California Hydrogen and Fuel Cell Summit Report

March 5 and 6, 2020 at CalEPA in Sacramento, CA

May 20, 2020

Abstract

The California Hydrogen Business Council organized and convened the 2020 California Hydrogen and Fuel Cell Summit at the California Environmental Protection Agency in Sacramento on March 5 & 6, 2020. This seventh CHBC Summit was designed to discuss the key challenges and policy needs of the hydrogen and fuel cell industry and how the diverse set of solutions can play a central role to achieve California's energy, environmental, climate and air quality goals. The Summit relied on select keynote speakers and focused roundtable discussions among expert panelists.

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This report provides highlights of the Summit and identifies important policy positions and goals that industry and government should advance in 2020 and beyond. The content is provided in bullet form to focus on core information presented.

Disclaimer

This report is a combination of quotations, paraphrasing and notes taken during the Summit by CHBC staff. The individual speakers have neither reviewed nor approved this report. Staff does not guarantee complete reflection of the presentations and discussions at the Summit. The slides from presentations given at the Summit are available on the CHBC website for CHBC members.

Questions?

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"Hydrogen is a game-changer and indispensable in achieving our long term climate goals." - Commissioner Cliff Rechtschaffen, California Public Utilities Commission

Executive Summary

On March 5-6, 2020, the 9th California Hydrogen Business Council Summit convened 230 government officials, industry experts, academia, and other thought leaders from across California and the nation to exchange ideas on how hydrogen technologies can enable the State of California's ambitious climate, clean energy, equity, resilience, and air quality goals. Senior experts shared their perspectives on how policymakers and industry can and must collaborate creatively to transform the state's energy system across sectors, deploying renewable hydrogen as a key solution to providing clean, reliable and affordable power, heat, and transportation, and to decarbonize the most challenging sectors like aviation and heavy industry.

The central takeaway was clear: **For this promise to become a reality, all stakeholders will need to embrace a new paradigm, as California has done through pioneering the first generation of renewable, zero emission technologies**. The state has made great strides in recognizing and helping to launch a number of hydrogen solutions, starting with the transportation sector and lately beginning to support hydrogen for other important applications, such as energy storage and electricity generation. And this is just a start.

In the many Summit Roundtables, the following issues came to the forefront:

- **Projects** – Projects in operation show policymakers what is possible and provide critical experience in building financeable projects. Large projects like LADWP's IPP hydrogen conversion and projects that leverage the massive existing gas system assets are particularly valuable. The recent focus on energy resiliency can also draw upon fuel cell advantages in new projects and demonstrations, including microgrids, backup power, and energy storage. Regulatory innovation at the CPUC is required to enable advanced hydrogen projects, and government funding and policies that provide long term certainty to investors are also needed to compel the new investments required.

- **Scale and Costs** - The challenges for green hydrogen are fundamentally market design-related and require scale, which will bring large industry players into the vision of deploying hydrogen projects to enable state goals. Particularly important to achieve is scale is supporting cost reduction and implementation of electrolyzers. The State and industry need to create large scale demonstration projects to reduce future project risk and make them financeable. A large industrial plant converted to run on renewable hydrogen would require a scale of electrolyzer capacity that would help drive down hydrogen costs. Similarly, a port with co-located projects to operate and move their goods with hydrogen would require 1 GW of hydrogen capacity, which would also help drive costs down. To realize this, industry needs access to wholesale rates and long term off-take agreements, like power purchase agreements have done for renewable power technology development, which will make renewable hydrogen financeable and real to policy makers. Access to the pipelines for renewable hydrogen, such as currently being addressed in a proceeding at the CPUC, is also critical. Coupled with this California needs a Renewable Gas Standard that includes renewable hydrogen, which sets long term targets with interim milestones that mirrors what California has in place for transitioning to renewables in the electricity

sector. This would provide the necessary certainty to investors, as the Renewable Portfolio Standard has done for renewable power technologies, to drive down costs, boost scale, and create green jobs.

- **Risk Reduction and Financeability** - Creating policies and demonstrations that reduce risks will make hydrogen projects more financeable bring industry commitments to the hydrogen future. For example, California must reduce the regulatory risk of permitting gasifiers, storing hydrogen underground in the gas system, regulating offshore wind, and the financing large projects. The State should find opportunities to partner in large projects, in order to encourage investments and bank financing of projects. Appropriate pricing of electricity for hydrogen production, compression and liquefaction is also needed.

