



Hydrogen Means Business in California!

CALIFORNIA HYDROGEN AND FUEL CELL SUMMIT

Hosted by the California Hydrogen
Business Council

This is the report of the 3rd Annual California Hydrogen and Fuel Cell Summit held in
Sacramento, California at Cal EPA on September 30-October 1, 2015

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CALIFORNIA HYDROGEN AND FUEL CELL SUMMIT

Day 1

Welcome, Introductions, Summit Overview

Jeff Serfass, Managing Director, CHBC

We are looking to develop sound government and sustainable hydrogen policies. Many thanks to the sponsors of this Summit, including Platinum Sponsor Toyota, and Break Sponsors Hydrogenics and Honda.

Keynotes: California Leadership in Sustainable Energy

California continues to act as the trailblazer for zero emission hydrogen fuel cell technology, and a number of new government commitments, incentives and goals established in 2015 support. High level government officials provided inspiring keynotes.

Janea Scott, Commissioner, California Energy Commission (CEC)

Governor Brown has set goals to reduce GHGs in California, along with Clean Air Standards. A portfolio of resources is desired to achieve these goals where fuel cells will play a great role. There has been a lot of progress in the transportation sector of the hydrogen industry. We need to work together to overcome challenges and barriers. There are key policies and goals to reach a greener and more sustainable California. The 2015 Integrated Energy Policy Report is in progress. More research needs to be done on hydrogen energy storage and to reduce the carbon content of creating hydrogen. The Alternative and Renewable Fuel and Vehicle Technology Program is an investment portfolio of low carbon and zero emissions vehicles.

Public station funding for hydrogen fueling stations to date is \$98 million with commitments to 45 new stations, 4 station upgrades, and 28 contracts for station operation and maintenance. Plans are to have 30 stations in operation in 2015 and 49 stations in 2016.

There is a current Hydrogen Station Financial Support solicitation with CapEx incentive funding and Operations and Maintenance funding. Station costs must come down from a current price of \$2-2.5 million. This can be done with better economies of scale, technology innovation and more cars increasing demand. There are equipment supply bottlenecks. Stations coming online today are public ready with credit card readers. The Energy Commission is working on hydrogen solicitation concepts and ongoing permitting and siting support.

Alberto Ayala, Deputy Executive Officer, California Air Resources Board (ARB)

Dr. Ayala and ARB work on regulations for clean cars and clean trucks for ports and heavy duty freight. The zero emission vehicle mandate has been key in driving investment and technology development. ARB is interested and will continue to promote hydrogen, and an important new policy is the California Heavy Duty Greenhouse Gas standards. The Heavy Duty industry needs attention to reach California GHG emissions goals. ARB needs the support of voices and advocates of hydrogen and fuel cells.

ARB is continuing to support the roll out of electric vehicles, and is working closely with the California public Utilities Commission (CPUC), California Department of Transportation (Caltrans), and the CEC on cross cutting policies. The regulation for public transit fleets has been put on hold due to the low state of technology development. There is a transfer of technology from fuel cell buses to the heavy duty freight platforms.

Low Carbon Transportation Investments can promote solar and hydrogen projects. Cap & Trade has allowed the state to reinvest in greening the state. The LCFS was adopted again last week by the ARB.

There needs to start a chain of thought for standards after 2025.

Keynotes: National Activity in Hydrogen and Fuel Cells

The two national programs H2FIRST and H2USA have implications for a national hydrogen fueling station rollout and for developments in California.

Sunita Satyapal, Director, Fuel Cell Technologies Office, Office of Energy Efficiency and Renewable Energy (EERE), Department of Energy (DOE)

The Energy Policy Act of 2005 requires a commitment by automakers no later than 2015 to produce fuel cell cars. There needs to be a step up in the portfolio of approaches for new vehicles. DOE reorganized into three EERE pillars: Sustainable Transportation (HFC, Vehicles, Bioenergy), Renewable Electricity Generation, and Energy Saving Homes, Buildings & Manufacturing.

