

# 2013 Pathways to 100% Renewable Energy Conference Report

Renewables 100 Policy Institute

February 2014



Renewables100  
Policy Institute



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## **About this Report**

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**Available presentations from the conference can be viewed and downloaded here:**

**<https://www.dropbox.com/sh/n7z26gx3nrqhl2f/bG7U5g4yhG>**

**Selected videos can be viewed here:**

**<http://www.renewables100.org/index.php?id=198#c1223>**

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# Executive Summary

## Introduction

On April 16, 2013, Pathways to 100% Renewable Energy became the first international conference in the Americas to focus entirely on 100% renewable energy targets and solutions. The standing room only audience in San Francisco gathered from four continents and more than ten countries for a full day of presentations by nearly forty experts from multiple disciplines, including government, grid operations, industry, technology research and development, finance, economics, transportation, workforce training, academia and non-profit advocacy.

Several themes emerged during the course of the day. Those that stood out include the following:

Transitioning to 100% renewable energy worldwide by mid-century at the latest, while challenging, does not present an insurmountable technological or economic problem. Although improved means will come and should be welcome, successful policies, workforce training programs and other best practices have been developed by frontrunners, and setting and achieving 100% renewable energy targets has become increasingly common among governments and businesses.

The main true problem is building political and social will. This is particularly challenging in the face of ever increasing resistance by incumbent energy players who perceive renewable energy's rapidly growing success to be a threat and who aim to have a stake in the energy system over the next decades. The transition to renewable energy, however, is also an opportunity for established energy related industries, if they are willing to change and take advantage of new revenue streams.

There are several increasingly favorable conditions for reaching a 100% renewable future by mid-century, including the opposing mid-long term trends of falling renewable energy technologies prices and rising conventional energy costs, growing global investment in renewables, increasing numbers of clean energy related businesses and industries, the added economic value of renewable energy to communities and regions, and the numerous hazards posed by the conventional energy system, including local pollution and global climate change.

## Key Ideas and Recommendations

The conference agenda consisted of six panels, five keynote speakers, and a brief welcome and closing. Key ideas and recommendations from each are as follows.

### Welcome

#### **Angelina Galiteva and Diane Moss, Founders of Renewables 100 Policy Institute**

The conference organizers from the Renewables 100 Policy Institute opened the day with brief remarks.

### Key Ideas and Recommendations

- 100% renewable energy has come from the bleeding edge to mainstream, especially in the power sector.
- The transition to 100% renewable energy is not a technical or economic problem.
- There are a growing number of examples around the world from which best practices can be learned.
- Each and everyone of us is responsible and has a role to play in the transition to 100% renewable energy.

### Keynote Addresses

#### **Opening Keynote: Dr. Eric Martinot, Senior Research Director at the Institute for Sustainable Energy Policies – Overview of 2013 REN21 Renewables Global Futures Report**

The first keynote address was delivered by Dr. Eric Martinot, lead author of the *REN21 Global Futures Report*, a comprehensive synthesis of a broad range of existing analyses and forecasts about renewable energy from around the world.

### Key Ideas and Recommendations

- Our thinking about the future of renewable energy tends to be out of date and too conservative because so much has been



changing so fast. For example, we have already reached projections that not so long ago, the oil industry, US government, and International Energy Administration forecasted for mid-century.

- How to reach high penetrations of renewable energy is no longer a question of overcoming technological or economic issues, as much as a question of dealing with policy, finance, business models, market development, and other social issues.
- Currently, renewable energy makes up 17% of the global energy mix, with about half of that coming from modern technologies, and the other half from traditional means like dung and burned biomass. About 20% of the world's electricity is produced by renewable sources. But renewable energy is rapidly on the rise. In Europe, renewables accounted for 80% of added power capacity in 2012, indicating it is not just "mainstream" any longer, but "leading."
- More money has been invested in renewables in each of the past three years than in fossil fuel and nuclear power generation combined. The US and China lead the world in renewable energy investment.
- The costs of renewable energy has been falling dramatically, with solar PV, for example reaching \$1/watt, which was considered "the holy grail" price back in the 1980s.

### **Panel 2 Keynote: Stephen Berberich, President and CEO of the California Independent System Operator (CAISO)**

The second keynote address of the day, delivered by CAISO President and CEO Stephen Berberich, opened the second panel session on *Overcoming Technical barriers To Integrating 100% Renewable Energy Into the Grid*.

### **Key Ideas and Recommendations**

- Tectonic changes are underway in the electricity industry, and it will likely be unrecognizable in 2050, as large centralized power generation is largely replaced by decentralized renewable power generation.
- The most important force of change is economics, as the conventional utility sector costs rise and the costs to generate and

store one's own power with renewables comes down. Climate change is also a key factor.

- The California electricity system between now and 2050 is likely to transition over three phases: 1. Where we are now. 2. A phase of countervailing trends when electrified transportation creates new load, and at the same time, greater efficiency reduces load, and when greater amounts of renewables come online, including biofuels and biogases that can replace natural gas. 3. By 2050, decentralized renewable power generation will have become predominant, with the transportation system probably the largest electricity consumer.
- Critical issues to address will be maintaining reliability, prioritizing clean and flexible generation, cost containment, providing transparent and immediate pricing, coordinating regional energy systems, considering electric utility shareholders to avoid constant resistance of the changes ahead, remaining within voltage parameters.

## **Luncheon Keynotes**

### **Luncheon Keynote 1: Dr. Donald Aitken, Principal, Donald Aitken Associates**

Dr. Aitken focused his remarks on his work on creating a 100% renewable power, heating, and cooling scenario for Mexico. He moved to Mexico's Lake Chapala area in 2006, and by 2007, found himself applying his decades of experience in the sustainability field on helping the region transition to renewable energy.

#### **Key Ideas and Recommendations:**

- Mexico responded to harsh climate change impacts with a bipartisan bill in 2010 that mandates a 30% emissions reduction by 2020, a 50% reduction by 2050, and 35% renewable power by 2024.
- Mexico has a strong renewable resource base, including having the strongest wind potential in the world, the 3<sup>rd</sup> largest solar potential in the world, and large geothermal and hydropower resources.
- In Mexico, it is possible to get to 100% renewable power by overlaying intermittent resources like solar and wind with stable

resources like geothermal and hydropower, and complimenting this mix with storage. Or as a less preferred choice, they could get to nearly 100% renewable power by using natural gas as a backup instead of storage.

- The town of Gualala, where Dr. Aitken lives, is a living example of how the pathway to 100% renewable energy in Mexico could be to start small and local and scale up. In 2007, he built the first passive solar designed house in his town that uses solar technology for its power and heating needs. Since then his lectures and word of mouth have catalyzed more than 400 solar in the area to go solar for their energy needs.

### **Luncheon Keynote 2: Frances Moore Lappé, Author and Founder of the Small Planet Institute**

Drawing from her recent book *EcoMind: Changing the Way We Think, to Create the World We Want*, Frances Moore Lappé, acclaimed author and founder of the Small Planet Institute, addressed the essence of how humanity creates and solves existential problems and how our collective psychology will impede or accelerate the urgently needed transition to 100 percent renewable energy.

#### **Key Ideas and Recommendations**

- The biggest barrier to 100 percent renewable energy is likely in our minds.
- We tend to see the world through cultural “mental maps” and thus see only what we expect to see.
- Humanity is creating the crisis-ridden world we live in, not because most people actually *want* this, but because of the nature of the dominant mental map based on the assumption of scarcity.
- The “scarcity-mind” believes reality is made up of the three “S’s”: separateness of all entities; stasis as the nature of things; and scarcity itself -- that there is not enough of anything, from food to energy to human goodness.
- The scarcity-mind creates a spiral of powerlessness that prevents people from seeing the solutions that exist and from implementing them.

- Even the best-intended environmental messages focused on “hitting the limits” of finite resources can promote fear and reinforce the damaging scarcity-mind.
- We can move instead to an “eco-mind” emphasizing that our problem is not nature’s limits but that we’ve broken nature’s laws. Then, as we align with nature, fear eases for we realize there is enough for all, enough goods and enough goodness in human beings.
- The eco-mind perceives the nature of reality in three C’s: continuous change, connectedness, and co-creation. This mindset promotes a spiral of empowerment.
- The eco-mind sees that in an interconnected world, we each influence reality moment-to-moment, so the only choice we don’t have is whether to change the world: We are with every choice we make. The eco-mind sees that in a world of continuous change “it’s not possible to know what’s possible” so we are free to move toward the world we want, including the transition to 100 percent renewable energy.

### **Luncheon Keynote 3: Edwin Lee, Mayor of San Francisco**

The Mayor of the Hosting City of San Francisco, introduced by San Francisco Department of the Environment Director Melanie Nutter, concluded the luncheon program.

### **Key Ideas and Recommendations**

- Mayors need to be focused, as the conference is, not just on announcing 100% renewable energy goals, but on how to actually get them done. Discussions like the conference are important to reveal what really is working, and where risk and resources can be put to get the biggest benefit.
- The local work has a global impact. Countries like China are no longer solely focused on GDP and other economic indicators, but on quality of life and environmental stewardship, and they are looking to frontrunners like San Francisco and others at the conference for leadership. They need leadership not only in technology and renewable energy commitments, but also in open governance.

- Highlights of recent clean energy achievements in San Francisco, include the 27 story Kilroy building, which has met LEED Platinum standards that can set the sustainability bar for other downtown development. The Bay Bridge is lit with 25,000 lights that only cost the city \$15 a day, while providing an artistic attraction that brings visitors and revenue to the city.
- There are 1000 green collar San Francisco city workers, and city energy policies have created other jobs as well.
- The Mayor is looking forward to achieving the city's zero waste and 100% renewable power goals by 2020, which he says have the programs and "the will power through the government agencies, the Board of Supervisors and the Mayor."

## **Panels 1-5**

### **Panel 1: Financing and Policy Drivers Of Cost-Effective Renewable Energy Advancement**

The first panel session examined what financing and policy mechanisms are leading to the most robust and cost-effective implementation of renewable energy, the primary focus being on renewable electricity, as this is where the world has the most experience so far. It also takes a look from a policy and financing perspective at issues the renewable energy field must address to secure long-term success.

Financing and policy were placed in the same session because in successful energy programs, they are inextricably linked. If money is like a fluid that flows wherever there is a chance to make more, policy is like a pipe that directs the money where to go. The longer and stronger the pipe, the more money will flow in that direction over a greater period of time. The conventional energy system could not have grown to be the dominant market force it is, nor could it have enjoyed the ample financing it has had, without decades of favorable policy. Strong, long term financing and investment in renewable energy will similarly requires the "policy pipes" to attract financing to flow in their direction.

**Moderator:** Paul Gipe, renewable energy analyst and Founder of Wind-Works

**Panelists:** York University Associate Professor and Sustainable Energy Initiative (SEI) Co-Chair Dr. Jose Etcheverry | Renewables 100 Policy

Institute Founder Angelina Galiteva | Rabobank North America Vice President Marco Krapels | Lawrence Berkeley Laboratory Researcher Joachim Seel | German Federal Environment Agency (UBA) Director Dr. Harry Lehmann

### **Key Ideas and Recommendations:**

- Ontario, Canada has been progressing toward a fossil free power system, with a mandate to ban coal by 2014, a feed-in tariff law to support renewable power adoption, and a policy framework has resulted in uptake of wind and solar projects. However, Ontario still favors nuclear power, which threatens the transition to renewables, and is also expensive and hazardous.
- Germany's feed-in tariff law encouraged massive early adoption. With the solar insolation of Juno Alaska, the Germans have installed 30,000 MW of solar power, while Californians, who rely on the RPS, state subsidized rebates, and federal tax credits, recently celebrated only a couple thousand MW of solar as their big milestone.
- Italy also implemented a feed-in tariff similar to Germany's and installed 9000 MW in one year in 2011 vs. 1500 MW during that time frame in the US.
- California is on track to meet and surpass its 33% Renewable Portfolio Standard (RPS) by 2020.
- The US is trending in the wrong direction. In 1983, 15% of the US power mix was renewable, and in 2012, only 12.7% was. We need to figure out and fix the laws that are causing this.
- Effective policies have "TLC" – Transparency, Longevity, and Consistency. They must address the need for an attractive enough return on investment, mitigate risk, and address non-financial barriers, such as interconnection. Cap and trade and carbon tax tend to lack transparency and be overly complex, while a well-designed feed-in tariff law, has more of the attributes of an effective policy.
- To provide the economic framework for transitioning to 100% renewable power, advanced feed-in tariffs are needed that guarantee prices, access to grid, and a sufficient time frame of payment. The tariff can remunerate system services, not just the

kilowatt hours produced, and we should be thinking about opening the feed-in tariff to these variables. The feed-in tariff price should also decline over time.

- Advanced feed-in tariffs encourage local ownership and financial benefit. 40% of renewable electricity capacity in Germany – and over 50% of wind power - is owned by individuals, with low shares owned by investment funds, utilities, and industrial customers. In the US, where advanced feed-in tariffs have not been implemented for the most part, we see the opposite.
- Well designed feed-in tariffs also foster job growth. Germany has developed 380,000 jobs in the clean energy sector since the feed-in tariff law went into effect.
- Renewable power is trending toward decentralization, which supports grid stability and diverse, reliable, fossil free, inflation-proof fuel supply, with nearly the whole cost consisting of the up front investment.
- The time to set 100% renewable energy targets is now because planning and investment for energy assets happens decades in advance. 100% renewable targets must be accompanied by milestones and policies that make sense.
- Electric vehicles have a major role to play in the 100% renewable power future by providing grid storage and two-way communication with the grid. Renewable power can also make driving electric vehicles 15 cents cheaper per mile to drive.
- Spiking costs and unreliability of conventional power and cost effectiveness of solar are making solar and other renewables increasingly attractive. People also like the idea of becoming their own power company.
- US citizens have spent \$600 billion subsidizing fossil fuels over the last 60 years, and for this size investment, they should expect lower prices, and a clean, long term supply. Fossil fuels have not delivered. By contrast, a comparatively tiny amount of public funds have been put into clean renewables, and prices have plummeted. 100% renewable energy is inevitable because it will be cheaper.

- It is critical for politicians not to stop the relatively new support for renewable energy that is propelling new industries, especially given that fossil fuels have benefited from massive subsidies for so long.
- Renewable power is attracting investment from a wide cross section from farmers to large corporations.
- Investing in installing renewable power is a hedge against future conventional power rates.
- Abundant natural gas through fracking and cheap coal are not securing lower power bills. The only way to do this is to own your own power at a fixed cost over a long term.
- Renewable energy is a proven excellent investment for Rabobank, with zero defaults on billions of dollars in financing over the past 5 years.
- Currently only 14 out of 12,000 banks have renewable energy financing departments, but this is bound to change. When it does, new sources of capital will be needed. Crowdfunding is one example of a promising innovative mechanism.
- Installed costs of residential solar PV systems in Germany are dramatically lower in Germany than in the US. "Soft costs" – that is, non-hardware costs are the reason for the difference. Also the US has a patchwork of regulations and policies that differ state by state, rather than a comprehensive national policy.
- Financing PV systems in Germany is easier than in the US, so Germans typically own their solar systems instead of leasing them like people in the US often do.
- Germany's nuclear shut down mandate, which began in 2002, has recently resulted in the shut down of 9 nuclear power plants. Despite the phase out of nuclear power and the grid attaining 22% renewable electricity in 2012, Germany remains a power exporter, and the grid remains stable.
- The German Federal Environment Agency (UBA) has been studying how Germany can reach 100% renewable power by 2050, with the surprising finding that the nation can generate 100% of its electricity using renewable resources within its own borders. This includes factoring in the avoidance of sensitive areas, like conservation land



and tourist landmarks. UBA concluded in this study that a regional approach is preferable to an entirely local system approach, which would be too narrow to easily cover the needs of cities, or to an international approach, which would entail expensive transmission lines and other complexity.

- To reach 100% renewable electricity in Germany, storage and demand side management are needed overcome intermittency. Some problems with the German grid will arise, due to issues around the reunification of East and West Germany and the need to make up for power in concentrated areas where nuclear power plants are being shut. These problems are solvable.
- The real bottlenecks of the future are land area due to increasing global population and the limited resources (copper, etc.) needed to build up the new energy structure. We have enough, but that does not mean we don't have to be more efficient, better at recycling, etc.
- Research and Development must be part of policy to achieve 100% renewable energy targets.
- Sharing information, training the workforce, and capacity building are critical to reaching 100% renewable energy goals.

## **Panel 2: Overcoming Technical Barriers to 100% Renewable Energy in the Power Sector**

The second panel aimed to address technical concerns about transitioning to 100% renewable power and to present technological solutions at the forefront of ensuring that such transitions are possible in regions throughout the world.

Moderator: Renewables 100 Policy Institute Founder and CAISO Governor Angelina Galiteva.

Panelists: International Solar Energy Society (ISES) President Dr. David Renne | University of Leuphana Professor Dr. Alexa Lutzenberger | Comverge Vice President Frank Lacey | California Energy Storage Alliance (CESA) | Executive Director Janice Lin, Navigant Principal Research Analyst Peter Asmus | Stanford University Professor of Civil and Environmental Engineering and Director of the Atmosphere/Energy Program Dr. Mark Jacobson | German Federal Environment Agency (UBA) Director Dr. Harry Lehmann

## **Key Ideas and Recommendations:**

- The word “barriers” in the panel title would be more aptly called “challenges.” With all challenges, there are opportunities.
- Many available roadmaps already show how to get to a significant penetration of renewable energy - up to 100% - to achieve critical greenhouse gas reductions. All conclude there may be different approaches, but there are no real technical issues in getting to 100% renewable power.
- Projections for future renewable energy penetrations are already looking conservative because expanded markets have all been triggered by a chain of events - such as increased investment, stable and scalable manufacturing, and proactive policies - that all give positive feedback to each other.
- Challenges include properly managing the variable generation by some renewable power technologies like PV with proper tools like solar and wind forecasting; taking action at local levels; implementing sensible urban planning and building design; integrating transportation strategies; understanding and managing consumption patterns; and increasing energy efficiency. Other challenges include the low price of natural gas (although this could be transitory); limited resources for commercializing emerging technologies; and empowerment across genders and socio-economic strata.
- The critical question is not whether 100% renewable power is technically feasible, but whether there will be the socio-political will. People don't like to be told by the government what to do. The 100% renewable power movement could take a cue from the internet, which was a good example of something that was not imposed on people, but adopted by people when they saw the value.
- Biogas presents the most varied opportunities for energy solutions of all renewables, including heat, CHP, injection into the natural gas distribution grid, and energy storage. More than 8000 biogas plants have been installed in Germany.
- While it is important not to use cropland for biogas, a massive opportunity remains to make biogas out of organic waste. Diverting

organic waste from landfills can help prevent pollution and create energy. We need to focus on infrastructure to separate and collect the waste, so that it is usable, then conditioning it to be made into a variety of useful products, including electricity, heat, biomethane, bioethanol, biodiesel, and humus.

- In the new power system, the different energy sectors will connect in new ways. For example, 32 million PEVs are expected to be on German roads by 2030-40. Also overproduction of renewable power may be used to make hydrogen and methane that is distributed in existing natural gas pipelines, which would allow electricity, along with other sectors like heating and transportation, to more easily become renewable resource based.
- The automobile industry is supportive of emerging solutions like “power to gas” (aka “solar methane”) because it does not want to keep having to change and is seeking long term planning.
- Airplanes may be able to use liquid fuels by similarly converting renewable power to gas.
- Another available technology solution that can help to provide backup to intermittent renewable sources like wind and help to stabilize the grid is demand response (DR). DR currently serves tens of thousands of commercial and industrial customers controls more than a million devices. PJM on the east coast of the US has a capacity market where DR is currently being used.
- Energy storage technologies are a broad asset class that can play a part in a 100% renewable power mix by storing excess renewable generation for use at a time when it is needed, as well as by providing back up to intermittent renewable power sources. Whereas traditionally, fossil peak generators have been ramped up and down to help manage fluctuating load and supply, storage can do this without pollution and more cost effectively.
- There are more than 200 GW of storage projects in place currently, with more than half being pumped hydro, and the grid storage industry is gaining steam.
- A challenge to advancing storage solutions is that our power system was built on the premise that energy can't be stored, so it is hard for storage developers to capture the full value and revenue streams. Regulatory solutions are required to change this. California has

taken an important step. Governor Jerry Brown signed the first legislation in the state exclusively focused on energy storage - AB 2514 – which requires the California Public Utilities Commission to open a storage proceeding.

- It is a mistake to assume storage is expensive. More research into the cost effectiveness frameworks needs to happen. Recent analysis suggests that battery storage is actually more cost effective than a natural gas peaker plant of the same size because it has a more flexible range and can charge and discharge its full capacity.
- Two more technologies that can play key roles in 100% renewable power systems are microgrids and virtual power plants (VPPs) that allow microgrids, DR, storage, and renewable generation to work together. These technologies may overlap in the future.
- Microgrids are smart networks capable of optimizing and aggregating diverse distributed generation resources, and disconnecting from the larger grid, which is of interest in the wake of major storms. Along with use in developed regions, microgrids can be deployed in developing regions where weak or no grids exist and to reduce or eliminate expensive power resource imports like diesel fuel.
- The Canary island of El Hierro has achieved a 100% renewable power system with a combination of pumped storage, wind turbines, distributed PV, solar thermal, and a microgrid that controls got all those technologies to work together.
- A VPP can be defined as a “system that relies upon software systems to remotely and automatically dispatch and optimize generation, demand side or storage resources, including plug-in hybrid vehicles and bi-directional inverters in a single, web connected system.”
- In Germany, a Regenerative Combined Power Plant has aggregated 36 MW of wind, solar, biogas and hydro generation scattered around the country to supply power to the equivalent of 12,000 households (23 MW) and has proven that theoretically Germany could run on 100% renewable power.
- Denmark will need to use VPPs and microgrids to attain its mandated goal of 100% renewable energy overall by 2050.

- In the 100% renewable power system, different sectors will connect in new ways. For example, a sizeable amount of the transportation sector will run on electricity.
- University of Stanford Professor Dr. Mark Z. Jacobson and his colleagues found that if all energy consumption is converted to electricity and electrolytic hydrogen, the power demand goes down about 32% worldwide due to the efficiency of electricity vs. internal combustion. Dr. Jacobson and his team also found that a global 100% renewable energy system could require only .6 % of world's land, could be achieved with existing technologies, and that there are no material limits to achieve this scenario, but recycling may be needed. Similar scenarios have been created on the state level for California and New York.
- Going 100% renewable would eliminate 2.5-3 million mortalities a year. The state of New York would save 32 billion dollars in health and other externality costs a year, a total of 3% of the state's GDP. California would likewise save 7% of state GDP by preventing health damage from conventional energy use.

### **Panel 3: Integrating 100% Renewable Energy Into the Transportation Sector**

Often discussions about renewable energy begin and end with the building sector, but transportation must be included if we are to have a true 100% renewable energy future. The third panel of the conference aimed to present solutions in the exciting, cutting edge field of fossil-free mobility, as well as some of the issues that must be overcome to fully integrate the transportation sector into an all renewable energy system.

**Moderator:** Senior Advisor to California Governor Jerry Brown, Cliff Rechtschaffen

**Panelists:** CEO of KnGrid Steve Davis | CEO of EVGrid Tom Gage | Business Development and Sales Manager at DriveNow Peter Dempster | University of Leuphana Professor Dr. Alexa Lutzenberger | CEO of Origin Oil Riggs Eckelberry

### **Key Ideas and Recommendations:**

- The Vehicle to Grid (V2G) model for plug-in electric vehicles (PEVs) has become a success story over the last 16 years. V2G began with a paper by Professor William Kempton of the University of Delaware,

who later teamed up with AC Propulsion, which developed an electric drive system with a bi-directional charger.

- Early estimates of how much V2G charging could earn monthly as an ancillary service totaled approximately \$300.
- By 2007, the first operational V2G system was operating, and the following year, pilot projects with BMW and EV2G (a joint project by University of Delaware and NRG) were in progress.
- By 2013, V2G had achieved proof of concept, with about 300 kilowatts of ancillary services operating in PJM territory.
- Despite technological advances, Original Equipment Manufacturers (OEMs) are, still unwilling to support Vehicle to Grid technology (V2G) because the regulatory frameworks to support a V2G market are still largely absent.
- Enabling direct access tariffs by the PEV service providers downstream of the utilities meter and giving vehicle owners access to the wholesale access tariff is the only way to enable dynamic pricing, intelligent dispatch, and scenarios in which PEV owners enter the wholesale market.
- KnGrid entered into exclusive license agreement with RWE, a major German utility, which developed a bidirectional communications protocol with Mercedes Benz that has been installed in 5000 charging stations in Germany. This software will be part of a demonstration project at UC San Diego, as well as installed in Mercedes Smart ED 3 and the BMW i3. The revenue for PEV owners with this system is in ancillary services and is estimated to be \$300-500 month depending on what part of the country they are in.
- Manufacturing PEVs can produce up to 30% more greenhouse gas emissions than conventional vehicles, but making them with renewable power can erase that emissions increase.
- Markets for PEVs and renewable energy can go well together, as evidenced by the popularity of purchasing home solar among BMW customers.
- With 80% capacity left in PEV batteries after 10 years, battery 2<sup>nd</sup> life is area of research that holds considerable potential.

- In one experiment, BMW found that a system it installed combining battery storage, solar, a multi port inverter, and a smart meter, which allowed the battery to discharge in response to building load needs, could produce substantial energy savings.
- 2<sup>nd</sup> life batteries can also be used to back up the grid and act as a micro-island with solar panels, in the event the grid goes down.
- BMW is additionally looking into integrating low cost, 2<sup>nd</sup> life batteries with large scale solar and wind, with demonstration projects around the world.
- In planning for 2050, we cannot separate transportation from other energy sectors, nor can we separate the discussion of 100% renewable energy from resource efficiency.
- There is also not just one mobility solution. While electric vehicles are great solution for cities and car sharing, they are limited for mid-range and long-range driving, and there are not enough raw materials to build enough of them for global use. Biofuels, on the other hand, are good for maritime transportation, while pure plant oil can be used for agricultural or fishing applications because it is non-toxic if leaked. . Methane produced from excess renewable power is another massive opportunity that can be efficiently applied to power, heating/cooling, industrial, and transportation sectors – and can take advantage of the existing natural gas grid.
- California is home to 318,000 clean tech jobs, but this number could be much higher if the state better supported other aspects of the sector beside research and development. Along these lines, California ought to nurture the entire algae industry or continue to risk losing jobs to other locations.
- To remove “apathy of adoption,” all barriers must be taken away to using algae (or any energy source) – i.e. It must become plug and play like gasoline is today.
- To support clean, alternative fuel development, the EPA ought to track lifecycle emissions instead of tailpipe emissions.
- Algae has vast and varied market potential other than clean fuel, including nutritional, pharmaceutical, feed, and fertilizer applications.

- Low production costs are key to algae reaching its market and job creating potential; \$66/barrel production costs are competitive and feasible.
- Algae has numerous environmental and technological advantages over fossil fuels throughout its lifecycle and would fit into a Low Carbon Fuel Standard.

#### **Panel 4: Zero Net Energy Buildings – Samples and Best Practices from Around the World**

In a 100% renewable energy system, buildings are no longer just energy consumers, but wherever feasible, also energy producers. This panel focused on examples and pathways for creating Zero Net Energy (ZNE) buildings that minimize their energy use with efficiency and balance their energy use with renewable energy generation.