- **Education** – We need government and industry visionaries with a story that compels action where progress is difficult. Education of legislative staff and members is critical for them to be comfortable moving aggressively ahead toward adoption of hydrogen solutions. Industry needs to exhibit and showcase technologies to build excitement among policy makers. Ideas shared included a Bill Nye-type Hydrogen 101, an exhibition on the lawn of the Capitol, and a plan to showcase hydrogen at the 2029 Olympics. Industry needs to also educate consumers to develop their interest in hydrogen technological and market solutions.

- **Battery - Fuel Cell Policy Parity** – There must be policy parity between fuel cell and battery electric vehicles. This includes revising the SB 350 transportation electrification definition to include fuel cell electric vehicles to encourage private investment in infrastructure, encouraging transit agencies to consider both types of electric bus – fuel cell and battery electric – and other provisions. It was also proposed to convene a multi-agency working group to accelerate HD and off road ZEV infrastructure with a level playing field among battery and fuel cell solutions. Generally, policies must reflect htat hydrogen is key to fully utilizing renewables for transportation and is the only ZEV fuel able to compete with hydrocarbon fuels in fueling time, range and at-scale cost.

- **Power Generation** - With SB 100, hydrogen must play a role in power generation and the other 40% of energy use beyond the reach of the RPS. Transitioning power plants that run on natural gas to green hydrogen is possible to begin doing today and can play a key role in the state not only achieving the SB 100 zero carbon by 2045 goal, but the broader state goal of carbon neutrality by 2045 by addressing non-retail electricity sales that SB 100 doesn't capture.

- **Ports** - The need and desire to clean up California's ports, with their goods movement infrastructure can provide a galvanizing focal point for many hydrogen production and utilization pathways.

- **California Leadership** - California has a great opportunity to continue to be a leader in decarbonizing energy use but we need an overarching policy framework that includes hydrogen to do so. Doing a job analysis to document the return on state investment is one of the next steps that could solidify continued California leadership.

Opening Keynote: Janice Lin, Strategen

- **Recommendation to create a green hydrogen task force to address hydrogen's role to achieve SB100** – green hydrogen is "a game changer"
    - Hydrogen can help overcome difficult energy and emission challenges, e.g. integrating more renewables, decarbonizing hard to abate sectors like steel, chemicals, trucks, ships
    - **Challenges for green hydrogen are fundamentally market design-related and require scale**
- **New paradigm is needed for system-wide transformation with this untapped energy vector**
    - Optimize in the power and heat energy sectors.
    - Planning for reduced GHGs needs to evolve across all sectors.
    - Align benefits and value streams, not just lowest cost.
- Presented Intermountain Power Project, a salt dome cavern for long term energy storage for renewable hydrogen

Opening Keynote: California Senator Henry Stern

- **Industry needs to accurately evaluate environmental benefits**
    - There needs to be a collective focus from gov't and industry on actions resulting in change today - not just 2030 or 2045 - to advance our goals.
    - Can't afford to risk stranded assets that can result from bad investments
    - Need a Hydrogen 101 workshop for the legislature

Roundtable: What Can the Legislature Achieve in the 2020 Session to Advance the Role of Hydrogen to Meet California's Climate and Energy Goals?

- **Moderator Lorraine Paskett, Cambridge LCF**
- **V John White, CEERT** – Three issues industry should address:
    - **Restore funding for vehicles, with multi-year infrastructure provisions, in proposed budget**
    - **Access to surplus renewable energy to produce electolytic hydrogen**
        - Wholesale rates and solar projects with hydrogen offtake agreements
        - Need demo projects, maybe with municipal utilities who have more flexibility; need more experience building electrolyzer projects; current hydrogen supply is fragile; can build electrolyzers next to a substation coupled with fueling facility
    - **Address California's woody biomass and the wildfire risk challenges with renewable hydrogen production pathways.**
- **Michael Colvin, Environmental Defense Fund** –Two items to advance:
    - **Restore funds in State budget for hydrogen and transportation**
    - **Leverage existing gas system asset**
        - Stop leaks first – make pipelines efficient, which will reduce the supply needed
            - **Separate the costs to stop leaks and upgrade the pipelines; maintenance costs should not be mixed or confused with the costs of adding hydrogen capability to the system**
        - **Begin transition of decarbonized gas system by injecting hydrogen**

