

CONFERENCE REPORT

Pathways to

100%

Renewable
Energy

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Toward Electrification of All Sectors:
Getting Across the Finish Line

3rd International Conference

UC Berkeley | Krutch Theater | April 12-13, 2018

Organized by



Renewables100
Policy Institute

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About this Report

The report was published by the Renewables 100 Policy Institute, a 501(c)3 non profit organization. Our mission is to study and accelerate the global transition to 100% renewable energy in ways that are efficient, ecological, and benefit the most people.



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INTRODUCTION

In April 2018, the third Pathways to 100% Renewable Energy conference gathered top experts from across California, the U.S. and beyond before an audience of approximately 300 people over two days at University of California Berkeley to address the opportunities and challenges in transitioning away from dependence on fossil and nuclear resources to 100% renewable energy sources system wide and across sectors. The theme of the 2018 conference was Toward Electrification In All Sectors : Getting Across the Finish Line, in view of the increased role the electrical system will have in enabling the decarbonized electricity, gases, and fuels needed to go 100% renewable energy economy wide and at scale, as well as in view of the need to get from ideas to action and from part way to entirely reliant on decarbonized renewable sources for all energy uses.

This report features highlights from each of the conference keynotes, conversations, and panel sessions, which were delivered by senior experts from multiple sectors, including business, research, government, labor, environmental justice, venture capital, and industry. The top takeaways from this year's conference were:

100% renewable energy across sectors is doable, and to get there, policy and financial investment need to accelerate considerably and beyond frontrunners like Hawaii and California.

Succeeding in the 100% renewable and zero carbon transition is going to require substantial electrification in transportation and buildings, along with mass scale deployment of renewable gas and fuels, largely produced using renewable electricity, for applications like seasonal storage and transportation applications for which battery electric technology is not well suited.

The speed of the renewable energy revolution is happening faster than most could imagine even five years ago – and must go even faster and more inclusively.



SESSION HIGHLIGHTS

Keynotes



Ken Alex,

Senior Policy Advisor,
Office of California Governor Brown

**California's Global Leadership on
Climate and Renewable Energy**

Highlights:

It's likely that by mid-century we'll lose the ice cover in the arctic. If that happens, because the ocean is much darker than the ice cover and therefore retains more heat, the loss of that ice cover is comparable to adding a trillion tons of CO₂ to the atmosphere, which is about half of what we think is the carrying capacity we have left for 2 degrees. That's a sobering thought.

We need to spend a lot more time, money, and energy on adaptation and resilience. Californians are now required to integrate adaptation and resilience into all infrastructure spending, and those principles are also becoming part of the requirements for general plans for local governments.

There is a growing recognition that it is no longer enough to only reduce emissions, we have to sequester carbon in different ways. The good news is that there are multiple avenues for doing so and that there's progress being made on a number of them.

The biggest issues in climate change are about political will and scale. There are technologies already available or on their way that can deal with the set of problems that we face, but how do we integrate that into our economy and reduce our emissions by 40% over the next 12 years? That is the biggest set of challenges.

The public very much supports improving transportation and repairing our highways, but there is also a very strong opposition to having a gas tax. If you can't have a fairly modest tax to repair the roads and to improve transportation, what happens when we do all the hard work of fighting climate change that will potentially increase the price of oil and gas?

"Even in arguably the most progressive state on this set of issues, it's not easy. We need to be diligent and our effort needs to be continuous."



SESSION HIGHLIGHTS

Keynotes



Sebastian Kind,

Undersecretary of Renewable Energy,
Argentina Ministry of Energy & Mining

**A Success Story from South America:
Strategies for Renewables to Supply New Load Growth**

Highlights:

Recent legislation in Argentina has turned the renewable energy market from a hostile investment environment into a success story. Development of projects spurred by The National Legal Framework for Renewable Energy is predicted to surpass the milestone of 20% renewable generation in the energy mix by 2025. 147 projects are currently committed with \$2.5 billion of renewable infrastructure being built today.

International investors were presented with a \$13 - \$15 billion investment opportunity to incorporate 10 GW of new renewable energy generation infrastructure into Argentina's grid. The National Legal Framework for Renewable Energy, a bipartisan law, involves two parts: the Renovar Program, which involves joint purchases through the national ISO, and corporate partnerships with individual providers. The Renovar program consists of 3 levels of guarantee, the last of which is backing by the World Bank due to the airtight nature of the law.

Make sure that policy is designed with the market in mind, not just for corporations. Incorporating market pulls, without designing the law specifically for corporations, into the regulatory decree ensures that the law will outlive any single 4-year administration. Since the implementation of this law, the price of solar has been reduced by a factor of 10, and the price of wind has been reduced by a factor of 5 since the deployment of this law.

"We demonstrated that the large deployment of renewables is absolutely feasible... even with the investment environment we face in Argentina... There are 1600 MW under construction and \$2.5 billion in capital coming to Argentina today. Today our roads are full of towers, blades, cells, and solar panels."

SESSION HIGHLIGHTS

Keynotes



Phil Ting,
Member of the California State Assembly

Highlights:

If you want clean air, you absolutely need to have clean cars. 40-50% of California's greenhouse gas emissions come from transportation, and 80% of that transportation comes from you and me driving cars that aren't clean.

In Southern California, 1.2 million people live 500 feet from a freeway. Many of those people have sound walls, so they don't hear the cars driving by, but those sound walls don't have air filters. So they're breathing in all the tailpipe emissions from all those dirty cars. Everybody has a right to breathe clean air, no matter how rich or how poor you are."

We're starting to grapple with the issue of batteries at the end of their life. We have large lithium-ion batteries that we need to figure out how to best recycle, reuse, and repurpose. We're only at the initial stages of these developments.

Infrastructure is also a challenge. We need more charging infrastructure around cities so that people who don't have garages, people who aren't able to charge at home, have the opportunity to charge.

SESSION HIGHLIGHTS

Keynotes



Jonathan Weisgall,
VP Government Relations,
Berkshire Hathaway

Highlights:

There are 4 big factors affecting utilities in this drive for renewable energy that are unaffected by what's happening in Washington. 1) The cost of renewables is lower than ever before. 2) Customers want renewables. 3) Cities and States across the country are developing aggressive renewable integration policies. 4) Federal Tax Credits for renewables mean that right now wind and solar energy is basically on sale.

By 2020, Mid American Energy Company will generate the equivalent of 95% of their Iowa customers electricity needs with renewables, primarily wind, and has a goal of achieving 100%. The company is invested in 4400 MW of wind already, and is on a road to 6000 MW. They are managing to achieve high capacities of renewable electricity and still offer low rates to consumers.

Mid American's high renewable capacity is only possible because they are part of a multi-state balancing authority. They are part of the fifteen state under the Mid-Continent Independent System Operator (MISO). This commercial market extends from Louisiana to Montana and allows them to buy electricity from out of the region when the wind is not blowing and sell it when there is more wind than Iowa can use.

Farm owners want wind turbines on their property. The income they receive from hosting the turbines provides them with reliable secondary income against the fluctuating price of food commodities. Mid American will be paying nearly \$2 billion over the next 30 years in land owner payments to farmers, along with taxes.

For 100% renewables to work, we need a strong legislative framework, good regulatory outcomes for customers, and certainty in prices. All are being accomplished across the country today.