Most of fuel cell budget has been in R&D and there are currently over 215 demonstration FC vehicles. There has been an 8x increase in non-DOE funding of backup power and forklift fuel cell purchases including early markets such as fuel cell cargo trucks at airports. The goal for vehicle fuel cell system costs in 2020 is \$40/kW.

The major cost component of fuel cell systems is the catalyst; the major cost of stations is compression; and the major cost of hydrogen storage is carbon fiber.

There have been 40 products introduced into the market as a result of the DOE commercialization efforts. Jobs that have been created are more than 450 per year. There is a \$2.2 billion fuel cell market with over 50,000 fuel cells shipped in 2014. The U.S. produces 10 million metric tons of hydrogen, mostly from steam methane reforming (SMR). Even with its use of natural gas, there is a significant environmental benefit of using hydrogen from SMR compared to a fossil fueled internal combustion Engine (ICE) vehicle. The strategy is to use natural gas in the short term, followed by biomass pathways and then solar pathways.

Looking at DOE/EERE innovations, H2USA was launched two years ago as a public private partnership with industry to coordinate the development of solutions enabling the hydrogen fueling infrastructure. H2FAST, H2 Financial Analysis Scenario Tool, is a tool developed by NREL as an online calculator for analyzing hydrogen fueling station financial investments. H2Tools is a portal created by Pacific Northwest National Laboratory to organize and disseminate hydrogen safety information. H2 Refuel H-Prize was created to help develop innovations for home and community hydrogen fueling.

DOE Labs are a reservoir of talent for science and technology. How do we leverage this talent? Lab and university teams will be working on renewable hydrogen projects. Small Business Vouchers are to provide clean energy small businesses with easy and affordable access to laboratory capabilities to solve critical technology issues. Three new analysis projects: Global Competitiveness Analysis, Integrated Network of Regional Technical Centers, and a Fuel Cell and H2 Opportunities Center.

There is an open \$11 funding opportunity in heavy duty fuel cell vehicle technologies.

CEO Keynote: Vision of Hydrogen and Fuel Cell Business

Anthony Leo, Vice President - Applications and Advanced Technology Development, FuelCell Energy

Investors are becoming more comfortable with project financing of stationary fuel cell projects. FCE is getting more traction with Utilities, Solid Oxide Fuel Cells, and micro CHP systems with mostly PEM echnology. FuelCell Energy feels like they have a very efficient way to make hydrogen, and see global energy challenges in:

- Cleaner power generation
- Energy quality and security
- Hydrogen transportation infrastructure, and
- Growth and asset return

There have been pilot programs with utilities so they can see fuel cells work. For FuelCell Energy, 2016 is about execution, 2017 is about getting costs down and 2018 is about market expansion.

There is at least a \$50 billion market worldwide for fuel cells. The biggest slices of reducing fuel cell cost of energy are fuel costs and operating costs. Reducing the cost of electricity from fuel cells has to do with capital costs (plant size, scalability, manufacturing efficiencies); the cost of capital with the risk premium going down significantly; fuel cost; and operating cost. FuelCell Energy is mostly involved with DFC carbonate fuel cells and is working on SOFC. Also FCE is working on renewable hydrogen through biogas with anaerobic digesters. FCE's trigeneration system produces electricity, heat, and industrial hydrogen. It has to be done at the MW scale to be feasible, and utility scale deployment is important to the company.

FCE is currently working on a 63 MW project in Beacon Falls, CT. Their high efficiency fuel cell is sized to 3.7 MW and has 88% total system efficiency. Relative to California policy, FuelCell Energy products can have significant roles in helping California meet several environmental policy goals.

