Energy Vision for Our Futures

Keeley Bombard and John O'Neil, EE 538, Spring 2022

Over the course of the semester, we conducted twelve interviews with experts within the energy industry to piece together their energy visions for the future. Using the list of experts within the Municipal Sustainable Energy Forum (MSEF), Boston University, and the interviewees themselves as a resource, we interviewed the following energy experts:

- Ari Peskoe, Director of the Electricity Law Initiative at the Harvard Law School
- Audrey Schulman, Co-Founder and Co-Executive Director of the Home Energy Efficiency Team
- Baird Brown, Principal of Eco(n) Law LLC
- Cutler Cleveland, Associate Director of the BU Institute for Sustainable Energy and E&E Professor
- Gerry Braun, Energy technology generalist with decades of energy R&D and business leadership
- Karl Rábago, Independent Consultant at Rábago Energy LLC
- Larisa Dobriansky, Chief Business and Regulatory Innovations Officer at General Microgrids
- Lorenzo Kristov, Independent Consultant
- Lynn Arthur, Founder and President of PeakPower Long Island
- Moneer Hazzam, Principal at Beacon Climate and Founder of SolarOne Solutions, Inc.
- Richard Chase, Commissioner of the Princeton Municipal Utility
- Sierra Dall, Founder of the Municipal Sustainable Energy Forum

The core questions we asked are as follows:

1. What is your vision for the future of a clean, safe, efficient, reliable energy system?
2. How do we get there?
3. What are the barriers to getting there?
4. How might we address those barriers?
5. What role will the utilities play in this energy future?

We took a voice recording during the interviews and did a transcription of the answers to our questions. That transcription was used to create the write-ups seen throughout this paper. Each write-up is not a 100% direct quote of the interviewee, but we were faithful to the sentiments provided and did get the approval of the experts we interviewed to confirm that we adequately represented their views throughout this document. The questions we asked began in the same way, but due to the nature of each person's expertise, we sometimes deviated from those. Additionally, the length of the conversations varied. All this to say, these interviews are not directly comparable to each other because of the variation in the questions asked and the

depth of answers given. We have treated each write-up as its own stand-alone document, and compiling them here makes it possible for people to see the energy visions of these experts in one place.

The interview process revealed many fascinating insights from energy experts across the country. We are extremely grateful to our participants for taking the time to speak with us and share their energy visions. During our conversations, there were some common threads that the experts shared, and we wanted to consolidate some of those below. While there are commonalities, each interview has their own unique nuances that can be best understood through the write-up of that specific interview. Regardless, it is still helpful to see what many of the energy experts seemed to agree on. Those themes are:

- **The need for community based changes**. This could include microgrid renewable energy infrastructure on a neighborhood or municipality scale and distributed generation from individual homes.
- **Moving away from the investor owned utility model** because they do not align with the interests of the citizens. Utilities are still useful to manage transmission in the new distributed generation transactive market, but should not be responsible for generation.
- **Focus on education and outreach** to inform communities about the benefits of distributed generation and microgrids. Coordinate with local community organizations to advocate for these opportunities.
- **Integrate renewable energy** into the existing grid along with storage infrastructure.
- **Build collaborative relationships** between communities, local governments, and utilities.
- Increase the rate at which we are building these community based projects to increase the adoption of these projects across the country. **The more common it becomes, the better.**

Overall, the common themes focus on distributed generation, integrating renewable energy infrastructure and storage into the electricity grid, and working with communities to ensure the energy transition comes from the bottom up. We hope that these discussions will lead to policy implications that will help advance progress toward a reliable, resilient, and clean energy system.

Ari Peskoe

Ari Peskoe is the Director of the Electricity Law Initiative at the Harvard Law School Environmental and Energy Law Program. He primarily works on electricity regulation. Earlier in his career, he was an associate at a law firm in Washington, D.C. where he litigated before the Federal Energy Regulatory Commission about the Western Energy Crisis. He received his J.D. from Harvard Law School and graduated from the University of Pennsylvania with degrees in electrical engineering and business.

KB: What is your vision for the future of a clean, safe, efficient, reliable energy system? And how do we get there?

AP: It's an interesting question. I'll admit that I don't spend a lot of time visioning. Most of my time is sort of in the weeds on sort of specific legal debates. But I can come up with a vision, it's a society that's powered by predominantly clean energy. Where energy continues to be affordable, and plentiful. And we're probably mostly running on electricity. Seems like that's the plausible path forward, although maybe new technologies will emerge.