Renewables provide stable and predictable energy prices. We can predict what the cost of a wind farm will be over 30 years because we know what the cost of the fuel is: zero

Before, we would be rejected for new projects if they exceeded the RPS standards, today that attitude has changed.

"We have done it, we are proud of it, and we think this is really in the best interest of our customers...and this story goes beyond California".



SESSION HIGHLIGHTS

Keynotes



The Honorable Chris Lee

Hawaii State Representative

Highlights:

An ambitious RPS united stakeholders for rapid, effect change in all sectors. The 100% RPS passed in 2015 at a vote of 74 to 2, with neither of the people who voted 'no' remaining in office. Even fossil fuel utilities have gotten on board, after due diligence mandated by the RPS revealed that they could achieve the goal 5 years early with savings of \$5 billion statewide. Hawaii currently has an energy mix of about 30% renewables.

Decarbonizing transportation is a pillar for Hawaii's transition to carbon neutrality. Transportation is currently responsible for $\frac{2}{3}$ of the fossil fuel use in Hawaii. A recent law passed identifies 37 areas of policy focus to guide leaders to zero fossil fuel use in ground transportation by 2045.

Climate change threatens drastic changes to Hawaii and further drives momentum for taking action. \$19 billion in damages is expected along the coastline over the next few decades. The state Climate Commission predicts the loss of beaches, drinking water supply, and an increase of intense hurricanes, to name a few. Monetizing these predicted effects of climate change justifies for us the steps on the renewable energy front to do our part.

Solar power is taking the electricity sector transition by storm. 1 in 3 single family homes currently has rooftop PV. A new utility-scale solar facility with onsite storage on the Big Island will increase the capacity by 114 MW. The visible nature of rooftop PV has created momentum for promotion of other renewables as lower cost alternatives to fossil fuels.

Progress is taking synthesis of industry with the government across all levels. It is the nuts and bolts of how infrastructure is rolled out at the city and county level that makes this possible.

"This is something which everybody a few years ago said was impossible - utilities, my colleagues in government, private investors. I don't think anyone thought this was something we could achieve."

SESSION HIGHLIGHTS

Keynotes



The Honorable Kevin de León

California State Senator

Highlights:

California is committed to progress, even where the federal government is moving backwards. The California legislature has pushed for radical environmental reform since the Reagan Administration. Due to strict water, air, and wildlife protection laws, Californians are living longer, and the kids are no longer getting as sick.

California has proven that the economy can grow while protecting the environment. As proof, the average Californian family currently spends about half as much on energy as a family in Louisiana. 500,000 clean energy jobs have been created since the passing of the landmark climate law AB 32 in 2006. There are 10 times more jobs in the clean energy space in California than coal jobs in the entire country. With the right leadership, legislation can help grow the economy and help the environment.

California could be on the way to 100% renewables by 2045.* With states like Hawaii laying out fearless 100% renewable targets, California should be confident in itself that it can achieve this goal. California should be incredibly optimistic due to the power of state and local leadership, growing international momentum behind clean energy policy, and recent technological developments. 76% of Californians already support clean energy.

**Note that later in 2018, California passed SB100, of which Senator de León was lead author and which mandates among other goals that the state get all its electricity from renewable and zero carbon sources by 2045.*

“If you dream big, with transformational policy, if you have the audacity, with some science to back it up, and a roadmap, you can actually catalyze this market and move forward.”

SESSION HIGHLIGHTS

Keynotes



Cliff Rechtschaffen

Commissioner, California Public Utilities Commission (CPUC)

**A Success Story from South America:
Strategies for Renewables to Supply
New Load Growth**

Highlights:

Smart regulation sets the necessary groundwork to spur green technological development.

California policymakers have focused environmental policies on mitigation, adaptation, and researching new technologies. Governor Jerry Brown recently allocated \$35 million for research of new clean energy technology. Experience continues to show that regulation - the proper type of regulation - does drive innovation, does push technology forward

Once research into what is possible is done and incentives have spurred the market, policymakers should take a step back to let the green market grow. In California, the effort has been focused on trying to define the product or the value proposition we're looking for and then set clear rules and clear market structures in order to achieve those objectives. As technologies mature and as programs mature, it is best to move away from incentives. Technologies and companies need to stand on their own two feet because the government cannot continue to incentivize technologies where the market has transformed.

Energy storage mandates were thought unattainable, then later prompted by the utilities themselves. In 2010, Jerry Brown sponsored a bill as Attorney General to require the CPUC and other municipal utilities set mandates for energy storage procurement. It was criticized as premature, but strict mandates have caused the price of storage to decrease by a third. Ironically, it was the utilities themselves that championed a bill in 2016 which mandates distributed generation energy storage procurement.

Electric vehicles were seen as a distant dream until policy required their rapid development.

Five years ago, the Air Resources Board thought California would be lucky to have vehicles with a range of 80-100 mile electric range. Now there are 44 different electric vehicles sold in California and a few with a range beyond 200 miles. Fuel Efficiency Standards set in 2012 paved the way for 1.5 million EVs to be on the road by 2025 and 5 million by 2030. EVs are still 5% of car sales in CA and just 1% nationally, but policy got the wheels turning.

Renewable Portfolio Standards are a seminal policy-technology interaction example. Despite complaints, increasingly ambitious RPSs have been met by utilities each time they are set. When the first RPS of 20% renewables by 2017 was set in 2002, utilities warned that it was impossible to meet. Now we have 50% renewables by 2030 with talk of 100% by 2050 and utilities have no choice but to find the most efficient way to meet them.

"Now the market has taken over as renewables approach grid parity, and we have the ironic spectre of coal and nuclear companies in the Midwest begging for subsidies from the Department of Energy so that they don't go bankrupt."



SESSION HIGHLIGHTS

Keynotes



Montserrat Ramiro Ximénez
Commissioner, Mexico Energy Commission

Highlights:

Mexico is vulnerable to climate disasters due to its geography. Climate change is predicted to cause an increase in the frequency and intensity of natural disasters. Hurricanes, droughts, and other climate events affected 2.5 million Mexicans and caused \$18.5 billion in damages. This is three times the entire national natural disaster budget. These threats have spurred governmental action. We should not have to wait for our house to burn down to get fire insurance, so why wait for a horrible disaster to happen to accelerate climate action?

The Mexican government has grounded international promises into national law. In the signing of the Paris Accords in 2015, Mexico committed to an energy mix of 35% renewables by 2024 and 50% by 2050. These commitments were then written into Mexico's Energy Transition Law, as insurance that the targets will be reached.

The renewable energy market in Mexico is starting with a clean slate. Due to restructuring of a previously vertically-aligned energy market, boundless opportunity exists for the emergence of a renewable energy market in Mexico. Regulatory leaders are trying to balance the emergence and promotion of new technologies with the stability of the grid.

Market instruments keep clean energy technologies competitive and efficient. Clean energy certificates markets are centered around giving clean energy certificates with monetary value to clean energy developers to incentivize generation. After the establishment of long-term power auctions, the first three auctions have already obtained 7 GW of clean energy for Mexico. This instrument has dramatically accelerated the country's progress toward its RPS

Most of the technologies required to make the energy transition possible are already existent and economically viable. However, we must not forget that proper regulation is required to properly accelerate this transition. The importance of the regulatory challenge lies in balancing technology change and the stability of our systems.”

“The pathway to 100% renewable energy requires regulators that are open to redesign current market structures with a vision of the energy industry of the future.”