**Moderator:** California Energy Commissioner Andrew McAllister, oversees the state's ZNE policy implementation.

**Panelists:** Senior Advisor Climate Innovation at World Wildlife Fund (WWF) International Stefan Henningsson | Creator of Green Idea House Robert Fortunato | Training Director at Zero Net Energy Center Alameda County Byron Benton | President of the Solar Energy Business Association of New England Tom Thompson | Assistant Business Manager Southern California Pipe Trades, DC No. 16 Mike Layton | CEO of Origin Oil Rigs Eckelberry

#### **Key Ideas and Recommendations**

- California's policy is to aim for all new residential construction to be ZNE by 2020 and all new commercial construction to be ZNE by 2030.
- ZNE is a balance of energy efficiency and renewable energy.
- A major challenge is to adopt a definition of ZNE that can be put into building code, which California aims to do in its 2013 Integrated Energy Policy Report (IEPR).
- Buildings are part of the 100% renewable energy transition in all sectors. We could potentially save 25% of global energy use just in the building sector, which is about the equivalent amount of energy used by the transportation sector. Buildings account for about 38% of global energy use, which must be greatly reduced by 2050.



- The main issue is not availability of technologies, but getting them adopted at scale.
- In 2011, WWF released a report laying how to achieve 100% renewable energy globally by 2050. WWF's headquarters in the Netherlands and Washington D.C. are case studies of ZNE building.
- The Zero Net Energy (ZNE) Center in Alameda, California is a training facility for electrical workers that practices what it preaches on sustainability by producing as much energy as it consumes. The ZNE Center was designed to use 75% less energy than a comparable commercial building, so that it is able to supply all the electricity needs for the building with less than 140 kw of solar and wind power. Construction costs were about the same as a comparable traditional construction project.
- With the support of national regulations in France, Origin Oil has pursued a joint venture to grow algae in tubes on the roof of La Défense in Nanterre, which is harvested with the Origin system, as well as to sanitize the building's wastewater with the Origin algae system. The project has been particularly lucrative and is part of an emerging group of experiments in "urban algae."
- The Green Idea House in Hermosa Beach, California shows that an average, two story California single family home can be retrofit go be ZNE, zero carbon, and non-toxic at less cost than conventional construction. The Green Idea House generated 3 MWh more energy with 6.5 kilowatts of rooftop solar than the occupants use. High efficiency construction and appliances cut the energy load by over 70% compared to the old house, despite adding 800 new square feet and "all with simple stuff that costs less money."
- Keep it simple when defining ZNE for the general public: Harvest as much energy with renewables as the building occupants use on an annual basis.
- The keys to reducing ZNE retrofit costs are: use less embodied energy, create less waste, do it with less toxicity, repurpose items that would have gone into landfill in the construction process, and use no and low cost tools like Google Sketch Up to design features like overhangs that reduce heating and cooling needs.

- ZNE is nothing new – it has been around for decades – but in the Northeast US, there is more interest since Hurricane Sandy. Rooftop solar combined with battery storage can ensure secure power during times like Hurricane Sandy. During the hurricane, while the region suffered widespread electricity outages, one school with a such a powered the school and provided emergency shelter for 80 people for four days.
- ZNE is a pathway to new jobs. This has potential for union support, as 65-70% of credits that qualify for LEED standards in the US are installed by UA union craftsmen.
- The most effective policy mechanism to generate more jobs on the onsite renewable energy front has proven to be the well designed feed-in tariff, such as the one deployed in Germany, which has long led the world in solar installations. Unfortunately in the US, this policy has been demonized on false pretenses of threatening grid stability and raising energy prices.
- ZNE buildings should meet a “triple bottom line” of reduced environmental impact with peak efficiency; improved capitalization rates, which increases marketability and allows attractive lease rates; and higher productivity and reduced absenteeism among commercial building occupants.
- Three main actions are needed: to set local, state and federal regulations and standards for high performance buildings, to build a train workforce to build them, and to educate customers about the energy efficiency, safety concerns, and complexity of these new building systems.
- Training in high performance buildings must cover a wide range of subject matter, including energy, plumbing, heating and cooling. To help further education about ZNE building, mobile training centers could be brought to conferences to teach about technologies like solar thermal and water usages.
- Big business leaders must continue to call for much stricter building standards from the policy side.
- We need to clear up misperception in the construction industry that it costs 20-25% more to construct a Zero Net Energy house. The reality is not so, but the misperception makes policymakers hesitant.

- There is a moral call for developed countries to show the way, in order to prevent millions in developing countries from moving into the cities, where there is all too often an emphasis on inefficient, cheap pre-fabricated buildings.
- We must be sure to not be too specialized in training, so that we create a well rounded skilled workforce, as it is imperative that we get renewable energy and energy efficiency systems that work well.
- Create a system that says if one creates a building that performs well, one will get a bonus. Currently, the money for builders in places like the US is in the waste, not in the performance. Architects and contractors are generally paid by the square foot, so that bigger buildings are more lucrative. Buildings must work at the utility bill level, and policy and regulatory systems must support that.
- A well designed feed-in tariff has proven to be the most robust job creating policy in the renewable electricity business, and these should be implemented in the US to promote job growth.

### **Panel 5: Local Communities and Regions Shifting to 100% and Beyond**

The final panel of the day showcased how specific cities and regions are setting and achieving 100% renewable energy targets, and also presented ideas from experts who have been at the forefront of following the 100% renewable energy movement in Europe. The group offered a glimpse of what hundreds of communities around the world are doing to move to a carbon and plutonium free energy system and the challenges and benefits involved. The panel included representatives and elected leaders from five cities or counties that have made commitments to 100% renewable energy. Three of these leaders were from conservative political parties, while the others were from renowned progressive cities, but the emphasis was firmly on the need for renewable energy to not be politicized. The call was clearly to rise above politics because shifting to efficiently used renewable energy simply makes sense to boost local economies and protect current and future generations.

**Moderator:** Donald Aitken Associates Principal Dr. Don Aitken

**Panelists:** District of Rhein-Hunsrueck Head Bertram Fleck | Greensburg, Kansas Mayor Bob Dixon | Lancaster, California Mayor Rex Parris, Vice Mayor of Mill Valley, California and Founder of LEAN Shawn Marshall, Renewable Energy Program Manager for the City of San Francisco

Department of Environment Danielle Murray | DeENet Manager of Renewable Energies and Regional Climate Protection at deENet and 100ee Dr. Peter Moser | World Future Council Climate and Energy Director Stefan Schurig

### **Key Ideas and Recommendations:**

- The rural District of Rhein-Hunsrueck Germany has transformed from an energy importer to an energy exporter in less than two decades.
- Such a transformation requires leadership that rises above ideologies and gets the job done to set an example, rather dwelling on all the reasons that renewables are difficult.
- Local governments play a critical role in the energy transition. While the federal sets laws and regulations, local governments must convince the local people to adopt them and must carry them out successfully.
- Economics was a main driver behind Rhein-Hunsrueck's decision to adopt a 100% renewable energy plan. The district wanted to stop spending millions on fuel imports and build up its minimal industrial economy.
- By 2013, Rhein-Hunsrueck was home to 14 biomass plants, 3000 solar PV systems, and 149 wind turbines that covered 104% of electricity demand, and these figures are expected to rise in 2014. By 2015, the district will have nearly 300% electricity generated by renewables, with the ability to export 200%. By mid-century at the latest, Rhein-Hunsrueck plans on eliminating fossil fuels entirely from all its energy consumption, including heat and transportation, by saving energy and increasing use of renewables.
- The investment in the transition to renewable energy in Rhein-Hunsrueck by the private sector, including local citizens, has so far totaled nearly \$700 million. With its energy transition, the district had by 2009 already avoided 269,000 tons of CO<sub>2</sub> emissions through renewable electricity, heat and biofuels and \$15.7 million in import costs for coal, natural gas and mineral oil. The net annual monetary gains for Rhein-Hunsrueck equal approximately \$29 million, making it their most financially successful program to date.

- Local governments should begin with building efficiency and conservation improvements to avoid overspending on renewable energy technologies, and it should start with public buildings to set an example.
- Local governments should also create solid plans for transitioning to 100% renewable energy to avoid making future mistakes.
- It is also critical to provide community education tools about renewable energy, including for children.
- The City of Greensburg, KS made a decision to put sustainability at the center of its recovery from a devastating tornado in 2007.
- More conservative members of the Greensburg, KS community were able to embrace the concept of "going green" by recognizing the connections to ancestral wisdom and ways. For example, renewable energy and efficiency concepts like wind mills, geothermal heating and cooling, and passive solar design have a heritage that is centuries old, even if the technologies have modernized.
- Greensburg, KS requires all municipal buildings to meet a LEED Platinum standard and other buildings in the town are similarly efficient.
- Renewable power and heat technologies used in Greensburg, KS include solar panels, wind turbines, and geothermal wells.
- With the addition of a 12.5 MW wind farm financed by the local John Deere dealership, Greensburg, KS has more renewable power than it can use and has become a power exporter to neighboring communities.
- At the core of sustainability is community and how people treat one another.
- Communities need to include, along with crisis management, visionary management, in order to not just survive, but thrive.
- Concrete action is critical to give people hope. Vision without action is merely a dream. Action without vision is just passing time.

- The City of Lancaster, California has committed to achieving net zero power – that is, generating as much power as consumes, all with efficiently installed renewables - by 2020. The main motivator of the city's decision is addressing the climate crisis.
- Lancaster benefits from being one of the sunniest places on earth, but it has become a front runner in the US on installed solar capacity primarily because it set a goal to become net zero energy.
- Another key to Lancaster's success has been to proactively reach out to and support clean energy businesses and partnerships. For example, the Mayor helped forge a partnership with Chinese battery maker BYD and KB Homes to build a series of net zero and plus energy homes in Lancaster.
- Lancaster city staff looks for reasons to say "yes" to renewable energy projects, instead of "no," streamlining permitting and eliminating fees where possible.
- A packet of guidelines and ordinances ought to be created and sent to Mayors around the country to encourage the broader adoption of net zero energy/100% renewable energy goals and plans.
- Community Choice Aggregation (CCA) is one mechanism that allows local governments and districts in the US to aggregate the power load of residents and businesses use in order to procure power for its citizens at better prices on the wholesale market. Ideally, CCA is a pathway to realizing decentralized energy and renewable energy development.
- Today, 80% of homes and businesses in Marin County are served by CCA, which allows customers to get twice the renewable power as they would from the local investor owned utility, PG&E, and opt up for \$4/month to 100% green power. While not perfect, this CCA is the cleanest in the country. Marin County has a goal to reach 100% renewable power community wide with the help of its CCA by 2020.
- Despite these programs, the California CCA market is slow due primarily to a monopolized investor-owned utility market, plus costs and regulatory issues.

- In the deregulated power market of Illinois, 80% of the state is served by CCA contracts. Most of these are unfortunately fossil fuel contracts, but there is some progress toward renewables.
- LEAN was created to push cities to adopt CCA programs that integrate renewable energy, efficiency, and good policies like feed-in tariffs.
- In 2010, the city of San Francisco committed to achieving 100% renewable power by 2020. In 2011, a Renewable Energy Task Force was created to make recommendations for how to achieve this goal, which released a report with six strategies to pursue. Broadly, these were to increase efficiency, encourage local renewable energy adoption, include renters in the energy transition, provide 100% renewable power purchasing options, promote private investment, and improve local renewable energy access.
- Since 2008, the City of San Francisco has created numerous ordinances and programs to promote climate protection and clean energy. With current policies, San Francisco is on track to achieve 50% greenhouse gas reduction below 1990 levels by 2050. To reach its goal of 80% reductions by 2050, significant work remains to be done, especially cleaning up the transportation sector, which emits 45% of the city's greenhouse gases.
- While it may have a ways to go, San Francisco has made many strides in the energy sector, including soaring from only 5 solar PV systems in the year 2000 to 3640 in January 2013.
- DeENet is a Germany regional development initiative, focusing on the whole energy supply chain as it applies to renewable energy and efficiency. Its government funded Institute IdE researches and supports 100% renewable energy regions in Germany, and also cooperates with 9 countries. So far, they have mapped 136 regions Germany that either have made significant strides toward achieving 100% renewable energy in at least one sector or that have at least set a goal to. These cover 29% of Germany's territory – mostly in rural areas where renewable energy is easier to implement – and 26% of the population.
- The main reasons found for why regions choose to transition to 100% renewable energy in Germany are not energy independence or a “green” image, but instead money and the added regional value created.

- Factors contributing to success in achieving 100% renewable energy targets in regions include engaged leaders, a strong point person, community acceptance, local ownership, sustainable energy use, and competent planning and management.
- The 3 phases of developing 100% renewable energy regions appear to be: the first movers, the models who create best practices, and finally, the rural and urban communities that cooperate to create regional 100% renewable energy systems.
- The power of crowds is a main driver of the 100% renewable transition. Crowds are becoming energy producers, and crowds are rejecting the perils of nuclear and fossil fuels. Parallel to the communications sector, prosumers are disrupting monopolies.
- Another driver of the 100% renewable transition is the power of pioneers. Like the digital revolution, the energy revolution is not being led by the mainstream, but by pioneering newcomers.
- A third influence on the 100% renewable transition is the power of free stuff. As information wants to be free in the new telecommunications world, so does energy. In the old system, fuels cost money and make profit margins for corporations. In the new system, renewable energy fuels are free for the people.
- The global 100% renewable energy transition will require promotion and education. New media outlets can harness these three powers described above to better spread the word.
- Information and communication have been democratized in the past quarter century, but while energy is heading in this direction, it is still lagging. Everyone in Africa has a cell phone, but in rural communities, they still might walk a half a day to charge them.
- The main hindrance to moving faster in the energy sector is the political will.
- While Germany made strides by slipping feed-in tariff legislation through and strengthening it into highly effective policy, the more successful renewable energy becomes, the stronger the incumbents PR push becomes against it. We must not make the mistake of thinking that the road ahead will be easy.



- 100% renewable energy is the way of the future, no matter how uphill the battle.

### **Closing Program Highlights**

- The Renewables 100 Policy Institute team started the closing session by encouraging everyone to help build the will so clearly needed by supporting the first worldwide movement to Go 100% Renewable Energy launched in 2010 by the Institute on [www.go100percent.org](http://www.go100percent.org).
- Dr. Tanay Uyar, President of Eurosolar Turkey and Head of the Marmara University Faculty of Engineering Energy Section, reminded the audience that we must not forget that achieving 100% renewable energy is a detail in the larger context of our vast and long shared living space heated and lit by the sun.
- Adarsha Shivakumar, Head of the Youth Advisory Board at Alliance for Climate Education (ACE), closed the conference with a call to action from youth across America. He and his team reminded the audience that children across the globe are depending on the adults with expertise and decision making power to make the transition to 100% renewable energy happen, in order to solve the planetary crises facing us all. "The price we pay for the privilege we have (in the developed world) is the duty to use that privilege for the good of others. My freedoms don't end where your nose begins. My freedoms end where my responsibilities begin," declared Shivakumar. "While we may disagree on how we get there, most of us share the same goal of a better future, and it is this unity that we must remember as we try to make a better world for all. "

# **Pathways to 100% Renewable Energy Conference**

## **Summary of Presentations**

The following is an overview of key ideas and recommendations offered by each conference speaker, along with a detailed summary of each presentation.

### **Welcome – Angelina Galiteva and Diane Moss, Founders of the Renewables 100 Policy Institute**

#### Key Ideas:

- 100% renewable energy has come from the bleeding edge to mainstream, especially in the power sector.
- The transition to 100% renewable energy is not a technical or economic problem.
- There are a growing number of examples around the world from which best practices can be learned.
- Each and everyone of us is responsible and has a role to play in the transition to 100% renewable energy.

#### Summary:

The inaugural Pathways to 100% Renewable Energy conference opened with welcoming remarks by the Renewables 100 Policy Institute Founders Angelina Galiteva and Diane Moss. Galiteva recounted how 100% renewable energy was a concept far out on the bleeding edge, when the Institute was founded in 2007, but that it is now becoming mainstream in the power sector, and increasingly so for heating, cooling and transportation.

She asserted that research and experience reveals that the transition to 100% renewable energy is not a technical or economic problem and that there is a growing list of examples, including cities, regions, countries, and businesses, who are setting and achieving 100% renewable energy goals.

Galiteva dedicated the conference in memory of long time friend and intellectual founding father of the Renewables 100 Policy Institute, Dr. Hermann Scheer, who was a long time German Parliamentarian, lead architect of Germany's renewable energy policies, renowned pioneer and advocate for renewables, and who passed away in 2010. One of his favorite stories set the tone for the day:

### The Story of: Everybody, Anybody, Nobody and Somebody

There was an important job to be done, and Everybody was sure that Somebody would do it.

Anybody could have done it, but Nobody did it.

Somebody got angry about that because it was Everybody's job.

Everybody thought Anybody could do it, but Nobody realized that Everybody would not do it.

It ended up that Everybody blamed Somebody

when Nobody did what Anybody could do.

Moss, after thanking the event's sponsors, introduced the first keynote speaker, Dr. Eric Martinot, author of *REN21 Renewables Global Futures Report* and Senior Research Director at the Institute for Sustainable Energy Policies.

### **Dr. Eric Martinot – Overview of 2013 REN21 Renewables Global Futures Report**

#### Key Ideas and Recommendations:

- Our thinking about the future of renewable energy tends to be out of date and too conservative because so much has been changing so fast. For example, we have already reached projections that not so long ago, the oil industry, US government, and International Energy Administration forecasted for mid-century.
- How to reach high penetrations of renewable energy is no longer a question of overcoming technological or economic issues, as much as a question of dealing with policy, finance, business models, market development, and other social issues.
- Currently, renewable energy makes up 17% of the global energy mix, with about half of that coming from modern technologies, and the other half from traditional means like dung and burned biomass. About 20% of the world's electricity is produced by renewable sources. But renewable energy is rapidly on the rise. In Europe, renewables accounted for 80% of added power capacity in 2012, indicating it is not just "mainstream" any longer, but "leading."

- More money has been invested in renewables in each of the past three years than in fossil-fuel and nuclear power generation combined. The US and China lead the world in renewable energy investment.
- The costs of renewable energy has been falling dramatically, with solar PV, for example reaching \$1/watt, which was considered “the holy grail” price back in the 1980s.

The [REN21 Renewables Global Futures Report](#)<sup>1</sup> looks into the future of renewable energy by drawing from interviews with more than 170 leading experts from around the world and from the projections of 50 recently published energy scenarios. Packed into the report’s main 40 pages is a distillation of these 5000 pages of scenarios and 1000 pages of interview notes.

One key message from the report is that how we think about renewable energy tends to be 5-20 years out of date when it comes to understanding what the future of renewables looks like. Another is that it is that renewable energy advancement is no longer a question of technology or economics, but of policy, finance, business models, market development, and other social issues. Until now, policies have mostly been directed at reducing high costs, but that will change.

### *Current Status*

Currently, 17% share of the world’s total energy supply comes from renewable energy. Out of that, about half is from modern technologies and half from traditional means like dung and burning biomass.

20% of the world’s power is generated by renewable sources. 15% is from hydro, with other 5% growing quickly.

Notably, the renewable energy makes up a higher percentage than nuclear power in the global electricity mix.

Wind power has been growing by 25 – 30% per year, reaching a total of 280 GW of global capacity by the end of 2012. Remarkably, China has become the global leader in wind, despite starting at practically zero in

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<sup>1</sup> Download the report here:

<http://www.ren21.net/REN21Activities/GlobalFuturesReport.aspx>

2005. The country saw wind as a strategic technology, wanted to become an industrial leader, and has clearly succeeded.

Solar PV been growing by 50-60% annually for the past 7-8 years and is the fastest growing energy technology in the world. Total capacity of PV reached 100 GW at end of 2012, with Germany, Italy, Spain, the United States, and Japan being the frontrunners.

In the past three years, more money has been invested annually in renewable energy than in fossil and nuclear energy combined. The US and China have become the investment leaders.

80% of added power capacity in Europe in 2012 was renewable. Such numbers show renewable electricity is not just “mainstream” now; it is “leading.”

Regarding policy, there were 50 countries with policies to support renewable energy in 2005, and now there are over 120 countries, the majority of which are now developing countries. There are likewise 120 countries with some type of target for future shares of renewable energy.

#### *Looking to the Future*

When determining how much renewable energy to anticipate in the future, Dr. Martinot pointed out that historically, projections tend to fall short. One takeaway looking at the trends is that conservative scenarios, which have projected only a 15%-20% share renewable energy by mid-century and have been put forth by oil companies, the US Department of Energy (DOE), and the International Energy Administration (IEA), are no longer credible. Shares in the 30-50% range have attained a much higher level of credibility than even a few years ago. The real question to be looking at today is: Can we go above 50% by mid-century?

There are now projections of up to a 65% share of renewable power in the EU by 2030.

Likewise in the US, there are many projections of large increases of renewable power.

However, heating and transport sector scenarios are a different story, due to factors such as uncertainty technologically and a need for changes in building codes, materials, etc.

Many say that annual global investment in renewable energy will double by sometime between 2020-2035. However, new sources of finance will be

needed. Most financing until now has come from bank lending and utility balance sheet financing. Going forward, new sources of finance will emerge, such as pension funds, insurance funds, sovereign wealth funds, potential investments by oil companies, and increasingly popular community funds. We will need to overcome the lack of understanding of the low risk of renewable energy compared to most conventional technologies. A variety of new business models also will need to be developed.

To achieve high shares of renewables, the main challenge is the integration of renewable sources into the power, industry, building and transport sectors. There are many options for integrating renewable power into the grid and managing variability. When Dr. Martinot started researching the future of renewables, he thought we absolutely needed energy storage, which is a common perception. In Japan, for example, many perceive renewable electricity to be expensive because it is assumed it must be installed with storage. Likewise, oil companies say that storage technology breakthroughs are needed for high penetrations of renewables. The reality, however, is that storage can be only a modest part of the solution.

Other balancing options are more significant parts of the solution. Demand response, for example, along with several other options, is already being employed by utilities around the world. Denmark, Germany, and the U.S., said Dr. Martinot, are leaders in these solutions.

To integrate renewable energy into the transport system, electric vehicles and advanced biofuels are the major pathways. There will need to be a variety of vehicle types and ownership for different uses and a transition away from the model of “one vehicle size fits all” to a much larger array of vehicle types and mobility services.

Regarding integrating renewable energy into buildings, the technology for heating and cooling exists. For example, solar thermal for cooling is viable economically, particularly when installed during construction. A key here is to implement passive/low energy construction so that buildings don’t need much heating or cooling energy to begin with.

Many different kinds of companies have a role in the renewable energy future, such as oil, automobiles, utilities, and IT.

Cities are already engaged on the local level, with hundreds having policies to support renewable energy. Many have 100% renewable targets, low energy building codes, and renewable transport targets.

Another phenomenal trend has been the cost reduction in renewable energy technology. The cost of PV, for example, is below \$1/watt. In the 1980's, recalled Martinot, that was considered by many to be the "holy grail" number; once reached, it would be "game over" and solar PV will readily proliferate. Accounting for inflation, he reports we have now actually gone well below that \$1/watt level. Without subsidies or policies, the cost of solar power is becoming competitive with retail electricity prices.

Martinot ended by sharing that the cost of panels is now remarkably a very small part of the equation, with other costs now more important, such as those for labor, installation, wiring, and other balance-of-system costs. A new generation of policies and practices must address these costs, rather than just the costs of panels – for example, pre-installing the wiring during building construction for true "plug and play."

### **Panel 1: Financing and Policy Drivers Of Cost-Effective Renewable Energy Advancement**

Moderator Paul Gipe, Founder of Wind-Works,<sup>2</sup> opened this panel by explaining the focus would be on policy and financing drivers that we can use to get to the renewable energy future being discussed. He said that it can be instructive to look at frontrunners like Denmark, which has set targets of 100% renewable power and heating by 2030 and 100% renewable total energy by 2050. Or Germany, which has a goal to achieve 80% renewable power by 2050 and 60% renewable overall by the same date, with many regions having more ambitious targets.

He noted that one of the stated purposes of the German renewable energy law<sup>3</sup> is to reduce conflict and war over fossil fuel resources, which could be instructive to the US, which invested 4 trillion in the recent Iraq war.

The first speaker he introduced was Dr. Jose Etcheverry, Associate Professor and Co-Chair, Sustainable Energy Initiative (SEI) at York University in Canada. Dr. Etcheverry is also one of the architects of the Green Economy Act of Ontario, which Gipe remarked is among the most

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<sup>2</sup> See <http://wind-works.org/cms/>

<sup>3</sup> The German renewable energy law is the Renewable Energy Sources Act (EEG). See: <http://www.erneuerbare-energien.de/en/unser-service/mediathek/downloads/detailview/artikel/renewable-energy-sources-act-ee-2012/>

progressive renewable energy policies in North America since Jerry Brown was last governor of California.

### **Panel 1 - Speaker 1: Dr. Jose Etcheverry**

#### Key Ideas and Recommendations:

- Ontario, Canada has been progressing toward a fossil free power system, including a mandate to ban coal by 2014
- Ontario also passed a feed-in tariff law to support renewable power adoption.
- The policy framework has resulted in uptake of wind and solar projects.
- Ontario still favors nuclear power, which threatens the transition to renewables. Nuclear energy is also expensive and hazardous.

#### Presentation Summary:

Dr. Etcheverry opened his presentation by relaying that Ontario has been moving more quickly to move beyond fossil fuels, with a revolutionary decision to ban coal by 2014. The province also implemented a feed-in tariff law to support local renewable electricity development.

Thanks to this policy framework, small installations of wind and solar have been happening so quickly, they are outpacing Google Earth's ability to track them. Ontario is also home to the largest solar installations in North America, including one project of 90 MW in size. PV manufacturing is going on as well.

Dr. Etcheverry pointed out that Ontario has not been moving as quickly to phase out nuclear power and warned that the province should not try to replace coal with uranium. He asserted that if we continue to commit to fossil and nuclear energy, we cannot commit to renewable energy. One major problem with nuclear power, he said, was that it is expensive. Especially new plants tend to fail to come online and have inflated cost blowouts. He cautioned that there is also no solution for the waste, security and weapons proliferation concerns. His hope is that there at least be a debate about whether plans for nuclear plants are needed in Ontario and noted that in Quebec, the people closed the only nuclear power plant at the end of last year.



Paul Gipe added that the conference's hosting state of California was the first place in North America where the people closed a nuclear power plant – at Rancho Seco in Sacramento.

## **Panel 1 – Speaker 2: Angelina Galiteva**

### Key Ideas and Recommendations:

- The power and utility industries are becoming increasingly exciting with the growth of electric vehicles, storage, and other emerging energy technologies and markets.
- Transitioning to renewable electricity does not mean losing modern comforts, it just means being more efficient and cost effective.
- California is on track to meet and surpass its 33% Renewable Portfolio Standard (RPS) by 2020.
- To achieve a cohesive clean energy system, we need commitment backed up by solid, effective policies, not “greenwashing.”
- Effective policies have “TLC” – Transparency, Longevity, and Consistency. They must address the need for an attractive enough return on investment, mitigate risk, and address non-financial barriers, such as interconnection.
- Cap and trade and carbon tax tend to lack transparency and be overly complex, while a well-designed feed-in tariff law, has more of the attributes of an effective policy.
- Germany's feed-in tariff law encouraged massive early adoption. With the solar insolation of Juno Alaska, the Germans have installed 30,000 MW of solar power, while Californians, who rely on the RPS, state subsidized rebates, and federal tax credits, recently celebrated only a couple thousand MW of solar as their big milestone.
- Italy also implemented a feed-in tariff similar to Germany's and installed 9000 MW in one year in 2011 vs. 1500 MW during that time frame in the US.
- Advanced feed-in tariffs encourage local ownership and financial benefit. 40% of renewable electricity capacity in Germany – and over 50% of wind power - is owned by individuals, with low shares

owned by investment funds, utilities, and industrial customers. Here in the US, where advanced feed-in tariffs have not been implemented for the most part, we see the opposite.

- Feed-in tariffs also foster job growth. Germany has developed 380,000 jobs in the clean energy sector since the feed-in tariff law went into effect.
- Renewable power is trending toward decentralization, which supports grid stability and diverse, reliable, fossil free, inflation-proof fuel supply, with nearly the whole cost consisting of the up front investment.
- 100% renewable energy targets are no longer pie in the sky. By mid-century, 100% renewable energy should be the norm.
- The time to set 100% renewable energy targets is now because planning and investment for energy assets happens decades in advance.
- 100% renewable targets must be accompanied by milestones and policies that make sense.
- The US is trending in the wrong direction. In 1983, 15% of the US power mix was renewable, and in 2012, only 12.7% was. We need to figure out and fix the laws that are causing this.
- Electric vehicles have a major role to play in the 100% renewable power future by providing grid storage and two-way communication with the grid.
- Renewable power can also make driving electric vehicles 15 cents cheaper per mile to drive.
- Utilities have a role to play in the renewable energy transition, if they are responsive to change. This goes for all of us.