Spotlight on Renewable Hydrogen

Brian Goldstein, Executive Director, Energy Independence Now (EIN)

EIN is the only nonprofit that solely advocates for FCVs and hydrogen stations, having helped draft the California Hydrogen Highway Initiative as well as the recommended stations required to reach critical mass. There is not enough volume currently to drive investment in renewable hydrogen. FCVs are about to have their Tesla moment with the end goal being 100% renewable hydrogen. Need to figure out as a group how this can work. Need to break the silos between the transportation, power generation, and gas production. The ultimate goal is to build a broad energy system that can capitalize the high value of hydrogen. There are many findings/needs that need to be addressed:

- Policy – highlight key drivers for RH2 growth from all sectors
- Market – need 2-3 examples of viable projects
- Funding
- Roadmap – outline key stakeholder actions and realistic goals
- Outreach – encourage stakeholders to support roadmap, “as important as the roadmap itself”

From the audience, Bud Beebe with SMUD wants to work with EIN on participating in policy development and education.

Regional Environmental Actions

Dr. Matt Miyasato, Deputy Executive Officer for Science & Technology Advancement, South Coast Air Quality Management District (SCAQMD)

We have to meet federal deadlines for ozone. We have commercial technologies to help us reach our goals, and they will help us meet GHG goals as well. We can get close to the federal standards just by meeting the governor’s 50/50/50 goals. Criteria pollutant reductions are needed now. “We need vision, leadership, and a lot of money.” – Dr. Joe Lou, SCAQMD Governing Board.

There have been dramatic reductions in emissions but there still hot spots around the port and in the inland empire.

Damian Breen, Deputy Air Pollution Control Officer, Head of Strategic Innovations Section, Bay Area Air Quality Management District (BAAQMD)

The population of the Bay Area Air District is 7 million in 9 counties and 5.7 million on-road vehicles. The main factors are in the series of the pollutants and from particulate matter. 1,800 cancers in 1,000,000 people is an unacceptable health risk that is three times higher than average. BAAQMD’s Clean Air Plan will have aggressive air quality targets. Stationary fuel cells will be a major component to reduce emissions in the Bay Area. Distributed generation is needed to meet 2050 goals. Industry needs to reduce the cost of stationary fuel cells and look for more sources of renewable hydrogen. They’re targeting a total number of 45 stations in the Bay Area and looking at additional funding for hydrogen stations from the Greenhouse Gas Reduction Fund.

Spotlight on Clean Transportation – Public Transit

Fuel cell electric buses are proving to provide clean and reliable public transportation in two California cities. Public transit can play a key role in the early stages of FCEV deployment with their fueling stations and by helping potential customers understand the technology in their daily routine.

Introduction by H. E. Chris Peeples, At-Large Director/President, Alameda-Contra Costa Transit District

Lauren Skiver, CEO/General Manager, SunLine Transit

Industry needs to talk about the risk. Public transit and risk don’t go together. Many CEOs have a hard time putting fannies in seats and managing risks. SunLine’s service area is over 1100 square miles and will soon have the largest fuel cell bus fleet with recent grants. Industry is currently on the 10th generation of fuel cell buses and believes all-electric buses with fuel cell range extenders are the future. They want to see more

hydrogen used to lower the cost and are looking for a solution to produce hydrogen within their facility. Transit industry partners need to know that they need to accept the mission and the risk. SunLine constantly educates the entire organization on why hydrogen is important. The public is supportive if you help them understand the benefits of the technology.

Advice to other transit agencies and customers: Make sure your boss supports hydrogen. Commercialization of hydrogen fuel cells is being done. CNG is major player right now and perceived as "no risk". However, there is only one CNG engine manufacturer. Communications and assumption of risk have to happen. SunLine is working on procurement of Buy America and creating a Center of Excellence in a partnership with Rio Hondo College.