    - **With SB 100, hydrogen must play a role in power generation and the other 40% beyond reach of the RPS**; need to build new electric power now
        - Any legislative signals we can provide will be important
- **John Ackler, California Senator Archuleta Legislative Director**
    - **Need industry to focus on educating legislative staff and members**
        - Need one voice in industry to build legislature's confidence
    - **Create policy parity with BEVs by being more active**
        - Play to the strengths of the solutions this industry offers
    - SB 662 started a hydrogen dialogue in our office
        - Bill proposes funding infrastructure with gas utility investments, which are well suited to provide infrastructure development
        - **Hydrogen should have eligible pathway to decarbonize in SB 350 and SB 100**
    - **SB 895 updates stranded CEC fund for zero emission fueling projects**
    - **SB 1379 proposes ARB, GoBiz and UC system to collaborate to showcase hydrogen at 2029 LA Olympics**

Keynote: Steve Bohlen, Lawrence Livermore National Laboratory – Getting to Carbon Neutral by 2045

- "Getting to Neutral: Options for Negative Carbon Emissions in California" study focuses on negative emission pathways California can pursue to achieve its goals.
- **Biggest opportunity for industry is through the conversion of waste (including municipal waste, woody biomass and ag wastes) to hydrogen through gasification and sequestering the carbon**
    - California has a large-scale geologic CO2 storage potential
    - Need resources of fossil fuel industry for geologic storage of CO2
- Benefits
    - Improved forest management and wildfire prevention
    - Job creation, especially in the Central Valley
    - State's oil industry can transition to a low carbon future
    - Air quality improvement
- **A guaranteed stream of wastes to produce carbon benefits with underground carbon sequestration can help finance hydrogen production**
- **Need to reduce regulatory risk for permitting new gasifiers, sequestration sites, and demonstration projects at scale**
- **Need industry, state, and federal officials to partner and demonstrate at scale, to prove business case for further investment from banks**

Roundtable: Renewable Hydrogen as a Key Enabler: How to Transition from Fossil Fuels?

- **Moderator Janice Lin, Founder and Board Member, Green Hydrogen Council; Founder and Chief Executive Officer, Strategen**

- **Steve Bohlen, Lawrence Livermore National Laboratory**
- **Joe Lyou, Coalition for Clean Air and SCAQMD Board Member**
    - **Need visionary leadership, technology and a "helluva a lot of money"**
    - **Need a truck rate (a fee) changeover for the 17,000 drayage trucks, to raise more money for green, carbon free ports**
- **Jack Brouwer, National Fuel Cell Research Center**
    - **Need to focus on complete decarbonization of the ports -** with one offshore wind farm, the Ports of Long Beach and Los Angeles can be decarbonized and reduce the cost of renewable hydrogen.
    - **Need an accounting system in place to track green hydrogen production and supply**
- **Wladimir Sarmiento-Darkin, Linde**
    - **Need order of magnitude increase in station funding and hydrogen production at scale**
    - **Need legislation for use of renewable electricity at the source of production**

Roundtable: What are the Policy and Technology Challenges to Achieving Zero Carbon and Renewable Hydrogen Production at Scale and Reliable Supply at Low Cost?

- **Moderator, Diane Moss, CHBC Policy Director and Founding Director, Renewables 100 Policy Institute**
- **Sean Ebnet, Orsted**
    - **Need scaled electrolyzer production, up to 500 MW stacks**
    - **Need to recognize the route to market, with renewable hydrogen access of natural gas pipelines**
    - **Need more prescriptive policies or mandate (like the RPS was for electricity) that compel investments**; investments follow policy
        - Orsted would like to be investing in California and needs to see policies that make the $35 billion it will invest for growth compelling in California
    - **Need to demonstrate efficacy and safety at scale, with reduction of regulatory risk, for banks to invest**
    - **Need policy that allows prices to adjust as market prices evolve too support investments**
- **Tanya Peacock, Southern California Gas Company**
    - Have 100,000 mi of pipe in the ground that we are interested in utilizing to support the energy transition, to decarbonize the molecules we transport; we are essentially a molecule transportation company.
    - **Need an overarching policy framework for decarbonized fuels, like hydrogen**
        - Fuels have great value in providing flexibility and reliability; can connect the electric grid and gas grid and deliver carbon neutral energy across sectors
    - **To develop policies, it is helpful to showcase projects**
        - Dunkirk has 200 homes supplied by increasing amounts of hydrogen introduced into the gas grid, hydrogen generated by excess wind; demonstrated use of hydrogen for storage and energy
        - Jupiter 1000 is an industrial scale electrolytic hydrogen project to test impact of hydrogen on industrial processes with a blended NG supply