SESSION HIGHLIGHTS

Keynotes



**The Honorable
Nancy Skinner**
California State Senator

Highlights:

We must wean ourselves off of fossil fuels, including natural gas. California transitioned to natural gas early on, so most of the state's peaker plants still rely on it. The Low Cost, Low Carbon bill (SB 338) focuses on diverting funding for new peaker plants and exploring new ways to meet peak needs without fossil fuels. Integrating the grid to avoid over generation will be a large part of this.

Decarbonizing transportation starts by looking at where the highest vehicle miles traveled (VMT) occur. California's statutory goal is to electrify transportation. As we move toward electrifying transport, we really have to focus on high VMT."Transportation network companies such as Uber and Lyft contribute significantly to a city's daily VMT. In San Francisco alone, Uber and Lyft vehicles contribute 170,000 VMTs per day. SB 1013 sets increasing goals for the percent of miles required to be electric ending in 100% electric VMTs in company-owned cars.

Green electrolytic hydrogen is a key solution to getting us to zero emissions transportation and mass scale storage that will allow integration of renewables. SB 1369 seeks to advance this important technology.

"As we move toward 100% renewables in the electricity sector, we must work to make sure we are meeting our peak needs in ways other than depending on fossil fuel resources."

Conversation on UC Leadership & International Knowledge Exchange

Carbon Neutrality & 100% Renewable Energy

Dr. Harry Lehmann, General Director, German Federal Environment Agency

Dr. Jack Brouwer, UC Irvine Associate Director of the National Fuel Cell Research Center (NFCRC) and Advanced Power and Energy Program (APEP)

Highlights:

Hydrogen storage is a key component in zero carbon energy systems and needs policies to remove barriers to economic deployment. Electrolysis of hydrogen powered by renewable energy like solar power is capable of the vast amounts of long duration storage we are going to need as we transition to renewables. However, this is currently more expensive than hydrogen creation using steam reforming of natural gas. The high capital cost of the equipment is not the largest barrier to creating hydrogen; the main barrier is policies that do not allow electrolyzers to use cheap electricity that would otherwise be curtailed for hydrogen creation and the lack of policies that could create payments for creating hydrogen for the grid to bridge this economic gap.

Energy storage is crucial in the transition to renewable energy. Whether it is a university campus or a country's electrical grid, establishing energy storage to balance mismatches in electricity surplus and deficit is necessary. While traditional battery storage is the current preferred method, it cannot remain cost effective for all scales and applications. Without also deploying other storage solutions, including sustainable hydrogen storage, carbon neutrality just gets pushed into the future.

Ambitious goals and multi-pronged approaches are necessary in order to follow through on promises. UC campuses have a goal to achieve carbon neutrality by 2025, and to achieve it are focused first on efficiency. UC Irvine has also committed to deployment of electric and hydrogen-powered buses, local solar generation on campus, battery and electrolytic hydrogen storage, electrifying many end uses, and establishing renewable energy purchase programs between UC campuses. As a result, energy use decreased by 50% from 2006-2014. Through its Climate Action Plan, Germany has committed to 80-95% reduction in greenhouse gas use by 2050 and aims to get there via a diverse set of policies targeting multiple sectors. The remaining 5% is reserved for agriculture, since they have found that no scalable zero carbon agricultural practices currently exist.

When comparing the cost of fossil fuels and renewable energy implementation, long-term costs of carbon are too often ignored. We must operate after the point of making a decision to switch away from fossil fuels because they are harming the environment and then find the most cost-effective way to make that switch.

Carbon neutrality will require a different profile of renewables depending on location. Due to intermittency and limited storage options, no single renewable energy approach will be able to get every system to carbon neutrality. Sharing the knowledge that different areas attain with different suites of renewable generation will be important, as will be highlighting how crucial it is to include flexibility in planning.

Going 100% renewable across sectors is doable – and has its challenges. For example, the only way that we're going to end up getting to zero carbon is going to be through adding way more renewable energy that we even currently are planning to install. Also, if we are talking about greenhouse gas neutrality in Germany, other industrialized countries or the whole world, then we have to not only lower energy demand efficiency but also by eliminating some uses. And changing a society is feasible but not easy, especially changing it in a democracy.

“We are using the millions of years of investment that the Earth has put into fossil fuels in a couple hundred years.”



PANEL

ZERO EMISSIONS TRANSPORTATION

Moderator: **Ryan McCarthy**, Science and Technology Policy Advisor, California Air Resources Board

Panelists:

Carla Peterman, Commissioner CPUC

Ryan Popple, CEO, Proterra

Salvador Llamas, COO, AC Transit

Gia Brazil Vacin, ZEV Infrastructure Project Manager, Governor's Office of Business and Economic Development (GO-Biz)

Highlights:

One of the most exciting and challenging opportunities for transitioning to an all renewable system is to leverage renewable energy to completely decarbonize the transportation sector.

If we can transition to 100% renewable electricity, then we can have a scalable, large-volume solution for completely zero emissions well-to-wheel transportation. This is extremely urgent in California where the transportation sector is the largest greenhouse gas emitting sector in the state.

The California Air and Resources Board is pushing for 100% ZEV sales in California. California co-founded the International ZEV Alliance which is a commitment among countries, states, sub-national, and national jurisdictions to reach 100% ZEV sales as soon as possible, and no later than 2050. This is being accomplished through a combination of incentives, investments, and regulations, pushing on all fronts: the vehicle side, the fuel side, the land-use side, and planning side.

Governor Brown signed an Executive Order on January 26, 2018 that increased California's targets for zero emission vehicles from 1.5 million on California roads by 2025 up to five million by 2030. It also set infrastructure targets both for charging stations and for hydrogen stations. California's new targets are to have 200 hydrogen fueling stations and 250,000 electric charging stations, with 10,000 of those being DC fast chargers, all by 2025. This move has sent a strong signal to industry that the state is committed to zero emissions transportation. The state believes that battery electric and hydrogen electric are complementary, and that investment is needed in both in order to achieve the state's goals

Right now, California has 33 open public hydrogen fueling stations for light duty vehicles.

Another one is coming online very soon, and 65 have already been funded through the Energy Commission. By 2025, California expects to have 200 stations open, which is double the original goal.

One of the challenges that hydrogen faces is that right now it's fairly expensive relative to other fuels, although as volume increases, costs will decrease over time. Along with light duty vehicles, the medium and heavy duty sectors also play an important role in helping to scale up and bring down costs. Hopefully, hydrogen will reach cost parity with other fuel sources.

When SB 350 passed in 2015 in California, it gave the CPUC a legislative role in promoting the electrification of vehicles. In response to that, utilities have filed nearly a billion dollars in proposals to date, with about forty-five million already approved by the CPUC. These projects reach a multitude of sectors such as residential customers, buses, trucks, and ports.

The utility role in zero emissions transportation has expanded in three main ways. First, as a provider of fuel, the utilities play the main role in decarbonizing the grid which powers ZEVs by increasing renewable generation. Second, as a distribution grid manager, utilities make sure there is enough fuel available to customers as well as ZEVs at a reasonable price. Lastly, utilities are becoming increasingly responsible for actually providing the charging infrastructure, so people can charge outside of their homes. Utilities have not historically been involved in this last area, but by becoming so, they have the opportunity to place charges strategically in ways that are most beneficial to customers and grid operations. Collectively the utilities have funding to put 12,500 electric vehicle charging points around the state.