If we won't work on it, we won't buy it. There needs to be a place where technicians can go to work on hydrogen technology. We need to engage the community! Fuel cell stacks are starting to have a longer life. The message is that fuel cell buses do work! **SunLine has yet to change the brakes on any of their fuel cell buses.**

Spotlight on Clean Transportation – Infrastructure

Tyson Eckerle, Zero Emissions Vehicle Infrastructure Project Manager at CA Governor's Office of Business and Economic Development (GoBIZ)

Parts of the recipe for success in permitting are:

- Proactive engagement
- Very sensitive to planning considerations
- Planning is an art, it's the look and feel of the station

By the end of 2015, 18-20 stations will be open. More will be operating but not yet available to the public. Once a station is fully constructed, it has to go through the permitting process, get a metrology sticker, fill protocol confirmation from OEM, and have the station developer ready for customers. In every step there are chances for delays. Issues with point of sale (credit card) equipment can exist on the backend.

Michael Dray, H2 Program Manager, Calstate LA

If we stay on this path we are going to succeed. On site electrolysis hydrogen production capability is 60 kg/day. They have many technical supporters to thank including many CHBC members. They operate "The People's Station".

Tim Brown, COO, First Element Fuel

Goal is to give fuel cell vehicles a chance. FEF was awarded 28 stations by CEC, 13 are in construction, 2 in final building permit, 2 in zoning process. **They are in the valley of death; it's going to get worse before it gets better.**

Eddy Nupoort, Project Director, H2 Logic

H2 Logic is part of NEL ASA listed on the Oslo Stock Exchange. Their goal is to sell stations. Their current station used in Europe is a turn-key container module for a drop in station installation. Their station can deliver up to 200 kg/day. The station comes fully tested by H2Logic prior to shipment to customers. They have delivered 20 stations to 7 countries, many in Denmark. They have joint ventures with Air Liquide. More than 98% proven station reliability. Permitting process in Denmark is similar to California. Due to preproduction, stations can be installed in only 2-3 days.

Dr. Jerrold Hutton, Millennium Reign Energy

Their mission is to provide homeowners with the potential to become energy independent and immune to energy cost changes, national disasters and other events beyond their personal control. There are seven components to the deployment of a scalable hydrogen fueling infrastructure, which are safety, power management, efficient & cost effective hydrogen, purification of hydrogen, compression, storage, and usage.

They manufacture a line of products for generating hydrogen and are currently working on a megastack. They have a major operation in Hawaii. Their competitive advantage is affordability and scalability.

Spotlight on Clean Transportation – Fuel Cell Electric Vehicles

Vehicle manufacturers have been working hard over several decades to produce FCEVs that meet customer, price, performance and safety expectations. In this segment, OEMs will discuss their progress and next steps in the form of short presentations. Moderated by Catherine Dunwoody, Chief, Fuel Cell Program, California Air Resources Board.

Jackie Birdsall, Engineer, Toyota Motor Engineering & Manufacturing North America Inc.

The Toyota Mirai has a range of 305 miles on a fill that takes about 5 minutes. They simplified the system by eliminating the humidifier. Had technical advancements in the fuel cell stack and tanks to give various advantages. Mirai rollouts begin next month. The Mirai is able to power a house for a week with the right home equipment.

Steve Ellis, Manager, Fuel Cell Marketing, American Honda Motor Co.

Honda will make several announcements at the upcoming Tokyo Motor Show. Honda has been in-step with Toyota since the beginning of fuel cell development and will make their FCEV available starting in Japan March 2016 with USA and Europe to follow.

Gilbert Castillo, Senior Group Manager, Alternative Vehicle & Advanced Vehicle Strategy, Hyundai Motor America

The Tucson received a lot of positive attention, especially in Washington D.C., for being an “ordinary car”. They worked to make sure any insurance provider will insure the vehicle. Hyundai has experienced many delays with stations, as we have heard from others. 95% of customers are satisfied with the Tucson and recommend it.

- Discussion: There is an uncertainty on market acceptance of the FCVs. This hurdle is just about crossed. Stations play the key role in this; strategically placed stations will make the difference.
- Discussion: There is a federal website which logs safety incidents. Every manufacturer has seen accidents occur with no major challenges going forward.
- Discussion: There needs to be a simple solution to the customer station experience.