    - **Neighboring states are directing utilities to develop renewable gas programs, utilizing the power of utilities to decarbonize fuel**
    - **Key policies needed**
        - **More directed renewable gas policies**
        - **A renewable gas standard – an RPS for gas**
        - **Standards for injecting hydrogen into NG systems**
- **Elias Greenbaum, GTA**
    - Policy drives technology
        - DOE H2@Scale 2019 report says "The use of hydrogen and fuel cells in transportation is currently challenged by high capital costs, insufficient reliability high energy consumption and an unacceptably large land area requirement"
    - **Need policy to support a 1 GW (100 - 10 MW wind turbines) offshore wind farm**
        - Eliminates 25% CAPEX for cables and substations, 30% OPEX for insurance for cables
        - Energy transport by hydrogen in pipelines is 8X cheaper than transport by electricity in cables
    - Need 7.5 billion kg of hydrogen to power all vehicles by renewable hydrogen
        - Solution could be 110 mi x 110 mi area in water, with 12,400 – 10 MW wind turbines and electrolyzers
    - Policy issues
        - **Need to get offshore regulatory policies for floating offshore wind turbines in place; 100% 2045 goal won't happen without offshore wind**
- **Sandy Goldberg, Advisor to CPUC Commissioner Rechtschaffen**
    - SB 1369 went into effect last year, which requires agencies to consider green hydrogen an eligible form of storage; PUC is beginning to implement in various proceedings
    - **Biomethane proceeding added a phase 4 for the amount of renewable hydrogen that can be injected into pipelines; next November will be a proposal to set a standard**
    - **UC Irvine study to determine technical limits for injection of hydrogen**
    - **Transportation electrification proceeding is considering special rates and rate design for vehicle fuels and could include production of hydrogen for the transportation sector**
    - **Ongoing Integrated Resources Planning proceeding on how to plan for meeting state's GHG reduction goals has a high hydrogen scenario for deep decarbonization strategy, looking out to 2045,** whereas IRP process that is binding on the utilities is only looking out to 2030; using CEC study results
    - **Self-Generation Incentive Program (SGIP) has seen increased incentives and renewable hydrogen could be an eligible fuel if it meets CEC eligibility criteria; SGIP requires 100% renewable fuel for fuel cells**

Roundtable: Zero Emission Heavy Duty Freight, Transit and Clean Ports: An Opportunity for Scaling Hydrogen Mobility and Infrastructure

- **Moderator Patty Monahan, Lead Commissioner on Transportation, California Energy Commission**
    - Exciting time to be talking about medium and heavy duty transportation; **only way to meet State goals is to bend the curve on transportation pollution**
- **Nicolas Pocard, Ballard Power Systems**

- Fuel cells provide power, range, payload and fast refueling
    - Commercial vehicles are all about asset utilization
    - You don't want to overload your axles with batteries
- With heavy duty, it is all about the total cost of ownership and availability
    - **Need to reduce costs**
        - **Reduce hydrogen cost by 60%**
        - **Reduce fuel cell system cost by 70%**
    - Deloitte-Ballard Report says, in less than 10 years, it will become cheaper to run a fuel cell electric vehicle than to run a battery or internal combustion engine vehicle for certain commercial applications

- **Kim Okafor, Trillium – A Love's Company**
    - With over 500 Love truck stops across the country, Trillium is the alternative fueling member of the Love's family; over 40 alt fuel stations, mostly CNG, but also renewable natural gas, renewable diesel, biodiesel, electric charging and hydrogen
    - Recently completed Orange County Transit Authority's fueling station with delivered liquid hydrogen from Air Products
- **Katrina Robinson, Office of California Senator Nancy Skinner**
    - Senator Skinner has been trying to help **build out incentives for hydrogen and hydrogen vehicles with legislation**
    - **SB 44 last year pushed for long term, multi-year funding for HVIP heavy duty incentives; will be pushing again this year; last year only provided one year of funding**
    - SB 1369 in 2018 put a definition in statute for green hydrogen
    - This year **SB 1122 will allow green electrolytic hydrogen to count toward the RPS goal of 100% carbon-free energy**
        - **Will ask CARB include in Scoping Plan process how it can better use green hydrogen to meet the State's energy goals and how it can use curtailed energy to produce new forms of transportation fuels and other benefits to reduce GHG emissions**
- **Heather Arias, Transportation and Toxics Division, California Air Resources Board**
    - This year **pushing hard in GHG reduction, ships at berth, omnibus Advanced Clean Truck rule**
    - Late this year will be **regulations for truck refrigeration units TRUs)**
    - **Next year will be locomotives, forklifts and harbor crafts**
    - **Following year, 2022, will be ACT2 with fleet trucks, drayage vehicles and cargo handling**
    - **Opportunities in** fuel cell propulsion but also **moveable gen sets where battery trucks have to plug in to charge, to avoid costs of electric infrastructure to handle that**
        - ARB is looking for ways for technologies to partner
    - We don't have a lot of time to push the technologies out there
        - **Need demo and pilot projects now, partnering with the air districts in heavy duty fuel cells, locomotives, trucks**
        - **Ultimate goal is zero emissions across the board with lower cost, affordable products**
- **Joe Impullitti, South Coast Air Quality Management District**
    - No regulatory authority over mobile sources, **so develop innovative solutions to achieve voluntary adoption through R&D, demonstration and deployment**
    - Funding through $1 fee on vehicle regulations, ~13 million/yr, leveraged to $144 million with State and federal project funds

