represents a step change in all areas of geothermal energy production. It opens up orders of magnitude more commercially viable resource potential, and it opens up projects that are much larger in their scale and with much more attractive economics. There are a number of reasons for that, but it is the next generation of geothermal we are talking about projects that are ten times larger than the ones that are operating today and enjoy declining costs as they deploy and at that scale.

The boom in EGS kicked off with the commercial operation of Project Red, which was Fervo's commercial-scale pilot project in Northern Nevada, right near Winnemucca. We partnered with Google and operated—and are currently operating—a conventional

geothermal project in Northwest Nevada a couple of years ago to test out this idea. The idea was to drill horizontally about 8,000 to 10,000 feet deep and then go horizontally another couple thousand feet. You create a big "L" in the subsurface. Inject high-pressure water and sand into that rock formation in a targeted way to create planar fractures that extend through the heat formation, then connect those fractures with another paired horizontal well. We then take the water that is existing in that reservoir and basically pump it through that cycle, through that well pair, generating electricity. Our project came online at the end of last year. We connected it to the existing hydrothermal project that was operating at that site. Our steam goes directly into their system, and we create greater generation for them. The scale of this project is about 3.5 megawatts.

We started producing power at the end of last year, and the operational data has been fantastic. We are seeing increasing temperature growth. It has exceeded a lot of our models. We are getting the flow rates, both in heat and amount of water, that are necessary for commercial operation. This kicked off a lot of excitement in the industry and gave us, as a private developer, the green light to take this to the next level of scale. We are currently drilling a 400 megawatt project. For comparison, 3.5 megawatts was the two-well pair original pilot. This is significantly larger in size; it is about the size of a decently sized gas plant. We are drilling right now in Southwest Utah; this project is called Cape Station. The first phase will come online—90 megawatts—in 2026. The second phase will come online in 2028. That project is fully contracted to utilities in California. It is the first of its kind EGS project anywhere in the world. This is extremely exciting to see it work at scale and to bring down the cost and the speed of deployment.

You can see in this chart, which is drilling performance, it is days versus depth—basically, how fast are we able to reach a certain depth while we are drilling. Drilling is about 50 percent of the capital expenditure cost of building a geothermal project. Bringing down the speed and the cost of that drilling is essential to making this a cost-competitive resource more broadly. The gray lines are the wells that were drilled at the conventional geothermal project in Winnemucca. The red lines show our performance on our commercial scale pilot, and the blue lines demonstrate what we are currently doing today in Utah. As we get steeper, that means we are drilling faster and deeper, and that opens up cost savings that can then be applied towards generating more production from that well, reaching hotter temperatures, or bringing it online faster.

Putting that into money's terms—our first couple wells at Project Red cost about $1,000 per foot. We are now into the range of $400 or sub-$400 per foot of drilling. What is not shown in the fine print here is that wells six, seven, and eight in Utah were drilled to deeper depths, hotter temperatures—basically a better resource. On an efficiency basis, we are capturing those efficiencies in our development. This is exactly the type of cost decline profile we saw in oil and gas for shale, what we saw in wind and solar and batteries, where deployment begets lower costs, which then helps fund cost-competitive power energy generation, which begets more financing and further deployment.

Fervo has acreage positions across the West. Nevada is our largest acreage holding. We have a little over 300,000 acres for geothermal energy development in the State of Nevada. We are extremely excited about the opportunities for development here.

I would close by noting a couple points of recommendation for this Committee and the Legislature to be thinking about. One, these are projects of a slightly different kind than conventional geothermal. It is certainly of a different scale, and there is the potential, given the demand for clean, firm, baseload power across the West and in this State, with the economic growth we have seen and continue to see with the demand for electricity, we are

going to need a regulatory State that is partnering with the industry to make sure we have technically savvy folks who are well-resourced and have a facility with this type of technology, so we can permit applications effectively, choose the right projects, and make sure communities have a voice in that process, so we are not in a position where people are in conflict with this growth for power, and we can make sure we move forward responsible development. Further, I will note this is a new technology. It is a first-of-its-kind project we are building in Utah. Geothermal has been historically and continues to be the least-supported clean energy resource from the federal government, so we are often looking to compete with projects that enjoy enormous amounts of subsidies. Anything that can be done to help provide the cheapest possible power to our customers—ultimately, the end users of this State—is hugely important in moving the needle for deployment.