Day 2

Keynotes: Renewable Energy, Energy Storage and Grid Management

Cliff Rechtschaffen, Senior Advisor, Governor’s Office

Cliff sees this as an exciting time with lots of challenges and opportunities. Hydrogen fuel cells can play an important role. The Governor has very ambitious goals regarding climate change, in transportation and renewable energy, e.g. to reduce emissions in the transportation sector by 90%. Climate change requires all hands on deck, especially as it pertains to transportation. The mandate to have 1.5 million zero emission vehicles on the road by 2025, which requires all types of technology. The Governor’s Office wants to expand the fuel cell market sector and expand the fueling infrastructure.

Cliff recommends that attendees sign up to get GoBiz monthly reports on H2 station progress. He sees hydrogen as very versatile and can play a very important role across applications. It can be a very valuable grid asset. We don’t want to curtail renewables or pay customers to take excess renewables. Over-generation will be a problem. The Challenge we face is bringing things to scale. We need solutions and we need them soon. The challenge of business leaders is to show they work and they can be brought to scale. We want to increase reliability and reduce costs.

The Governor’s Office has released a plan that integrates EV charging and H2 fueling and they are going to establish vehicle-to-grid pilots. They are looking at how to meet peak demand charging and are looking at P2G research projects. CARB and DOE are in the process of co-funding a study with NREL on the business case of P2G in the short term. The CPUC is open to proposals and projects from utilities who look at this area, presenting another opportunity where projects could be initiated and evaluated. Our doors are open, we want to make this an interactive process. Suggestions and comments are very welcome. Funding will come from the EPIC program of the CEC, not sure if there will be funding through Cap & Trade program. The CPUC may provide funding. Cal ISO may fund some demonstration projects in conjunction with the CEC.

Tom Bialek, Chief Engineer, San Diego Gas & Electric (SDG&E)

The hydrogen and fuel cell technologies are really quite interesting. SDG&E is already at 33% renewable energy. A lot of work has been done around electric vehicles with 18,000 plug-in electric vehicles. A vast majority is off-peak charged and creates a reduced cost for fuel. Adding an EV to a house load is like adding an air conditioner. They are looking to ultimately and primarily provide charging infrastructure to charge during the day and now look at that as a load to modify. Charging during the middle of the day becomes important as the duck curve comes into play. They are going to have circuit level pricing.

We can do a lot of different things with energy storage. It provides the ultimate flexibility with the utility. SDG&E is required to procure 165 MW of energy storage. We are totally technology agnostic but cost counts. We would love to run an R&D project but have no real flexibility to run pilots. They have five existing substation level projects. Bids have been received for the 500-800MW of new capacity to address the closure of San Onofre Nuclear plant. The key challenge has been the integration of these devices into the system. They are experiencing issues with the number of different vendors in a single installation. One of the biggest challenges is citing and permitting. It's increasingly about IT/Communications issues.

SDG&E is not wedded to a particular technology. It's about what can we do under the conditions imposed upon us, and what flexibility we have with pilots and research programs. How can we provide a much more holistic solution that benefits us all? Immediate need is to mitigate intermittency of PV, near term need is to store excess renewables. Most importantly, use cases drive technology choices. We expect to see more change in the next 10 years than we've seen in the last 100 years.

Mark Rawson, Research Technology Officer, Sacramento Municipal Utility District (SMUD)

A public owned utility is different than an investor owned utility, providing additional flexibility to look at fuel cell technologies. Key drivers of change are technological, environmental, political, economic, and social. A whole host of things are happening from a policy perspective. They need to bring technologies into the energy space to address issues with intermittent renewables. Currently they are close to their RPS goals. Panels and residential solar costs are coming down. PV will play a significant role in what customers do in the future. 500-700MW of new PV could come on to the grid in the next 10 years as customer distributed generation. Storage cost curve is steep and will come down to a projected cost of less than \$100/kWh in 2040. EVs are going to become much more of a resource they are going to use in the future. They are doing a lot of research on characterizing solar production in their territory and how does the intermittency change the power flows of their distribution system. This makes them look at new strategy of how they design and use their distribution system.