The CPUC is working with hydrogen producers to ensure that more hydrogen is derived from renewable energy, including renewable electricity, instead of gas. AC transit has shown with a micro-level demonstration that it is feasible to use clean solar energy to produce hydrogen to run zero emission busses.

As the investment community sees that California is in, they're far more likely to join the movement. As an example, Proterra received a manufacturing grant worth about \$3 million dollars from the state that they have leveraged many times over to acquire investments from the private investment community.

Zero emissions bus fleets are growing throughout the US in blue, red and purple states. In addition to California, states like Texas, Utah, Montana and Alaska are buying zero emission busses from companies like Proterra. An electric bus that has 175 miles of range is competitive when bus routes average around 130 miles per day. Hydrogen also certainly plays a role in the zero emission bus revolution. The industry currently does not know how to build an electric vehicle that can drive all the way across the country and refuel along the way in a few minutes. There must be other types of zero emissions technology in transportation to meet all needs.

Hydrogen also certainly plays a role in the zero emission bus revolution. The industry currently does not know how to build an electric vehicle that can drive all the way across the country and refuel along the way in a few minutes. There must be other types of zero emissions technology in transportation to meet all needs.

Hydrogen fuel cell busses and battery cell busses are both forms of an electric bus. They both have electric drive systems, they both have energy storage on board, and they both have a battery management system. The two systems can actually work together where hydrogen is stored on board the bus to supplement the batteries via fuel cell electricity generation, which might alleviate any range anxiety bus operators experience with electric busses.

AC transit's fuel stations can currently fuel up to twelve busses back-to-back. Soon, however, they'll need to be able to fuel 30-40 busses overnight. One new technology coming to market is cryogenic pumping, which removes the hydrogen compression steps. This will allow AC transit to fuel 30-40 busses within a 10-hour window. Looking even further into the future, they'll need to be refueling hundreds of busses overnight, which will necessitate even better fueling technologies.

"When AC transit first got its fleet of hydrogen fuel cell busses, the real challenge to learn very quickly how can we keep these buses on the road. We just adopted a philosophy that we're not going to be afraid to fail and it's okay that we don't know what to do but we're going to continue to try. We started to self-diagnose, we started to learn by trial and error, and we started to train our mechanics. We realized right away that this technology is not sustainable if we cannot maintain it ourselves. In the last few years, we've trained 223 mechanics on zero emission bus technology with over 8,700 hours of zero emission bus training."



INTEGRATING THE BUILDING SECTOR'S ROLE INTO 100% RENEWABLE ENERGY SYSTEM

Moderator: **Andrew McAllister**, Commissioner, California Energy Commission

Panelists:

Byron Benton, Training Director, IBEW-NECA Zero Net Energy Training Center

Bryan Dove, Director of Asset Management, Mutual Housing California

Todd Foley, Senior Vice President of Strategy, Policy & Government Relations, American Council of Renewable Energy (ACORE)

Dr. Ramamoorthy Ramesh, Endowed Chair in Energy Technologies, UC Berkeley Assistant Lab Director, Lawrence Berkeley National Laboratory (LBL)

Highlights:

Analyzing the temporal aspect of energy use is necessary to create zero net energy communities. It is no longer enough to look at a building's mid-day and middle-of-the-night energy use values and balance them out within the home. To create buildings and communities that are truly using just as much energy as they create, we must move toward thinking about the emissions values and adding a long-term temporal aspect to analysis.

Greener buildings hold benefits beyond protecting the planet. From saving money to reducing the risk of health problems, designing new buildings and renovating existing ones to be zero net energy has numerous benefits beyond the environmental ones that often first come to mind. For example, incorporating natural light into building designs not only reduces energy use by limiting the amount of time that the lights need to be turned on during a given day, but also functions as a psychological break when the outside world is visible to users. Similarly, incorporating fresh air ventilation into a traditional heating and cooling system cuts down energy consumption while reducing the likelihood of getting sick.

Efficiency comes first. According to the US Energy Information Association, buildings account for 40% of total energy consumption in the US. Changing behavior to reduce energy use as much as possible and then filling in what is absolutely necessary with renewables is the most cost-effective way to bring buildings down to zero net energy. This can take the form of passive measures, such as thermostatic valves which allow shower water to heat up without running, or more active measures, such as power strips that can turn off entire entertainment systems at once. Energy monitors installed in Mutual Housing at Spring Lake reduce use by 3-5% just by lighting up red for high energy use and green for lower use.

Learning from stellar examples. IBEW-NECA's Zero Net Energy Training Center and LBL's Flexlab are both hubs for zero net energy modeling and testing. The Zero Net Training Center is a 46,000 square foot building originally built in 1981 and renovated 5 years ago to reach zero net energy. It has achieved its zero net goal for the past 5 years and attracted visitors from near and far including a recent visit by French Polynesian leaders to assess buildings options for planned floating, sustainable islands. The Flexlab is the most advanced energy efficiency testing center in the world, with several chambers to test individual buildings and building systems under real-world conditions. Reaching 100% renewable energy will take this kind of collaboration and learning best-practices from successes.

Real people live in buildings, creating new challenges and unpredictability. Mutual Housing at Spring Lake, Woodland is a community comprised of 62 units for permanent farmworkers. This group, with an average income of \$30,000 per year, is often overlooked when considering a transition to a more sustainable future. With all the latest Energy Star appliances installed and solar panels on the roofs, energy use was still much higher than expected. Interviews revealed unforeseen uses such as electric wheelchairs and user issues, such as not understanding how to use the new environmentally-friendly air conditioners properly. Community organizing and educational outreach are ongoing efforts to solve these issues and ensure that all of the energy-saving tools are used properly in the future.

The customer will not pay a penny more, and they shouldn't pay a penny more, for zero net energy. It is really important to bring the cost of energy down to a parity where the customer doesn't know the difference - whether it's coming from a nuclear power plant, a coal-fired plant, or from the rooftop.

Rooftop solar is a piece of the puzzle, not a silver bullet. NREL found that technically, solar PV when installed on existing roofs could produce 39% of the annual national power demand. This does not take into account economic feasibility or practicality. Solar power must be a piece of a system of systems, but we need other solutions. For example, buildings must be able to "talk" to each other and exchange energy in real-time. Rather than focusing on how to get individual homes to zero net energy, we must also focus on creating an integrated system of communities in which solar from California works with hydropower from Oregon and Washington and wind from Wyoming. By looking at the building context, we can begin to optimize opportunities in a smarter way.

Training contractors on energy efficiency is crucial. 90% of building stock is comprised of existing buildings, meaning there are countless structures in need of energy efficiency renovations. IBEW-NECA contractors go through a 5-year apprenticeship program for updating buildings including training on automated demand-response. In the solar industry alone, 70% of jobs are in installation. We must move to a place where the contractors and installers are so qualified that the government does not need to check their work. Expanding training programs is the most effective way to ensure this transition to renovated buildings goes smoothly.

Lithium-ion batteries are not the only solution to the issue of storage. Due to the intermittency of renewable energy, storage is the next challenge looming between us and 100% renewable energy. When scaling up the technology used for batteries in the Prius to the scale of the grid, the cost is no longer feasible. We have to be more creative about storage solutions, such as converting excess electricity during times of surplus into usable fuels. NREL's Photon to Fuel program is researching just that with the hopes that these green fuels created on-site can serve as storage for extra electricity generated by renewables in buildings.