But beyond that, I don't have a specific architecture of how the system should be designed. I think that there's been a lot of progress over the past couple of decades in creating entities that manage the system and plan the system that are not motivated by profit. So I'm thinking specifically about the regional transmission organizations and the electric power sector, who, ideally, are independent of any commercial interests, and ought to be operating in planning the system with the public interest in mind. The current system falls short in a lot of ways. But if I'm imagining my vision, then there's a lot of these entities, whether they're explicitly government entities, or whether they're nonprofit entities that are doing a lot of work to facilitate investment, and are not themselves investors. That could happen at the local level, that can happen at the regional level, even at the national level. And we somehow separate ownership from control.

KB: As someone who's coming at this from the perspective of a lawyer who's involved in energy issues, what are the specific energy issues that you work on?

AP: What I've spent a lot of my time on in the past several years is the different roles that state and federal regulation play and how those two interact with each other and can sometimes seemingly conflict with each other and may prevent progress on clean energy issues. These days, I spend a lot more of my time on transmission, which also has overlapping federal and state roles. I think one of the challenges in making progress is that the legal systems were written generations ago, and didn't anticipate the current set of clean energy needs, and clean energy continues to be, at the federal level at least, divided along political lines. And so we're not making any progress in changing these laws. It's just regulators trying to understand these laws in a new way that can lead to progress. And that's obviously controversial.

So, I think because energy is such a heavily regulated industry, and electricity is, in particular, even more regulated than other other segments of the industry, the law plays an essential role. And reforming those laws is hard in our political system. So currently, the laws are in some ways a barrier to real, meaningful progress.

KB: What are the next steps that you would potentially like to see people moving towards? Would it be maybe a specific law that you work on that has been stalled? And if so, what would that be?

AP: I think the idea of having one big law from the US Congress that's gonna set some legal targets for the energy industry on greenhouse gas emissions seems like a dream that keeps dying. We had efforts from 2006 to 2010. And those didn't lead to anything, and we just had the most recent effort. Though, it's much more limited, nobody tried to really revive the idea of sort of an economy-wide emission limit, or cap and trade system or anything like that, there were more limited efforts, and those haven't yet come to fruition. So I'm not going to try to predict sort of what the politics of 2028 might be. I suppose that an overarching single law that takes care of everything is not really happening.

But I think the approach these days that seems to be leading to some progress is more targeted sector by sector approaches, targeted investments, whether it's like electric vehicle charging for transportation, or investing in low carbon technologies for industry, or clean energy tax credits for the electricity sector, sort of a piecemeal approach from the federal government, and then complimentary work at the state level. But it's more fractured, there are some states that are very interested in clean energy, and other states that are less interested, and being less proactive about it, though, I think the cost of the technologies have come down so much that these conversations are now happening everywhere, even in states that ostensibly don't care about climate or even clean energy, but they care about economic development and low energy prices. And so they're having policy conversations about clean energy issues.

From my perspective, I think the transmission infrastructure is an enabling technology for clean energy. And so if there was some progress on that at the federal level, that could come from Congress, it could come from the Federal Energy Regulatory Commission. That would be encouraging. My view on that is that the utility industry, ironically, is a barrier to progress here. And so I think we really need Congress to step in and do something about that. But they're a politically powerful industry. And so I'm not optimistic about the prospects for more heavy handed regulation of interstate transmission. So there may be other ways to get to the goal of building more large-scale interstate transmission. And there's many regulatory pieces to that. There's the siting of it, who gives permission to a developer to build a line. There's also how you pay for it. And there's also how this infrastructure gets planned, who's in charge of planning it? To really achieve the vision of a really unified interstate system, I think we really need new approaches to all of those things.

KB: When you brought up transmission, I wanted to ask, are you involved in or aware of the stalled transmission project right now from Quebec to Maine that's having a lot of issues?
AP: Yeah, that project is an interesting project. I think it's hard to draw lessons from it, it's sort of unique in that it was supported by the Maine utility that was going to build it. So I think they were an affiliate company of the biggest utility in Maine. And they were all for it. They got the regulatory approvals that they needed, mostly from the state. And I think there may have been a federal approval or two needed as well, I don't remember the details. But then, it was voted on by the people of Maine, which is highly unusual. Typically, these sorts of issues don't go to the ballot. And it was incumbent energy companies that owned power plants in Maine, or in neighboring states that bankrolled the campaign against the power line, because they saw cheaper power from Quebec as threatening to their interests.