Roundtable: Providing Resiliency in a High Risk Energy Environment – What is the Role of Renewable Hydrogen and Fuel Cells?

- **Moderator Katrina Fritz, California Stationary Fuel Cell Collaborative**
- **Joyce Steinglass, California Public Utilities Commission**
    - **Track 2 will provide more on the Senate mandates of SB 1369, looking at rates; still considering role that renewable gas will have.**
    - Industry should continue to participate in CPUC workshops
- **David Erne, Microgrid Resources Coalition, California Energy Commission**
    - **CHBC should continue to partner with the Coalition and participate in workshops; no hydrogen and fuel cells currently in any California microgrid**
    - **Value of resiliency provides a good opportunity for hydrogen and fuel cells**
    - PSPSs have reshaped the discussion in the state; people are exploring role of microgrids
- **Pippin Mader, Office of Community Air Protection, Technology Assessment Section, California Air Resources Board**
    - CARB's emissions inventory indicated that the use of additional diesel generators during last October's Public Safety Power Shutoffs (PSPSs) was equal to 30,000 diesel trucks operating for the same period of time
    - **ARB is pushing for zero emission batteries and fuel cells to be considered first when backup power is needed.**
        - Batteries seem relatively easy to produce the power needed but the costs increase linearly as additional energy storage is needed
        - **Fuel cells may be a feasible technology when longer duration storage is needed; fuel cells can be used as base load, can provide resiliency during the outage**
- **Chris DiGiovanni, PG&E**
    - **Involved in how can we utilize the gas system to decarbonize end uses like HD trucking marine and rail, but also how do we decarbonize the gas system with hydrogen**
    - **PG&E launched an RFP in December looking for solutions to PSPS events at substations; we are aware of the environmental damage being caused by diesel generators**
    - Long term, natural gas is not the solution to resiliency
    - **CHBC should partner on a big multi-market demo project**
- **Allie Detrio, Microgrid Resources Coalition**
    - California is one the greatest opportunities for microgrids
    - **Hydrogen is one of the next generation of microgrid options to meet 2045 California goals**
- **Sarah Brady, California Council on Science and Technology**
    - **Studying PSPS and other matters related to resiliency**
- Panel responses to questions:
    - **Urged additional curriculum development and assistance to community colleges to train the future work force**
    - **Need public education about what a fuel cell is, for example, so the public can be advocates**

Keynote: Hector de la Torre, Member of California Air Resources Board

- **To meet zero emission goals, we need to reach zero in every sector, and find ways to compensate for any remaining emissions by sequestering an equal amount in our natural and working lands through carbon capture and sequestration, direct air capture, or other mechanisms.**
- **This will require an integrated systems approach where we look at all sectors as a whole, and not each sector in isolation.**
- **Industry has to engage consumers**; government policy is not created in a vacuum; **industry has to be there, being visible with voices, with data.**
- **Need a good narrative and provide a credible demonstration of how government support today can reduce risk and catalyze greater self-reliant industry expansion tomorrow**
- **Demonstrate foresight and effective management to avoid unforeseen issues like the hydrogen shortage experienced last year at fueling stations**
- It was important to have a permitting guidebook to get stations sited, a product developed by GoBiz
- SB 498 Report has **31 recommendations – develop consensus and prioritize the 3 to 5 that we want and focus on them**. Some of the important recommendations are:
    - Provide predictable and expanded programs that enable customer choice
    - Provide increased incentive funding to ensure that priority populations in school districts can access zero emission transportation
    - **Provide CEC with additional funding to deploy ZEV infrastructure, particularly near heavily impacted priority populations**
    - **Define SB 350 transportation electrification to be inclusive of renewable hydrogen, enabling private investment, and to provide a solution for energy storage needs and support of the electric grid**
    - **Extend California Clean Transportation program beyond 2023**
    - **Convene a multi-agency working group to accelerate HD and off road ZEV infrastructure – we want to level the playing field between battery and fuel cell electric vehicles**
    - **LCFS can help incentivize investments in more renewable feed stocks like dairy manure (which also helps with our short lived climate pollutants), food wastes and waste water treatment plants**