Policies lay the groundwork for zero net energy housing. Building codes in California are some of the strictest in the world, and they are continuously being revised to become stricter. This high bar spurs motion, as contractors scramble to keep up. Strict policies can work with this momentum by using tax credits to incentivize construction of renewables and restructuring the energy market to allow renewable energy to better compete in power markets. We will only come close to 100% renewable energy with players throughout the entire building sector moving in the same direction.

Three Big Challenges

"Designing the project as efficiently as possible is very important, but we can't make it so complicated that a resident can't understand it."

"We can write all the [building] codes we want, tie them up with a bow, and throw them out into the world, but the contractor and the customer have to understand it enough to do quality work. It's an on-going challenge."

"The tax credits set on renewable energy are set to phase down and out, while the tax credits for conventional sources of energy remain permanent and deep in the code. So we've got some big challenges on that front."



TRANSFORMING THE ENERGY GRID

Moderator: **David Olsen**, Chair, California Independent System Operator (CAISO) Board of Governors

Panelists:

Ric O'Connell, Executive Director, GridLab Energy

Susan Kennedy, Founder & CEO, Advanced Microgrid Solutions

Dr. Harry Lehmann, General Director, German Federal Environment Agency

Talita Porto, Member of Board of Directors, Brazilian Electric Energy Trading Chamber (CCEE)

Geoff Syphers, CEO, Sonoma Clean Power

Highlights:

In March of 2018, Portugal was able to power itself entirely off of renewably generated electricity. To accomplish this feat, Portugal has been strategic about where they locate their renewable resources, in particular, locating them to support local distribution and facilitating the development of local distribution grids, thus minimizing the cost of new transmission. Portugal is a great illustration of how larger grids are necessary to share resources, smooth out the variability of wind and solar resources, provide a broader market, and do that in a way that can complement the development of local generation.

Buildings can be active participants on the grid. Buildings are becoming virtual power plants by transforming the whole building load into a dispatchable resource. Demand response customers are happy to participate because they are compensated without sacrificing comfort. The utilities are happy to participate because they're now able to use these buildings as load following resources and as peaking resources.

We're moving completely away from the old paradigm into a brand new world in which load curve is no longer, so all the resources are no longer stacked in terms of when they are needed for load following, peaking, and spinning reserve. That is now gone completely out the window in any area where you have a significant penetration of renewables. In the new paradigm, there is both dynamic generation and dynamic consumption. For planning purposes, the utilities and grid operators are now chasing a moving target on both sides of the supply and demand balance equation, which is an extremely expensive problem to try to solve.

We are seeing a major change in grid economics where customers have the most valuable resource in being able to provide load following and ancillary services. This basically eliminates the middleman, aggregators, utilities, and all the wholesale energy providers that are trying to sell those resources into the grid.

Let's work backward from 100% renewable, affordable reliable zero carbon energy for all human purposes available to everyone, and ask, what do we have to do to get there and what does every decade look like along the way. By working the problem backwards, it assumed the end state has happened. This allows us to identify some of those key problems that we don't know how to solve, but know we have to solve, which is different than asking what incremental progress can we make today.

Similar to what Advanced Microgrid Systems is doing with using buildings as dispatchable loads, Sonoma Clean Power is putting together a distributed energy resource aggregation tool called GridSavvy for homeowners. This tool can aggregate any number of types of behind the meter resources such as batteries, electric vehicles, and thermostats, which can then be coordinated and dispatched at different value points as virtual power plants, allowing smaller customers to actively participate in the grid as shapeable loads.

To promote the growth of renewable sources, the Brazilian government has developed specific auctions for renewable energy contracts. These auctions heavily utilize subsidy policies, such as discounts on transmission and distribution tariffs. Recently, these auctions resulted in the lowest price of renewable electricity in the history of Brazil. Wind power was negotiated at \$20 per megawatt hour and solar at \$35 per megawatt hour.

There are at least three archetypes of a grid based renewable energy supply, and we need to leverage more than one to succeed. One is decentralized where everyone has a house with solar panels and a battery, allowing them to live completely off the grid. A second is international cooperation, where the grid is connected across national boundaries, and countries exchange electricity resources with each other. The third is regional integration of the grids and electricity markets. We cannot solve any of our energy problems in industrialized countries with only one of these archetypes.

The prices of photovoltaics and batteries are declining to the extent that in principle it is becoming economically feasible for increasing numbers of consumers to go off the grid, but this risks putting undue burden on the disadvantaged few to pay for the grid. It cannot be that in 2030 the grid is only paid for by the large corporations and underserved who rely on grid interconnection. We have to find solutions for sharing risk and sharing costs.

New transmission will be needed to enable grid cooperation that leverages renewable sources where it is abundant and accelerate reaching 100% renewable electricity cost effectively. California still needs large transmission infrastructure and expansion of that infrastructure, especially to transport the wind power produced in the Midwest out to the coasts. The whole West is moving towards higher renewable penetrations, as it is not just California anymore that wants a lot of renewables. A new study by NREL examines expanding the interface between the Eastern and Western grids and considers several scenarios of building massive new transmission. We're going to need both decentralized resources and also the transmission grid to move lots of power.

Grid Labs is currently conducting a study of transitioning to 90 percent renewable electricity in Minnesota by 2050. This study has highlighted the critical need for more flexible loads, such as electric vehicles, which not only electrify transportation, but also provide flexible load to absorb variable energy.

A major obstacle in transforming the energy grid is getting the rules to catch up to the technology. Gaps in the rules have created problems for Sonoma Clean Power and other community choice aggregators in capacity planning, for example, with the possibility of over building one type of renewable resource and under building another. Advanced Microgrid Solutions delivered a hundred percent on what they were asked to with their batteries during a heat wave, but were paid as little as 50 cents on the dollar for their services because of rules which average load over 10 days, and do not compensate hourly. It's much harder to convince a customer to join a community choice aggregation or put a battery in their building if the rules are still against them.

Another feature of transforming the electricity grid, along with decarbonization and decentralization, is digitization. We have far better software and communication tools than ever before, but this hasn't really hit the energy industry as it needs to.

We need solutions that tackle those hours of the year with extremely low renewable generation. That five to ten percent of the year is going to need a solution. The scale of storage that we will need to employ to maintain our current reliability in this scenario is astronomical. One solution, such as is being used in Europe, is increased regional interconnection, as more than likely there will always be renewable generation available somewhere in Europe. Another solution is provided by Advanced Microgrid Solutions with their demand side dispatchable load management coupled with hyper-awareness of when the last five to ten percent of non-renewable resources will be activated. A third solution is mass scale seasonal storage, such as hydrogen which can be produced in vast quantities using renewable electricity and used at a later time.

Inexpensive renewable and distributed generation has completely changed the way we not only generate but procure, distribute, and consume energy. With solar and wind prices down at below three cents a kilowatt hour, the consumption is now irreversible. Customers are putting on rooftop solar and other distributed clean resources because the price point has come down so low that the utility can't even compete with their own customer in terms of selling them electricity at a higher price. They're in a price war with their own customers at a price where they cannot win.

"We use the word integrate like we're going to stick renewables around the edges. It really has to be that renewables are at the heart of the system and we need to stick other resources around the edges."

"If people are continuously earning money from renewable generation then all the problems with the system are solvable. If the windmill makes 'flap-flap-flap' then you hate it. If it makes 'bling bling bling' then you love it."