#### Presentation Summary

Galiteva began where Dr. Etchevery left off by pointing out that California also recently had an existing problem with a nuclear power plant – the one at San Onofre. She asserted energy regulators were confident that the grid would be stable, despite the unanticipated shutdown of the troubled San Onofre reactors, an assessment that proved to be well founded. The nuclear power plant was permanently shut down

about two months after the Pathways to 100% Renewable Energy conference, and there were no reported black outs as a result of the loss of the power and voltage support previously supplied by the reactors.

Galiteva went on to say that after many years of her experience in the utility industry, she saw bright new opportunities for the field. No longer is the industry only about generating power, explained Galiteva, but also about electric vehicles, storage, IT, microgrids, demand response, energy usage patterns, and making the grid smarter and more efficient. "Our beers will be just as cold, our lights will be just as bright," she assured the audience, "but we'll be doing it (more) cost effectively."

She observed that the transition underway is in large part a grassroots effort and being led by cities.

In California, she explained that the 33% Renewable Energy Portfolio Standard (RPS) is on track to be met and surpassed by its 2020 target date. The objectives of the RPS, she said, are to:

- increase the overall renewable power supply
- create jobs and new industries
- improve the environment
- mitigate climate change
- increase energy security
- support new technology.

She declared that success requires commitment, and that this commitment must be serious and backed up with solid, well planned efforts aimed at meaningful results. She warned that "there is plenty of greenwashing going around," goals that are not being accomplished, and feed-in tariffs that are set up to not achieve much. Galiteva asserted that there needs to also be effective top down regulations, along with the grassroots efforts, if we are to ensure that we achieve a cohesive energy system based on clean technologies. Traditional regulatory policy is a three-fold system of mandates, standards, and public education.

Some policies have been more effective than others. Why is this so? She explained that to be effective, policies need to offer a formula that is flexible enough and allows us to incorporate new industries. Echoing a 2009 report by Deutsche Bank Climate Advisors,<sup>4</sup> she said what is most

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<sup>4</sup> See *Paying for Renewable Energy – TLC at the Right Price* by DB Climate Advisors (2009) [https://www.dbadvisors.com/content/\\_media/1196\\_Paying\\_for\\_Renewable\\_Energy\\_TLC\\_at\\_the\\_Right\\_Price.pdf](https://www.dbadvisors.com/content/_media/1196_Paying_for_Renewable_Energy_TLC_at_the_Right_Price.pdf)

needed are policies with “TLC” – that is, Transparency, Longevity, and Certainty or Consistency. Plus they must address the need for an attractive enough return on investment, mitigate risk, and address non-financial barriers, such as interconnection.

Galiteva said that carbon tax and cap and trade have shown to be complicated and non-transparent. Feed-in tariffs (FITs), on the other hand, when properly designed, have been the best mechanism for stimulating investment and ramping up renewable electricity installment the most rapidly and cost-effectively.

She described the German feed-in tariff law as one of the more successful renewable energy policies worldwide. Germany implemented this comprehensive renewable energy policy in 2000 and amended it in 2004 with the following basic provisions: If someone installs a renewable electricity system, they get paid a fixed amount by the utility for 20 years, immediate interconnection, and a clear pathway to pay for grid upgrades. The amount paid per kilowatt hour of renewable power generated is differentiated by technology, attractive enough to spur investment, and degresses with time (i.e. those installing in earlier years will get a higher tariff for 20 years than those installing in later years).

The law encouraged massive early adoption, she explained. For example, with the solar insolation of Juno Alaska, Galiteva pointed out that the Germans have installed about 30,000 MW of solar power, while Californians recently celebrated only a couple thousand MW of solar as a big milestone.

Galiteva pointed out that Italy also implemented a feed-in tariff similar to Germany's and installed 9000 MW in one year in 2011 vs. 1500 MW during that time frame in the US.

She emphasized that a feed-in tariff is not a subsidy. It is simply a remuneration for power produced by renewable sources, the amount of which drops down over time to encourage innovation.

Galiteva explained that feed-in tariffs encourage local ownership and financial benefit. 40% of renewable electricity capacity in Germany – and over 50% of wind power – is owned by individuals, with low shares owned by investment funds, utilities, and industrial customers. Here in the US, she said, we see the opposite.

Galiteva shared findings by Paul Gipe that per capita in select markets in countries with feed-in tariffs, there is also massive job growth. For instance,

from 2004-2012, 380,000 jobs were created in Germany, making the renewable electricity sector the largest growth sector in the country.

An interesting trend in renewable electricity, she noted, is that it is tending to be decentralized, as opposed to the traditional system that is made up of large power plants under centralized control. Decentralization gives reliability to the grid distribution and transmission system by supplying load where you need it and eliminating line losses and strain on transmission grid. She noted that over 65% of renewable power capacity in Germany is made up of small installations under 200 kilowatts in size.

Decentralized renewable power also creates a diverse, reliable fuel supply that is fossil free and inflation proof, with nearly the whole cost consisting of the up front investment.

Galiteva asserted that 100% targets are no longer pie in the sky and that by 2050 at the latest, 100% renewable energy should be the norm. She expressed confidence that we have the technologies, and some technological breakthroughs will help us get even further faster.

Because conventional power generation and transmission cost a great deal of money and take time, it is crucial to begin planning now for the future grid mix we want, with targets, milestones, policies that makes sense, and a commitment to reaching the goals we set. In other words, if want to see a 100% renewable grid in the next decades, the time to set the targets and framework for achieving this is now.

Galiteva showed that shockingly, the percentage of renewables in the US power mix have actually slid downward in recent decades. She showed US government figures that in 1983, the US power mix was at 15% renewable, and in 2012, it was only 12.7%. She said that it is critical have to figure out what the US is doing wrong with legislation, in order to make the nation's renewable electricity advancement move along faster.

Finally, Galiteva addressed the issue of electric transportation policy in relation to the 100% renewable power grid of the future. Key questions arise, such as how do we decouple the battery from the vehicle cost to bring down the upfront price of electric vehicles, which are still a barrier to widespread adoption? Who should own the battery?

She explained that electric vehicles have a role to play in integrating clean energy into the grid. For instance, their batteries can be used for electricity storage. They can be used for two-way communication with the grid to allow users to both buy power from the grid and sell power to

the grid from the battery storage. Utilities can also benefit from battery storage after the battery's useful life in the vehicle.

Using renewable electricity to power electric vehicles also has economic benefits to the user. She cited a finding by George Washington University that driving solar powered plug-in electric vehicles costs 5 cents/mile, compared to 20 cents per mile when using conventional electricity.<sup>5</sup>

Galiteva concluded by saying that all of us, including utilities, have a major opportunity to play a part in this new era that has begun. To succeed, we all must be responsive to change. The benefits will be to save our essential life sustaining resources, like water, air and earth, with the transition.

Paul Gipe commented that in contrast to countries like Germany and Denmark, no windmills in California are owned by citizens or farmers. With this, he transitioned to the next speaker, Marco Krapels, North American Vice President of Rabobank, an institution which Gipe explained has been a leader in financing homeowner, citizen, and farmer owned renewable power in the Netherlands since the 1980's.

### **Panel 1 - Speaker 3: Marco Krapels**

#### Key Ideas and Recommendations:

- Spiking costs and unreliability of conventional power and cost effectiveness of solar are making solar increasingly attractive.
- People like the idea of becoming their own power company.
- We have to transition to 100% renewable energy because it is the moral and environmental imperative to do so, it is scientifically and technologically possible, and it makes business sense.
- US citizens have spent \$600 billion subsidizing fossil fuels over the last 60 years, and for this size investment, they should expect lower prices, and a clean, long term supply. Fossil fuels have not delivered.

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<sup>5</sup> *Solar PV as a Solution*, Presentation by GW Solar Institute Director Ken Sweibel, George Washington University (2011)

- By contrast, a comparatively tiny amount of public funds have been put into clean renewables, and prices have plummeted. 100% renewable energy is inevitable because it will be cheaper.
- It is critical for politicians not to stop this relatively new support for renewable energy that is propelling new industries, especially given that fossil fuels have benefited from massive subsidies for so long.
- Renewable power is attracting investment from a wide cross section from farmers to large corporations.
- Investing in installing renewable power is a hedge against future conventional power rates.
- Abundant natural gas through fracking and cheap coal are not securing lower power bills. The only way to do this is to own your own power at a fixed cost over a long term.
- Renewable energy is a proven excellent investment for Rabobank, with zero defaults on billions of dollars in financing over the past 5 years.
- Currently only 14 out of 12,000 banks have renewable energy financing departments, but this is bound to change. When it does, new sources of capital will be needed. Crowdfunding is one example of an innovative mechanism.

### Presentation Summary

Marco Krapels opened with an illustrative story about one of his clients, a farmer who installed solar panels because it made business sense. He observed that more and more people working the land are taking control of their own energy.

With spiking energy costs and a historic threat of rolling black outs in areas like California, solar is becoming increasingly attractive to his clients, explained Krapels. He said solar costs about the same as paying the power company, the payback period is short, and one becomes one's own power company. How would this not be the right choice? "Everyone should be stepping up and be doing this," stated Krapels.

He continued that we know we have to transition to 100% renewable energy because it is the moral and environmental imperative to do so. It is

scientifically and technologically possible as well. But it also has to make business sense.

Krapels laid out how it makes business sense for people, including his clients. We citizens, he explained, have poured \$600 billion of subsidies into fossil fuels. He asserted that we should expect after such an investment to have an infinite source of clean power, declining prices, and stable source of power. However, we do not, and prices have actually increased, making fossil fuels, he stated, a terrible investment.

He went on to relay that policymakers in the US and elsewhere came up with the idea to put a tiny fraction of public support into renewables. As a result, we've seen a substantial drop in costs per kilowatt hour for solar and wind. Because such a small amount of encouragement has yielded such big results, he sees that it is inevitable that we are going to make the transition to 100% renewable energy because it is going to be cheaper.

Krapels said we need the right politicians who don't abruptly stop the policies which support renewable energy industries that have only benefited from such support for a few years, while fossil fuel industries have received our \$600 billion over the last 60 years.

When it comes to who is adopting renewable energy, Krapels pointed out it is not only individuals like his client the farmer. Large corporations like Wal-mart are also jumping on board, in order to be sustainable and to lock in power source at fixed cost. Renewable energy provides all these players, from big companies to a small farmers an opportunity to turn a volatile cost into a fixed cost, remarked Krapels.

He compared this to a derivative. "When you sell someone an interest rate swap," explained Krapels, "you are selling them a hedge against a future rate. When someone goes solar, they are effectively hedging a future energy cost. The math is really simple: The cost of the solar minus local incentives and tax deductions is the numerator. You divide them over the expected amount of annual kilowatt hour production by the solar system over a 30 year lifespan. If the outcome is lower than what you are currently paying the utility, you go solar. It is a no brainer. Farmer's see it. They own tractors and guns and own solar."

Krapels asserted that this is not a partisan or treehugger issue. This just makes business sense by giving businesses real power independence.

He asserted that hydraulic fracturing of natural gas, by contrast, will not ultimately lower rates long term for consumers. He pointed out that "we



have had cheap coal for decades, but that did not turn my or my clients bill into a lower bill. The only way to do that is to own your own power at a fixed cost."

He said that for the bank, it is a great investment. Over the last 5 years, he said Rabobank has billions of dollars out in financing, and their default rate has been zero. Returns are high, he said, because the asset class is still not well understood. Some may confuse solar with a financial failure like Solyndra. But actually, by financing a solar power plant with an infinite source of fuel and fixed rate contracts to sell the power over long term, it is tough to lose money. Krapels said that you just need to make sure that the proven solar technology works alright, which is assured by the fact that the technology is proven. Even if the manufacturer is not around in 5 years, he explained it does not matter because the technology has been around for 30 years.

Krapels stated that only about 14 banks out of 12,000 have a renewable energy finance department. In other words, there is not a lot of competition. At some point, however, he said, those few in the game will be exposed and will need a different source of capital. He mentioned innovative options that are emerging, such as crowdfunding to democratize funding into a safe, sound asset class.

Paul Gipe echoed Krapels by sharing that Schleswig Holstein Landesbank lends in a local state in northern Germany and reports zero defaults in 20 years of financing renewable energy projects.

#### **Panel 1 – Speaker 4 - Joachim Seel**

##### Key Ideas and Recommendations:

- Installed costs of residential solar PV systems in Germany are dramatically lower in Germany than in the US.
- "Soft costs" – that is, non-hardware costs are the reason for the difference.
- In Germany, twice as much solar was installed in 2012 as in the US, and Germany has 4 times as much solar cumulatively installed as in the US.
- German renewable energy policy – namely the feed-in tariff law – has been the driver behind Germany's comparatively robust PV growth.

- Financing PV systems in Germany is easier than in the US, so Germans typically own their solar systems instead of leasing them like people in the US often do.
- One reason for the price difference between the two countries is that the US has a patchwork of regulations and policies that differ state by state.
- According to the National Renewable Energy Laboratory (NREL), other cost factors contributing to the price difference include: profit and overhead (the largest contributor), customer acquisition, installation labor, red tape, and the extent to which policies are streamlined.

#### Presentation Summary:

Joachim Seel, Researcher at Lawrence Berkeley National Laboratory, presented his analysis of why the installed costs of residential solar PV systems in Germany are dramatically lower than in the US. His research was funded by the US Department of Energy Sunshot program, which strives to bring the price of PV systems to \$1/w by 2020.

Seel explained that solar modules are down globally in cost, but that PV systems consist of other “soft costs” Those non-hardware costs need to come down.

He showed that in Germany, twice as much solar was installed in 2012 as in the US, and that Germany has 4 times as much solar cumulatively installed as in the US. The reason he gave was that the German renewable energy law made PV more attractive than did policy in the US.

He said that Germany experienced particularly high growth from 2010-2012 because prices came down more quickly than expected. He said that the US also had record amounts of solar installed in 2012, but that the market is nonetheless much smaller. He pointed out that this is surprising considering that Germany has solar irradiation of Alaska. He said it pencils out for German solar owners because they enjoy comparatively low total costs for installed solar systems.

Seel pointed out whereas in Germany, PV systems are typically customer owned, in the US, customers are willing to give away ownership to companies with leasing models because financing is difficult.

He explained that in 2006, the price of small solar PV systems of 10 kW or less were about the same in Germany and the US. At that time, there was a shortage of silicon capacity for producing solar modules. Germany responded to the shortage by adjusting the non-module prices, and the feed-in tariff kept pressure on installers to drive those costs down. Today, the module price is still similar in Germany and the US (\$.89/watt), but the overall system is higher in the US. Whereas the average cost of a residential 5 kW system in Germany costs about \$11,000, it costs about \$24,000 in the US.

One reason he gave for the difference is that the US has heterogeneous markets in different states with different regulatory structures. There is also a difference in market size, Germany's being much smaller, but he reported that this only accounts for about a third of the price difference.

Seel said that there need to be fundamental changes in the US. According to a survey by the US National Renewable Energy Laboratory (NREL), the following factors are contributing to the cost differences of PV between the US and Germany:

- *Profit and overhead.* This is the biggest figure contributing to the price difference.
- *Customer acquisition.* These costs are higher in the US because it is harder to seal the sale than in Germany. This is influenced by higher customer awareness in Germany and greater certainty of investment return offered by the German feed-in tariff law compared to the more complex investment frameworks in the US, like the federal tax credit and programs that are tied to changeable electricity rates. Interconnection costs are also higher and less certain in the US than in Germany. German installers additionally leverage partnerships with local installers, which can be seen on the homepages of major PV manufacturers.
- *Installation labor.* In the US, installation takes twice as long, so there are more costs. Roofs are also more uniform in Germany and are largely made of tiles, on which it is easier to install solar than it is on shingles that are common in the US. But these variables cannot fully explain price difference. It may be that greater speed comes with more experience with installation in the US.
- *Red tape.* Permitting and regulations are more difficult in the US, whereas in Germany, there is no building permit or inspection requirement for rooftop solar.

- *Streamlined policies.* Germany has one national policy with minimized fragmentation. At least on a statewide level in the US, interconnection and permitting should be streamlined. The steady decline in the German feed-in tariff forced the overall lowering of system price over time to maintain an attractive value proposition. This is not captured with policies like the investment tax credit in the US.

**Panel 1 – Speaker 5: Dr. Harry Lehmann, Director of Climate and Energy at the German Federal Environment Agency (UBA)**

Key Ideas and Recommendations:

- UBA is a government agency that advises the government and the public and is independent of the elected administration.
- The German transition to sustainable energy sources – or “Energiewende” – has a history dating back to the 1970’s oil crisis and also has roots in the anti-nuclear and peace movements.
- Germany’s nuclear shut down mandate, which began in 2002, has recently resulted in the shut down of 9 nuclear power plants.
- Despite the phase out of nuclear power and the grid attaining 22% renewable electricity in 2012, Germany remains a power exporter, and the grid remains stable.
- UBA has been studying how Germany can reach 100% renewable power by 2050, with the surprising finding that the nation can generate 100% of its electricity using renewable resources within its own borders. This includes factoring in the avoidance of sensitive areas, like conservation land and tourist landmarks.
- UBA concluded in this study that a regional approach is preferable to an entirely local system approach, which would be too narrow to easily cover the needs of cities, or to an international approach, which would entail expensive transmission lines and other complexity.
- To reach 100% renewable electricity in Germany, storage and demand side management are needed overcome intermittency.
- To provide the economic framework, feed-in tariffs are needed that guarantee prices, access to grid, and a sufficient time frame of

payment. The tariff can remunerate system services, not just the kilowatt hours produced, and we should be thinking about opening the feed-in tariff to these variables. The feed-in tariff price should also decline over time.

- Some problems with the German grid will arise, due to issues around the reunification of East and West Germany and the need to make up for power in concentrated areas where nuclear power plants are being shut. These problems are solvable.
- The real bottlenecks of the future are land area due to increasing global population and the limited resources (copper, etc.) needed to build up the new energy structure. We have enough, but that does not mean we don't have to be more efficient, better at recycling, etc.
- Research and Development must be part of policy to achieve 100% renewable energy targets.
- Sharing information, training the workforce, and capacity building are critical to reaching 100% renewable energy goals.
- Germany is on its way to transitioning to 100% renewable energy. The country needs allies outside Europe, such as the US.

#### Presentation Summary:

Dr. Harry Lehmann opened with an overview of the German Federal Environment Agency (UBA) and its jurisdiction:

- Agency is almost 40 years old
- Obligated and able to make long term strategies and to advise the government and citizens
- Does not change with elections or policy change

He explained that UBA has been looking into 100% renewable energy targets and solutions and is supporting the Pathways to 100% Renewable Energy conference because they believe they need allies with countries and states that have sustainability commitments.

Dr. Lehmann then briefly shared the following forty year history of the German energy transition – or “Energiewende.”

- Started with oil crisis in 1970's
- Was linked to the anti-nuclear and peace movement

- First feed-in tariff concepts in the 1980's
- First feed-in tariff law in the 1990's
- Over 40 countries now have feed-in tariffs, some better than others
- Nuclear phase out law was passed about 10 years ago.
- Then Chancellor Angela Merkel decided that because of climate change, Germany should have nuclear power for 10 years longer than planned. That became "the phase out of the phase out."
- After Fukushima, Germany recommitted to banning nuclear power, which became "the phase out of the phase out of the phase out."
- Since then, 9 nuclear power plants have been shut down.
- Germany remains an electricity power exporter, and the grid remains stable.
- Germany has achieved more than 22% renewable energy in electricity sector and is working on heating and transport solutions.

In looking at archetypes of future 100% renewable power supply, Dr. Lehmann noted that typically people think in terms of centralized vs. decentralized electricity production, national vs. international frameworks, and energy self-sufficiency of buildings that produce more energy than they need. He explained that focusing entirely on local, decentralized systems is a narrow view that UBA knows will not work everywhere, for example in big cities. On the other hand, international systems like the Trans-Mediterranean cooperation envisioned by some in Europe, with similar ideas in Japan, are technically feasible, but extremely costly in terms of upfront capital and infrastructure. The other option for planning a 100% power supply is to adopt a regional system.

In 2010, UBA released a study of how Germany could reach 100% renewable electricity by 2050.<sup>6</sup> The agency tried to gather information regarding the pros and cons of different regions in Germany in terms of resource availability of various renewable resources. He explained the agency was surprised that the amount of renewable power possible to generate within German borders exceeded expectations. While it was never previously UBA's goal to get to 100% renewable power supplied by resource entirely within German borders, remarkably it seemed feasible. There was some resistance within the agency that the information would not be trusted because it exceeded expectations, but they proceeded. After that, Dr. Lehmann explained, other institutions pursued 100% renewable energy scenarios.

Other key findings of UBA's study of how to achieve a 100% renewable power supply in Germany include:

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<sup>6</sup> See <http://www.umweltbundesamt.de/sites/default/files/medien/publikation/add/3997-0.pdf>

- UBA's study used detailed models with real weather data, and learned it worked.
- Storage is needed to overcome intermittency. Examples include chemical storage, batteries in electrified transportation, solar methane that can be produced from excess renewable power production and put into grid, and solar hydrogen.
- Also needed is demand and supply management.
- In the last 20-30 years, we have developed the technologies that give us the ability as a society to make choices.
- If we look at issues of reliability, local added value, and economic benefit for the most people, the agency thinks regional systems offer the best balance in Europe.
- Policies must not only address electricity. Binding emissions targets to the renewable energy supply also has to happen. Only with these strong policies will industry and society know where to go.
- To provide the economic framework, feed-in tariffs are needed that guarantee prices, access to the grid, and a sufficient time frame of payment. The tariff can remunerate system services, not just the kilowatt hours produced, and we should be thinking about opening the feed-in tariff to these variables. The feed-in tariff price should also decline over time.
- Even if you keep away from sensitive areas (e.g. tourist and conservation areas) Germany has 10 times more land than is needed to reach a 100% renewable power supply. This helps to make decisions about issues like offshore wind, which is very expensive.
- Other environmental constraints to be considered include biodiversity, building infrastructure, adapting the grid, and building out the storage system.
- Problems with the German grid are based in part on the unification of East and West Germany. Also nuclear power plants have been concentrated near one place, so when they are switched off, a large amount of power needs to be imported there. Those problems are solvable. The amount of people going against grid

upgrades has lowered in recent years because of the rising desire for high amounts of renewable energy.

- Real bottlenecks of the future: land area (the world must feed 9 billion people by the end of the century), limited resources (copper, etc.) needed to build up this infrastructure. We have enough, but that does not mean we don't have to be more efficient, better at recycling, etc.
- Research and Development must be part of policy. We did not stop inventing trains once the diesel train was invented.
- Sharing information, training the workforce, and capacity building are critical.

Dr. Lehmann concluded by sharing that he believes Germany has started the transition to 100% renewable energy. He says Germany has developed the policies, and that setting out on this course is a win-win for the first movers. Germany has created approximately 400,000 jobs due to the energy transition. He asked those in the room to be the "next ship to 100%" renewable energy, explaining that if Germany doesn't have allies outside Europe, the whole movement will die because the European market is not big enough. The American market and Americans are needed to implement the 100% renewable goal.

## **Panel 2: Overcoming Technical Barriers to 100% Renewable Energy in the Power Sector**

The purpose of this panel was to identify how to ensure a reliable, economical electricity system, as we transition to 100% renewable power resources.

The panel kicked off with an introductory keynote address by Stephen Berberich, President and CEO of the California Independent System Operator (CAISO), the regulatory body that oversees transmission grid operations in California. Mr. Berberich was welcomed by panel moderator David Olsen, Managing Director of the Western Grid Group and member of the Board of Governors of CAISO.

## **Panel 2 – Introductory Keynote Address: Stephen Berberich, President and CEO of the California Independent System Operator (CAISO)**

### Key Ideas and Recommendations:



- Tectonic changes are underway in the electricity industry, and it will likely be unrecognizable in 2050, as large centralized power generation is largely replaced by decentralized renewable power generation.
- The most important force of change is economics, as the conventional utility sector costs rise and the costs to generate and store one's own power with renewables comes down. Climate change is also a key factor.
- The California electricity system between now and 2050 is likely to transition over three phases: 1. Where we are now. 2. A phase of countervailing trends when electrified transportation creates new load, and at the same time, greater efficiency reduces load, and when greater amounts of renewables come online, including biofuels and biogases that can replace natural gas. 3. By 2050, decentralized renewable power generation will have become predominant, with the transportation system probably the largest electricity consumer.
- Critical issues to address will be maintaining reliability, prioritizing clean and flexible generation, cost containment, providing transparent and immediate pricing, coordinating regional energy systems, considering electric utility shareholders to avoid constant resistance of the changes ahead, remaining within voltage parameters.

#### Presentation Summary:

Stephen Berberich began by echoing Galiteva perception expressed earlier that morning that it is an unusually exciting time to be in the electricity industry.

To help people better understand the background of the CAISO, he explained that the agency is responsible for reliably and cost-effectively running 82% of the state power grid. The CAISO makes sure the grid is balanced every few seconds and runs a massive day ahead and real time market in which last year, \$8.5 billion dollars cleared. Berberich added that they “also accept the mantle of providing leadership, support and expertise for the state’s drive to decarbonizes the electric industry.”

Berberich declared that “tectonic changes are underway in the electricity industry” and that he does not “think the current industry will be recognizable by 2050.” He explained that the existing industry paradigm is big power generation connected by big transmission, “far flung systems

that dump the power into the distribution system that goes to end consumers." He predicted this system would likely be antiquated sooner than later.

He identified three major forces of change contributing to this trend:

- *Economics.* Labor and procurement costs are rising for utilities, and transmission and distribution systems urgently need costly upgrades.
- *Customers and pricing.* Current prices are "being masked by unsustainably low natural gas prices," he stated. Meanwhile the cost of decentralized renewable power technologies and storage is coming down. In some cases, these costs are already competitive with retail utility rates, which he explained gives people the benefit of control over their own grid.
- *Climate Change.* This crisis is becoming more obvious and urgent, although a survey of customers suggests it is secondary to economics as a key driver of change in the electricity industry.

He also predicted the grid would be powered at least predominantly by renewable energy over the next few decades, and that this transition would occur in three phases.

#### 1. Phase 1: Where we are today.

This phase, Berberich said, is dominated by the status quo with a gradual shift as new technologies emerge. Central station renewable electricity backed by conventional generation will predominate. Distributed generation will continue to grow during this time, as costs continue to come down, and as storage technologies come forth. Plug-in electric vehicles are beginning to play a role.

Priorities in this phase are to:

- make the back up conventional power plants as efficient as possible and to use them only to the extent that renewables are not available and cannot meet demand, e.g. during morning and evening ramps.
- shift from intermittent and uncontrollable to much more controllable power.

- maintain reliability and cost-effectiveness
2. Phase 2: Countervailing trends and increased distributed renewable generation

During this phase, on the one hand, power demand will go up because transportation will become electrified, due to needing to lower greenhouse gas emissions and pollution. On the other hand, efficiency will increase, keeping power use down. Continued reliance on centralized power plants and transmission, while uncertain, is likely to decrease. Natural gas can transition to various types of bio-energy. Just as there is still a dial up market in the age of broadband, there may be slow adopters of distributed renewable generation during this phase.

3. Phase 3: By 2050, a predominantly decentralized, renewable power system.

By this time, predicted Berberich, “generation will occur predominantly where consumption occurs at local level. Many, if not most homes will be effectively off grid with storage and electric vehicles and their own generation to meet their electric needs.” Elements of the grid may have to remain to handle large consumers, for example, PEV charging infrastructure, which will likely be the largest user of power at that point in his view. The power system will be “dramatically more carbon free than today, and the vast majority of demand will be met with renewable and distributed resources.”