Roundtable: Seeing the Forest for the Trees? A Holistic View of the Value of Hydrogen in the Energy System

- **Moderator Jeff Reed, University of California - Irvine/Advanced Power and Energy Program** –
    - **Need to promote a holistic view of the value of hydrogen in energy systems and discuss the policy frameworks.**
    - Hydrogen often doesn't receive the treatment that it should; in separate market strategy analyses, hydrogen is viewed as contributing, maybe 15-25% of primary energy, but it is not viewed holistically.
- **Cliff Rechtschaffen, Commissioner, California Public Utilities Commission**

- **Hydrogen, particularly green hydrogen, is a game changer and indispensable in achieving our long term climate goals**, but **costs are still a barrier – production costs, upfront costs of vehicles - and the infrastructure is not here yet.**
- **Need to show cost and investment progress to believe a role by 2030**
- **Struggling with policy and related issues of how to transition off natural gas while we continue to rely on it for customers who need that fuel and deal with short lived climate pollutants and best use of wastes (from landfills, dairies, forests), and the building sector and transportation sector**
- **Need a statewide policy and strategy for hydrogen**
- **Need innovation in both technology and procurement models**

- **Michelle Sim, Southern California Gas Company**
  - How do we play a role to support the customer's end use needs while supporting the state's decarbonization goals
  - The 21st century system needs to be:
    - Clean, with increased renewables on the grid, with renewable carbon neutral gases
    - Reliable and resilient
    - Affordable
    - Integrated energy system
- **Gil Castillo, Hyundai**
  - **Word of mouth passion at grass roots level is where the sales are made and not sure that it is favorable for hydrogen with recent fueling issues**
- **Jeff Reed, UC Irvine, Advanced Power & Energy Program**
  - To advance as a sector, **hydrogen needs more like the scoping plan for SB 100 implementation, or something that has a binding nature to it for achieving the goals, with statutory mandate or regulatory authority**
    - Anaerobic digestion has a waste management mandate
    - Gasification doesn't have a mandate yet, but with wildfire prevention interests, we may see mandates develop
    - Electrolytic hydrogen may be the market price setter because it won't have any such mandates behind it
  - How does renewable hydrogen reach scale?
    - **There needs to be policies in place across the demand sectors to drive production costs down**
    - **The time to get to halving of RH2 costs, is actually quite brief. A lot of the costs are in transportation of the fuel.**
    - By 2025, station utilization can increase from 30% to 80% and that gets half your costs out, with additional cost reduction potential in station components like compressors.
  - **On the supply side, we need to reduce the cost of electrolyzers which can get us to $2/kg renewable hydrogen. Low electricity costs are important and high utilization of the electrolyzers is important. Two cent electricity can produce $2/kg hydrogen. With CapEx, we can produce hydrogen in the $2 to $3/kg range in a short period of time.**
  - **Part of our policy has to address the role of forest biomass in producing hydrogen**
  - What does California need to do?

- **Revisit policy vision documents with a more rigorous assessment of net benefits and risks of various pathways (Visions, scoping plan, IEPR…),** particularly liquid biofuels versus RH2
- **Begin physical pilots in key areas of potential, funded by looking through the lens of a commercial lender**
    - **Electrolytic hydrogen at scale**
    - **Gasification of woody biomass with enough operating history to be financeable**
    - **Hydrogen neighborhoods as done in Europe**
    - **Marine, rail, port operations**
    - **Refining**
- **Progression toward commercial financeability should be a focus – understanding and reducing technical risk embedded from the start; structure like loan guarantees, applying diligence similar to a bank**

Day 2 Opening Keynote: Jesse Schneider, Nikola Motor - Hydrogen's Unique Opportunity to Transform the Entire Transportation Sector