So it's sort of, in one sense, a classic story of incumbents blocking progress. But in another sense, actually, the people of Maine did come out against the project. And so it's also a local opposition movement. And so in that sense, there's the classic NIMBY story a little bit. So it's hard to know what I don't know, I haven't taken a deep enough dive into it to really draw any key lessons. But you certainly could imagine a world where the federal government approves it. Is that a better scenario where the people of Maine don't want the project but the federal government does? It's sort of one of these trade offs that maybe we just have to grapple with, if we're really going to build a lot of new infrastructure.

KB: When you are talking about expanding transmission, is the benefit of that targeted transmission from places that are more rural to places that are more populated, like wind farms? Is that the goal? Or is it just the fact that our existing transmission, even within those populated areas, is insufficient? Essentially, do we need to beef up what we already have, or add in connections to places that are further away? Or both?
AP: I think it's definitely the first one. It may also be the second one. So, I think when you change where our power is coming from, you may need to change how the power moves to ensure that the system stays reliable. And I don't know the extent to which that's going to impact more urban areas, or whether you need to make new connections. Because the system is changing so much, and part of this may just evolve. It's a dynamic system. So it could be both, but it's definitely the first one.

KB: What are the barriers to getting to this energy vision and how might we address those?
AP: There's a lot of political issues in terms of the incumbent's political and economic power. So that's both the electric utility industry and the oil and gas industry. And the coal industry still has some political salience in some parts of the country, although that seems to be perhaps dwindling. But these are powerful industries that certainly have a hold at the national level, and in many states across the country. And so, I spend more of my time focused on the electricity

industry. And there, what we've seen in a number of states is the way that you get clean energy legislation done is you give the utilities a piece of the action, you essentially have to buy them off. So for some states, what that means is that if you're going to go to 100% clean energy, like what Virginia did, they reserved a part of the market for clean energy projects explicitly for the utilities.

So they say the utilities have a right under the law to build, you know, 30% or 50%, whatever the number is, of all new clean energy projects. In other parts of the country, where utilities don't own power plants, like in Massachusetts, I'm not sure what this trade off will look like. I think what we really need is non-utility companies participating in building the wires infrastructure. And utilities have really sort of held on to this, they exert exclusive privileges in this domain. So I'm not sure how you sort of pry it open, or if you do something to get the utilities to engage in building projects that they may not want to build. And so it's a tough thing. I think, ultimately, it would be great to scale the utilities back to their bare essentials. But obviously, they're gonna fight back against that. And so I think what you probably have to do as a political matter is find out ways to give them a piece of the action. I don't know how you do that for the oil and gas industry, if we want to just absolutely use much less of their product over time.

Yeah, I don't know the answer. I mean, maybe the gas industry, a lot of folks who would talk about clean hydrogen? I haven't really looked into it to know the feasibility. But maybe that's a way to build more pipelines and keep that going. Massachusetts has a pilot project involving the gas industry and geothermal. Maybe there are different solutions in different parts of the country. But for the oil industry? I don't know.

KB: How do we make a deal that will encourage utilities to make this transition, because they know that they have to relinquish their ability to manage a lot of things that they're used to managing? And so, what do you give them?

AP: It's really sort of always puzzling to me why they're not leading electrification efforts more strongly. I think part of the answer is because a lot of them own gas utilities, and so they're sort of conflicted on this issue. But for them, it just seems like a natural thing. If you know electricity is going to be the fuel of the future, the dominant fuel, you would think the electricity industry is going to be absolutely leading the charge and they're just not. But you know, you could imagine a deal where you say, look, electricity is going to win here.

When you have these sorts of local monopolies that are gonna be perpetual, just be happy with that, and sort of give some ground on the interstate piece of it. But they're not giving ground on that either. And they want to continue to own generation in many parts of the country. So it's tough, but I feel like at least you can imagine a deal for electricity. It may be as we talked about, there's a deal for natural gas like with geothermal or hydrogen, but I'm just not sure with the oil industry or the coal industry.

KB: Yeah, definitely. It's easier to make the argument to the electricity utility, by saying you're gonna win. So let yourself win. As opposed to with oil, it's more like you're gonna lose, let yourself lose. It's a harder sell on that front for sure. Is there anything else that you want to say or mention?