Berberich noted that several elements must be addressed going forward:

- Reliability must be maintained. At the same time, there must be a focus on clean and flexible generation, which means investment in infrastructure, including retrofitting coastal plants in California to eliminate unsustainable once-through cooling.
- Cost must be contained. If rates go up too fast, renewables “will be blamed regardless of whether it is their fault,” warned Berberich.
- Consumers need to be empowered with transparent and immediately visible pricing.
- Because regionalism plays a big role in use of renewable energy, it is critical to coordinate regions with complimentary resources to succeed at building a strong grid.

- The conventional electric utility model has to be rethought, and their shareholders need to be taken into consideration, or there will be a fight every step of the way.
- Voltage to homes and businesses need to remain within parameters in line with the laws of physics. Inertia is important to the system.

To do this right, Berberich concluded, “we’ll need to deepen the collaborative spirit among sectors in our industry” and “focus on that rare balance between thoughtful environmental stewardship and cost containment. And we’ll need to unlock the potential of new technology in the design of a grid that maintains reliability while protecting the environment for our children and grandchildren.”

He ended by affirming that the CAISO is committed to working with all stakeholders on this important effort.

## **Panel 2 - Speaker 1: David Renne, President of the International Solar Energy Society (ISES)**

### Key Ideas and Recommendations:

- The word “barriers” in the panel title would be more aptly called “challenges.” With all challenges, there are opportunities.
- Many available roadmaps already show how to get to a significant penetration of renewable energy - up to 100% - to achieve critical greenhouse gas reductions. All conclude there may be different approaches, but there are no real technical issues in getting to 100% renewable power.
- Projections for future renewable energy penetrations are already looking conservative because expanded markets have all been triggered by a chain of events - such as increased investment, stable and scalable manufacturing, and proactive policies - that all give positive feedback to each other.
- Challenges include properly managing the variable generation by some renewable power technologies like PV with proper tools like solar and wind forecasting; taking action at local levels; implementing sensible urban planning and building design; integrating transportation strategies; understanding and managing consumption patterns; and increasing energy efficiency. Other

challenges include the low price of natural gas (although this could be transitory); limited resources for commercializing emerging technologies; and empowerment across genders and socio-economic strata.

- The critical question is not whether 100% renewable power is technically feasible, but whether there will be the political will. People don't like to be told by the government what to do, and the 100% renewable power movement should take a cue from the internet, which was a good example of something that was not imposed on people, but adopted by people when they saw the value.
- Carbon pricing, along with microfinancing in developing countries, may help to spur necessary investment in the transition to 100% renewable electricity.

#### Presentation Summary:

The first speaker on this panel, Dr. David Renne, President of the International Solar Energy Society (ISES) was introduced by the panel co-moderator Angelina Galiteva. He began by stating that "Although the panel makes reference to overcoming the barriers to technically achieving 100% renewable power, I prefer to call them challenges. With all challenges, there are opportunities."

He pointed out that there are many roadmaps already available that show how to get to a significant penetration of renewable energy - up to 100% - to achieve critical greenhouse gas reductions. They all come to the same conclusion that while there may be different approaches, there are no real technical issues in getting to 100% renewable energy. Dr. Renne relayed that the International Panel on Climate Change (IPCC) reports that the technical potential of renewable energy far exceeds energy requirements over the next 100 years.

Dr. Renne added that several reports also highlight massive growth of solar PV, and that 2012 capacity is expected to be around 100 GW. Growth in coming years of both solar PV and concentrated solar power (CSP) will also likely exceed some expectations.

He said that projections for the future are already looking conservative because expanded markets have all been triggered by chains of events that all give positive feedback to each other. For example:

- Private investment has increased.
- Manufacturing has become scalable.
- There are lower technology costs and expanding markets.
- Governments are thus motivated to come up with policies to further incentivize the market.
- The current imbalance in the photovoltaics market where supply is exceeding demand has pushed prices down – a good thing overall, but which will correct itself over time.
- R & D funded by government and private industry has helped improve the efficiency and cost-effectiveness of renewable technologies.

Challenges remain however, including:

- The variability of generation by some renewable power technologies like PV, which presents a challenge for system operators. As penetration increases, this has to be properly managed. Proper tools, like solar and wind forecasting, must be given to utilities.
- The need for action on the local and community levels
- Sensible urban planning
- Measures to encourage improved building design
- Integrating transportation strategies
- Understanding and managing consumption patterns,
- Increasing energy efficiency
- The low price of natural gas (although this will likely be transitory)
- Limited resources for emerging technologies
- Empowerment across genders and socio-economic strata

Dr. Renne emphasized that it is critical to provide energy access for all populations. Currently 1.3 billion people have no access to electricity, and over 2 billion are still using traditional biomass for heating and cooking. He reported that the United Nation's Secretary General Ban-Ki Moon has come up with a goal for energy access for all by 2030 via mechanisms, such as lower prices, diversified manufacturing into emerging markets, and microfinancing.

The critical question, Dr. Renne explained, is not whether 100% renewable power is technically feasible, but whether there will be the political will to make it happen. People don't like to be told by the government what to do, he cautioned. He added that the internet was a good example of something that was not imposed on people, but adopted by people. He recommended that the pursuit of 100% renewable power should follow a

similar model and predicted that people will see the value of the proposition.

He asserted that additional investments will also be needed to reach the 100% renewable electricity goal, which could be helped along soon by carbon pricing.

Dr. Renne closed his remarks by affirming that ISES is focused on supporting a transition to 100% renewable energy for all used wisely and efficiently and that they would be continuing the conversation at their future conferences.

## **Panel 2 – Speaker 2: Dr. Alexa Lutzenberger, Professor at University of Leuphana**

### Key Ideas and Recommendations:

- Renewable energy creates a regional money value chain through tax income, land rental, tourism, job creation, security of energy supply, and fuel import reduction.
- Biogas presents the most varied opportunities for energy solutions of all renewables, including heat, CHP, injection into the natural gas distribution grid, and energy storage
- More than 8000 biogas plants have been installed in Germany.
- While it is important not to use cropland for biogas, a massive opportunity remains to make biogas out of organic waste. Diverting organic waste from landfills can help prevent pollution and create energy.
- We need to focus on infrastructure to separate and collect the waste, so that it is usable, then conditioning it to be made into a variety of useful products, including electricity, heat, biomethane, bioethanol, biodiesel, and humus.

### Presentation Summary:

Dr. Alexa Lutzenberger began her presentation by laying out the importance of the regional money value chain created by transitioning to renewable energy. She explained that renewable energy brings money to communities through tax income, land rental, tourism (e.g. some regions in Germany are advertising as “100% Renewable Energy Regions”), local job creation, energy supply security, and independence

from energy imports, which stabilizes and lowers prices. She gave as an example of the added value to one German region the opening of a pre-school with a big banner announcing that it was sponsored by renewable energy.

One type of renewable energy that presents the greatest number of energy solutions is biogas. Biogas, explained Dr. Lutzenberger, can be:

- Burned to create heat
- Used for combined heat and power (CHP)
- Cleaned and put it in the natural gas grid
- Stored for when energy is needed

About 8000 biogas plants have been installed in Germany. There are several reasons why there are so many:

- Most are small, agricultural biogas plants.
- Biogas presents a new revenue opportunity for farmers with closed material loops, with marketable byproducts like fertilizer.
- Farmers can use the energy produced to create their own power and heat and to be independent from utilities/energy suppliers.
- Biogas plants can also serve the larger community (in swimming pools, schools, etc.)

Biogas also presents challenges, not the least of which is the fact that land is limited, and we must feed 9 billion people by the end of the century.

However, massive potential remains to make biogas out of organic waste. Most waste ends up in landfills, which pollute the environment, when it could be reduced, recycled and much of it used for energy. Approximately 50% of municipal waste is typically organic. Additionally, agricultural waste like manure, residues, straw, and crop waste make up another major resource.

To move forward, Dr. Lutzenberger recommended that we develop new infrastructure to collect and separate waste to make it usable. Then we must condition the waste to make multiple products, like electricity, heat, biomethane, bioethanol, biodiesel, and humus. With this, we will have a critical set of solutions in place to shift to a 100% renewable energy system.

## **Panel 2 - Speaker 3: Frank Lacey, Vice President of Comverge**

### Key Ideas and Recommendations:



- Demand response (DR) is an “intelliwatt” that can be remotely managed.
- Comverge is a DR company that uses special software to serve 15,000-20,000 commercial and industrial customers and a residential portfolio with control of about a million devices.
- DR is a solution for 100% renewable power systems because it can provide backup to intermittent renewable sources like wind and help to stabilize the grid.
- PJM on the east coast of the US has a capacity market where DR is currently being used.

#### Presentation Summary:

The next panel speaker was Frank Lacey, Vice President of Comverge, a demand response (DR) company based in Pennsylvania. Lacey explained that Comverge is one of largest DR providers in North America, serving close to 15,000-20,000 commercial and industrial customers. The company also has a strong residential business portfolio, with about 1 million devices they can control mostly through utility contracts. Comverge additionally controls pool pumps, air conditioners and other devices of about 150,000 customers in Pennsylvania to manage peak loads on the grid.

To control these various devices, Comverge uses specially developed software. “DR traditionally has been thought of as a negawatt,” said Lacey, but really it is demand responding to a signal that can ramp demand down or up. He explained that more accurately, it is “an intelliwatt. An intelligent watt of electricity that can be remotely managed.”

How does that fit into this conference? Lacey explained that we all know the challenges of confronting intermittent resources like wind, and DR can provide a back up. With DR, peak load devices like air conditioners can be controlled to help ISOs balance their systems. DR can tie directly to storage, industrial facilities and residential devices and can follow load signals quickly. “We have the ability to follow a 2 second load signal with 97-98% accuracy” in the industrial sector, said Lacey.

So where is this working? PJM in the US mid-Atlantic states has a capacity market where DR is being used.

To conclude Lacey recommended that we get out of a “1990’s perspective” of renewable power. “The only way to do that,” he asserted, “is to get the market to function and serve where it can serve.” DR plays a critical role in allowing that to happen.

Angelina Galiteva echoed this recommendation, pointing out that California just issued a flex alert, which is an alert designed to help balance the grid by asking consumers to conserve power at specific, critical times. “DR would help,” asserted Galiteva.

**Panel 2 – Speaker 4: Janice Lin, Executive Director of the California Energy Storage Alliance (CESA)**

Key Ideas and Recommendations:

- Energy storage is a broad asset class that includes many types, such as batteries, chemical, thermal, ice or molten, mechanical, compressed air, and pumped hydro, and can be deployed throughout the electricity system.
- These technologies can play a part in a 100% renewable power mix by storing excess renewable generation for use at a time when it is needed, as well as by providing back up to intermittent renewable power sources.
- Whereas traditionally, fossil peak generators have been ramped up and down to help manage fluctuating load and supply, storage can do this without pollution and more cost effectively.
- There are more than 200 GW of storage projects in place currently, with more than half being pumped hydro, and the grid storage industry is gaining steam.
- A challenge is that our power system was built on the premise that energy can’t be stored, so it is hard for storage developers to capture the full value and revenue streams. Regulatory solutions are required to change this.
- California has taken an important step. Governor Jerry Brown signed the first legislation in the state exclusively focused on energy storage - AB 2514 – which requires the California Public Utilities Commission to open a storage proceeding.

- It is a mistake to assume storage is expensive. More research into the cost effectiveness frameworks needs to happen. Recent analysis suggests that battery storage is actually more cost effective than a natural gas peaker plant of the same size because it has a more flexible range and can charge and discharge its full capacity.

#### Presentation Summary:

Janice Lin opened her presentation with three questions: What is Energy Storage? How it can be leveraged as a resource for 100% renewable energy? How do we overcome the barriers, which are regulatory and policy related, not technical?

To answer the first question, Lin explained that storage is a broad asset class with many subclasses and types – e.g. batteries, chemical, thermal, ice or molten, mechanical, compressed air, pumped hydro – that can be deployed throughout the entire power system

To answer how storage can enable a path to 100% renewable energy, Lin started by sharing a CAISO chart from February 2013 that shows the California net load over the course of typical March day from 2012-2020, which has become known as the “duck” curve.

This chart shows the belly of the duck getting fatter and fatter over time during mid-day, meaning there is greater potential for excess renewable power generation relative to demand during those hours. In the late afternoon, the curve swoops up, creating “a neck” in which demand intensifies relative to supply, creating a challenge for grid operators. Lin said that storage can provide a solution. It can “put the duck on a diet” by storing the energy made during the middle of the day by renewables. And it can “flatten the duck’s head” by providing power later in the day when it is needed. This is particularly good news, she explained, because most of the cost and pollution of the power system is tied up in that “duck’s head” – that is, the peak load hours of the day.

Lin added that the CAISO scenario is at an hourly resolution, but if you look at the power system in a minute by minute resolution, there is a great deal of fluctuation in load and supply. Historically, this has been covered by peak fossil generators, but Lin stated that storage can do it more effectively and without pollution.

Lin said there are storage projects in place now totaling more than 200 GW. More than half is in pumped hydro. 65 GW is in Uninterruptable Power Supply (UPS) systems, not counting the transportation sector. The industry is gaining steam, she affirmed. As an example, she cited the 36 MW/9000

kwh advanced lead acid system in No Trees, Texas, where there is a 135 MW wind farm.

A challenge, Lin explained, is that our power system was built on the premise that energy can't be stored. It is therefore hard for storage developers to capture the full value and revenue streams. Overcoming this challenge requires regulatory intervention. Fortunately, Governor Jerry Brown signed the first California legislation exclusively focused on energy storage - AB 2514 – which requires the California Public Utilities Commission to open a storage proceeding.

There is also the challenge of people perceiving storage as expensive, but this is a mistake, said Lin, because “the cost effectiveness frameworks have not yet been done.” She emphasized that it is important to compare the benefits of the alternatives, not just the costs. To illustrate, she offered a brief overview comparing 50 MW gas peaker plant to a 50 MW battery. The gas peaker has a flexible range of about 40 MW, operated only few months of the year, while the battery can work throughout the year and can get a flexible range of about 100 MW because it can charge and discharge the full 50 MW.

The bottom line, Lin said, is that the battery delivers better value for the expense, according to preliminary analysis by the Electric Power Research Institute (EPRI) that did not include GHG benefits.

To conclude, Lin encouraged people to learn, get engaged, and advocate in their local environments because, she said, it will take this to change 80 years of history.

## **Panel 2 – Speaker 5: Peter Asmus, Principal Research Analyst, Navigant**

### Key Ideas and Recommendations:

- Two technologies that can play key roles in 100% renewable power systems are microgrids and virtual power plants (VPPs) that allow microgrids, DR, storage, and renewable generation to work together. These technologies may overlap in the future.
- Microgrids are smart networks capable of optimizing and aggregating diverse distributed generation resources, and disconnecting from the larger grid, which is of interest in the wake of major storms.

- Along with use in developed regions, microgrids can be deployed in developing regions where weak or no grids exist and to reduce or eliminate expensive power resource imports like diesel fuel.
- The Canary island of El Hierro has achieved a 100% renewable power system with a combination of pumped storage, wind turbines, distributed PV, solar thermal, and a microgrid that controls got all those technologies to work together.
- Navigant defines a VPP as a “system that relies upon software systems to remotely and automatically dispatch and optimize generation, demand side or storage resources, including plug-in hybrid vehicles and bi-directional inverters in a single, web connected system.”
- In Germany, a Regenerative Combined Power Plant has aggregated 36 MW of wind, solar, biogas and hydro generation scattered around the country to supply power to the equivalent of 12,000 households (23 MW) and has proven that theoretically Germany could run on 100% renewable power.
- Denmark will need to use VPPs and microgrids to attain its mandated goal of 100% renewable energy overall by 2050.

#### Presentation Ideas:

Peter Asmus focused his remarks on two technologies that can play key roles in 100% renewable power systems: microgrids and virtual power plants (VPPs) that allow microgrids, DR, storage, and renewable generation to work together.

He explained that microgrids are smart networks capable of optimizing and aggregating diverse distributed generation resources. They are flexible, energy resource neutral, and able to “island,” that is, disconnect from the larger grid, which is of interest especially in the wake of recent major storms. The state of Connecticut has passed the first microgrid law and now has 27 proposed microgrids.

Remote microgrids can also be used in areas where there is no, or a very weak, grid. Asmus reported that the United Nations is focusing on this as a solution for energy poverty and as a response to climate change. This lends hope that developing countries, instead of getting our rejected technology, could actually be on the cutting edge. Microgrids are becoming attractive in developing regions that depend on diesel, which is becoming more costly than solar, which fits easily into microgrid

solutions. This is especially so on islands where diesel costs 30-50 cents per kwh.

Asmus shared the example of the Canary island of El Hierro, which is known as “the 1<sup>st</sup> 100% renewable island.” El Hierro, which has no connection to a larger grid and had been running on diesel generators that were emitting 200 tonnes of CO<sub>2</sub> per year. They had installed pumped storage and wind turbines to which they added distributed PV, solar thermal, and a microgrid that gets all those technologies to work together. The company that worked on the project is a client of Pike/Navigant called Yunicos, which is a German group with the slogan “Let the fossils rest in peace.”

Virtual power plants (VPP), Asmus continued, are in many ways like microgrids, but they cannot island. Essentially, they aggregate distributed energy resources at a point in time only to meet demands in that moment. They can also expand and contract depending on market conditions. Navigant defines VPP as a “system that relies upon software systems to remotely and automatically dispatch and optimize generation, demand side or storage resources, including plug-in hybrid vehicles and bi-directional inverters in a single, web connected system.”

VPPs require a certain amount of smart infrastructure to be in place, unlike some microgrids that can just be run by inverters. Asmus sees VPPs and microgrids overlapping in the future.

In the US, Asmus explained, VPPs have no generation, only DR resources. Many vendors are focusing on the VPP model mainly because of FERC regulatory activities.

In Germany, he cited a case study of a Regenerative Combined Power Plant, which aggregated 36 MW of wind, solar, biogas and hydro generation scattered around the country. This project supplied power to the equivalent of 12,000 households (23 MW) and proved that theoretically Germany could run on 100% renewable power.

Basically, Asmus concluded, VPPs and microgrids are essential parts of a 100% renewable energy future. Take the country with the most ambitious goal – Denmark, which has a mandated target of 100% renewable energy overall by 2050. Asmus stated that the country can only reach its target by including VPPs and microgrids.

**Panel 2 – Speaker 6: Dr. Mark Jacobson, Professor of Civil and Environmental Engineering and Director, Atmosphere/Energy Program, Stanford University**

### Key Ideas and Recommendations:

- Drastic problems like climate change, security and air pollution require drastic solutions.
- Repowering the world with renewable resources is critical to address greenhouse gas emissions, air pollution, energy security, land use, water supply, and catastrophic risk.
- Jacobson's preferred electricity technologies are solar, CSP, wind turbines, geothermal, hydropower, tidal power, and wave power. These types of electricity production powering electric and hydrogen powered vehicles are what his team considers best for transportation.
- Their study found that if all energy consumption is converted to electricity and electrolytic hydrogen, the power demand goes down about 32% worldwide due to the efficiency of electricity vs. internal combustion.
- A global 100% renewable energy could require only .4 % of world's land for the footprint, .6% for spacing.
- A worldwide 100% renewable energy scenario could be realized with 50% wind (3.8 m 5 MW wind turbines), 40% solar (6% rooftop, 14% solar PV plants, 20% CSP), 4% hydroelectric, which already mostly exists, 4% geothermal, 1% wave and 1% tidal.
- There are not material limits to achieve this scenario, but recycling may be needed.
- Similar scenarios have been created on the state level for California and New York.
- Going 100% renewable would eliminate 2.5-3 million mortalities a year. The state of New York would save 32 billion dollars in health and other externality costs a year, a total of 3% of the state's GDP. California would likewise save 7% of state GDP by preventing health damage from conventional energy use.
- Going 100% renewable is not a technological or economic problem. It is a social and political program.

### Presentation Summary:

Dr. Jacobson has been developing plans for repowering the world, the US, and individual states with solar, wind, and hydropower. His team's primary concerns are climate, security, and air pollution. He explained that in the last 100 years, over 100 million people have died prematurely from fossil fuel pollution. Meanwhile, sea ice is disappearing, temperatures are rising fast, and higher population and increasing energy demand is causing energy shortages and high prices. He declared that drastic problems require drastic solutions.

His team evaluated what they assessed as the cleanest energy technologies in terms of the following criteria:

- Greenhouse gas emissions
- Air pollution
- Energy security
- Land use
- Water supply
- Catastrophic risk

They assessed that the highest ranking electricity options were solar, CSP, wind, geothermal, hydropower, tidal power, and wave power. These types of electricity production powering electric and hydrogen powered vehicles are what they consider best for transportation.

They did not recommend nuclear, carbon capture and storage, natural gas or biomass for most purposes. Liquid biofuels were not recommended due to pollution issues, regardless of the type – e.g. corn, sugarcane, or cellulosic ethanol or biodiesels or CNG.

In 2009, Dr. Jacobson and his colleague Mark Delucchi developed a world plan for 100% renewable energy, focusing on the technical and economic point of view.<sup>7</sup> A summary of their conclusions is as follows:

- The 2010 global end use power demand was 12.5 terrawatts for all purposes (power, transportation, heating/cooling, industrial).
- Based on EIA projections, the world energy demand will be 17 terrawatts by 2030.
- If we convert everything to electricity and electrolytic hydrogen, the power demand goes down about 32% worldwide due to the

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<sup>7</sup> *A Plan to Power 100 Percent of the Planet with Renewables* by Dr. Mark Z. Jacobson and Dr. Mark A. Delucchi, Scientific American (November 2009) <http://www.scientificamerican.com/article/a-path-to-sustainable-energy-by-2030/>



efficiency of electricity vs. internal combustion. This is before energy efficiency improvements come into play.

- The plan would only require .4 % of world's land for the footprint, .6% for spacing.
- In the US, a 37% reduction in power demand can be achieved just by converting our energy infrastructure.
- In California, there could be a 44% reduction in demand because transportation is where you get the greatest improvements.
- In the final scenario, they calculated it being made of 50% wind (3.8 m 5 MW wind turbines.) "If that sounds like a lot, said Dr. Jacobson, "keep in mind that we produce 70 million cars a year," and installing wind turbines is "a one time production for 30 years." Likewise, he explained, the world produced 750, 000 airplanes during WWII, nearly half of those in the US.
- 40% of the final scenario was solar (6% rooftop, 14% solar pv plants, 20% CSP)
- 10% of the scenario was everything else – 4% hydroelectric, which already mostly exists, 4% geothermal, 1% wave and 1% tidal
- There are not material limits, but recycling may be needed.

Dr. Jacobson also relayed specifics regarding his 100% renewable energy scenario for the state of California:

- There is more solar than wind. The scenario includes 25% onshore wind, 10% offshore wind, 10% residential rooftop PV, 15% government /commercial rooftop pv, 15% solar pv plants, 15% csp, 5% geothermal, 4% hydro (90% already exists, with no new dams needed for the rest because they can be on existing dams that don't generate electricity or by using existing dams more efficiently), .5 % tidal power, .5% wave power.
- The aforementioned renewables can replace all existing fossil, nuclear and biofuel.
- The land use and water area is shown in the graphic below.

In New York, Jacobson assessed that 100% renewable energy could be reached with a combination of 40% offshore wind, 10% onshore wind, and 30% solar, again not with a lot of land use. To put the land requirements for these amounts in perspective, he explained that there is about 340 terrawatts of solar potential worldwide in high solar locations, which equals roughly 30 times the world demand. Similarly with wind, there is 6-7 times more onshore or near shore wind available than world demand.

Jacobson also looked at whether we can combine these technologies to reliably meet power demand. His study for California looked at every hour

of renewable resource availability in 2005-6, and his team was able to match power demand - even without demand response, PEVs, or grid upgrades - 99.8% of the hours over those two years.

He asserted that if we were to add DR, storage, or oversize the grid to power, we could power demand and dump excess electricity for producing heating like is done in Denmark or for producing hydrogen. He said it is "just an optimization problem."

He and his team also examined costs, and came up with the following findings:

- Onshore wind at 4-10.5 cents/kWh is cheaper than natural gas in the Great Plains.
- Geothermal is competitive.
- Hydro is as well.
- Fossil fuels are 9.7 cents/kWh on average for electricity + 5.3 cents for external costs, so about 15 cents/kWh. These costs are projected to go up to 18-21 cents/kWh in 2020-2030. Meanwhile, the costs of clean energy technologies are coming down.
- In the five states in the US with the highest penetration of wind (in the Midwest), the average price of electricity went up on average 2 cents/kWh from 2003-2011, while going up on average 3.6 cents/kWh in other states. In Hawaii, which relies largely on diesel imports, the cost went up 17 cents/kWh. The reason the cost increase is lowest in the highest wind states is that fossil fuel prices are variable, whereas wind, water and solar only have upfront capital costs and free fuel.

From a health perspective, Jacobson said that going 100% renewable would eliminate 2.5-3 million mortalities a year. The state of New York would save 32 billion dollars in health and other externality costs a year, a total of 3% of the state's GDP. California would likewise save 7% of state GDP by preventing health damage from conventional energy use.

Jacobson ended by repeating a now familiar theme of the event: Transitioning to 100% renewable energy is not a technical or economic problem. It's a social and political program. He and his colleagues have started their own program called the Solutions Project<sup>8</sup> to support the changes needed.

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<sup>8</sup> See <http://thesolutionsproject.org/>

## **Panel 2 – Speaker 7: Dr. Harry Lehmann, German Federal Environment Agency (UBA) Climate & Energy Director**

### Key Ideas and Recommendations:

- Achieving 100% renewable power is not a barrier, but rather an opportunity.
- In the new power system, the different energy sectors will connect in new ways. For example, 32 million PEVs are expected to be on German roads by 2030-40. Also overproduction of renewable power may be used to make hydrogen and methane that is distributed in existing natural gas pipelines, which would allow electricity, along with other sectors like heating and transportation, to more easily become renewable resource based.
- The automobile industry is supportive of emerging solutions like “power to gas” (aka “solar methane”) because it does not want to keep having to change and is seeking long term planning.
- Airplanes may be able to use liquid fuels by similarly converting renewable power to gas.
- In the German Federal Environment Agency's (UBA's) roadmap for how Germany can achieve 100% renewable power by 2050 using resources within national borders, grid management and storage play key roles.
- In the 100% renewable power system, different sectors will connect in new ways. For example, a sizeable amount of the transportation sector will run on electricity.
- Also, the natural gas grid can be used to distribute gas created by renewable sources, such as excess renewable power that is used to make methane.
- The true barrier is not technical, but in the mind.

### Presentation Summary:

Dr. Lehmann opened by echoing previous opinions that achieving 100% renewable power is not a barrier, but rather an opportunity. He explained that in the roadmap his agency developed for reaching 100% renewable

electricity in Germany by 2050, attaining such a goal is technically possible the help of grid management and storage.

In the new power system, the different energy sectors will connect in new ways, he said. For example, 32 million PEVs are expected to be on German roads by 2030-40. Also the natural gas grid can become a key part of the solution, if overproduction of renewable power is used to make hydrogen and methane that is distributed in existing natural gas pipelines. This would allow electricity, along with other sectors like heating and transportation, to more easily become renewable resource based. Pilot projects that use the natural gas grid in this way are already in progress, including two cars at UBA that are running on this type of "solar methane." The automobile industry is supportive, says Lehmann, because it does not want to keep having to change and is seeking long term planning. Airplanes may be able to use liquid fuels by similarly converting renewable power to gas.

Lehmann added that he meets many skeptics does not think the technical barriers they are concerned about exist. "But," he stated, "we have to tear down the biggest barrier, the barrier in the mind."

## **Panel 2 – Question and Answer**

A question was posed from the audience regarding whether there is a need to internalize externalities into energy costs. Panelists agreed that this was important to creating a more realistic economic framework.