- **Hydrogen is the key to fully utilize renewables for the transportation sector and make a quantum shift away from fossil fuels. Hydrogen is the only ZEV fuel to compete with hydrocarbon fuels in fueling time and range… and at scale and cost**
- Using green electricity as the source, hydrogen will significantly reduce GHG and criteria pollutants while creating a circular economy. We can only do this with industry and government working together
- **To compete with diesel, electricity costs need to be the "true cost of renewables", and we need government and industry working together to make hydrogen at scale, to enable mass decarbonization**

Remarks: Bill Elrick, California Fuel Cell Partnership - Hydrogen Transportation – 2020 Challenges and 2030 Vision

- **Need market conditions to enable 1,000 hydrogen stations fueling 1 million fuel cell vehicles by 2030, primarily for light duty vehicles**
- It is all about scale
    - **Need to expand infrastructure, which requires right market-based policies**
- What's holding us back?
    - **Need to talk beyond the choir by creating visibility and awareness**
    - **Secure funding for scaling up**
- **Need to produce an exhibit - a hydrogen village - with all of the components on the Capitol lawn**
    - **Combine that with 1-1 meetings with legislators and staff**
    - 1st week of August (idea presented before COVID-19 shut down the State and the country)

Roundtable: Has the Ship Really Sailed? The Importance of Light Duty FCEVs in California and Beyond

- **Moderator: Bill Elrick, California Fuel Cell Partnership**
- **Tyson Eckerle, Governor's Office of Business and Economic Development (Go Biz)**
    - **Do need to get to scale, which depends on getting private industry to invest**
    - **We need to organize all market stakeholders around market development, to address the lack of awareness**; need same amount of movement and momentum in hydrogen that we see on the battery side; **need to exhibit and showcase to get the excitement among policy makers**
- **Steve Ellis, American Honda Motor Company**
    - **One technology alone does not satisfy consumer needs**
- **Shane Stephens, First Element Fuel**
    - **Four reasons why fuel cell vehicles in the light duty sector are critical to pursue:**
        - **FCEVs can mimic the performance of a gasoline car – range, fast refill – can build a car that the consumer wants**
        - **There is a clear pathway to achieve zero carbon with no miracles or storage challenges**
        - **Can achieve scale with greater fueling capacity in the volumes needed**
        - **Can see a business case today with an off ramp for government subsidies by the end of this decade**
- Question to panelists – We have each of the sectors, except consumers, represented on this panel - What does your sector need and what do you have to give the other sectors?
    - Steve Ellis – **the customer needs certainty; Honda needs certainty; this is the opportunity for the State.**
    - Tyson Eckerle –Government needs you all to be successful – stations have to work, **need more models from the auto industry**
    - Shane Stephens – **the challenge lies in retail fueling**
        - **Stations have to perform better with no waiting time, able to fuel more cars at the same time**
        - **Need a more robust supply chain - #1 reason for our stations being off line is the lack of fuel**
        - **Need to drive down the price of hydrogen at the pump; wish we had started First Element Fuel three years earlier with a trajectory that fits**
        - **Need more hydrogen suppliers in the market with the retail customer experience of gas and diesel, not the industrial gas market**
        - **Need consistent government programs; ARB's LCFS program and CEC's recent solicitation are genius for developing the market; need tax credits and consistent policy signals**
- **For CEC Commissioner David Hochschild, we need to reach out, show him our value and the opportunity in terms he understands**
- **See a pathway for the price to be equivalent to gasoline within 5-8 years, but it takes scale and increased competition with more market participants**
- **Need a robust supply network that can handle disruptions**; **need to make the investments**; in the past we have not placed enough emphasis on contingencies and redundancies.

- **Without State support, all elements of the transition – cost reduction, reliability, and infrastructure development – will suffer**. **Customers and automakers need certainty.**
- **There is a limited amount of money that the state has and we need to work creatively on solutions. The Climate Catalyst Fund proposed by Governor Newsom is exactly the kind of tool needed**. **Private partners are ready to come in, in a big way, if the State policies and funding are consistent**.