LOCAL LEADERSHIP ON 100% RENEWABLE ENERGY

Moderator: **Elizabeth Doris**, Principal Manager for State, Local, & Tribal Governments, National Renewable Energy Laboratory (NREL)

Panelists:

Deborah Raphael, Director, City of San Francisco Department of Environment

The Honorable Kate Sears, Marin County Supervisor

Strela Cervas, Statewide Organizing Director, California Environmental Justice Alliance

Highlights:

Local government policies can prioritize community benefit such as local employment as well as a greener future. San Francisco, for example, has adopted progressive policies including requirements for green roofs or solar panels on new roofs, charging stations for EVs in new developments, energy-use benchmarks, and frequent building audits. The local community college has doubled their EV mechanic program to prepare for upcoming fleet upgrades. Collaboration with unions in San Francisco and Marin County meanwhile also prioritizes creating green jobs that are not a downgrade from traditional union jobs and local hire requirements ensure community employment benefits.

It is important as we think of pathways to 100% renewable energy to consider the accessibility of this transition. While the dirtiest infrastructure, such as fracking operations and coal-fired power plants, is usually located in rural communities, these communities have not traditionally been considered when envisioning the transition to renewable energy. CEJA is putting an end to this city-first mentality by pushing for legislature that includes rural working communities and capacity building in disadvantaged areas. SB 350 is an example of legislation with excellent recommendations about promoting jobs specifically in disadvantaged communities. The value of green jobs in rural America is higher compared to urban areas because there is less transferability in these regions.

Capacity building is important both for establishing local leadership of sustainability programs and for increasing participation in them. CEJA has focused on creating innovative hands-on curriculum, increasing outreach in various languages, and empowering women to be leaders in their communities to foster sustainable maintenance of programs. To teach about feed in tariffs in accordance with a policy called Solar for All, strategies such as discussion about what an ideal energy distribution system was spurred so that concepts came from the community rather than being fed to the members. AB 693 (Multifamily Affordable Housing Solar Roofs Program) made it to the final vote largely due to the intense training of women-of-color by the Women's Policy Institute and the momentum that this created. Other capacity building programs in the Bay Area are Resilience by Design, which created 12 teams to design solutions to the growing threat of sea level rise, and a community-engagement project in Marin focused on permaculture and social equity.

Looking critically at and removing barriers to engagement of underserved communities in green projects creates positive, sustained change. Local leaders in San Francisco have participated in several meetings and trainings to practice radical curiosity and question what barriers to engagement exist in their city that contribute to institutional racism. For example, a solar installation project was designed to fund solar installation in low-income, single-family households. Community organizers were doing all the right things: offering childcare, food, speaking several languages, approaching doors at the right time. But participation was still low. Through digging deeper, leaders realized that many of these homes have roofs in such poor condition that they were unfit for solar panels. Once another program was set up to improve roof stability, participation in the program literally went through the roof. Capacity building in participation is equally as important as capacity building in leadership for realization of long-term change.

Emphasizing behavior change is key when envisioning long-term shifts to renewable energy. “Drawdown” is a comprehensive plan with 100 feasible methods that can be used to address climate change, both on the adaptation and mitigation sides. Marin was the first community to apply, and the plan was launched in October 2017. It is a massive undertaking which prioritizes installation and implementation of 100% renewable energy, low-carbon transportation, sustainable food waste disposal, and carbon sequestration projects. Successful public engagement has been realized through community organizing and creating crucial partnerships with grassroots organizations. More engagement is needed in the business sector to solidify the actualization of behavior changes needed to achieve the goals of the plan.

The messenger really matters. You can’t just have a public agency or a utility company coming in and sending their community liaison and giving a workshop because there’s a lot of resistance in the community. There’s a lot of cynicism in the community. People are constantly knocking on their doors, trying to sell them stuff, so there are a lot of trust issues and it has to be built.

“Part of working with communities and making sure communities are resilient to change as we start to adopt these technologies is getting ready not just for the known challenges, that we know are coming, but also being able to react to the ones we can’t see yet.”



THE CUTTING EDGE OF RESEARCH & INNOVATION

Moderator: **Dr. Peter Green**, Deputy Director, National Renewable Energy Laboratory

Panelists:

Nicholas Flanders, CEO, Opus 12

Danny Kennedy, Managing Director, CalCEF

Nancy Pfund, Founder and Managing Partner, DBL Partners

Dan Shugar, CEO, Nextracker

Highlights:

Many of the advancements that we've seen in advanced energy technologies, such as wind, solar, and geothermal, have been the result of advances in other fields of science. The good news from around the globe is that, unlike 50 years ago, these advances are coming from everywhere, not just the United States. It is important that the entire global community contribute because in the end, we're all going to need to find a collective solution. If some parts of the world are left behind, we're all going to pay the price for it.

On average, it is true that energy intensity, the amount of energy used per unit of GDP, is decreasing, but it's not true everywhere. It's not true in developing economies where their populations are growing at an exponential rate, and all those people are trying to achieve a higher standard of living. It's also not true in many developed economies where a study by the World Bank shows that once the average income of a nation gets beyond a certain point, the energy intensity plateaus. The only way we are going to fix these issues is through policy, which can reverse trends and set new ones to put us on the right path.

LED lighting is a good illustration of how clean energy technology that is dismissed at the beginning can become commonplace with the right effort. When the discovery of the LED was made by Japanese scientists, nobody believed that this technology could ever work on a large scale. But today, because of their perseverance, we have cheap white light. LEDs used to be very expensive, but the price drop over the last five years has led to their widespread adoption.

There are several advances happening in wind technology right now. Wind turbines are getting bigger, which allows regions with less wind resource to still be able to produce power with the wind they have. Also new materials, designs, and manufacturing techniques are allowing for far more efficient and cost effective turbines. These mechanical innovations are being combined with advancements in computer modeling and artificial intelligence to optimize wind turbine performance on site.

We'll have to collaboratively and carefully integrate many solutions into the final 100% renewable grid. Because not every region has the same local resources, we're going to need to build up an entirely new transmission interconnection across the United States to share resources. We're going to need storage solutions, some of which work well in certain areas but not others. What's right for one community also may not be right for another, which is where the techno-economic analysis must come into play.

The future of energy is in its nexus with information technology. NREL is currently working in collaboration with companies to develop software that uses machine learning to optimize energy efficiency measures in residential homes to maximize energy savings and customer comfort. The data collected from these users can be aggregated to the community level, which along with AI could optimize an entire community's energy usage. The data collected by EVs on driving and charging preferences can also be used in this type smart energy network. All these data can then be used to create data-driven policy measures which are both informed and effective.

Opus 12 has developed a device that uses electricity and a newly developed catalyst to break apart CO₂ and water, which are then recombined into new products like liquid fuels. The device is able to recycle emissions with renewably generated electricity to create many types of basic products that are traditionally made from fossil fuels. Opus 12 is achieving this at industrial scale.

One of the main themes of getting to 100% renewables across sectors is further driving down the cost of renewable power to perform other tasks such as renewable gaseous and liquid fuel production. Renewably produced liquid and gaseous fuel is slowly converging to cost parity with traditional fossil fuel production.

The entrepreneur is the key actor in this pathway to 100% renewables. The California Clean Energy Fund estimates that we will need about 100,000 new clean energy startups, and over a trillion dollars of value creation annually, to facilitate the clean energy revolution.