Also asked was how to address the political problem of so many focusing on natural gas and other conventional energy and setting only small renewable energy targets?

Dr. Lehmann replied that we have to give utilities a chance to make money in new markets. And clear goals must be written and followed. He said he was hopeful that people will change their minds in the next decade, reflecting that 30 years ago in Germany, utilities only thought about fossil and nuclear fuels. The new generation, he said, is more open minded.

Dr. Jacobson added that we have to dispel myths. In 2012, he said, the number one new source of new power in the US was wind. The bottom line is that there is a lot of misinformation about natural gas floating around.

## **Luncheon Keynotes**

### **Introduction by Melanie Nutter, Director of the City and County of San Francisco Department of the Environment**

Melanie Nutter opened the Luncheon with the following highlights of the City and County of San Francisco's track record and aspirations on environmental stewardship and energy innovation.

- Zero waste program – recycling and composting program diverts 80% of waste in San Francisco.
- EV infrastructure – 200 charging stations have been installed on public and private property, although the city's priority is public transit first.
- Green building policies – Any new construction must be LEED Gold. The commercial building ordinance requires any commercial building to establish benchmarks and report energy use back to the city, along with undergoing an energy audit every 5 years to increase awareness.
- GHG reduction: The focus is on mitigation in the built environment and transportation. San Francisco has reduced carbon emissions 14% below 1990 levels, which is double the Kyoto protocol. Going forward, San Francisco aims to achieve 25% below 1990 emissions by 2017 and 80% by 2050. Reaching 100% renewable power by 2020 is a critical component.

She then introduced the first luncheon Keynote Speaker, Dr. Donald Aitken.

### **Luncheon Keynote Speaker 1: Dr. Donald Aitken Aitken, Principal, Donald Aitken Associates**

#### Key Ideas and Recommendations:

- Mexico responded to harsh climate change impacts with a bipartisan bill in 2010 that mandates a 30% emissions reduction by 2020, a 50% reduction by 2050, and 35% renewable power by 2024.
- Mexico has a strong renewable resource base, including having the strongest wind potential in the world, the 3<sup>rd</sup> largest solar potential in the world, and large geothermal and hydropower resources.

- In Mexico, it is possible to get to 100% renewable power by overlaying intermittent resources like solar and wind with stable resources like geothermal and hydropower, and complimenting this mix with storage. Or as a less preferred choice, they could get to nearly 100% renewable power by using natural gas as a backup instead of storage.
- The town of Gualala, where Dr. Aitken lives, is a living example of how the pathway to 100% renewable energy in Mexico could be to start small and local and scale up. In 2007, he built the first passive solar designed house in his town that uses solar technology for its power and heating needs. Since then his lectures and word of mouth have catalyzed more than 400 solar in the area to go solar for their energy needs.

#### Presentation Summary:

Dr. Aitken focused his remarks on his effort to begin creating a 100% renewable power, heating, and cooling scenario for the country of Mexico. He relayed that he moved to Mexico's Lake Chapala area in 2006, and by 2007, found himself applying his decades of experience in the sustainability field on helping the region transition to renewable energy.

This occurred in a context of a nation that has been hard hit by climate change impacts. For example, Dr. Aitken recounted, 2010 Hurricane Alex caused massive floods, followed by Hurricane Frank, and in 2012, Hurricane Bud, Carlotta, Ernesto. Meanwhile, the northern half of Mexico was suffering extraordinary drought.

He said that Mexico responded more aggressively than the US to these disasters, with a bipartisan climate bill passed in April 2010 that mandates a 30% emissions reduction by 2020, a 50% reduction by 2050, and 35% renewable power by 2024.

Dr. Aitken explained that Mexico has a strong renewable resource base. The country has the 3<sup>rd</sup> greatest solar potential in the world, with 5.5-6.6 kwh/square meter/day all year long. Some groups are starting to develop large scale projects, but the contribution of solar power is still small. On a positive note, one concentrated PV system in Baja already has 50 MW and is aiming for 450 MW with a high (40-51%) efficiency conversion.

Mexico, he continued, also has the highest wind potential in the world, with 6 major regions of high (Class 4) wind potential. Most installed wind

capacity is concentrated where it is most economical down on the isthmus.

Geothermal energy is conveniently concentrated where it will be needed most, Aitken pointed out. Additionally, he said, 22% of Mexico's power is created by hydro, and the country has the second largest hydro project in world.

But how to get to 100% renewable power? He explained that key is to combine technologies appropriately. He cited research that has shown that combining solar and wind in California matches the state's load within 90%.

In Mexico, stated Aitken, it is possible to get to 100% renewable power by overlaying intermittent resources like solar and wind with stable resources like geothermal and hydropower and complementing this mix with storage. Or as a less preferred choice, he said they could get to nearly 100% renewable power by using natural gas as a backup instead of storage.

Dr. Aitken said that thinking big and national can start small and local start with one solar roof. He cited as an example his own home, which in 2007 when he built it, was the first one to have passive solar and heating in his region. In 2008, he gave several lectures about the house, and four more solar houses got built. In 2009, the number of solar homes rose to 17, by 2010, it was 30, by 2011, it was 200, by 2012, it was 350, and by mid-2013, more than 400 homes in the area were powered and heated by solar energy. "Now we are the solar capital of Mexico!" declared Aitken. If Mexico could continue to scale up this way and use all the renewable resources at its disposal, he concluded, it could mean energy prosperity for Mexico and protection of the earth from climate change.

### **Luncheon Keynote 2: Frances Moore Lappé, Author and Founder of the Small Planet Institute**

#### Key Ideas and Recommendations:

- The biggest barrier to 100 percent renewable energy is likely in our minds.
- We tend to see the world through cultural "mental maps" and thus see only what we expect to see.
- Humanity is creating the crisis-ridden world we live in, not because

most people actually want this, but because of the nature of the dominant mental map based on the assumption of scarcity.

- The “scarcity-mind” believes reality is made up of the three “S’s”: separateness of all entities; stasis as the nature of things; and scarcity itself -- that there is not enough of anything, from food to energy to human goodness.
- The scarcity-mind creates a spiral of powerlessness that prevents people from seeing the solutions that exist and from implementing them.
- Even the best-intended environmental messages focused on “hitting the limits” of finite resources can promote fear and reinforce the damaging scarcity-mind.
- We can move instead to an “eco-mind” emphasizing that our problem is not nature’s limits but that we’ve broken nature’s laws. Then, as we align with nature, fear eases for we realize there is enough for all, enough goods and enough goodness in human beings.
- The eco-mind perceives the nature of reality in three C’s: continuous change, connectedness, and co-creation. This mindset promotes a spiral of empowerment.
- The eco-mind sees that in an interconnected world, we each influence reality moment-to-moment, so the only choice we don’t have is whether to change the world: We are with every choice we make. The eco-mind sees that in a world of continuous change “it’s not possible to know what’s possible” so we are free to move toward the world we want, including the transition to 100 percent renewable energy.

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- The eco-mind sees what is possible, including the transition to 100 percent renewable energy, and believes we each have the power to be part of making that happen.

#### Presentation Summary

Frances Moore Lappé, acclaimed author and founder of the Small Planet Institute, began her address with a now recurring theme of the conference: “If there is a barrier to 100 percent renewable energy, it’s probably in our heads.”

She said she has come to realize that we can only see the world through culturally formed filters –or our “mental map,” as she calls it. As Albert Einstein said, “It is theory which decides what we can observe.” She added that we must ask ourselves, “What do we believe in?” Because

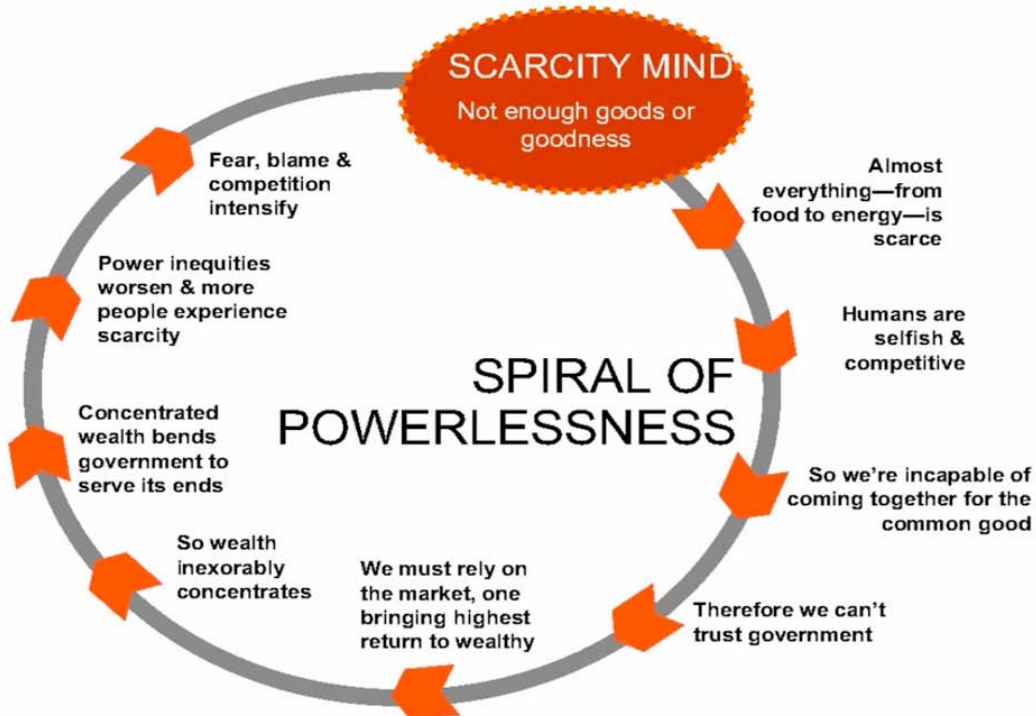
believing is seeing, and “if we are looking for the wrong thing, we will not see what’s right in front of our noses.”

Lappé pointed out that most people don’t want to live in a world so full of crisis and suffering as the one we have. So why are we creating a world together that not one of us individually would choose? “What is the cultural filter or the nature of our mental map that traps us so blindly?” she asked.

Her answer is the affliction of what she has labeled “scarcity-mind.” She pointed to an example she has been studying most of her life – food supply. Lappé noted that there are currently 20-30 percent more calories per person per day than there were in the late 1960s. So why is there still hunger in the world? “We are creating scarcity out of plenty,” she said.

Lappé explains scarcity-mind as consisting of three S’s: Separateness, Stasis and Scarcity. In this mental system, reality is made up of separate entities; things are static, and there is not enough of anything, from food to energy to human goodness.

The result of living in this scarcity-mind is a spiral of powerlessness, as illustrated below.



Lappé asserted that solutions to our problems – whether energy or food – are known. The biggest hindrance to our collectively recognizing and applying these solutions is this spiral of powerlessness, which starts with the misguided premise of scarcity.

She said that environmentalists' messages can unwittingly reinforce the spiral of a scarcity-mind. One example of such a message is the idea that we are approaching the limits of finite planetary resources. Even if this is a fact and has some place in the dialogue, she suggested that identifying the problem as “out there” – primarily as quantitative natural barriers we've run up against – can distract us from seeing how we humans ourselves are creating waste and destruction from plenty. Doing so generates fear and makes people feel vulnerable, often with unintended consequences. If people are afraid that there is not enough food, for example, they may desperately seek potentially damaging measures, such as geo-engineering and genetically modified (GM) seeds.

“The scarcity-mind fails,” Lappé explained, “because it is perversely aligned with our nature. Fueling fear, it can't meet deep human needs for connection, meaning and power.” She questioned whether this type of fearful mindset may be leading to more suicides, which she pointed out have increased by 65 percent worldwide in the last 45 years. More people kill themselves than are murdered or die in war in the world today. “The scarcity-mind is not working,” she reflected.

It is key, she continued, that we move from the scarcity-mind – the idea of hitting the limits of nature – to the “eco-mind” – the idea of aligning with the laws of nature. Another way of putting it is that we ought to be moving from 3 S's to 3 C's: continuous change, connectedness, and co-creation. This eco-mind, she says, generates a spiral of empowerment, as illustrated below.



She added that one reason Germany may have become a world leader in renewable energy is that its society cultivates this spiral of empowerment. For instance, it ranks 83 (of 100) in terms of how much money controls the political process. The US, on the other hand, ranks 29. She also cited leadership like late German Parliamentarian and renewable energy pioneer Hermann Scheer, who championed energy democracy and promoted positive messages; for example, that the sun supplies 15,000 times the daily dose of energy that we currently use.

With an eco-mind, Lappé explained, we can move out of this mindset of scarcity of goods and goodness. She noted Dr. Aitken's presentation as a fine example of how with an eco-mind, we can influence people, change each other from moment to moment, and recognize the power we have by the choices we make. We can rethink fear, she quipped, as an "inner applause" similar to our pounding heart. We can also develop bold humility. And we can celebrate surprises like the one she had when Texas, the heart of the fossil fuel industry, started becoming the nation's wind energy leader.

Rather than being an optimist or pessimist, Lappé rejoiced that she is becoming a "possible-ist," who sees that it is possible to go to 100 percent renewable energy – and that we all have the power to help make that happen.

### **Luncheon Keynote 3: Edwin M. Lee, Mayor of San Francisco**

#### Key Ideas and Recommendations:

- Mayors need to be focused, as the conference is, not just on announcing 100% renewable energy goals, but on how to actually get them done. Discussions like the conference are important to reveal what really is working, and where risk and resources can be put to get the biggest benefit.
- The local work has a global impact. Countries like China are no longer solely focused on GDP and other economic indicators, but on quality of life and environmental stewardship, and they are looking to frontrunners like San Francisco and others at the conference for leadership. They need leadership not only in technology and renewable energy commitments, but also in open governance.
- Highlights of recent clean energy achievements in San Francisco, include the 27 story Kilroy building, which has met LEED Platinum standards that can set the sustainability bar for other downtown development. The Bay Bridge is lit with 25,000 lights that only cost the city \$15 a day, while providing an artistic attraction that brings visitors and revenue to the city.
- There are 1000 green collar San Francisco city workers, and city energy policies have created other jobs as well.
- The Mayor is looking forward to achieving the city's zero waste and 100% renewable power goals by 2020, which he says have the programs and "the will power through the government agencies, the Board of Supervisors and the Mayor."

#### Presentation Summary:

Director of the City of San Francisco Department of the Environment Melanie Nutter introduced Edwin Lee, the 43<sup>rd</sup> Mayor of San Francisco. Mayor Lee opened by emphasizing that the conference's focus on how to achieve 100% renewable energy dovetails with the core of interest of Mayors, which is "not to just announce goals, but actually ..to get them done."

"I am glad to welcome this wonderful conference," he continued, "because I know that in the interaction with all the different voices from

academia, from business, from non-profits, from other government officials...will let us know what really is working, where can we put the risk and resources to get the biggest benefit and the biggest bang...We want to do this for the world."

He relayed that he had recently returned from China and realized how much other countries are looking to places like San Francisco and others represented at the conference for leadership. The Mayor reflected that the bragging rights among Chinese municipal leaders previously had focused on purely economic indicators, but that "qualitatively, this trip was a little different. They're not talking so much about GDP being the most important thing. They are talking about the quality of life in their city, and they're suggesting that they have a challenge...that they must do better as cities." If they are going to house tens of millions more people in the near future, Mayor Lee shared, they recognize "they've got to deal with their environment."

The Mayor celebrated some recent clean energy highlights in the City of San Francisco, including the newly opened 27 floor Kilroy office building that is to house Salesforce.com and that "had the boldness of announcing that they will be LEED Platinum." Mayor Lee said that the developers know they are "setting the stage" for other major building developments downtown to do the right thing by taking the dual challenges of energy savings and job creation saving challenge" and to "mold them into the very fabric" of new development.

He also pointed out the Bay Bridge lights, an achievement that he said blends art, energy efficiency, and gains for the city. With 25,000 LED lights, the Mayor said the energy cost for this massive project, which spans the Bay Bridge from Treasure Island to San Francisco, will not exceed \$15 a day. He said it also is expected to bring to the city \$97 million of additional revenue and 50 million visitors in the years ahead who will come to see the project.

Mayor Lee relayed that San Francisco's sustainability policies are paying off in other ways as well. For example, he said, the Energy Watch program creates new jobs, there are 1000 green collar city workers, and the Go Solar program has created more than 100 new jobs, with more to come particularly for the disadvantaged, so they can "see a path forward."

The Mayor, however, was unwilling to rest on the city's laurels. "I want to be challenged...by our Department of the Environment and all the ideas you have here at this conference...We need to get these goals implemented." He declared that whether it's Frankfurt or cities nearby,

“we want to join them in a Sister Cityhood that gets the job done for the rest of the world.”

He shared that China and others are looking for examples to show them a way forward, not only in terms of technology and commitment, but also in “our open government attitude about this.” As an admitted “bureaucrat” of 23 years, he said, “You’ve got to keep pressuring us to be more open in our government.”

Mayor Lee concluded by sharing that “the most exciting years I’ve had is implementing our environmental goals.” He shared that he is looking forward to achieving the city’s zero waste and 100% renewable electricity goals by 2020, which have the programs and “the will power through the government agencies, the Board of Supervisors and the Mayor.” The conference, he declared “will be of great help in making sure that the best ideas, the workable ideas come forward.”

### **Panel 3: Integrating 100% Renewable Energy Into the Transportation Sector**

#### **Introduction: Cliff Rechtschaffen, Senior Advisor to California Governor Jerry Brown**

Panel moderator Cliff Rechtschaffen opened the third panel with a brief background on California’s clean transportation goals. He emphasized that while the state of California is leading the United States on climate change, it is critical to the state’s climate goals, energy independence, and air quality to go further, in large part by decarbonizing transportation. He cited a major step in this direction taken by Governor Brown in 2012, the signing of an Executive Order to increase zero emissions vehicles in California to 1.5 million by 2025. The state has also set a goal to reduce greenhouse gas emissions from the transportation sector 80% by 2050.

#### **Question and Answer with Panelists:**

In view of these priorities, Rechtschaffen asked the panelists to answer two questions:

##### **1. What are the few things you would do in California to get us on that path?**

Panelists answered as follows:

- *Steve Davis, CEO at KnGrid:* His company is focused on lowering costs and increasing the adoption curve for plug-in electric vehicles

(PEVs). With KnGrid technology, he said PEVs are participating in the wholesale power market, including but not limited to demand response programs. He encourages a fee and dividend policy because vehicle owners will be paid by grid owners.

- *Tom Gage, CEO at EV Grid:* He seconded Davis. He said that we will have a million PEVs on the road by 2020, if not sooner, which will equal 25 GW of storage and about 10 GW of available power. They can either be integrated with the grid or cause problems on the grid. There is no middle ground. Key to PEV commercialization is the full integration of the vehicles as a power resource for the grid. A combination of utilities and regulators are currently standing in the way and needs to become part of the solution.
- *Peter Dempster, Business Development and Sales Manager at BMW's Drive Now:* Markets and incentives for renewable energy and for PEVs accelerate each other and act as lifestyle extensions of one another. Regulators should support new products like smart charging that allow PEVs to be a different player in the grid than they currently are.
- *Dr. Alexa Lutzenberger, Professor at the University of Leuphana:* We need completely new thinking in the transportation sector, she said. The past solution was the car using diesel or gasoline. Synthetic methane from excess intermittent renewable power production is one of the solutions we should add to the mix.
- *Riggs Eckelberry, CEO of Origin Fuel:* We are moving too slowly in well-head to tailpipe analysis. Liquid fuels will not be going away. Along with Steve Davis, he asserted that PEVs and liquid biofuels are natural allies and that range anxiety is an issue that can be alleviated by biofuels. He also added that algae can help to cleanly power PEV facilities.

**2. In the changing landscape foreseen, what will be the roles – and how will they change – for the traditional players, such as utilities, auto manufacturers, and power generators?**

- *Riggs Eckelberry:* The gorilla in the middle of the room is natural gas. It is viewed as a cleaner bridge fuel, but for how many decades will this last? Also, it is a fossil fuel. He quipped that his company can clean up frack water, and they happy to service that problem. But he reiterated that what he thinks is really needed is to move to well-head to tailpipe analysis and that California should take a lead.



- *Dr. Alexa Lutzenburger:* She said that using the existing natural gas infrastructure for synthetic methane or hydrogen is an opportunity to avoid immense costs and resources that would otherwise be needed to build new infrastructure. She added that we must be aware of constraints, including that there is not enough raw materials to make only battery-powered vehicles. We will also have to feed 9 billion people in 2050 and will be experiencing heavier impacts from climate change. Therefore, we cannot rely on land intensive or food sourced biofuels. We have to instead look at sustainable solutions, and we are only at the beginning of developing them. Biofuels and electric vehicles are part of the solution, but not the whole picture. She emphasized that we also have to look at whether we really need to move in any given situation or whether we have can use other options like teleconferences, Skype, and telecommuting.
- *Peter Dempster:* BMW is forming completely new, disruptive strategic partnerships. For example, the company is partnering with the largest wind energy developer in the country to offer a green energy package - which offsets electricity used by the BMW Active E during the two year lease - directly to PEV customers. That is, when customers go to the car dealer, they can sign up for a plan to buy 100% wind energy or solar for their home through a partnership with Real Goods Solar. Additionally, BMW is exploring battery second life in which PEV batteries that are no longer useful for automotive applications can be used for grid storage, which supports renewable energy intermittency.
- *Tom Gage:* Car companies are in retail and know how to sell cars. Oil distributors know how to sell gas. Utilities have no idea how to sell electricity on a retail basis, as this is not part of their highly regulated business. But this will have to change.
- *Steve Davis:* A recent California Center for Sustainable Energy (CCSE) [study](#) <sup>9</sup> showed nearly 40% of EV purchasers have solar at their home, indicating a strategic direction. Initiatives like the Colorado Solar Gardens Act, which introduced virtual net metering, suggests that utilities are starting to look like distribution system operators.

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<sup>9</sup> See: <http://energycenter.org/programs/clean-vehicle-rebate-project/vehicle-owner-survey/july-2012-survey>

## Panelist Presentations

Rechtschaffen introduced the individual presentations by explaining that the speakers were asked to think about addressing the following questions regarding California policy when framing their thoughts:

1. How can the state capture and monetize the full range of benefits of plug-in electric vehicles?
2. Should utilities be mandated to buy a certain quota of PEVs?
3. What should the role of natural gas be in California's transportation sector?
4. Is the California Low Carbon Fuel Standard, which requires a 10% reduction in the carbon intensity of fuels by 2020 and which is comparable to policy in the European Union and that which is under development elsewhere in the US, workable?

### Panel 3 – Speaker 1: Steve Davis, CEO of KnGrid

#### Key Ideas and Recommendations:

- Despite technological advances, OEMs are unwilling to support V2G because the regulatory frameworks to support a V2G market are still largely absent
- Enabling direct access tariffs by the PEV service providers downstream of the utilities meter and giving vehicle owners access to the wholesale access tariff is the only way to enable dynamic pricing, intelligent dispatch, and scenarios in which PEV owners enter the wholesale market.
- KnGrid entered into exclusive license agreement with RWE, a major German utility, which developed a bidirectional communications protocol with Mercedes Benz that has been installed in 5000 charging stations in Germany. This software will be part of a demonstration project at UC San Diego, as well as installed in Mercedes Smart ED 3 and the BMW i3.
- The revenue for PEV owners with this system is in ancillary services and is estimated to be \$300-500 month depending on what part of the country they are in.

#### Presentation Summary:

KnGrid started with a customer and central server for automakers that would be usable for customers from any utility and visible for any grid

balancing authority, said Davis. Then there is the charging space, which should also always be visible and dispatchable.

In spite of technological developments by companies like AC Propulsion, none of the OEMs are Vehicle to Grid (V2G) ready nor are they ready to support it. He implied that the reason is that regulators and utilities have not yet created the market. What is needed, he said, is “enabling direct access tariffs by the PEV service providers downstream of the utilities meter and giving vehicle owners access to the wholesale access tariff” which is “the only way to enable dynamic pricing, intelligent dispatch, and scenarios in which owners enter the wholesale market.” This is what utilities have in mind for demand response,” Davis added, but there is no transparent market for this. This has been a major source of tension.

Davis reported that KnGrid has entered into an exclusive license agreement with RWE, a major German utility, which developed a bidirectional communications protocol with Mercedes Benz. “This means the dispatch signal and dialogue with the system operator goes all the way down into to the battery management of the car, and the car tells the grid operator what it’s ready for. That is the smart grid we’ve all been dreaming of. That is a reality today.” He said that there are 5000 charging stations in Germany working this way. The Mercedes Smart ED 3 and the BMW i3 are going to be equipped with this software, and KnGrid is going to be demonstrating this at the UC San Diego campus starting in June.

Rechtschaffen interjected with a question: “What’s the revenue stream to the BMW owners in this?”

Davis responded that one is the ancillary services, and this is why the [Non-Generator Resource \(NGR\)](#)<sup>10</sup> market is being awaited to go into production later in 2013. The Federal Energy Regulatory Commission’s [755 rule](#) also has a pay for performance calculation.<sup>11</sup> Right now, he said people are seeing revenues of \$300-500 a month depending on what part of the country they are in. PJM, for example, has higher regulation prices. What the actual mileage payments come out to be remains to be seen.

### **Panel 3 – Speaker 2: Tom Gage, CEO of EV Grid**

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<sup>10</sup> See:

<http://www.caiso.com/informed/Pages/StakeholderProcesses/CompletedStakeholderProcesses/NonGeneratorResourcesAncillaryServicesMarket.aspx>

<sup>11</sup> See: [www.ferc.gov/whats-new/comm-meet/2011/102011/E-28.pdf](http://www.ferc.gov/whats-new/comm-meet/2011/102011/E-28.pdf)

### Key Ideas and Recommendations:

- The path of least resistance to integrating PEVs and power grids over the coming years is "Vehicle to Grid" ("V2G") solutions.
- This model has become a success story over the last 16 years.
- V2G began with a paper by Professor William Kempton of the University of Delaware, who later teamed up with AC Propulsion, which developed an electric drive system with a bi-directional charger.
- Early estimates of how much V2G charging could earn monthly as an ancillary service totaled approximately \$300.
- By 2007, the first operational V2G system was operating, and the following year, pilot projects with BMW and EV2G (a joint project by University of Delaware and NRG) were in progress.
- By 2013, V2G had achieved proof of concept, with about 300 kilowatts of ancillary services operating in PJM territory.

### Presentation Summary

Gage opened by posing the question of how PEVs and power grids will become profoundly integrated in the next years, so that the grid works and PEVs reach their full market potential. He responded that the path of least resistance is integrating PEVs into existing ancillary grid services – or what we call "Vehicle to Grid" ("V2G") today.

This model, he said, has become a success story over last 16 years. Gage laid out the highlights on following timeline:

1997- Professor William Kempton at the University of Delaware published a paper that proposed PEVs could participate in ancillary services markets.

1999 – AC Propulsion developed a drive system that included a bi-directional charger. Importantly, it met anti-islanding provisions for any grid tied inverter and allowed outside signals to control it. The company started working with Prof. Kempton. Around time Gage and his colleague Alec Brooks also visited Los Angeles Department of Water and Power (LADWP) and met with Angelina Galiteva (then LADWP Director of Strategic Planning) and David Freeman (then LADWP General Manager) and received seed funding to do a study on V2G.

2002 – By this time, Gage and his team had built a vehicle with a bi-directional charger, hooked up to a bi-directional charging station. They were working with the California Air Resources Board (CARB) and CAISO, for which they played the demand signal. They tallied that with real time pricing, the car would have earned \$300/month if it had been considered an ancillary service.

2005 – By then, Professor Kempton had a real program up and running to develop software and hardware to allow the vehicle to communicate, the grid operator/ third party to aggregate many PEVs, and to present them as one entity to the grid operator.

2007 – By this year, Prof. Kempton had a PEV built by AC Propulsion that had this bi-directional charger on board. It worked properly and was demonstrated live at FERC. Jon Wellinghoff, who later became FERC Chairman, then coined the term “Cash back cars.”