AP: It feels like the energy vision could have a lot of pieces to it. So there's potentially a lot of rabbit holes we could go down. But I feel like we hit the key legal and political issues that I spend more of my time on.

Audrey Schulman

Audrey Schulman is Co-Founder and Co-Executive Director of the energy-efficiency non-profit the Home Energy Efficiency Team (HEET), and has led it since its start in 2008. She created the nation's first statewide public natural gas leak map using data reported by utilities. Through her co-leadership of the FixOurPipes.org study, she helped municipalities coordinate with utilities to find solutions to fix gas leaks faster and at less expense. She started the Large Volume Leak Study in an effort to help gas utilities identify super-emitting gas leaks and repair them. Together with Zeyneb Magavi (HEET Co-Executive Director), she has developed HEET's innovative GeoGrid solution to decarbonize gas heating and is guiding its adoption in Massachusetts and other states.

KB: What is your vision for the future of a clean, safe, efficient, reliable energy system? How do we get there? (Note: here is a link to a description of the GeoGrid mentioned below)
AS: I specialize in the thermal area, so the heating and cooling. The way I always move forward is I find the problems, and wherever the biggest problems are is where the biggest opportunities are. So, gas utilities currently are facing existential death, because in a decarbonized lower emitting world, we will not be able to burn gas widespread, so I hope that gas utilities gradually transition from pumping gas through pipes under the ground to pumping just plain water under the ground attached to boreholes in the right of way of the street and delivering to people through heat pumps that are connected.

This is cleaner, safer, and less expensive. I think that's always an important point to make with this because we cannot raise bills. It's not equitable if we raise energy bills. Safer, better, renewable, non-emitting energy. For the areas that can't be done by the GeoGrid, simply because its not financially viable for the utilities to do it, then those can be done by individual installs of heat pumps, either air source or ground source, or there are going to be some industries that still need some form of combustion and they might be connected to some form of renewable natural gas or green hydrogen networks, because most of them are clustered.

KB: What role will the utilities play in this energy future? How do we make a deal with them that places the public's interests first and gains cooperation?
AS: If you look at the history of gas utilities, for instance, they simply start off as private companies and I've got this incredible book that shows how all of these "gas works" (as they were called back then) were everywhere who would use pipes actually made from civil war rifle barrels threaded in one after the other, because you might as well repurpose them! It's a history of innovation and of change and the reason why we have utilities is because all of those private companies were digging up the streets everywhere, they were not regulated in terms of safety or the quality of the energy delivered etc., and so gradually over many years they moved towards increasing regulation, and now what we have is a private company, an investor owned utility

generally, and whatever else we go to, it's just a smaller utility and maybe not regulated, right? So, the small district energy companies that I've seen sometimes aren't as careful.

Some people just hate utilities and I just want to make sure that it's clear that they're all somewhat associated with greater or lesser regulatory control. Being as they are the ones that bring us our heating and electricity for heating or lighting or whatever else, we might as well use them. It's a way for us to have partial control over them through the regulators. Utilities are a way of doing things in an equitable way. Everybody has access to electricity and everybody in a gas territory can, if they are close enough, have access to gas, and it's like with water. We don't all have water wells in our backyard, that would be incredibly expensive and really hard to maintain the safety of the water, etc. We have a utility to deliver it and that's the same with the energy, and that's why as we move towards this cleaner more sustainable future, we have to involve the utilities.

KB: What are the barriers to getting there? How can we address those barriers?
AS: The biggest barrier is just getting the information out. The gas utilities, once we can talk to them, tend to be quite attentive. The regulators, once we've explained the benefits, tend to be attentive. EverSource went out, after training their gas salespeople to sell Geo, and had the best sales day in two days of selling geo that they've ever had in their lives. It was orders of magnitude easier to sell the Geo than it is to sell gas, so I think customer acceptance might not be a problem but simply having the time to explain the idea to enough people and then also making sure we've got access to resources.

Massachusetts has allocated $5 million of ARPA funding to a GeoGrid research team, so we've assembled a research team including two national labs and Harvard and MIT and many others, to be able to both help with the design of the installation as well as get ongoing data from the installation well beyond what a utility would normally do, and to make an assessment not only of the effective of the whole system for all six installations in Massachusetts, but also to imagine what the scaled up impacts would be and to put all the information in a transparent normalized data bank so that anybody can compare the stuff apples to apples.