Customers are changing from consumers to producers of electricity. They are seeing a trend towards customers wanting bundled services. Their traditional utility model is under siege from upward price pressures and entrepreneurial attack. Their business model is changing greatly to adjust to these threats. The utility is operating a market place. There are so many different things happening with policy and what the customer wants, which creates a lot of fuel cell opportunities. Will start to see fuel cell technology playing a larger role going forward. SMUD is trying to keep their finger on the pulse of technology development.

Utilities of the Future

Moderated by Graham Noyes, Attorney, Keyes, Fox & Wiedman LLP

Jack Brouwer, Associate Director at UC Irvine, National Fuel Cell Research Center

Hydrogen Energy Storage and Power-To-Gas

Southern California Gas Company is supporting an effort to investigate P2G. Complete shift of wind demand is possible. The NG pipeline is an existing energy storage system. 11TWh is available from existing underground areas, which is capable of meeting demand for 6 weeks. UCI has injected hydrogen into their natural gas pipeline, possible the first occurrence in the US. Currently upgrading their microgrid. UCI has conducted various tests on injecting hydrogen into a natural gas grid to find the effects and gather results. There is a question about insuring the pipeline and how it will impact the amount of hydrogen injected into the pipeline.

Brendan Shaffer, Senior Research Engineer, Advanced Power and Energy Program

Microgrids/Integrated Grids

Problems from increased renewables are going to present themselves. The future will be central resources and distributed resources. The key to microgrids is that they can interact with the grid and act in island mode. UCI goal is net zero carbon by 2025 with \$330 million in sponsored microgrid research. There are many technologies incorporated into the UCI microgrid. Regional resources are better than local sources due to diversity, enabling a better smoothing out of demand. A lot of research has been done on different ways of dealing with excess renewables.

Rob Harvey, Director Energy Storage, Hydrogenics

Whither Power-to-Gas in a Distributed Energy Future?

Elon Musk single handedly doubled the awareness of grid storage. Utilities have to change their business model but they will not be eliminated. The prediction of doing away with the grid is premature. P2G can be a large asset and a distributed generation asset. We have 100 MW of distributed fuel cells in CA. P2G can ramp down but not up. As California moves toward 50% renewable fuel, P2G really comes into play in dealing with surplus generation for large blocks of time, load following and operating reserve. 37% of GHG inventory in 2013 is from transport, while electricity generation is 20%. P2G provides a number of renewable fuel options: car, natural gas pipeline, and liquid fuels. P2G economic drivers are decreased equipment CAPEX while increasing capacity factor, decreasing OPEX, with multiple revenue streams.

Michael Strizki, President & Founder, Hydrogen House Project

Off-Grid Energy Options

Hydrogen fuel is allowed on airplanes in the small cell phone charger, while bottled water is not. Most of the vehicle projects he's done have been a fuel cell extending the range of a battery. He produced a solar hydrogen powered portable power and water purification plant. He was awarded \$500,000 to build the first solar/hydrogen house in 1996. He uses propane tanks to store hydrogen. Developed a hydrogen heater and a hydrogen boiler. Makes and stores hydrogen from June to September for the hydrogen house. In the winter the days are short and the panels are covered from snow, the fuel cell then powers the house. "Joule Box" is what is used in the current hydrogen house. Sees the home to the energy infrastructure in the future. The first hydrogen house took 3.5 years to get permits. Hydrogen is still the ultimate battery, even compared to the emerging battery technologies.