2008 – BMW produced a fleet of V2G capable cars based on their Mini E's using an electric drive system from AC Propulsion. NRG also joined forces with the University of Delaware and formed the EV2G project that would take on aggregation responsibility and license the University of Delaware software.

2012 – The Mini E program was winding down, with 30 put into a fleet in Delaware. PJM meanwhile agreed to accept the ancillary services. It was necessary to make sure the response of the vehicle was faithful to the PJM command, and this took time to work out.

2013 – Other vehicles are now being brought into the mix, and “we currently have a true proof of concept,” Gage affirmed. He added that there should be about 300 kilowatts of ancillary services operating in PJM territory. He declared that on March 28, 2013, “We received our first check!”

### **Panel 3 – Speaker 3: Peter Dempster, Business Development and Sales Manager at BMW's Drive Now**

#### Key Ideas and Recommendations:

- BMW sponsored an event called Pathways to 100% Renewable Energy because it is aligned with several of the company's priorities.
- BMW has been focused on using renewable energy and other sustainable technologies to produce its vehicles.

- Manufacturing PEVs can produce up to 30% more greenhouse gas emissions than conventional vehicles, but making them with renewable power can erase that emissions increase.
- Markets for PEVs and renewable energy can go well together, as evidenced by the popularity of purchasing home solar products among BMW customers.
- With 80% capacity left in PEV batteries after 10 years, battery 2<sup>nd</sup> life is area of research that holds considerable potential.
- In one experiment, BMW found that a system it installed combining battery storage, solar, an multi-port inverter, and a smart meter, which allowed the battery to discharge in response to building load needs, could produce substantial energy savings.
- 2<sup>nd</sup> life batteries can also be used to back up the grid and act as a micro-island with solar panels, in the event the grid goes down.
- BMW is additionally looking into integrating low cost, 2<sup>nd</sup> life batteries with large scale solar and wind, with demonstration projects around the world.

#### Presentation Summary:

Peter Dempster opened with the following question: "Why has a car company sponsored an event called 'Pathways to 100% Renewable Energy'?"

He began his explanation by laying out three points to the PEV lifecycle:

- **Production**

BMW has been aiming to use renewable energy and other sustainable technology in the production of its vehicles. The company invested \$100 million in a carbon fiber production plant in Washington state, where the company has access to hydro-electric power. In Spartanburg, SC, BMW builds 300,000 vehicles annually using landfill biogas to supply half of energy needs. All handling equipment there is powered by hydrogen fuel cells. They are researching turning some of the landfill biogas into hydrogen to further reduce production emissions. In Leipzig, Germany, where the i3 is being produced, production is powered by a local wind farm.

BMW is especially focused on making EV production clean, explained Dempster, because there may be higher emissions associated with making these vehicles – up to a 30% increase. That evaporates, if renewable energy is used to produce the vehicle. The i3 expected to actually see a 50% reduction in greenhouse gas emissions compared to very fuel efficient diesel with the help of wind powered production throughout its lifecycle.

- Utilization

Markets for PEVs and renewables can go well together, Dempster said. Illustrating the point, 40% of MINI-E customers had invested in solar.

Among conventional BMW buyers, adding a green electricity package to their PEV purchase increased the take rate by 23%. These numbers led to two products offered with the BMW Active E: 1) a partnership between BMW and Green Mountain Energy, a major wind power producer, wherein customers purchase Renewable Energy Credits (RECs) in the equivalent amount of electricity the Active E uses in a two year period with a mechanism for topping up. 2) BMW established a home solar preferred partnership with Real Good Solar, wherein buyers could opt for a power purchase agreement or purchase of the entire asset with the purchase of their car. A customer poll showed that 30% of Active E customers invested in a renewable power product, while 60% of the remaining customers were looking into it and intended to purchase such a product in the next 3 years.

- Battery 2<sup>nd</sup> Life

Recognizing that after 10 years, there is still 80% capacity left in a PEV battery, Dempster said that BMW has been researching what market potential there could be for the battery in a second life after it is no longer optimal for vehicle charging. One experiment was done the day before the conference at the BMW Mountain View, CA, where the company has a 30 kWh lithium ion battery, a 100 kw 4 port inverter facility, and solar panels. The company practiced “peak shaving” in which they set a limit to the power that the building would consume and had a real time connection between the building smart meter and the battery, so that the battery could discharge in response to real time building load. With that system, they are expecting to save about \$300/month in electricity costs.

Another potential benefit identified for 2<sup>nd</sup> life battery is that if the grid goes down, the battery in combination with solar power can create a

micro-grid island. BMW is also looking into integrating low cost, second life batteries with large scale solar and wind, with demonstration projects around the world.

Dempster concluded by pointing out that sustainable electric mobility is very disruptive. People are fueling at home, for example, and emissions are no longer associated with onboard liquid fuel use. Similarly, 100% renewable energy is very disruptive, and he said "I hope that you are all part of the disruption."

### **Panel 3 – Speaker 3: Dr. Alexa Lutzenberger, Professor at the University of Leuphana**

#### Key Ideas and Recommendations:

- In planning for 2050, we cannot separate transportation from other energy sectors, nor can we separate the discussion of 100% renewable energy from resource efficiency.
- There is also not just one mobility solution. While electric vehicles are great solution for cities and car sharing, they are limited for mid-range and long-range driving, and there are not enough raw materials to build enough of them for global use. Biofuels, on the other hand, are good for maritime transportation, while pure plant oil can be used for agricultural or fishing applications because it is non-toxic if leaked. Methane produced from excess renewable power is another massive opportunity that can be efficiently applied to power, heating/cooling, industrial, and transportation sectors – and can take advantage of the existing natural gas grid.

#### Presentation Summary:

Dr. Lutzenberger stated that in planning for 2050, we cannot separate transportation from other energy sectors, nor can we separate the discussion of 100% renewable energy from resource efficiency. A windmill, for instance, requires substantial resources to be built and is more efficient when it is working.

There is also not just one mobility solution. While electric vehicles are great solution for cities and car sharing, they are limited for mid-range and long-range driving, and there are not enough raw materials to build enough of them for global use.



Biofuels, on the other hand, are good for maritime transportation, while pure plant oil can be used for agricultural or fishing applications because it is non-toxic if leaked.

Dr. Lutzenberger pointed out that the large existing natural gas grid provides a massive opportunity, if excess renewable power from a 100% renewable power system is used to create methane. Essentially, the excess power can be used to turn hydrogen and carbon dioxide created by industry into renewable based methane. The oxygen that is a waste product from the process can be used for industrial applications and to make industrial processes more efficient.

While hydrogen alone can technically only make up 10% of the content in the natural gas grid, she explained that renewable power to methane has the same consistency as natural gas, so is without limit. 380 terrawatt hours of electricity can potentially be produced from excess renewable power and stored in the natural gas grid.

Using this renewable methane simply to make electricity has a low efficiency of only 36%, but if the waste heat from the process is used to create and store heating and cooling, the efficiency climbs to more than 85%.

### **Panel 3 – Speaker 4: Riggs Eckelberry, CEO of Origin Oil**

#### Key Ideas and Recommendations:

- California is home to 318,000 clean tech jobs, but this number could be much higher if the state better supported other aspects of the sector beside research and development.
- Along these lines, California ought to nurture the entire algae industry or continue to risk losing jobs to other locations.
- To remove “apathy of adoption,” all barriers must be taken away to using algae (or any energy source) – i.e. It must become plug and play like gasoline is today.
- To support clean, alternative fuel development, the EPA ought to track lifecycle emissions instead of tailpipe emissions.
- Algae has vast and varied market potential other than clean fuel, including nutritional, pharmaceutical, feed, and fertilizer applications.

- Low production costs are key to algae reaching its market and job creating potential; \$66/barrel production costs are competitive and feasible.
- Algae has numerous environmental and technological advantages over fossil fuels throughout its lifecycle and would fit into a Low Carbon Fuel Standard.

#### Presentation Summary:

Mr. Riggs opened by asserting that although California makes business more expensive for some with its greenhouse gas regulations, the state also is home to a clean tech sector with 318,000 jobs that makes sense to nurture. However, when it comes to doing anything in energy other than researching, companies tend to move their business elsewhere. Aurora Algae, for instance, began its research and development in California, but when it came time to open a commercial production facility, the company did so in Australia. Eckelberry stressed that the whole algae industry needs to be nurtured to generate jobs.

He said another challenge to address is the “apathy of adoption.” How do we get people to respond to anything? The answer is to take all the barriers away. Plug and play is essential.

Another issue he raised is that EPA is only tracking tailpipe, rather than lifecycle, emissions. There are a lot of problems, however, associated with the lifecycle of fossil fuels, including methane emissions which is a particularly deleterious greenhouse gas. The attractiveness of natural gas and liquid fuels like gasoline is that they are plug and play, but we need something better than fossil fuel, and it must be cheaper.

Algae is an important solution, asserts Eckelberry, not just because it can be a clean energy fuel, but also because it has vast market potential. The nutritional and pharmaceutical algae business is well established and strong, for example, and new industries are emerging in fertilizer and feed, in addition to fuel. Realizing the potential of these markets will require low production costs, he said, but if we succeed, we will have a lot of jobs. He added that \$66/barrel production costs for algae are feasible, which is very competitive.

Advantages of algae include:

- Can be farmed anywhere.
- Product can go to distant processing centers.
- Wide participation all the way down to the farmland level.

- Loves arid land and salty water.
- Carbon neutral, so every pound you use displaces carbon in fossil fuels.

Eckelberry summed things up by stating that the algae industry can take advantage of a Low Carbon Fuel Standard (LCFS) and create real jobs that are not just in research, but also in farming, processing, and refining. While fossil fuels will keep getting more expensive, algae will get cheaper and will find multiple uses.

### **Panel 3: Closing Questions**

The panel closed with a question from the audience: Why would someone want to volunteer their EV battery for second life use on the grid?

Tom Gage responded because “batteries are getting better and better” and because the owner gets a financial consideration, either through cheaper electricity, cheaper battery costs, or an outright payment.

### **Panel 4: Zero Net Energy Buildings: Samples and Best Practices from Around the World**

#### **Introduction by Moderator, Andrew McAllister, California Energy Commissioner**

#### Key Ideas and Recommendations:

- California’s policy is to aim for all new residential construction to be ZNE by 2020 and all new commercial construction to be ZNE by 2030.
- ZNE is a balance of energy efficiency and renewable energy
- A major challenge is to adopt a definition of ZNE that can be put into building code, which California aims to do in its 2013 Integrated Energy Policy Report (IEPR).

#### Summary:

Commissioner McAllister oversees California ZNE policy, which he explained has set goals to make all new residential construction zero net energy (ZNE) by 2020 and all non-residential construction ZNE by 2030. He stated that distributed renewable generation (e.g. rooftop solar) customers and those who pursue energy efficiency improvements are

within the building performance rubrick, making artificial barriers between the two unnecessary. Essentially ZNE is balance of energy efficiency and renewable energy.

He clarified that California does not yet have an adopted definition of what a ZNE building is, in large part because of the challenge of putting that into code. The California Energy Commission, however, is looking at that issue in the 2013 Integrated Energy Policy Report (IEPR)<sup>12</sup>, which is headed by Commissioner McAllister. It is urgent to come up with a definition, he asserted, because the state's building standards under Title 24<sup>13</sup> are updated every three years, and there are only a few more cycles before the state's ZNE target date.

#### **Panel 4 – Speaker 1: Stefan Henningsson, Senior Advisor Climate Innovation at World Wildlife Fund (WWF) International**

##### Key Ideas and Recommendations:

- Buildings are part of the 100% renewable energy transition in all sectors.
- We could potentially save 25% of global energy use just in the building sector, which is about the equivalent amount of energy used by the transportation sector.
- Buildings account for about 38% of global energy use, which must be greatly reduced by 2050.
- The main issue is not availability of technologies, but getting them adopted at scale.
- In 2011, WWF released a report laying how to achieve 100% renewable energy globally by 2050.
- WWF's headquarters in the Netherlands and the US are case studies of ZNE building.

##### Presentation Summary:

Mr. Henningsson opened with a few fundamentals. First, he noted that buildings are part of the 100% renewable energy transition in all sectors. Second, he said that according to the IEA, there is potential to save 25%

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<sup>12</sup> <http://www.energy.ca.gov/2013publications/CEC-100-2013-001/CEC-100-2013-001-CMF.pdf>

<sup>13</sup> <http://www.energy.ca.gov/title24/>

of global energy use in the building sector alone – roughly equivalent to the amount of energy used by the transportation sector. Third, buildings account for about 38% of global energy use, and this must shrink a good deal by 2050. And fourth, the issue is not availability of technologies, but getting technologies adopted at scale.

Henningsson then laid out key principles and findings of WWF's 100% renewable energy by 2050 scenario that it created in 2011:<sup>14</sup>

- Renewable energy is expected to be efficiently used to account for all building heat.
- All new buildings will be ZNE.
- Existing buildings will be retrofit at a high rate (2.5% of floor area annually), an ambitious rate that has, in fact, happened in some parts of the world.
- Heating solutions include solar thermal, geothermal, and biomass.
- The changes must mainstream. Cited as an example is the City of Freiburg, Germany, which has reduced household energy consumption by up to 80% by investing and subsidizing millions of euros and implementing strict building standards. New builds in 1992 had a stringent local standard of 65 kwh of heating energy per sq meter per year. Recently that standard has been tightened to 15 kwh of heating energy per square meter per year, which is essentially a Passive House standard. This requires only a couple kilowatts of solar to have an energy plus house that can charge your car.

Henningsson pointed out that WWF has two headquarters that are case studies of ZNE building. Their building in Washington, DC is in addition to ZNE, quadruple LEED Platinum. The building is equipped with motion sensor lighting, solar hot water heating systems, and the third biggest green roof in the United States, which helps take rainwater off streets.

The WWF headquarters in the Netherlands includes local materials, a heating and cooling system that uses geothermal principles, triple glazed windows with wooden louvers that allow for adjustable lighting, finishes with recycled content, and power supplied by rooftop photovoltaic panels.

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<sup>14</sup>See: [http://wwf.panda.org/what\\_we\\_do/footprint/climate\\_carbon\\_energy/energy\\_solutions22/renewable\\_energy/sustainable\\_energy\\_report/](http://wwf.panda.org/what_we_do/footprint/climate_carbon_energy/energy_solutions22/renewable_energy/sustainable_energy_report/) An update addressing the availability of materials critical to the transition to a 100% sustainable energy future and how and which supply-chain bottlenecks should be addressed is here: [http://awsassets.panda.org/downloads/critical\\_materials\\_report\\_jan\\_2014\\_lr.pdf](http://awsassets.panda.org/downloads/critical_materials_report_jan_2014_lr.pdf)

## **Panel 4 – Speaker 2: Byron Benton, Training Director Zero Net Energy Center Alameda County**

### Key Ideas and Recommendations:

- The Zero Net Energy (ZNE) Center is a training facility for electrical workers that practices what it preaches on sustainability by producing as much energy as it consumes.
- The ZNE Center was designed to use 75% less energy than a comparable commercial building, so that it is able to supply all the electricity needs for the building with less than 140 kw of solar and wind power.
- Construction costs were about the same as a comparable traditional construction project.

### Presentation Summary:

Mr. Benton focused his remarks on the Zero Net Energy (ZNE) Center, which opened in Alameda, California in May 2013 and aims to produce as much energy as it consumes. The ZNE Center, which offers sustainability focused electrical career training to 2,000 apprentice and journey-level electricians in Alameda County, is able to achieve its goal first and foremost because it was designed to use 75% less energy than a comparable commercial building. The energy saved in the 46,000 square foot building, Benton stated, is the equivalent of 500 fewer barrels of imported oil annually, of taking 30 gasoline passenger vehicles off road a year, and of reducing the building's carbon footprint by 175 tonnes. Notably, the construction costs for the ZNE Center were about the same as traditional construction projects.

Since 2011, the training center has been jointly owned by the International Brotherhood of Electrical Workers Local 595 (IBEW) and the Northern California Chapter of the National Electrical Contractors Association (NECA). Partners on the project included FCGA Architecture, Environmental Building Strategies, and Noble Construction.

Specific technical features of the ZNE Center include:

- **Roof monitors**, a signature element of the building that are anywhere from 8 feet square to 8 ft x 24 ft and that support solar panels, let natural light into the building below, and exhaust air by use of natural ventilation out of the site through the east and west vents. On the north side, one side

faces south and heats a wall, creating thermal mass that in the winter will help heat the core of the building naturally.

- **LEDs** with lighting control and occupancy sensors.
- **“Variable refrigerant flow” (VRF)**, which Benton explained is a more effective way to transfer heat. With VRF, when you cool a space, heat is removed, and liquid refrigerants are turned into a gas. The gas can then get redirected to another part of the building to heat.
- **Laptops that are 90% more efficient** than the previous computers
- **Onsite solar and wind power** systems totaling 139 kw

#### **Panel 4 - Speaker 3: Riggs Eckelberry, CEO of Origin Oil**

##### Key Ideas and Recommendations:

- With the support of national regulations in France, Origin Oil has pursued a joint venture to grow algae in tubes on the roof of La Défense in Nanterre, which is harvested with the Origin system, as well as to sanitize the building's waste water with the Origin algae system.
- The project has been particularly lucrative and is part of an emerging group of experiments in “urban algae.”

##### Presentation Summary:

Origin Oil undertook a joint venture in Paris, France with its investor Ennesys that is taking advantage of a French energy regulation (RT 2020) mandating that by 2020, all new buildings must be “energy positive” – i.e. produce more energy than they consume - and that they naturally purify and recycle their own water.<sup>15</sup>

France is in a building boom, explained Eckelberry. He said that while building high in Paris is prohibited, on the outskirts and in the provincial regions, there are very tall buildings, and all must be RT 2020 compliant.

At La Défense in the Parisian suburb of Nanterre, the joint venture is growing algae in tubes on the roof, harvesting it with the Origin system, and then sanitizing the waste water with the Origin algae system. The project is intended as an adjunct to a solar PV strategy.

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<sup>15</sup> <http://www.rt-batiment.fr/batiments-neufs/reglementation-thermique-2012/presentation.html>

So far, the project has been unusually lucrative. The return on investment has been 14 fold, and Eckelberry says they are expecting the post-money valuation to soon be around 40x because the French government is getting into the act.

The project is part of the beginnings of “urban algae.” Another experiment Eckelberry noted is a building in Hamburg, Germany where algae is growing in louvers on the façade.<sup>16</sup>

#### **Panel 4 – Speaker 4: Robert Fortunato, Creator of the Green Idea House**

##### Key Ideas and Recommendations:

- The Green Idea House shows that an average, two story California single family home can be retrofit go be ZNE, zero carbon, and non-toxic at less cost than conventional construction.
- Keep it simple when defining ZNE for the masses: Reduce the energy load first by doing the simple things: e.g. orientation and overhangs for heating and cooling, good air sealing. Then when the loads are reduced, harvest as much energy with renewables as the building occupants use on an annual basis.
- The keys to reducing ZNE retrofit costs: use less materials, create less waste, do it with less embodied energy and toxicity, repurpose items that would have gone into landfill. Logically that should cost less.
- The Green Idea House reduced the energy load by over 70% compared to the old house before the retrofit - and this was with 800 sq. ft added to the old house. A simple solar PV array generated 3 MWh more energy with a 6.5 kilowatts rooftop solar array than the occupants used. Even adding an EV did not make a significant dent in the electricity bills.

##### Presentation Summary:

Fortunato is the builder and owner of the Green Idea House, a single family home in Hermosa Beach, California that was recently retrofit to be zero net energy, zero carbon, and non-toxic – at less cost than conventional construction. The Green Idea House was 5 years in the

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<sup>16</sup> <http://www.iba-hamburg.de/en/themes-projects/the-building-exhibition-within-the-building-exhibition/smart-material-houses/biq/projekt/biq.html>



planning, 1 year in construction, and at the time of the conference, was 1 year in testing.

Fortunato recounted that the concept came to him in 2001, when his son was born, and the growing family needed more space. Prior to that moment, he and his wife had worked and traveled for two years overseas and understood that the rest of the world uses far less resources and energy than Americans do. While teaching in Denmark, he also visited some of the most sustainable places in that country, like Samsø Island, which has reinvented their economy and ecology around their available space and resources. He saw from his travels that “the future is here, it is just unevenly distributed.”

As an economist, explained Fortunato, it was clear that with the Green Idea House, “we had to measure - to track how the building works and what it costs.” He said that tracking can be done simply via household utility bills. Fortunato argued that the general population needs that kind of simplicity when it comes to learning about and adopting ZNE, and in that spirit, offered that ZNE be defined in easy terms as: “We harvest as much renewable energy as we use on an annualized basis.”

Fortunato stated that with ZNE building, “We have the opportunity to lock in our utility rates forever. It is a hedge against inflation. You can do it for less money than standard construction.”

He noted that up to 53% of energy goes into building sector. “So much energy is being wasted on the job site. If you use less embodied energy, create less waste, do it with less toxicity, and repurpose items that would have gone into landfill in the construction process, it will cost less. This is doable today, and we did it.”

Fortunato told the audience that on Google Sketch Up, his family designed the building for free. They just had to re-understand where South is. “50-60% of the heating and cooling in my house comes from a (south facing) 5 ft overhang that in the summer, shades the building, and in the winter brings in heat – for free.”

Part of the Fortunatos' goal was to create a community around their idea. They have succeeded by having thousands of people tour the project, with thousands more visiting project the website.<sup>17</sup>

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<sup>17</sup> <http://www.greenideahouse.com/>

The Green Idea House, Fortunato noted, has gone on to win several awards and to become a model home in Southern California Edison's ZNE program. But one of the biggest benefits has been the new slashed household energy bills.

In the first year, the Green Idea House, which is equipped with 6.5 kilowatts of rooftop solar power, created 3 MWh more energy than the Fortunatos used. High efficiency construction and appliances cut the energy load by over 70% compared to the old house pre-retrofit, despite the fact that 800 new square feet were added during the retrofit. This was achieved "all with simple stuff that costs less money," said Fortunato. Even adding an electric vehicle did not make a significant dent in electricity consumption and bills.

Commissioner McCallister commented that while it is critical to bring the public on board with simplicity, regulators still need a definition so that building departments know how to assess whether a project passes code or not. Questions must be answered, such as what happens if someone loads up a building that starts out ZNE with new fixtures and appliances that cause more energy to be consumed than the building produces? Is the building no longer ZNE? How do codes address these types of issues?

**Panel 4 – Speaker 5: Tom Thompson, President, Solar Energy Business Association of New England (SEBANE), CEO, Gridwerks Consulting, Inc. Policy Director, New York Solar Energy Society (NYSES)**

Key Ideas and Recommendations:

- ZNE is nothing new – it has been around for decades – but in the Northeast, there is more interest since Hurricane Sandy.
- ZNE is a pathway to new jobs.
- The most effective policy mechanism to generate more jobs on the onsite renewable energy front has proven to be the well designed feed-in tariff, such as the one deployed in Germany, which has long led the world in solar installations. Unfortunately in the US, this policy has been demonized on false pretenses of threatening grid stability and raising energy prices.
- Rooftop solar combined with battery storage can ensure secure power during times like Hurricane Sandy. During the hurricane, while the region suffered widespread electricity outages, one school with

a such a powered the school and provided emergency shelter for 80 people for four days.

- America needs stronger leadership, starting with hearing from strong 100% renewable energy experts and advocates.

Presentation Summary:

Thompson started out by asserting, "ZNE has been done. The future was 33 years ago. Today, even Walgreens is going net zero."

But the dialogue has ramped up in the aftermath of Hurricane Sandy, said Thompson. He noted that New Jersey Governor Chris Christie has been advocating for preparing for climate change, even if you don't believe in it.

ZNE building, he explained, can be a pathway to getting people employed. On the renewable energy front, he asserted that the most effective mechanism is the well designed feed-in tariff, as others had discussed over the course of the conference, which can help leverage the massive resource of solar power. He noted that while China may be now leading on global manufacturing of PV, Germany is still way ahead on installations, proving that well designed feed-in tariffs are the policy that get solar panels and other renewable power sources up and running. Unfortunately, Thompson lamented, the feed-in tariff has become demonized in state houses of America. The list of excuses, he said, include that it will destabilize the grid and that it is too expensive. However, "the Germans have shown us that it is not a technical problem. The grid has not fallen apart." The same is true for forecasting renewable electricity. "Just because some renewables are intermittent does not mean they are unpredictable."

Thompson said that there is a strong business case for decentralized renewable power like rooftop solar. He explained that we can use batteries to store energy, and if the grid goes down, we can still have power.

He told the story of Bayonne Middle School's solar system, which when Hurricane Sandy hit, powered the school and provided emergency shelter for 80 people for four days.

Thompson noted that more renewables in the grid are bringing down spot prices of power. His colleague Dr. Richard Perez shows that the value of solar for customers is about \$300/MWh in NJ, where SRECs are trading for \$150.

He closed by quoting the CEO of Siemens as saying “Germany’s shift to renewable energy is the project of the century.” Thompson added, “Where is that kind of leader in America? Maybe America needs to hear from us.”

#### **Panel 4 – Speaker 6: Mike Layton, Assistant Business Manager Southern California Pipe Trades, DC No. 16**

##### Presentation Summary:

Mr. Layton asserted that ZNE buildings should meet a “triple bottom line” of reduced environmental impact with peak efficiency; improved capitalization rates, which increases marketability and allows attractive lease rates; and higher productivity and reduced absenteeism among commercial building occupants.

He emphasized the need for three main actions: to set local, state and federal regulations and standards for high performance buildings, to build a train workforce to build them, and to educate customers about the energy efficiency, safety concerns, and complexity of these new building systems.

Training in high performance buildings must cover a wide range of subject matter, including energy, plumbing, heating and cooling. To help further education about ZNE building, Layton recommended that mobile training centers could be brought to conferences to teach about technologies like solar thermal and water usages.

He emphasized that sustainable building is a pathway to jobs for his union, pointing out that 65-70% of credits that qualify for LEED standards are installed by craftsmen from the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States, Canada and Australia (UA).

#### **Panel 4: Question and Answer**

**Andrew McAllister, Moderator:** How does the marketplace need to evolve – and how can policy support this - so that the skill sets are out there in sufficient numbers to allow the zero net buildings and high penetration of renewable energy and energy efficiency that we need to see happen?

##### **Summary of Panel Answers:**

- Big business leaders must continue to call for much stricter standards from the policy side.
- We need to clear up misperception in the construction industry that it costs 20-25% more to construct a Zero Net Energy house. The reality is not so, but the misperception makes policymakers hesitant.
- There is a moral call for developed countries to show the way, in order to prevent millions in developing countries from moving into the cities, where there is all too often an emphasis on inefficient, cheap pre-fabricated buildings.
- We must be sure to not be too specialized in training, so that we create a well rounded skilled workforce, as it is imperative that we get renewable energy and energy efficiency systems that work well.
- Create a system that says if one creates a building that performs well, one will get a bonus. Currently, the money for builders in places like the US is in the waste, not in the performance. Architects and contractors are generally paid by the square foot, so that bigger buildings are more lucrative. Buildings must work at the utility bill level, and policy and regulatory systems must support that.
- Focus on the fact that this is a major opportunity to push the jobs agenda for renewable energy and building trades.
- A well designed feed-in tariff has proven to be the most robust job creating policy in the renewable electricity business, and these should be implemented in the US to promote job growth.

**Question from the Audience** – In Nevada, we have enough solar to power the US, but our utility is focused on natural gas, and our legislature is uninformed. How do we create an informed, motivated public without any leadership in the state?

#### **Summary of Panel Answers**

- The lessons will come as you start working on ZNE projects. Start spreading the message today.
- You have to overwhelm the system with a grassroots movement.