Roundtable: How to Decarbonize "Difficult to Electrify" Sectors? Hydrogen in Heavy Duty Industry, Renewable Chemicals, Shipping and Aviation

- **Moderator: Jeffrey Serfass, California Hydrogen Business Council and Technology Transition Corporation**
    - You can't reach the State's 2045 goal of decarbonization of energy use with transportation alone
    - Even if you add in electricity and natural gas sectors, 40% of our energy use will be missed if we don't also address heavy industry and chemical sectors
- **Thomas Koch Blank, Rocky Mountain Institute**
    - Biggest challenge is not the high temperature, but rather that the raw material is an oxidized iron product and you need a catalyst to strip the oxygen out to get an iron product that you can then alloy into a steel product; **usually carbon is used to strip the oxygen out but you can do it with hydrogen which gives you no CO2 emissions**
    - **Hydrogen will add costs and inefficiencies to the process – more expensive**
        - **The downward trend of energy may make this cost-competitive – need $25/MWh electricity**
    - **Scaling hydrogen production brings the cost of hydrogen down – You would need a GW of power for a hydrogen steel making mill – this would create an anchor off-taker of hydrogen**
        - **Don't need to wait for green hydrogen to transition to hydrogen in steel making – can use grid power now and still break even in carbon intensity while developing the renewable hydrogen resource for the long term**
    - To decarbonize global steel industry you need a terraWatt of renewables
        - No primary steel making facilities in the U.S. are 100% renewables
    - **Need to identify clusters of demand and high volume hydrogen production sites to serve them, with strategies to align the demand and supply; integration into the NG grid is attractive to absorb these fluctuations, stabilizing the hydrogen supply**
    - **Ports are an interesting option, to co-locate with heavy industry, with connection to NG and other energy infrastructures**
- **David Allgood, California Air Resources Board**
    - **To reach total carbon neutrality we need to minimize emissions to the greatest extent possible in every sector; with whatever carbon we have left, we have to sequester it**
    - Policy options explored in recent webinar with materials posted on the CARB website
        - **Electrification may be practical for some of the applications, process changes may be practical for others, but fuel switching to renewable gas and hydrogen will have an important role**
        - **Hydrogen burns at a high temperature so that will be an advantage in some sectors like cement and glass that need high temperature heat and have limited options for electrification**

        - **Participate in CARB workshops to explore policies and concepts**
    - Need to consider costs, reliability, resilience, and the potential for stranded assets to move to a cost-effective path forward
    - **Need to work together on pilot projects for renewable gases**
- **Val Miftakhov, ZeroAvia**
    - We are decarbonizing aviation – a sector very hard to decarbonize – no other options besides hydrogen may exist
        - Level of power is greater than any ground-based transportation
        - **Aviation contributes 3% of GHG emissions worldwide, but there are no credible solutions that can scale; may grow to be 25% of GHG footprint as other sectors decline by 2050**
    - Life of aircraft is 30 years, about the same number of years left to 2050
    - **Batteries will require a miracle breakthrough to contribute in next 10 years; therefore, we are focusing on renewable hydrogen and fuel cells**
    - **The price point for hydrogen in aviation is ten times the price point for ground based transportation so we can clear into the market sooner**
        - Hydrogen-electric powertrain has 60% lower operating costs compared to turbines and 30% less than battery electric (while providing 4X the range)
    - **Aviation would have a high utilization of hydrogen and possibly be an anchor point for ground transportation fueling**
- **Dr. Joseph Pratt, H2 Advisors fueling and Golden Gate Zero Emission Marine**
    - **Hydrogen is not a niche player in marine; interest is across all marine sectors**
    - International Maritime Organization announced requirement of 50% GHG reduction by 2050; batteries can't do that; ships have a 30+ life time so 2050 is today
    - Hydrogen cost and availability is the primary concern among marine interests and there needs to be a TCO (total cost of ownership) benefit
    - **Need funding incentive programs to stir activity in the marine sector; almost all funding programs require retrofit and that is a problem for ships**

Keynote: Tom Soto, Diverse Communities Impact Fund - What is the Potential for Investment and Growth in the Hydrogen Industry

- The 4th industrial revolution, the change in connectivity and the 5G networks are indicators of change that can lead to hydrogen interest and investments
- Renewable energy is beginning to create more jobs than traditional energy
- **We need to push for pilot governmental programs and private investing in hydrogen and other renewable resources**
- **Existing NG pipelines could transfer up to 20% hydrogen from renewable resources**

Closing Keynote: Steve Szymanski, Nel Hydrogen and CHBC Vice-Chair – Does Hydrogen Mean Business in California?

- **Job creation is a bi-partisan issue; hydrogen clean energy solutions create jobs; "support for hydrogen is support for jobs"**
- Sunline Transit's renewable energy hydrogen fueling station project, with steel in the ground, creates direct, good paying jobs
- **We need to quantify the economic value of what we are doing, like Connecticut with its IMPLAN Economic Model analysis**
- **We should secure grant funding to complete IMPLAN analysis of industry in our state and document the return on investment for state funding of hydrogen initiatives**

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