Keynotes: Business Executive Vision on Sustainable Goods Movement & Freight

Andy Marsh, CEO, Plug Power

The industry needs billions of dollars in capital to make something happen. 8,500 GenDrive fuel cell units have been shipped. 25 GenFuels systems deployed as hydrogen fueling systems. All sites are liquid fueled. They have removed an equivalent of 1800 car-years off the road just at Home Depot. Walmart has 300 renewable projects going on, using almost none of their own money. Doing it because it saves them money. Hydrogen fuel cells can make the big market rapidly. **"We have failed to create the broader vision beyond the present. We need to paint a broad picture of the future."** Need to go to a subscription model. "Fuel cells need to be cost competitive with batteries and diesel engines." Plug Power has drastically reduced the costs of their equipment. For hydrogen, they pay between \$4-16/kg, usually it's about \$6-6.50 range. "I believe, today we can be cost competitive with competing technologies." **"We need available fuel that is \$6 per kg."** **"We need the Amazon of hydrogen."** "Need to find a way to generate hydrogen cheap, and make it as readily available as diesel fuel."

"Musk is better than Marsh." **"We need to aggressively promote ourselves."**

Spotlight on Sustainable Goods Movement & Freight

Moderator: Jon Leonard, Senior Vice President, Gladstein, Neandross & Associates (GNA)

Need to get tons of NOx reduction in the goods movement sector. It is increasingly more challenging to change the heavy duty sector. "Nothing matches diesel for energy density and low capital cost." \$500 for 650 miles. Battery electric trucks are more efficient and have zero emissions. Recently Cummins certified a 99% reduced emission engine.



Hydrogen Means Business in California!

Rob Del Core, Director, Fuel Cell Power Systems Group, Hydrogenics

Hydrogen Trains and the Zero Emission Freight Network

Hydrogenics is a total solution with zero emissions. They just did a deal with Alstom to commercialize fuel cell commuter trains. It's the same type of technology for freight trains going forward. Quantum has a new tank technology for freight. They are working on a hydrogen freight network. The goal is to provide solutions for a complete zero emission goods movement network.

800 kg of hydrogen required daily for the line haul locomotive. Switching transfer is 400 kg consumed per day. They have a vision of a 4000 kg/day hydrogen production stations using electrolyzers.

Tom Joseph, President, Bethlehem Hydrogen Inc

Role of Fuel Cell Powered Industrial Trucks in Infrastructure Development

It will take 15-20 years to have station number parity between gasoline and hydrogen stations. It took many agencies working together to realize their early station projects. They now have liquid hydrogen station models ready for deployment. Industry challenges are CapEx, safety review, codes and standards revisions, Equipment reliability, and design optimization. They have a 500 bar portable fleet option for medium size customers.

They have the ability to serve the local customers through distributed dispensers.

Innovative Products

Rich Cimino, Engineering Manager, The Boeing Company

Reversible SOFC System for Grid Energy Storage

They have an 18-month two-phase program for a 50kW reverse oxide fuel cell with the US Naval Facility Engineering Command, Expeditionary Warfare Center. They will be hooking it up to the Boeing grid for testing. The program will use renewables to generate hydrogen during the day, then use that energy to put it back on the grid. The entire unit is inside a container and can be expanded up to 250 kW. It is very scalable by increasing the tank size. SOFC was chosen for efficiency reasons, and it also allows flexibility with hydrocarbon fuels. The 18-month program comes to a close in January.

The program does address the Navy's goal of trying to reduce their carbon footprint.

Attendee Discussion Forum

Jeff Serfass, Managing Director, California Hydrogen Business Council

Opportunity for attendees to provide input on CHBC's programs, activities and events in 2016. Some say there is going to be a backlash when Toyota releases their Mirai this month to only two public retail hydrogen stations open.

Discussion: Needs to be more education and outreach to assure the public that hydrogen is safe.

Final Remarks

Jeff Reed, Director of Emerging Technology, Southern California Gas Company

Where We Have Been And Where We Are Going

Most of the concern is around commercial issues. Although cost remains an issue in this industry, there is precedence for cost reduction in other technologies such as PV. **"Image is everything."** **"We need to create the right kind of buzz."**

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