## **Panel 5: Communities and Regions Leading the Way to 100% Renewable Energy**

Moderator Dr. Don Aitken introduced the final panel of the day, which showcased how specific cities and regions are setting and achieving 100% renewable energy targets. The panel also included observations from experts who have been at the forefront of following the 100% renewable energy movement in Europe. Included on the panel were representatives and elected leaders from five cities/counties that have made commitments to 100% renewable energy. Spanning the political spectrum, these officials emphasized that shifting to efficiently used renewable energy should not be a politicized agenda, but rather one that simply makes sense to boost local economies and protect current and future generations.

### **Panel 5 – Speaker 1: Bertram Fleck, Head of the District of Rhein-Hunsrueck, Germany**

#### Key Ideas and Recommendations:

- The rural District of Rhein-Hunsrueck Germany has transformed from an energy importer to an energy exporter in less than two decades.
- Such a transformation requires leadership that rises above ideologies and gets the job done to set an example, rather dwelling on all the reasons that renewables are difficult.
- Local governments play a critical role in the energy transition. While the federal sets laws and regulations, local governments must convince the local people to adopt them and must carry them out successfully.
- Economics was a main driver behind Rhein-Hunsrueck's decision to adopt a 100% renewable energy plan. The district wanted to stop spending millions on fuel imports and build up its minimal industrial economy.
- Local governments should begin with building efficiency and conservation improvements to avoid overspending on renewable energy technologies, and it should start with public buildings to set an example.
- Local governments should also create solid plans for transitioning to 100% renewable energy to avoid making future mistakes.

- It is also critical to provide community education tools about renewable energy, including for children.
- By 2013, the district was home to 14 biomass plants, 3000 solar PV systems, and 149 wind turbines that covered 104% of electricity demand, and these figures are expected to rise in 2014. By 2015, Rhein-Hunsrueck will have nearly 300% electricity generated by renewables, with the ability to export 200%.
- By mid-century at the latest, Rhein-Hunsrueck plans on eliminating fossil fuels entirely from all its energy consumption, including heat and transportation, by saving energy and increasing use of renewables.
- The investment in the transition to renewable energy by the private sector, including local citizens, has so far totaled nearly \$700 million.
- With its energy transition, the district had already by 2009 avoided 269,000 tons of CO2 emissions through renewable electricity, heat and biofuels and \$15.7 million in import costs for coal, natural gas and mineral oil.
- The net annual monetary gains for Rhein-Hunsrueck equal approximately \$29 million, making it their most financially successful program to date.

#### Presentation Summary

Mr. Fleck is the “Landrat” or Head of the District of Rhein-Hunsrueck,<sup>18</sup> a rural part of Germany that is home to 101,000 people. He opened by sharing that the district covers 963 square kilometers, 45% of which is forest and 42% of which is used for agriculture. He recounted how the district over the recent years has transformed from an energy importer to an energy exporter by implementing efficiency improvements and local renewable energy installations.

The transformation began, he stated, with the right brand of leadership. Fleck declared that are two general types of leaders: those who discuss for years on end how difficult the transition to renewable energy is and those who rise above ideologies and start to just do it to create an example, discussing best practices after the fact. Identifying himself as the

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<sup>18</sup> A district in Germany is parallel to a county in the United States.

second type, he says this brand of leadership is needed to realize a successful energy program.

The importance of the role of local cities and regions, he said, ought not be underestimated. While it is true that Germany's federal government set laws for advancing renewable energy, as previously discussed throughout the day, Fleck explained that it is the job of local leaders to convince the people to adopt them. He cautioned that it is important to find the right angle to convince people. Citizens in his region, he explained, do not understand the finite nature and other risks of fossil fuels, despite the fact that problems like climate change impacts and fuel imports will cost Germany billions of euros. But what they do get is the rapidly increasing costs of conventional energy to their own wallets and the broad range of added value renewable energy brings to communities, for example, savings on local imported fuel costs and creation of new local jobs and businesses.

Fleck said that "municipalities and regions are the born strategic partners" to the federal government additionally because they actually can carry out the orders and plans by installing wind mills, solar panels, and other tangible clean energy solutions. It is also local regions that have the land area, make the land development plans, own many buildings, can permit and make examples of the solutions. Rhein-Hunsrueck has become a shining example for such a partnership, figuring out early on how to maximize national laws and regulations to implement change on the local level more quickly even than the federal government had planned. "The targets of the Federal Republic (of Germany) are too slow for our region, which can achieve them in 5-10 years," asserted Fleck.

When Rhein-Hunsrueck's decided to adopt a 100% renewable energy plan, Fleck explained that the district was spending \$370 million on energy imports, a major burden for his rural district with a barely existent industrial economy. \$122 billion in federal expenses were in the meantime spilling out of the country to other nations, like Russia and Saudi Arabia. Fleck recounted that the people of his district decided that there must be ways for this money to stay in their region to create jobs and retain added value for their communities.

He relayed that Rhein-Hunsrueck did not actually start with renewable energy development, but instead first focused on improving energy efficiency and conservation in the building sector. This made sense to district citizens, given that 40% of energy in Germany is used by buildings. Fleck advised starting here for anyone just beginning the process, in order to prevent having to invest in as much renewable energy production.



He also recommended that local governments start with their own public buildings to demonstrate leadership by example. In 1999, the district began conducting audits for power, heat, and water consumption at seven school campuses and one administrative building. Consumption patterns and loads were reported on a monthly and annual basis, and advice was issued for energy technology installations, as well as organizational and contractual measures. In the first 10 years, more than 200 pieces of such recommendations were implemented.

From 2006-2010, the district created an energy and climate strategy. Fleck emphasized that this type of roadmap is important to avoid discovering mistakes in the years and decades in the future. He also advised, however, that it is not critical to have the budget for the program at this point, just the plan.

Renewable energy installations were also underway by this time in Rhein-Hunsrueck. Fleck explained that although the first zero emissions school was built in the mid 1980s, no one could have imagined at that time that the roof would be optimal for producing energy. But 25 years later, plans were implemented to install PV that generates 33% more power than the school consumes.

Other early energy transition projects included installing solar panels and a biomass plant for heat at a local school swimming pool. In 2009, the district's waste management administration building was built according to Passive House standards<sup>19</sup> and creates more energy than it consumes, all with renewable sources. Rhein-Hunsrueck, Fleck explained, is considering applying this standard to all buildings, if technically and economically feasible. The upfront costs of this standard costs about 10-15% more in his region, but engineers have advised that a lifecycle analysis be applied to the building budget, given that 60-80% of the lifetime costs will be energy, not construction. This will make the economics significantly more favorable.

Fleck has observed that with locally harvested biomass, small communities can have their own heating supply systems, as long as the local leader is proactive. He recommended starting with a single project, like providing heat for a pre-school, then moving on to a community wide system. His district now gathers wood waste (for example, from tree cuttings) from 120 collection points. "Originally, people could come collect this material for

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<sup>19</sup> See [http://www.passiv.de/en/02\\_informations/02\\_passive-house-requirements/02\\_passive-house-requirements.htm](http://www.passiv.de/en/02_informations/02_passive-house-requirements/02_passive-house-requirements.htm)

use in their garden," he explained. "Later, we realized it was smarter to turn it into fuel, using a central processing plant that turns it into 50% energy for district heating and 50% compost. We invested \$9.6 million into 33 buildings (schools and sport centers)." By doing so, "annually we save 670,000 liters of heating oil, and \$15.5 million that would have left the region."

Other steps taken by the district included implementing a 1000 solar roof program. To encourage public adoption of the program, a website was created where people can look up the suitability of their roofs for PV using key data points, such as how many solar panels one should use, the costs, and the return on investment.<sup>20</sup> A local bank helped out by offering a special credit program. The results have been a success with more than 3000 citizens having taken part in the program.

Wind power has also thrived. While some people have issues with landscape changes, Fleck explained community ownership helps to overcome this hurdle. In Rhein-Hunsrueck, 149 wind turbines are community owned, and in 2014, Fleck says that figure is expected to rise to 332. Germany's rural communities, he explained, have made extensive use of cooperatives to facilitate local group ownership of renewable energy projects.

Another piece of wisdom Fleck offered to those wanting to change the world is to involve the children. In addition to making the transition to clean energy visible at local schools, the district created an extracurricular learning center for kids where they can learn how to live more sustainably and about renewable energy.

The results of Rhein-Hunsrueck's bold efforts are proven in its impressive numbers. By 2013, the district had become home to 14 biomass plants, 3000 solar PV systems, and 149 wind turbines that covered 104% of electricity demand (based on total electricity demand in 2009 of 473 million kWh in 2009). In other words, the district actually exports 4% of its power generation. That amount will go up in 2014, based on real, not just planned, projects. By 2015, said Fleck, "we will have nearly 300% electricity generated by renewables, so we can export 200%." By mid-century at the latest, Rhein-Hunsrueck plans on eliminating fossil fuels entirely from all its energy consumption, including heating and transportation, by saving energy and increasing use of renewables.

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<sup>20</sup> <http://www.solarkataster-rhein-hunsrueck.de/kartendienst/14502002/Default.aspx>

The economic benefits to date have also been outstanding. The investment in the transition to renewable energy by the private sector, including local citizens, has so far totaled nearly \$700 million. Out of this, \$170 million was invested directly in the region. The district simultaneously avoided 269,000 tons of CO<sub>2</sub> emissions through renewable electricity, heat and biofuels and \$15.7 million in import costs for coal, natural gas and mineral oil. The net annual monetary gains for Rhein-Hunsrueck equal approximately \$29 million. Fleck summed up the 100% renewable energy transition as “the best program we ever had.”

### **Panel 5 – Speaker 2: Bob Dixon, Mayor of Greensburg, Kansas**

#### Key Ideas and Recommendations:

- The City of Greensburg, KS made a decision to put sustainability at the center of its recovery from a devastating tornado in 2007.
- At the core of sustainability is community and how people treat one another.
- Communities need to include, along with crisis management, visionary management, in order to not just survive, but thrive.
- Concrete action is critical to give people hope. Vision without action is merely a dream. Action without vision is just passing time.
- More conservative members of the community were able to embrace the concept of “going green” by recognizing the connections to ancestral wisdom and ways. For example, renewable energy and efficiency concepts like wind mills, geothermal heating and cooling, and passive solar design have a heritage that is centuries old, even if the technologies have modernized.
- Greensburg requires all municipal buildings to meet a LEED Platinum standard and other buildings in the town are similarly efficient.
- Renewable power and heat technologies used in Greensburg include solar panels, wind turbines, and geothermal wells.
- With the addition of a 12.5 MW wind farm financed by the local John Deere dealership, Greensburg has more renewable power than it can use and has become a power exporter to neighboring communities.

### Presentation Summary

"Never give up. Never lose hope." These opening words of the Mayor of Greensburg Kansas carried special weight. In 2007, the City of Greensburg was leveled in a massive tornado. The citizens rebuilt the city into what today is a beacon of sustainability in the nation. Mayor Dixon shared the story of this remarkable city's resilience.

As Mayor Dixon recounted, the devastation from the disaster was vast and prompted soul searching.

"Lives were lost, and in a matter of minutes, the living were homeless. The true sustainable thing in the community was the relationships between community members. At the core, this is all about how we treat each other and how we live our lives to make this a better, productive place for all of us."

He also said this was an opportunity. Despite the immense challenges, asserted Dixon, "this is the most exciting time because we can make a difference."

The people of Greensburg began the labor of turning catastrophe into opportunity in a big tent put up by FEMA, where up to 600 people would show up for community meetings. This became a center of reflection and introspection. As Dixon put it, "Communities have to look at who they are and their values. You can't have a visioning process, if you don't know who you are, including your private life, your corporate life, your municipal life."

At first, recalled the Mayor, when people talked about "going green," his thought was that how his family did things on the farm growing up was green, and the rest sounded like it "belonged in 1968 wearing tie-dyed shirts, bellbottom jeans and hugging a tree." Ultimately, however, he came to recognize misconceptions in the concept of being "green," and that "we've made a political football out of being sustainable and good stewards of our resources." The key to engaging many of the local stakeholders, including himself, Dixon explained, was to packaged "going green" as "being about the ancestors." He recalled that the first thing his ancestors did when they settled on the plains was to drill a well and to erect a windmill to pump the water to their livestock and gardens. Then they moved that water through the cooling house they built to cool the milk and eggs and built a root cellar to store food, both of which were essentially geothermal energy concepts. They also pumped the water into a tower and heated it with the sun to be able to take a hot shower at night – a basic form of solar thermal technology. Those early practices,

Dixon observed, are “the heritage of the renewable energy technologies we are using today.”

Mayor Dixon learned from Greensburg’s difficult experience that while crisis management is critical, it is equally important to move to visionary management, which he explained this way:

“When you are knee deep in rubble, it’s pretty easy to let the realities of today cloud your vision of a brighter tomorrow. It’s easier to pack your bags and leave, but staying and rebuilding is leadership. Identify what you can change in the short term. Celebrate successes. Do not let suboptimal people cloud your vision of a brighter tomorrow. You have to decide if you want to be a surviving community or a thriving community.”

He explained that rebuilding the city actually gave the people of Greensburg a chance to address long time systematic problems. For example, they knew they needed a new water tower, which became a beacon of hope as it was built. “You have to have action,” the Mayor asserted. “Vision without action is merely a dream. If you take action without vision, you’re just passing time. If we take action with true vision, we can change the world.”

The people of Greensburg also opted for a sustainability path focused on triple bottom line of supporting business, environment, and people. 6 months after the tornado, the City Council passed a resolution that all municipal buildings would be LEED Platinum. The first in the state was the new arts center, a privately owned building, which is powered by wind and solar energy and which further protects the climate with green roofs. He quipped, “The ancestors called green roofs ‘sod houses.’ Don’t not lose track of where you came from because that is going to tell you where you’re headed.” He also commented that similarly the passive solar buildings and overhangs reminded him of his grandfather’s chicken coop, which used the same principles to make the hens lay more eggs by ensuring they got more sun in the winter.

Other sustainable features of Greensburg’s rebuild included LED streetlights that cut power consumption by 70%. The new City Hall, the Mayor told the audience, is made out of 75,000 bricks and wood reclaimed from the rubble. As Dixon explained, “The greenest building out there is the one that is already built because the resources are already used. The goal is simply to make it more efficient.” Additionally, a new school used limestone native to the region, along with 96 geothermal wells and a wind turbine. The local hospital also now has geothermal

wells, a wind turbine and solar PV installed. The new courthouse is LEED Gold with 32 geothermal wells installed.

Mayor Dixon also relayed how private enterprise bought in to this new era for Greensburg. The local John Deere dealership, which is the distributor for 35 western states and several Canadian provinces, built a LEED Platinum building. The dealership also diversified into the wind energy business, financing a 12.5 MW local wind farm after the National Renewable Energy Laboratory showed that it was a good wind region. This wind farm actually has made Greensburg an electricity exporter, said Dixon, helping to power 32 cities in its power pool. In other words, the city has become powered by 100% renewable power and its own utility with the wind farm.

Mayor Dixon ended by challenging communities to answer one question in figuring out their path: Do we want to leave the world a better place for the children?

### **Panel 5 – Speaker 3: Rex Parris, Mayor of Lancaster, California**

#### Key Ideas and Recommendations:

- The City of Lancaster has committed to achieving net zero power – that is, generating as much power as consumes, all with efficiently installed renewables - by 2020.
- The main motivator of the city's decision is addressing the climate crisis.
- Mayors, not the federal government, are the most critical go-to people if you want to get net zero goals implemented.
- Lancaster benefits from being one of the sunniest places on earth, but it has become a front runner in the US on installed solar capacity primarily because it set a goal to become net zero energy.
- Another key to success has been to proactively reach out to and support clean energy businesses and partnerships. For example, the Mayor helped forge a partnership with Chinese battery maker BYD and KB Homes to build a series of net zero and plus energy homes in Lancaster.

- Lancaster city staff looks for reasons to say “yes” to renewable energy projects, instead of “no,” streamlining permitting and eliminating fees where possible.
- A packet of guidelines and ordinances ought to be created and sent to Mayors around the country to encourage the broader adoption of net zero energy/100% renewable energy goals and plans.

#### Presentation Summary:

Mayor Parris began with sharing that the City of Lancaster has set a goal to reach net zero power by 2020, that is, to generate the equivalent electricity with renewables that it consumes community wide. The Mayor has been motivated by the climate crisis, which he laments is akin to 97% of peer reviewed scientists’ findings “saying an asteroid is aimed at us.” The Mayor emphasized his view that “this is not a partisan issue. It is science. We lose half the country, if we politicize this.”

Becoming a grandfather upped the Mayor’s sense of urgency about the legacy of the world we are leaving. “We must not treat this as simply a business,” he stated. “We only have a limited window to affect the course of that asteroid.”

He relayed that after traveling the world at his own expense to study the problem, he learned he was not alone in being moved to make bold changes on the local level. “The whole world knows something horrible is coming, but the solutions cannot be top-down.” From the US to China, “if you want net zero building, it is critical to talk to Mayors, not the federal government.”

Fortuitously, when Parris decided Lancaster would be the solar capital of the world, the facts about the city’s solar capacity turned out to be right, as Lancaster has some of the strongest sunshine in the world. But Lancaster has leaped ahead in watts per capita, the Mayor asserts, primarily because it set the goal to reach net zero before anyone else, which spurred competitiveness and a sense of urgency that captured the city.

Another thing the city did right, explained Parris, was open itself up to renewable energy businesses, start ups and ideas. As a testament to his commitment, the Mayor shared that he even offered his cell phone number to those wanting to launch a renewable energy related business in Lancaster. Sometimes, he said, he had to push the companies to move

more quickly because they were unaccustomed to a Mayor having such a strong sense of urgency.

The city forged a partnership with large residential developer KB Homes and Chinese battery, electric vehicle and solar company BYD. BYD was struggling to sell in China, and the Mayor introduced them to KB Homes, and asked the two companies to join together build homes that cleanly and efficiently generate more energy than they consume. The Mayor did his part to melt doubts by waiving permitting fees and making solar and wind system permitting an over the counter process. He relayed that in a nearby city, by contrast, "this takes 2-3 months, and you'll have to redo the plans 2-3 times." The homes have been built, are net zero energy, and have enough left over to also power electric vehicles. The project has had a ripple effect, with KB Homes having started to put solar panels on their other buildings. Parris says it comes down to financial common sense. He said, "Today it is economically stupid not to put solar on your home, if you are buying a new home."

The city's approach to the BYD-KB Homes partnership is typical of all renewable energy projects. In Lancaster, Parris explained, "staff looks for reasons to say yes, as opposed to reasons to say no. Yes should be the default. People should not have to pay a premium to install solar and be forced to buy from an investor owned utility they don't like. But" he warned, "this is what Mayors are doing by doing nothing."

Keeping up with the rapidly evolving field of renewable energy technology has at times been a challenge. For example, in 2011-2012, the City of Lancaster was presented with a plan to put in a concentrated solar thermal plant for 14 cents/kWh, which Mayor Parris explained made sense then but could now be outdated.

Mayor Parris frames the transition to efficient renewable energy as a public safety issue. He recommends that others frame it that way as well to help get buy in from his fellow Republicans, who can relate to this as a value.

He also drove home that being short on cash is no excuse for cities to not take action to advance renewable energy and efficiency. The Mayor said the city has made all its progress, including becoming the recent recipient of the EPA's most sustainable city award, without having money. It happened simply because the people in the community decided to take this on.



As next steps, the mayor wants to make a plan that is portable and scalable and to help create packages of tools, such as ordinances, to send to Mayors around the country. He also proposed making Lancaster a center for continuing the work of looking at 100% renewable pathways.

**Panel 5 – Speaker 4: Dr. Peter Moser, Manager of Renewable Energies and Regional Climate Protection at deENet and 100ee (100% renewable energy regions in Germany)**

Key Ideas and Recommendations:

- DeENet is a Germany regional development initiative, focusing on the whole energy supply chain as it applies to renewable energy and efficiency. Its government funded Institute IdE researches and supports 100% renewable energy regions in Germany, and also cooperates with 9 countries.
- So far, 136 regions have been mapped in Germany that either have made significant strides toward achieving 100% renewable energy in at least one sector or that have at least set a goal to.
- These cover 29% of Germany's territory – mostly in rural areas where renewable energy is easier to implement - and 26% of the population.
- The main reasons found for why regions choose to transition to 100% renewable energy in Germany are not energy independence more a "green" image, but instead money and the added regional value created.
- Factors contributing to success include engaged leaders, a strong point person, community acceptance, local ownership, sustainable energy use, and competent planning and management.
- The 3 phases of developing 100% renewable energy regions appear to be the first movers, the models who create best practices, and the rural and urban communities that cooperate to create regional 100% renewable energy systems.

Presentation Summary:

Dr. Moser is a Manager of Renewable Energies and Regional Climate Protection at deENet and 100ee (100% renewable energy regions in Germany). DeENet, he explained, was established in 2003 by the European Union, German Ministries and industries as a German regional

development initiative. DeENet covers the whole energy supply chain, with an emphasis on coordinating research projects in the fields of renewable energy, energy efficiency, and regional development. Dr. Moser shared that the non-profit association has more than 120 members, industrial companies, service and consulting companies, universities, research institutes, business associations, among others. In 2011, the Institute IDE was founded to research decentralized energy transitions with a focus on supporting and researching 100% renewable energy regions in Germany. This project, Dr. Moser explained, is funded by the Germany Environment Ministry (BMU) and receives technical advisement from the Germany Federal Environment Agency (UBA). The project is now cooperating with 9 European countries.

Dr. Moser and his team have been working on defining what exactly a 100% renewable energy region is. He relayed that what they have so far established is that such a region can be a town, district/county, or a combination of these. The researchers have been developing criteria for what it is to be a 100% renewable energy region.<sup>21</sup> On a basic level, they look for three fields: The goal to reach 100% renewable energy, the concept and organizational infrastructure that has been established for reaching the goal, and the status of the accomplishments. If a region has made positive progress, Moser said, it is a “100% renewable energy region.” Cities are differentiated as “urban regions.” If there is a target but not yet much progress, it is considered a “starter region.”

At the time of the conference, the project had so far mapped 136 regions in Germany that meet these definitions - 73 100% renewable energy regions, 60 starter regions, and 3 urban regions. Together, these cover 29% of Germany's territory and 26% of the population. Most of these are rural areas, as it is easier to achieve 100% renewable energy targets where there is more land area and fewer people.

Dr. Moser shared one case study, the District of Osnabrueck, which has the capacity to produce 100% of its energy needs with its own renewable resources, largely with wind and sun. More than 100% of its power needs can be generated with renewables. On the other hand, he explained that a major city like Frankfurt, while it has a 100% renewable energy goal, relies on cooperation with the surrounding rural area.

Dr. Moser and his team have researched the main reasons regions decide to transition to 100% renewable energy. What they found was that it was

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<sup>21</sup> *Go 100% RE for Regions, Definition of and Criteria for 100% RE Regions*, Lioba Kucharczak and Peter Moser, DeENet (2013)

not energy independence or a “green” image that primarily drives these regions. It is, as Mr. Fleck stated earlier in the panel, money and the added regional value created by attaining 100% renewable energy.

They also pinpointed several factors that contribute to success:

- Engage leaders in politics and economics
- Give the program a face – a point person
- High acceptance in the community
- Local ownership and cooperation with regional energy suppliers
- Sustainable use of energy resources
- Competence, planning and management

The process to become a 100% renewable energy region appears to have phases:

- 1<sup>st</sup> movers (like those represented at this conference) – create best practices
- Model regions – Austria and Germany, for example, have over 100 regions
- Competition phase – has stricter benchmarks
- Transformation phase – rural and urban centers cooperate to create 100% renewable energy regions

The concept of the 100% renewable energy region has become so important in Germany that there is a large annual conference in Kassel,<sup>22</sup> Germany devoted to the topic that attracts hundreds of attendees over several days. Dr. Moser ended his presentation by inviting all to attend.

### **Panel 5 – Speaker 5: Kirsten Hasberg, Founder of Energy Democracy TV**

#### Key Ideas and Recommendations:

- The power of crowds is a main driver of the 100% renewable transition. Crowds are becoming energy producers, and crowds are rejecting the perils of nuclear and fossil fuels. Parallel to the communications sector, prosumers are disrupting monopolies.
- Another driver is the power of pioneers. Like the digital revolution, the energy revolution is not being led by the mainstream, but by pioneering newcomers.
- A third influence is the power of free stuff. As information wants to be free in the new telecommunications world, so does energy. In

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<sup>22</sup> See <http://www.100-ee-kongress.de/english-information/>

the old system, fuels cost money and make profit margins for corporations. In the new system, renewable energy fuels are free for the people.

- The global 100% renewable energy transition will require promotion and education. New media outlets can harness these three powers to better spread the word.

#### Presentation Summary:

Hasberg says three major powers are driving the transition to 100% renewable energy: the power of crowds, the power of pioneers, and the power of free stuff.

Starting with the power of crowds, Hasberg pointed out that we are moving to a decentralized energy system, in which crowds of people are becoming energy producers, not just energy consumers. She drew a parallel to what is occurring in the communications sector, where people are now producers, not just consumers of information. Prosumers are breaking down monopolies and allowing people to shape their own perception of the truth and their own energy future. The parallel phenomena in the communications and energy sectors can work to advance each other, for example, by helping people learn more quickly about the energy revolution and their own energy use.

Also, she asserted that the power of crowds has been behind the rejection of the conventional energy system by early adopters. For example, in Denmark, where Hasberg is from, she remarked that the people – the crowd - decided to say no to nuclear power in 1985 in response to the oil crisis, years before Germany did.

Hasberg continued that progress in the renewable energy sector is also being advanced by the power of pioneers. She turned again to Denmark, which she pointed out is the first country in the developing world to have passed legislation requiring the entire energy supply – electricity, heating, and transportation - to be renewable by 2050. Around 1975, explained Hasberg, the picture was decidedly different. The government was promoting a coal and nuclear plan. Concurrently, though, alternative plans continued to be created and compared to conventional fuel plans. The people of the windy Northwest were blacksmiths with a do-it yourself spirit and with little love for the Copenhagen urbanites, and they were eager to develop their own visionary venture. This debate between those favoring the energy establishment and the new renewable energy pioneers was crucial to the development of Danish energy policy. Hasberg says that the Danish experience provides an important lesson in

not getting discouraged in the face of opposition, as the debate was actually critical, and the renewable energy pioneers were essential to the eventual adoption of the 100% renewable scenario in place in Denmark today. Hasberg again drew a parallel with the digital revolution, in which the pioneers disrupted the system from below in a similar David and Goliath struggle.

The third power, remarked Hasberg, is the power of free stuff. She explained that we are moving from an energy system with ongoing fuel and high maintenance costs to a system in which most of the fuel is free. This raises the critical question of how we bring these new technologies to market and inform the public about them.

In Hasberg's view, the answer lies in collaboration with digital technology. "Information and energy both want to be free," she asserted. "The biggest problem of this conference is that it's over soon and not everyone is here. If more than a billion people need to put solar on their roofs for the world to go 100% renewable, they should have a minimal knowledge at least of what we're talking about today. We are standing before the biggest information and educational challenge. Some people think that 100% renewable energy is a niche topic, like hobby fishing, but it won't stay that way" as the whole world gets on board with the transition. We should harness the power of crowds, pioneers, and free stuff, said Hasberg, to create new digital media outlets where we continuously promote the vision of 100% renewable energy and put forth the positive messages. One such outlet, she stated, is an online magazine and app called Energy Democracy TV, which is currently in development.

**Panel 5 – Speaker 6: Shawn Marshall, Vice Mayor of Mill Valley, California and Founder of LEAN**

Key Ideas and Recommendations:

- Community Choice Aggregation (CCA) allows local governments and districts to aggregate the power load of residents and businesses use in order to procure power for its citizens at better prices on the wholesale market.
- Ideally, CCA is a pathway to realizing decentralized energy and renewable energy development.
- Today, 80% of homes and businesses in Marin County are served by CCA, which allows customers to get twice the renewable power as they would from the local investor owned utility, PG&E, and opt up

for \$4/month to 100% green power. While not perfect, this CCA is the cleanest in the country and is central to Marin County's goal to achieve 100% renewable power community wide by 2020.