Finally, we have a great market environment here for clean, firm power. You heard it from NV Energy this morning, and you continue to hear it from manufacturers and tech companies: this is a great place to do business. I would encourage you to think about clean, firm power as the foundation for the economic growth. This next generation of data centers and manufacturers—Redwood Materials battery manufacturing and that sort of thing—will continue to bring money into this State with reliable, low-cost and carbon-free power. I am happy to take your questions.

Chair Harris:

Committee Members, do we have any questions? Vice Chair Watts.

Vice Chair Watts:

Thank you for the presentation. This is something that has come up across the day, which is our water limitations and challenges. Can you speak to the water usage profile, particularly on an ongoing basis for these facilities, and maybe also discuss any differences between enhanced geothermal versus the traditional geothermal resources?

Mr. Serrurier:

Yes, this is a question that comes up a lot, and you can imagine as we develop in Utah—Beaver County, where we are building our current 400 megawatt project, is also an area that is fully allocated and has not been issuing any additional water allocations. We are working in a water constrained environment. One thing that is important to note is while we use the term *hot dry rock* as the resource we are going after, it is a bit of a misnomer. In fact, the rock at that depth—8,000 to 10,000 feet—is saturated with water. Hot, soggy rock would perhaps be a more reasonable definition. When we create fractures in that rock, we liberate a fair amount of water, and that water is what we use to seed our closed-loop approach to cycling that brine up through the surface and then back down. In Utah, for example, we are not anticipating needing to drill or get additional allocation for water, as it is a non-consumptive use. On an ongoing basis, it is sort of a de minimis water usage and consumption. On the drilling side, that is a consumption use when we are drilling out the well field. That is a one-time requirement when we drill the wells, and unfortunately, that is somewhat unavoidable, but we do not need to use potable water for that. We can contract with agricultural runoff or any types of other contaminated water, as long as it works with our drilling equipment in terms of its quality, but it does not have to be potable or anything like that.

Vice Chair Watts:

Thank you for that; I appreciate it. We have had an initial conversation about the considerations for policy to support this particular industry, and I look forward to continuing those conversations to see what we can do. Thank you again.

Chair Harris:

Are there additional questions or comments from Committee Members? Not seeing any. We will close out Item XX.

AGENDA ITEM XXI—PUBLIC COMMENT

Chair Harris:

We will roll right into our last item, which is another series of public comment. Public comment will be limited to two minutes per speaker. You can provide comment either here in Carson City, in Las Vegas, or via phone at the phone number that is posted on the top of the agenda. We will start here in Carson City.

Olivia Tanager, Executive Director, Sierra Club Toiyabe Chapter:

Thank you, Chair Harris, and Interim Committee on Growth and Infrastructure. The Toiyabe Chapter believes that we all have the right to a livable planet and that our kids and our kids' kids deserve the best shot we can give them at addressing the climate crisis. The best time to have done that would have been 50 years ago, but the second best time is right now. That is why I am so frustrated that NV Energy is proposing new gas peaking power plants. Our Chapter celebrated the conversion of the Reid Gardner coal plant to a battery storage station and have been hoping for a similar outcome for the Valmy coal plant, once one of the dirtiest coal plants in the country. Now NV Energy is proposing that site have an increased reliance on fossil gas. NV Energy is choosing to take a huge step backwards in using fossil gas to meet increased energy demand instead of a clean alternative. You heard today that economic profit is the main driver behind that decision, not the health and safety of Nevadans. This conversation around the IRP is happening at the same time communities in Northern Nevada are worried about a basic service charge increase from $16 to $44 a month, which would disincentivize energy efficiency and make our basic service charge among the highest in the country. It would also put an undue burden on solar owners, requiring folks to pay almost $50 a month to NV Energy on top of their solar payments, even if they generate all their own electricity. NV Energy's profits cannot come at the expense of low-income ratepayers and community members who are already vulnerable to our rapidly warming climate here in Nevada. Reno is the fastest warming city in the country, and Las Vegas is the second. Nevada is also facing an incredibly severe affordable housing crisis. Nevadans know firsthand that we cannot continue to rely on fossil fuels to meet our energy needs, and we cannot continue to force rate hikes on low-income members who are already struggling to make ends meet. I ask that you do everything in your power to hold NV Energy accountable and put people over corporate profits. Thank you.