Diversity and inclusiveness is of the utmost importance in developing a clean energy economy. Currently, the clean energy start-up and investment world is not being as inclusive as it should be. Each new venture should be reaching into the depth and breadth of the Californian and global community. The clean energy economy represents an incredible wealth building opportunity, and today a lot of that is still going to the same demographics it always has, and even to the energy incumbents of the 20th century instead of the energy insurgents of the 21st century.

Innovation is not the monopoly of the privileged elite sitting in the Bay Area. On the contrary, the Silicon Valley innovators have actually slowed down their rate of innovation. A secret law of innovation is that when you double the population of people struggling with a problem set, you triple the rate of innovation. Innovation is an emergent phenomenon. In order to reach to our goal of 100% renewables and the trillion dollars of annual value in clean tech that we need to see, the rate of innovation needs to triple then triple again. We need new innovators and entrepreneurs that are dedicated to impact, bringing in new, diverse minds to discover solutions to their own local problems which can then be broadcasted globally.

There are many countries in Africa that are still subsidizing the fossil fuel industry to the tune of a billion dollars a year, so obviously we need to level the playing field. Africa is a huge market, where much of the population growth in the next 20 years will occur and where much of our future sustainable society will be built. People in the United States should have policy in place to help build up an electrified middle class in Africa. Because the energy incumbents are not present in Africa, we have an opportunity to push unhinged innovation there. We might start seeing smart grids in Ghana before the U.S., just like the widespread adoption of the mobile phone in Africa. The policy problem here is that various players are not all given a legitimate role in shaping our collective future. We must rebuild the table and level the playing field in order to achieve 100% renewable energy across the globe.

Ultimately, the efforts to bring electricity to Africa will and should largely be undertaken by Africans. In the past, the rest of the world has been unkind to Africa, but Africans now have the tools in their hands to electrify their rural population with solar technology that has been scaled by Germany, California, and China. Many places in Africa will leapfrog fossil fuels and start off with 100% renewably generated electricity on incredibly advanced micro grids.

In years past, the big deal in Africa was building roads and physical infrastructure, but currently a clean energy revolution is emerging. The Chinese have been leading infrastructure efforts, but African government officials and citizens complain about the fact that the Chinese infrastructure is simply falling apart. Thankfully, the future of solar and clean distributed energy infrastructure in Africa looks different. These areas have moved beyond the sovereign initiated efforts and are being accomplished by commercial, cost-effective, and growth-oriented efforts from the likes of NEXTracker and Flex to new entrants like Off Grid Electric. There's a whole slew of these companies that are able to attract financing from the impact community and the traditional venture community. Even African based hedge funds, private equity funds, and venture funds are beginning to invest in clean energy as well. This is an important step to ensure that there is an authentic link between the financing and the people that are being served.

The issue of curtailment should not be in our vocabulary. With a more intelligent grid, storage technology, and increased regionalization, curtailment is a systematic failure.

Lithium is great for driving your electric car, but it's not the best for medium use case energy storage. People see the duck curve, think we need storage, so the herd has gone with lithium, but we need other solutions for medium and long duration.

There are 700,000 people in this state that have rooftop solar who have no voice. They're not at that table, but they need to be at that table. They are the early adopters and we don't know anything about them. We don't know their demographics and we don't know whether they're happy.

Photovoltaic technology is completely magical. It's the only thing ever invented or discovered that makes electricity without moving parts or burning fuels. Once it came to market, everyone wanted solar, but unfortunately it was too expensive and unreliable. Thankfully, solar today is both cheap and reliable. Solar is bid on and sold by responsible utilities for two to three cents a kilowatt hour. It's about a fourth the cost of new nuclear and half the cost of gas. It's over, we've won.

"Innovations always happen because of...entrepreneurs that see the world differently. It doesn't happen because the incumbents decide they're going to change."



THE ROLE OF WOMEN'S LEADERSHIP

Moderator: **Angelina Galiteva**, Founding Board Chair, Renewables 100 Policy Institute

Panel:

Erica Mackie, CEO, Grid Alternatives

Angela Johnson Meszaros, Staff Attorney, Earthjustice

Aura Vasquez, Commissioner, LADWP

Jennifer Kropke, Director of Workforce and Environmental Engagement, IBEW 11

Highlights:

Workforce engagement on clean energy needs to be inclusive. That means training and providing opportunities to people of varying skill levels and educational background, different races, different sexual orientations, different cultures, those on the frontlines, those who are veterans, those who have a history of incarceration, and others both in mainstream and marginalized sectors of society.

Creating clean air and protecting climate and good careers can and must go together. Careers in clean energy need to go beyond jobs that pay \$25/hour to careers that pay \$65/hour and health-care and retirement benefits.

Environmentalists and labor can be effective partners. Providing local employment opportunities on clean energy projects for those in greatest need is a unifying priority.

We have to think about whether we are building wealth in communities or not and what that looks like.

The clean energy conversation has to be inclusive of underserved communities that may have different priorities than others. For example, if communities of color are absorbed with deep concerns about racial discrimination and violence, how does that factor in to how opportunities in the clean energy space are built there?

There is a long line of actions between creating policy and implementing them in communities that involves coalition building, creating programs that are relevant to practitioners on the ground and benefit everyone.

Energy access is an issue not only here in the United States. For example, there are 10-20 thousand people on the Navaho reservation without stable access to electricity.

Part of the path to 100% renewable energy still involves stopping new fossil fuel projects from being implemented. Renewable energy experts and advocates need to provide clean energy solutions as alternatives.

In the energy future, we need to challenge not just the incumbent fuel sources, but also the incumbency of who gets to lead, who gets to decide, and who gets to benefit from the choices made. This is an opportunity to think about how we organize society. Among the people who need to be leading the decision making process are those most effected by the pollution and other negative impacts of our conventional energy systems. That can mean things as basic as scheduling key conversations at times and places that impacted community members can participate.

LADWP has developed a 50 point equity matrix to help guide decisions on how to use subsidies, design programs, and make decision making more transparent both internally and externally, in order to make the benefits more equitable. These include informational tools like zip codes, gender, economics, the Cal Enviro Screen, among others. Earlier programs like incentives for solar rooftops had the unintended side effect of being adopted more readily by affluent consumers, at the expense of poorer ones. An example of a program that benefits the disadvantaged is one that offers approximately \$400 to low income residents to subsidize the purchase of used electric vehicles. Public EV charging infrastructure is also being added to low income neighborhoods. That said, LADWP like most utilities has a ways to go to bring more women into its workforce.

We need to be more intentional to develop programs with equity in mind.

To bring more women into the energy workforce requires STEM education from early on and role models. Girls need to be able to see women as engineers and regulators. Women need mentorship and sponsorship of women's leadership.

The panelists are driven to work on the transition to renewables in large part by existential need and compassion for the vulnerable. The women on the panel cited among their reasons wanting to live in a world that exists, making sure the air families breathe doesn't kill them, changing laws and what is considered acceptable to protect the vulnerable and not just capital, being a role model for the rest of the world and a protector of future generations from the pollution and other negative impacts of traditional extracted fuel energy systems, creating good jobs and other economic benefits for all socio-economic strata of society.

The titans of the clean tech sector need to embrace the working class the way the traditional energy sector has, so that people in the labor sector feel that the renewable and zero emissions technologies sector wants to work with and partner with them the ways that the fossil fuel companies have.