- Sonoma and San Francisco are also working on CCA plans to help them achieve their 100% renewable power goals.
- Despite these programs, the California CCA market is slow due primarily to a monopolized investor-owned utility market, plus costs and regulatory issues.
- In the deregulated power market of Illinois, 80% of the state is served by CCA contracts. Most of these are unfortunately fossil fuel contracts, but there is some progress toward renewables.
- LEAN was created to push cities to adopt CCA programs that integrate renewable energy, efficiency, and good policies like feed-in tariffs.
- The main reasons to implement a CCA program are economics, environmental protection, rate stability and savings, and consumer choice and local control of power supply.

#### Presentation Summary:

Shawn Marshall is an expert in Community Choice Aggregation (CCA), a policy that allows local governments and districts to aggregate the power load of residents and businesses use in order to procure power for its citizens at favorable prices on the wholesale market. Ideally, she explained, CCA can help local communities live out the policy goals of decentralized electricity generation, local renewable energy development, and keep the value within the local community – in other words, the goals that have been discussed throughout much of the conference. CCA, explained Marshall, is a partnership with the incumbent utility in which the local government takes over the supply side, and the utility supplies grid services unless and until the local community is off the grid. The utility charges an exit fee to enter into such a partnership. Marshall reported CCA is an available option in six states in the U.S..

At the time of the conference, said Marshall, 80% of homes and businesses in Marin County were being served by CCA. Sonoma and San Francisco, she explained, have also been working on CCA plans. Marshall says the Marin CCA program is the “biggest change you’ll never notice.” Customers get twice the renewable power as they would from the local

investor owned utility PG&E and can opt up for \$4/month to 100% green power.

Despite the Bay Area programs, she said that the California CCA market is painfully slow. Costs of business and regulations are issues, but the bigger one is that California is not a state that is open to customers choosing what utility they want. Because of this lack of deregulation, the state is largely controlled by the monopoly of incumbent utilities, who view CCA as a threat. By contrast, in the deregulated state of Illinois, which passed a CCA law in 2009, 80% of the state is served by CCA contracts. The problem there is that too much of the power being procured is fossil based, although Chicago has signed its first renewable energy contract, and municipalities like the City of Cincinnati<sup>23</sup> and the City of Evanston<sup>24</sup> are providing 100% renewable power at lower prices than conventional power. Marshall created an organization called LEAN<sup>25</sup> to push cities to adopt CCA programs that integrate renewable energy, efficiency, and good policies like feed-in tariffs.

Marshall identified four main reasons to shift to CCA, which can be mixed and matched according to policy objectives.

- *Economics.* A pooled customer base with an opt out clause leads to aggregated revenue that is returned to the local government in a targeted – not general – fund. In Marin, this revenue is funding EV charging stations, energy efficiency retrofits, and other clean energy programs. No taxpayer funds are needed. Marin started its program in 2011 with 7000 customers and by the time of the conference had 100,000 customers. The annual revenue stream is \$100 million.
- *Environment.* Marin hit its 2017 GHG reduction targets in 2012 and reduced its carbon footprint by 40,000 tons.
- *Rate stability and savings.* Communities in Illinois are enjoying 25% rate savings with CCA through “power of the crowd.” The savings are 10% in NJ. In California, Marin is competitive in rates with more than two times the amount of renewable energy in the mix as

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<sup>23</sup> <http://www.cincinnati-oh.gov/oes/news/green-power-community-of-the-year-award/>

<sup>24</sup> See:  
[http://www.go100percent.org/cms/index.php?id=77&tx\\_locator\\_pi1%5BstartLat%5D=26.4855027&tx\\_locator\\_pi1%5BstartLon%5D=-97.28484275&tx\\_ttnews%5Btt\\_news%5D=219&cHash=7bd04822e86a4daa5492a49519623cab](http://www.go100percent.org/cms/index.php?id=77&tx_locator_pi1%5BstartLat%5D=26.4855027&tx_locator_pi1%5BstartLon%5D=-97.28484275&tx_ttnews%5Btt_news%5D=219&cHash=7bd04822e86a4daa5492a49519623cab)

<sup>25</sup> <http://www.leanenergyus.org/>

PG&E. Sonoma is expected to have the same outcome for its CCA that will serve up to 450,000 people.

- *Consumer choice and local control of power supply.* CCA is a partnership with utilities in which ideally they take care of what they are good at, such as managing the grid and helping with interconnection, while local communities and regions take over power supply and the heavy lift of building out locally generated renewable energy.

Much of CCA, explained Marshall, is standardized across the country. For example, the opt out opportunity is typical. There are also minor differences among states influenced by variables like market conditions and regulatory frameworks. Risks tend to be mitigable and decreasing, as there is success accumulated on the ground to prove what works.

Marin Energy Authority, said Marshall, is not yet a perfect model, but it is currently among the cleanest CCA programs in the country, and central to Marin County's goal to achieve 100% renewable power community wide by 2020. The CCA has 15 power purchase agreements for new in-state renewable power generation of 3.2-30 MW in size. They initiated a feed-in tariff program, although so far, it has unfortunately been limited to one project, due to PG&E thwarting interconnection, which was not guaranteed in the program as it is in Germany's feed-in law. 6 MW of solar capacity has been installed with net metering, and \$4.5 million from the California Public Utilities Commission has been granted to target low income communities and multifamily dwellings.

Marshall ended by encouraging cities and counties to look into CCA its many potential benefits. "CCA may not be the path forward, but it is a path forward."

#### **Panel 5 – Speaker 7: Danielle Murray, Renewable Energy Program Manager for the City of San Francisco Department of Environment**

##### Key Ideas and Recommendations:

- Since 2008, the City of San Francisco has created numerous ordinances and programs to promote climate protection and clean energy.
- With current policies, San Francisco is on track to achieve 50% greenhouse gas reduction below 1990 levels by 2050. To reach its goal of 80% reductions by 2050, significant work remains to be



done, especially cleaning up the transportation sector, which emits 45% of the city's greenhouse gases.

- In 2010, the city committed to achieving 100% renewable power by 2020. In 2011, a Renewable Energy Task Force was created to make recommendations for how to achieve this goal, which released a report with six strategies to pursue. Broadly, these were to increase efficiency, encourage local renewable energy adoption, include renters in the energy transition, provide 100% renewable power purchasing options, promote private investment, and improve local renewable energy access.
- While it may have a ways to go, San Francisco has made many strides in the energy sector, including soaring from only 5 solar PV systems in the year 2000 to 3640 in January 2013.

#### Presentation Summary:

Murray began with an overview of climate and energy policies in San Francisco. She started with the Climate Change Goals Ordinance passed in 2008, which set aggressive citywide greenhouse gas reduction targets and encouraged the pursuit of greenhouse gas free electricity by 2030. The San Francisco Climate Action Plan additionally required inventories of emissions from waste, transport and energy and outlines strategies to meet local, state and Kyoto targets. The city's Electricity Resource Plan also sets several targets:

- Achieve GHG-free electricity supply by 2030
- Maximize Energy Efficiency
- Develop Renewable Power
- Assure Reliable Power
- Support Affordable Electric Bills
- Support Environmental Justice
- Improve Air Quality and Prevent Other Environmental Impacts
- Promote Opportunities for Economic Development
- Increase Local Control Over Energy Resources

San Francisco's greenhouse gas targets are as follows:

- 20% reduction below 1990 levels by 2012
- 25% reduction below 1990 levels by 2017
- 40% reduction below 1990 levels by 2025
- 80% reduction below 1990 levels by 2050

With current policies, stated Murray, San Francisco is on track to achieve 50% greenhouse gas reduction below 1990 levels by 2050. Electricity supply accounts for 23% of that reduction. Significant work remains to be

done with the transportation sector, which emits 45% of the city's greenhouse gases.

Murray recounted that in 2010, then Mayor Gavin Newsom announced a goal to reach 100% renewable power in San Francisco by 2020. In 2011, she explained the electricity mix in the city still had a ways to go, with 16% RPS eligible renewables<sup>26</sup>, 30% large hydro, 36% fossil fuels, and 18% nuclear. To address how to reach the 100% target, in January 2011, Mayor Ed Lee established a Renewable Energy Task Force comprised of local clean energy leaders, business and community stakeholders, representatives from environmental NGOs, labor, utilities, and relevant city departments. The purpose of the Task Force, explained Murray, is to provide recommendations on how the city can achieve 100% renewable power based on a portfolio of local, distributed generation, utility scale generation, and energy efficiency by 2020.

From February 2011 to May 2012, Murray relayed that the Task Force met monthly and produced a report released in September 2012. Six strategies were identified to achieve the goal:

1. Shrink the pie with increased energy efficiency by
  - Promoting energy audits and retrofits through two programs - Energy Watch<sup>27</sup> and Energy Upgrade CA<sup>28</sup>
  - Integrating green building and energy labeling into assessor-recorders database
  - Tightening building code energy requirements
  - Strengthening retrofit on resale rules
2. Encourage local renewable energy, in order to reduce transmission needs, improves local energy security, and keeps the city's energy dollars in the local economy. The Task Force recommended the following actions to implement this strategy:
  - Streamline solar permitting and provide online permitting
  - Provide stable funding for GoSolarSF (the local rooftop solar) incentive program
  - Support net metering
  - Develop feed-in tariff for local renewables under CleanPowerSF (San Francisco's CCA program)
  - Integrate renewables on aging downtown distribution grid

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<sup>26</sup> Large hydro is not eligible to be counted toward the renewable energy percentage requirements mandated by California Renewable Portfolio Standard.

<sup>27</sup> See <http://www.sfenvironment.org/energy/energy-efficiency/commercial-and-multifamily-properties/sf-energy-watch>

<sup>28</sup> See <https://energyupgradeca.org/overview>

- Address solar system shading
3. Break down barriers for tenants, which make up more than 60% of SF citizens, and expand access to local renewables, in order to democratize the local renewable energy economy and support local economic development
    - Passing through costs of energy efficiency upgrades and renewable energy pass-to renters and allowing for this under the city's strict rent control rules
    - Encourage green leases
    - Expand understanding and use of Virtual Net Metering, which is still relatively new in the industry
    - Support community renewable energy legislation on the state level
  4. Provide 100% renewable power purchasing options by
    - Implementing 100% renewable Community Choice aggregation Program - CleanPowerSF
    - Encouraging robust utility green power purchasing programs - PG&E Green Option
    - Expanding deliveries of 100% renewable municipal power by making SFPUC the default power provider for city properties & tenants and by Providing renewable SFPUC power for SF transit providers and new development areas

Such options, said Murray, are critical due to the constricted land area in San Francisco, which limits the amount of renewable energy that can be installed within the city boundaries. Even if every available roof in the city was used for solar installations, only 7% of the city's power needs would be met. It is also important to provide choices, in order to move beyond the monopolized electricity system.

5. Encourage private sector investment in renewable energy by
  - Expanding and reducing the cost of clean energy financing. This can be done by
    - Utilizing low-interest bonds
    - Supporting crowd funding
    - Supporting project aggregation in group buys
    - Engaging pension fund in clean energy investment
  - Leveraging the CCA to spur renewable energy development – for example, establishing programs for PPAs, feed-in tariffs for local projects, and on-bill financing for energy efficiency and solar
  - Providing clean tech demonstration opportunities

## 6. Expand access to local renewable energy

Murray reported that San Francisco's clean energy accomplishments include efforts in the following six areas:

1. Closing all the fossil fuel power plants in the city
2. Lowering energy demand with these policy measures
  - Green Building Ordinance that requires buildings to meet a minimum standard of LEED Gold
  - Existing Commercial Buildings Energy Performance Ordinance<sup>29</sup>
  - Residential Energy Conservation Ordinance<sup>30</sup>
  - SF Energy Watch audits and incentives
3. Developing local renewables, for example, implementing
  - 10 MW Municipal solar PV and biogas
  - 16 MW solar PV on private buildings
  - Streamlined solar permitting
  - GoSolar SF incentive program
4. Providing 100% renewable power
  - Municipal power is currently 100% hydro, solar, biomass, RPS based renewables
  - CleanPowerSF will provide 100% renewable power option for residents and businesses
5. Addressing Financing
  - Commercial PACE financing through GreenFinanceSF<sup>31</sup>
  - Green Tenant Toolkit
  - Aggregated purchasing & financing via Solar@Work and SF SunShares programs
6. Education and Outreach
  - SF Energy Map that shows every solar installation in the city, the solar potential and financial projection (payback period, etc.) for each rooftop or address<sup>32</sup>
  - Solar Water Heating and PV public outreach
  - Free solar site assessments

Murray ended her remarks by relaying that San Francisco's total number of installed solar systems impressively rose from 5 in the year 2000 to 3640 in

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<sup>29</sup> See <http://www.sfenvironment.org/energy/energy-efficiency/commercial-and-multifamily-properties/existing-commercial-buildings-energy-performance-ordinance>

<sup>30</sup> See <http://www.sfdbi.org/Modules/ShowDocument.aspx?documentid=124>

<sup>31</sup> See [https://commercial-pace.energyupgradeca.org/county/san\\_francisco/overview](https://commercial-pace.energyupgradeca.org/county/san_francisco/overview)

<sup>32</sup> See [www.sfenergymap.org](http://www.sfenergymap.org)

January 2013, most being residential installations. During that time, total installed capacity rose from barely anything to more than 23 MW. So while they may have a ways to go, San Francisco has also come a long way.

### **Panel 5 – Speaker 8: Stefan Schurig, World Future Council Climate and Energy Director**

#### Key Ideas and Recommendations:

- Information and communication have been democratized in the past quarter century, but while energy is heading in this direction, it is still lagging. Everyone in Africa has a cell phone, but in rural communities, they still might walk a half a day to charge them.
- The main hindrance to moving faster in the energy sector is the political will.
- While Germany made strides by slipping feed-in tariff legislation through and strengthening it into highly effective policy, the more successful renewable energy becomes, the stronger the incumbents PR push becomes against it. We must not make the mistake of thinking that the road ahead will be easy.
- 100% renewable energy is the way of the future, no matter how uphill the battle.

#### Presentation Summary:

Schurig, who traveled to the conference from Hamburg, Germany, began by reflecting on the remarkable differences he observed between the City of San Francisco today and when he first visited in 1989. He marveled at “all the billboards for Twitter, Facebook and other digital media,” whereas 24 years ago, there was not even internet. Likewise, there were no mobile phones or tablets, and Apple was struggling financially. Since then, Schurig noted, the technology development has caused societal change. More importantly, he said, this is not just happening in developed countries. “In Africa, everyone has a cell phone. Information and communication has been democratized.”

Energy is still lagging behind this massive transformation, said Schurig. He recounted a visit to a village in Ghana without electricity where solar panels were being installed on a hospital rooftop. “Everyone had a cell phone. But to charge the phones, a man came around and collected them in a basket, and walked for half a day to an electricity source!”

What we must do, asserted Schurig, is democratize the energy sector. "We have to empower communities to become energy producers and participate in the economic benefits," he said. This is power to the people with a dual meaning: bringing electricity to the people and also enabling them to produce their own electricity. This means that some of the political power will shift from energy companies to citizens.

Everyone who is seriously aiming for a living democracy, he stated, will immediately understand the added value of an inclusive renewable energy economy. So, he asked, "why aren't we doing this?" As this conference has made clear, Schurig reasoned, we have the technology, we know of good policies, we know renewable energy can be clean, and we know there are no fuel costs involved. We even have lessons learned and cities and communities that are doing it. The major problem is a lack of political will.

Summoning political will is clearly possible. Schurig recalled that when he returned to Germany in 1989, he encountered the reunification of Germany, as well as the creation of the political will to slip through a key piece of legislation, which was the first feed-in tariff in the country. As this legislation matured over the next decade and half, it provided the investment security that allowed renewable electricity to really take off in Germany.

But Schurig observed that his type of positive progress also meets major resistance from the incumbent energy players. For example, he relayed that conventional energy representatives have consistently told Germans that is not possible to integrate more than 4% of renewable energy into the nation's grid. But in fact, currently Germany has more than 23% renewable power and is not having blackouts. On the contrary, he explained that Germany is still a net electricity exporter.

Schurig warned that the pressure from the incumbents will not let up, however, any time soon. He said we must not be lulled by successes to mistakenly believe that the way forward will be easy. The more successful the renewable energy development, in fact, the stronger the PR campaign becomes against it, he predicted. "It will remain an uphill battle."

However, he stated, it is important to remain undaunted by that because renewable energy is the way of the future, 100% renewable targets are the way forward, and this must be the focus. He ended with Gandhi's famous description of the four phases of affecting societal change: "First,

they ignore you, then they laugh at you, then they fight you, then you win."

## **Closing Program - Highlights**

- The Renewables 100 Policy Institute team started the closing session by encouraging everyone to help build the will so clearly needed by supporting the first worldwide movement to Go 100% Renewable Energy launched in 2010 by the Institute on [www.go100percent.org](http://www.go100percent.org).
- Dr. Tanay Uyar, President of Eurosolar Turkey and Head of the Faculty of Engineering Energy Section at Marmara University in Istanbul, reminded the audience that we must not forget that achieving 100% renewable energy is a detail in the larger context of our vast and long shared living space heated and lit by the sun. He also invited participants to join him in Turkey where Eurosolar Turkey is actively engaged in studying how to achieve 100% renewable energy targets.
- Adarsha Shivakumar, Head of the Youth Advisory Board at the Alliance for Climate Education (ACE) closed the conference with a call to action from youth across America. He and his team reminded the audience that children across the globe are depending on the adults with expertise and decision making power to make the transition to 100% renewable energy happen, in order to solve the planetary crises facing us all. "The price we pay for the privilege we have (in the developed world) is the duty to use that privilege for the good of others. My freedoms don't end where your nose begins. My freedoms end where my responsibilities begin," declared Shivakumar. "While we may disagree on how we get there, most of us share the same goal of a better future, and it is this unity that we must remember as we try to make a better world for all."

## **Conclusion**

The 2013 Pathways to 100% Renewable Energy conference brought together a wide cross-section of stakeholders for a first-time international discussion focused on the urgent global need to set and implement 100% renewable energy targets, along with best practices for how to accomplish this. The all-day event was sold out and attracted participants from all over the world and multiple sectors, indicating that the time for this forum was ripe. Across national and cultural boundaries, political

parties, and generations, the event made evident a growing interest in addressing the facts that the transition to 100% renewable energy is inevitable and critically needed because non-renewable energy sources are by definition not going to last and meanwhile are causing multiple crises, as well as limiting local economic opportunities compared to renewable energy development.

Examples of high stakes concerns raised by conference participants stemming from continued dependence on traditional energy sources included aging infrastructure, rising conventional fuel costs, damaging pollution, geopolitical tension, limits placed on local community economic opportunities by energy incumbents, nuclear waste, and climate change.

Experts emphasized that it is imperative to prioritize setting 100% renewable energy goals now, to lay out clear steps on a timeline for achieving them, and to set policies that encourage investment in these steps because energy systems are planned decades in advance and because capping renewable energy goals at lower targets leads to inefficient, uneconomical planning.

The conference speakers conveyed an overarching opinion that despite excessive inertia in much of the world, there are, in fact, no barriers, other than psychological and social ones, to reaching 100% renewable energy globally by mid-century. While there are certainly challenges, the technologies, economic frameworks, and effective policies that can get us there exist and have been proven in the field.

Underscoring this conclusion, several participants shared data on businesses, regions and nations, especially in rural areas but increasingly in urban locations, that have already achieved and even exceeded 100% renewable energy goals, particularly in the power sector. Hundreds more locations aim to achieve 100% renewable energy targets in all sectors, including heating, cooling, and transportation, over the coming decades.<sup>33</sup> While the means to create all-renewable energy systems can and will be further perfected, the consensus was that the perfect ought not be allowed to become the enemy of the good.

Repeated often throughout the event is that our only big, real problem remains undoing the false perceptions about renewable energy and harnessing the political and social will to change. This will not likely be solved overnight, nor will it likely be overcome without struggle. The

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<sup>33</sup> See map on [www.go100percent.org](http://www.go100percent.org).



transition to a renewable energy economy is revolutionary and will inevitably disrupt and change how people all over the world have been doing things for a long time. Similar to the information and telecommunications revolution of the past twenty years, the renewable energy revolution will likely see old monopolies fall, new economic players rise, systems go from centralized to decentralized, and more individuals – including those in developing regions – gain greater choice, control and power to produce and profit rather than simply consume and pay.

The incumbent energy system players have an exciting opportunity to succeed in becoming part of the change, if they are adaptable. For example, as mobility becomes increasingly electric, electricity providers have a chance to become a greater part of the transportation sector. As methane for the natural gas grid is made from excess renewable power, all energy sectors will intersect in new ways. Energy will also overlap more with other sectors like IT, as the grid and appliances becomes smarter, bringing chances for energy industries to provide new services and gain new revenue streams. Not all incumbents, however, can be expected to embrace the challenge to innovate and to give up the business models from which they have long profited.

Since the conference, there have been signs of this dynamic tension between change and resistance. On the one hand, for instance, the novel ideas of an international 100% renewable energy conference and worldwide movement have become remarkably less novel. A number of attendees have now launched their own 100% renewable themed campaigns, projects and events.<sup>34</sup>

Furthermore, the list of 100% renewable energy projects and supporters also keeps growing worldwide, including prominent cities in Asia and Australia that have officially committed to reaching 100% renewable power, heating and cooling.<sup>35</sup>

Several traditional utilities and other long established energy-related businesses have also seized the opportunity to be part of the 100% renewable energy transition. At the end of 2013, Palo Alto Municipal Utility, for one, became the first utility in California to reach its goal to procure 100% renewable procurement community wide.<sup>36</sup> In the transportation

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<sup>34</sup> Examples include [The Future of Energy](#), [Global 100% Renewable Energy](#), and [WWF's Renewables It's Doable](#)

<sup>35</sup> See <http://www.go100percent.org/cms/index.php?id=4>

<sup>36</sup> [http://www.go100percent.org/cms/index.php?id=77&tx\\_ttnews%5Btt\\_news%5D=108&cHash=7a904852eaaf21dd64e8de1fd913776](http://www.go100percent.org/cms/index.php?id=77&tx_ttnews%5Btt_news%5D=108&cHash=7a904852eaaf21dd64e8de1fd913776)

sector, BMW launched sales of the new BMW i brand, which will be PEVs made from all renewable energy sources.<sup>37</sup> These are just two examples among many.

The conference also catalyzed a series of executive level discussions facilitated by the Renewables 100 Policy Institute between policymakers and regulators in California and Germany, which have focused on how the two frontrunners can learn from and support each other's climate and energy efforts. Included was a visit to Germany to meet with energy leaders by California Governor Jerry Brown and First Lady Anne Gust Brown, which took place in July 2013, several follow up meetings, and a trip by top officials from California's energy agencies who will meet with their German counterparts at the end of March 2014.

Against this momentum, on the other hand, are also cases of intensifying pushback. The new government in Germany, for example, while remaining generally supportive of the nation's successful renewable energy program, has announced it aims to slow down the German renewable energy transition.<sup>38</sup> The federal administration's primary explanation for putting on the breaks is to prevent the renewable energy law from continuing to cause too steep and fast a rise in ratepayer bills. Renewable energy installations, however, have had relatively little to do with rising power bills in Germany over the past few years.<sup>39</sup> The top causes for higher consumer costs have actually been expanded industry exemptions from paying for the renewable energy program and falling wholesale electricity rates due to increased shares of renewables in the grid, as well as low carbon prices. The calculation method in the German renewable energy law has slowed the reduced power rates from reaching the average consumer, although this is now showing signs of improving.<sup>40</sup> Meanwhile, the rapid rise of renewable power generation has made conventional power generation increasingly unprofitable in Germany, with natural gas plants sitting idle much of the time<sup>41</sup>, and coal

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<sup>37</sup> The all-electric BMW i3 will be the first model sold and has been available in Europe in late 2013, with expected availability in North America by Spring 2014.

<http://www.bmw.com/com/en/newvehicles/i/i3/2013/showroom/index.html#>

<sup>38</sup> See <http://www.bmwi.de/English/Redaktion/Pdf/eeg-reform-eckpunkte-english,property=pdf,bereich=bmwi2012,sprache=en,rwb=true.pdf>

<sup>39</sup> See *The EEG Surcharge for 2014*, p. 5, BEE (October 15, 2013) [http://www.bee-ev.de/downloads/publikationen/positionen/2013/20131015\\_EEG-surcharge-2014\\_Background-document-rev\\_EN.pdf](http://www.bee-ev.de/downloads/publikationen/positionen/2013/20131015_EEG-surcharge-2014_Background-document-rev_EN.pdf)

<sup>40</sup> See <http://www.renewablesinternational.net/german-utility-reduces-retail-rate/150/537/74600/>

<sup>41</sup> See <http://www.bloomberg.com/news/2013-03-12/europe-gas-carnage-shown-by-eon-closing-3-year-old-plant-energy.html>

power plants being largely dependent on exports to other countries.<sup>42</sup> It is not hard to see why the traditional energy industries are concerned. It is also not hard to see that the real reason for the slow down of the renewable energy program in Germany is likely not to protect average ratepayers, but to protect the market shares of long established industries with deep political ties that fear diminishing returns over the coming decades in the face of renewable energy's rapid expansion.

Another example of incumbent driven resistance is in San Francisco, where the CCA program at the core of the city's 100% renewable power plan has become stalled by politics reportedly being propelled by allies of the local investor owned utility, which has long tried to keep communities from implementing CCA.<sup>43</sup>

There are indicators that this type of policy instability around the world may have been shaking investor confidence in renewables. According to Bloomberg and others, global investment in the sector declined in 2013 for the second year in a row.<sup>44</sup> However, some of the decline also seems to have been driven by falling technology costs, and renewable capacity has been growing, with solar soaring to a 20% increase over the previous year. Japan also bucked the trend and vastly increased spending on renewable energy, as it struggled to make up for lost nuclear power. Bloomberg has also forecast that investments will rebound in 2014, as sales of green bonds hit a new record.<sup>45</sup>

Additionally boosting the positive forecast for renewable energy advancement are continual reminders that non-renewable fuels cannot last forever and are becoming increasingly uneconomical. Poking a hole, for example, in the popular notion that the US has centuries' worth of cheap, abundant natural gas, the US and Canada recently fell short on natural gas during a winter 2014 cold snap, forcing some grid operators to call for conservation measures<sup>46</sup> and causing propane shortages and price spikes.<sup>47</sup> The promise of stable nuclear power, which was badly shaken since the disaster at Fukushima, hit another snag in 2013, with

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<sup>42</sup> See <http://energytransition.de/2013/11/german-power-is-coal-for-export/>

<sup>43</sup> See <http://www.sfgate.com/science/article/CleanPowerSF-remains-mired-in-politics-4975691.php>

<sup>44</sup> See <http://about.bnef.com/press-releases/clean-energy-investment-falls-for-second-year/> and [http://www.cleanenergypipeline.com/Resources/CE/PressReleases/Clean\\_Energy\\_4Q13\\_Analytics\\_and\\_Graphs.pdf](http://www.cleanenergypipeline.com/Resources/CE/PressReleases/Clean_Energy_4Q13_Analytics_and_Graphs.pdf)

<sup>45</sup> <http://www.bloomberg.com/news/2014-01-27/renewable-spending-to-turn-corner-as-bonds-hit-record-bnef-says.html>

<sup>46</sup> See: <http://www.caiso.com/Documents/ISOissuesStatewideFlexAlert.pdf>

<sup>47</sup> See: <http://columbiadailyherald.com/news/local-news/propane-gas-drain-cold-weather-high-prices-fuel-shortage>

record five nuclear power plants shutting down prematurely in the US due to expenses.<sup>48</sup>

The fact remains that the eventual transition to 100% renewable energy is logically not a question of “if,” but only of “when” and “how.” The call to action of the 2013 Pathways to 100% Renewable Energy conference was clearly that we must do so sooner than later, if we are to create a better future for generations to come.

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<sup>48</sup> See:  
<http://www.dailytech.com/Vermonts+Only+Nuclear+Plant+Becomes+Fifth+Reactor+to+Close+in+2013/article33258.htm>