Tony Simmons:

The comments by the Sierra Club were interesting because it highlights a serious misunderstanding about the true cost of providing voltage control to solar customers. That has been the big flaw in the design in Nevada, is the fact that voltage control service in 1997 required 87 percent of the customer's annual bill. In 1997, when solar first began, an optimally sized system could save a customer 17 percent, and a $7,000 investment would

have a simple payback of 240 years. Rooftop solar has always been incorrect—the rate design for rooftop solar has always been incorrect. It has been before the Commission several times. Unfortunately, I have just realized the Commission is constitutionally constrained and cannot address an issue that NV Energy refuses to acknowledge proactively. That will be resolved during this next IRP. Thank you very much.

Chair Harris:

Thank you. Do we have any other people in Las Vegas who would like to give public comment? Not seeing any, BPS, is there anyone on the phone lines who is waiting to provide public comment today?

BPS:

The public line is open and working, but there are no callers to provide comment at this time.

Chair Harris:

Before we adjourn, I would like to thank our presenters for giving us a lot of great information. I appreciate them being engaged on today's discussion. I also want to thank our Committee staff who has done a ton of work behind the scenes to get this particular meeting—to get all of our meetings, but this one in particular—up and running so everyone could see the great information we saw today. It would not have gone so smoothly and on time without all the hard work they put in. Thank you, Senator Spearman, for bringing forward the bill and initiating this study. I look forward to having further discussions for anyone who presented today, whether it was on hydrogen or something that was tangential. Another reminder that we have the solicitation of recommendations available. If you have bill or policy ideas, please submit that for the Committee to consider. I saw quite a few in some of those PowerPoint presentations. With that, we will be adjourned until our next meeting on July 17, 2024. Have a great day, everybody. We are adjourned.

Written public comment was submitted:

Agenda Item XXI A—Edgar Flores, Senate District 2; and

Agenda Item XXI B—David Alonso, Chief Commercial Officer, HyAxiom

AGENDA ITEM XXII—ADJOURNMENT

There being no further business to come before the Committee, the meeting was adjourned at 2:29 p.m.

Respectfully submitted,

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Julianne King
Assistant Manager of Research Policy Assistants

_____

Kristin Rossiter
Senior Policy Analyst

APPROVED BY:

_____

Senator Dallas Harris, Chair

Date: _____

MEETING MATERIALS

AGENDA ITEM	PRESENTER/ENTITY	DESCRIPTION
Agenda Item II A	Troy Arias, Owner, Arias LLC	Written Public Comment
Agenda Item II B	Chris Bell, Private Citizen	Written Public Comment
Agenda Item II C	Bari Levinson, Volunteer, Sierra Club	Written Public Comment
Agenda Item IV	Ryan Bellows, Vice President, Government and External Affairs, NV Energy Ryan Atkins, Vice President, Resource Optimization, NV Energy	PowerPoint Presentation
Agenda Item V A-1	Kristin Rossiter, Senior Policy Analyst, Research Division, Legislative Counsel Bureau (LCB)	Senate Bill 451 (2023)
Agenda Item V A-2	Kristin Rossiter, Senior Policy Analyst, Research Division, LCB	SB 451 Supplemental Resources and Information
Agenda Item VI A-1	Senator Pat Spearman, Senate District 1	Memorandum Regarding an Update on Virtual Roundtable Discussions Related to Hydrogen
Agenda Item VI A-2	Senator Pat Spearman, Senate District 1	Article on NASA and Fuel Cell Industry
Agenda Item VII A-1	Roxana Bekemohammadi, Founder and Executive Director, United States Hydrogen Alliance (USHA)	PowerPoint Presentation
Agenda Item VII A-2	Roxana Bekemohammadi, Founder and Executive Director, USHA	Link to Fact Sheet
Agenda Item VII A-3	Roxana Bekemohammadi, Founder and Executive Director, USHA	Link to Fact Sheet
Agenda Item VIII A-1	Mark Chung, Group Manager, National Renewable Energy Laboratory (NREL)	PowerPoint Presentation