If I could be Goddess for a day with supreme powers, I would give everybody a woke pill.





PANEL

CORPORATE LEADERSHIP

Moderator: **Joel Makower**, Chairman & Executive Editor, Greenbiz Group

Panel:

Mark Ferron, Governor, California Independent System Operator (CAISO)

Sunya Ojure, Senior Manager of Sustainability, Salesforce

Rob Threlkeld, Global Manager of Renewable Energy, GM

Alfredo Hélio Syrkis, Executive Secretary of the Brazilian Forum on Climate Change (FBMC), Executive Director of the Brazil Center on Climate (CBC)

Highlights:

Last year was a record-setting year with 25.4 gigawatts of corporate renewable energy procurement according to Bloomberg New Energy Finance. Dozens of corporations, including Apple and Google, have reached 100% renewables in their global operations.

GM has approximately 350 facilities around the world in about 60 countries and is committed to getting to 100% renewable energy in all of them. In order to accomplish this goal, GM takes a four-pronged approach that prioritizes energy efficiency, strategic procurement, energy storage, and green policy making. GM spends about \$17 to \$20 million dollars a year on energy efficiency. The company's long history in the renewables space started with landfill gas procurement projects, which required massive amounts of capital and long-term commitments from both GM and the landfills. In return, GM received price stability and risk mitigation for its supply of methane. GM sees these projects as precursors of Power Purchase Agreements for renewables today, which they use heavily, especially in procuring offsite wind generation. Right now, GM is operating on about 20% renewable energy, and that number is only increasing.

About 5 years ago, large cloud companies began evaluating their energy efficiency and carbon emissions at the urging of environmental activists. This was a conversation that hadn't really come into the public view before because most people didn't recognize that there is an environmental impact associated with internet usage and cloud computing. Big data centers that store all the information in the cloud use tons of energy, and they weren't using renewable energy. Thanks to these efforts, large cloud-based companies such as Salesforce started to realize the magnitude of their environmental impact and pledged to work with their providers to reduce energy consumption and carbon emissions.

In 2013, Salesforce made its first renewable energy and carbon emissions commitments. Their initial efforts were focused solely on their data center infrastructure, which accounted for about 90% of their direct emissions. To decrease these emissions, Salesforce signed numerous Virtual Power Purchase Agreements to procure renewable energy, implemented heavy hitting energy efficiency measures across their properties, and purchased copious amounts of renewable energy credits and high-quality carbon credits. Salesforce's original goal was to become net zero carbon by 2050, but then in 2017, they realized that they had actually achieved that goal 33 years early.

Salesforce is basically 100% percent leased, which presents a challenge. Whereas their big tech peers like Google, Apple, and Facebook own their own buildings and data centers, Salesforce has data center service providers, which makes it much more challenging to control the energy flow of those buildings.

Larger corporations should be guiding smaller companies into their 100% renewables future. By blazing trails, creating blueprints, and solidifying contracts with stakeholders, large corporations have the opportunity to put together a playbook for smaller corporations to achieve their renewable energy and carbon goals.

The Brazilian Climate Center is a think-tank whose mission is to bring together government, private sector, NGOs, social movements, and academia to collaboratively figure out climate solutions. They are currently working on a roadmap for the implementation of the Brazilian nationally determined contributions from the Paris Agreement which has Brazil reaching net zero carbon in 2060. This plan will hopefully have a distinct political advantage in progressing forward because it comes from a consensual agreement between different stakeholders.

Brazil needs to kick the automotive industry into high gear to electrify and fight climate change. Unfortunately, Brazil has lately experienced an automotive industry boycott on dialogues about climate change. Even though they all recognize that electrification of transportation is the future, they want to keep the Brazilian market as reserved for the old oil-based infrastructure because they see a good business opportunity there. One solution might be to transition to electrification by first utilizing sustainably produced biofuels, the production of which captures carbon and does not jeopardize forests or food sources. A push for biofuels might bring the automotive industry in Brazil to the negotiating table more quickly, and it has a lot of advocates.

There are three kinds of mechanisms we can use to finance the measures needed to fight climate change. There's a carbon tax, which enables us to incorporate the true price of carbon into the pricing of our large scale systems. There's ending subsidies for fossil fuels, which directly total to \$600 billion and indirectly total up to a trillion dollars globally. And then there's positively pricing carbon such that lowering emissions saves money. This last mechanism, which Brazil introduced into the Paris Agreement, recognizes that reducing carbon emissions has an intrinsic economic value.

It's a little sad that the growth towards 100% renewables in the corporate sector is a result of bypassing the ineffectiveness of the utility sector. We're seeing tremendous efforts and fantastic results in the corporate space around renewables, but there's a bittersweetness to it. The sweetness is obvious: we've got very motivated and smart companies at the cutting edge who are really pushing the markets in the right direction. These companies are essentially bypassing utilities to purchase renewables directly through PPAs and virtual PPAs and their efforts are actually being properly focused in places like West Virginia where they don't have strong climate policies. The bitter part is the market failure on the part of the utilities that forces forward-thinking corporations to become their own energy service providers. We don't want to have a grid where every major load center is their own load serving entity. And we can't insist that the corporate world continue to strive for 100% renewables by each of them developing their own expertise in renewable energy. That's where utilities need to help out as energy service providers. Corporations that want 50% renewable energy should be able to procure that energy mix from their utility, and corporations that want 100% renewable energy should also be able to purchase that service. Utilities should offer a product which is transparent, cost-effective, and malleable to the needs of companies across the globe.

It is important to match load with generation contracts. Otherwise, you're just piling up renewables which ultimately are going to need to be shaped and firmed.

Long term, consistent policy is key to sustained corporate investment in the transition to renewables. When companies see proposed changes in the tax credits for renewables development and changes in political geopolitical situations around the world, it makes it difficult to predict the financial outcome of projects, and that slows investment.

"We always joke that your cat videos actually are having a lot of impact on climate change...As you put all of your photos into the cloud, all of that has an impact and it's exponential in growth."



CONCLUSION

There is no doubt that the transition to renewables keeps happening faster than most could have imagined not long ago. This is only reinforced by recalling that 100% renewable energy was still a relatively new idea in just a few years ago. Now, a few months after the 2018 conference, 100% renewable and zero carbon electricity by 2045 became the law of the land in California, echoing Hawaii's 100% Renewable Portfolio Standard created in 2015. On the heels of this landmark event came a similar law passed in the state of New Mexico and a commitment from the Governor of New York state to achieve 100% carbon neutral electricity by 2050. Similar initiatives are developing in other states across the country, for example, in Washington, Massachusetts, Minnesota, and Colorado. The momentum is clear, as are the opportunities for new industries, jobs, and roles for new leaders across all genders and socio-economic strata of society.

Looking ahead, the challenges will be to accelerate the rate at which investment, innovation, and inclusive engagement occur, expand the efforts to transition to renewable and zero carbon energy across all sectors, and tie these targets to other critical needs like deep greenhouse gas reduction, clean air, equitable distribution of benefits and opportunities, and conservation of natural resources. Only with faster progress can we hope to ensure survival and thriving of future generations in all socio-economic strata of society, and only with a holistic approach can we make sure that the solutions of today are smart and not the problems of tomorrow.



For conference videos, presentations, and program, please visit the event website at www.renewables100.org/en/pathways-2018/

For more information: pathways@renewables100.org