AGENDA ITEM	PRESENTER/ENTITY	DESCRIPTION
Agenda Item VIII A-2	Mark Chung, Group Manager, NREL	Links to Supplemental Information
Agenda Item IX	Scott Kelley, Ph.D., Associate Professor, University of Nevada, Reno Sean McKenna, Ph.D., Executive Director, Desert Research Institute David Hatchett, Ph.D., Interim Vice President, Executive Director of Research Infrastructure, and Professor, University of Nevada, Las Vegas	PowerPoint Presentation
Agenda Item X	Katie Ellet, President, Hydrogen Energy and Mobility, North America, Air Liquide	PowerPoint Presentation
Agenda Item XI	David Swallow, P.E., Deputy Chief Executive Officer (CEO), Regional Transportation Commission (RTC) of Southern Nevada	PowerPoint Presentation
Agenda Item XII	Paul Nelson, Government Affairs Officer, RTC of Washoe County Jim Gee, Director of Public Transportation and Operations, RTC of Washoe County	PowerPoint Presentation
Agenda Item XIII A-1	Ben Bryce, Senior Manager, State Affairs Southwest, Environmental Defense Fund (EDF) Christi Cabrera-Georgeson, Deputy Director, Nevada Conservation League (NCL)	PowerPoint Presentation
Agenda Item XIII A-2	Ben Bryce, Senior Manager, State Affairs Southwest, EDF Christi Cabrera-Georgeson, Deputy Director, NCL	Fact Sheet on the Science of Hydrogen's Warming Effects

AGENDA ITEM	PRESENTER/ENTITY	DESCRIPTION
Agenda Item XIII A-3	Ben Bryce, Senior Manager, State Affairs Southwest, EDF Christi Cabrera-Georgeson, Deputy Director, NCL	Fact Sheet: Preventing and Mitigating Hydrogen Emissions From Infrastructure
Agenda Item XIII A-4	Ben Bryce, Senior Manager, State Affairs Southwest, EDF Christi Cabrera-Georgeson, Deputy Director, NCL	Fact Sheet: Three-Pillar Rule is Essential to Safely Grow U.S. Clean Hydrogen Economy
Agenda Item XIII A-5	Ben Bryce, Senior Manager, State Affairs Southwest, EDF Christi Cabrera-Georgeson, Deputy Director, NCL	Fact Sheet: Hydrogen Risks are not Fully Addressed by the 45V Rule Guidance
Agenda Item XIII A-6	Ben Bryce, Senior Manager, State Affairs Southwest, EDF Christi Cabrera-Georgeson, Deputy Director, NCL	Link to Article on Climate Consequences of Hydrogen Emissions
Agenda Item XIII A-7	Ben Bryce, Senior Manager, State Affairs Southwest, EDF Christi Cabrera-Georgeson, Deputy Director, NCL	Link to Article on Climate Impacts
Agenda Item XIV	Matt Rosenfeld, Director, Technology and Innovation, Cyrq Energy	PowerPoint Presentation
Agenda Item XV	Dery Daye, Founder and President, HyMAX Development Corporation	PowerPoint Presentation
Agenda Item XVI	Scott Leedom, Director, Public Affairs, Southwest Gas James Stein, Manager, Energy Solutions, Southwest Gas	PowerPoint Presentation
Agenda Item XVII	Chris Dancy, Senior Project Manager, Renewables and Origination, NV Energy	PowerPoint Presentation
Agenda Item XVIII A-1	Kirsten Stasio, CEO, Nevada Clean Energy Fund (NCEF)	PowerPoint Presentation

AGENDA ITEM	PRESENTER/ENTITY	DESCRIPTION
Agenda Item XVIII A-2	Kirsten Stasio, CEO, NCEF	Links to Supplemental Information
Agenda Item XIX	Robert Nicholson, Senior Manager, PV [photovoltaics] Recycling, Solar Energy Industries Association	PowerPoint Presentation
Agenda Item XX	Ben Serrurier, Government Affairs and Policy, Fervo Energy	PowerPoint Presentation
Agenda Item XXI A	Senator Edgar Flores, Senate District 2	Written Public Comment
Agenda Item XXI B	David Alonso, Chief Commercial Officer, HyAxiom	Written Public Comment

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