That's the kind of thing that will get a lot of trust from everybody, because the utilities aren't trusted by some people so it's a way of everybody being able to feel like, "Okay! This works!" or "This doesn't work" or "This is how it should be done" or "This is how it should not be done".

KB: Is there anything else you want to mention or say?
AS: In order to move towards the cleaner, safer, less expensive future that we all want, we have to electrify everything. The idea now is to electrify everything and then produce that electricity with renewables and storage. So, the more we make that electricity use efficient, the less renewables we'll need, and the less storage we'll need, and the less we'll need to change our

electric grid and the less expensive it will be for everybody so the GeoGrid, the networked groundource heat pump system, appears to be the most efficient system out there. It gets a system wide coefficient of performance (COP) of six to eight meaning that the entire infrastructure is incredibly efficient. I think that it’s an important part of the answer because of that. Every answer is needed, every technology, because it's an incredibly complex problem that we're all dealing with, how to change the energy structure of our world, but that’s why I think that the GeoGrid has to be part of it.

Baird Brown

Baird Brown is the Principal of Eco(n) Law LLC, whose work includes bringing together energy customers, communities, technology, and finance partners to get projects in energy and sustainability underway. He first started working in waste to energy projects, involving energy contracts, energy regulation, public/private partnerships, municipal finance, and more. Along with representing the Philadelphia Energy Authority (PEA), the Delaware Sustainable Energy Utility (SEU), and the Microgrid Resources Coalition, he has also formed an affiliate Green Bank to help customers finance projects. His energy vision for the future involves many aspects from his work. Below is a discussion of his vision.

JO: What is your energy vision for the future, and how do we get there? How has your background and work shaped this vision?

BB: There is a big role that government agencies can play in shaping the future of energy and getting things to scale, that does not involve direct government intervention. PEA started a solarize program that included a low-income pilot program for solar. There was almost zero progress made on solar in Philadelphia before, and now it has expanded substantially. It just needed a kickstart. To help get these energy efficiency projects going in Delaware, the SEU brought together the private and public sectors, and pooled financing using tax exempt bonds for energy efficiency for many state-owned buildings and higher education. Efficiencies of scale moving us toward energy efficiency and clean energy are one important piece of the puzzle. We have got to empower customers in communities to be active, and we have to change things that get in the way.

There are a whole lot of limits, especially in current state utility law that make it harder for people to do things for themselves. At the operating level, utilities are fighting tooth and nail to keep things the way they are, while at the corporate level, they are thinking about the future of the grid, but that hasn't seeped down to the local level yet. In California PUC proceedings for micro-grids the utilities are fighting back to stop local generation ownership. Their interests simply do not align with many interests of customers and communities. I worked at Princeton University which has a campus-wide microgrid. It works with co-generation, two on-campus solar arrays and a five-story insulated water tank that stores thermal energy. It is usually connected to the larger grid, but can function as an "island" off of the grid during grid disruptions, keeping the university powered independently. I think this option should be widely available.

JO: What are some barriers in terms of advancing distributed generation and microgrids?

BB: In some places, the utility by law has to own and maintain the wires and transmission, which creates a barrier for microgrids. Once you have enough local generation resources, then the grid of the future will be sectionalized, with semi-autonomous local control, so if the main grid goes down from a weather event, a substation and its feeders can keep operating with local generation.

In some ways, a municipal utility is its own microgrid, but they don't have transmission within their borders and can't operate fully without the larger grid. Also, becoming a municipal utility is incredibly difficult. Boulder, CO tried, but the utility there fought back. The law does not make it easy. It is hard to invest the money for micro-grids because the structure isn't there that welcomes that investment.

One alternative for the future is integrating all smart devices using a virtual power plant. Essentially with this structure, you are aggregating all sorts of customers who have smart homes and distributed generation to sell electricity directly to the Regional Transmission Operator at a wholesale level, skipping the utility. An aggregator takes all of the abilities of smart appliances, smart heating and cooling, and local generation and storage and delivers it along with the contributions of thousands of other homes. The virtual power plant would make money from these sales to reduce collective energy costs. It will be hard for the utility and society to resist this. To create this collective response, the VPP aggregator would give customers the opportunity to respond to real-time transactive rates for selling and purchasing electricity. The potential savings a VPP creates at the wholesale level are huge but there are 10 times the length of wires at the distribution level than at the transmission level, and an even greater savings opportunity there.

JO: To sum up, how do we get to this energy vision for the future?

BB: Workarounds. We need to work around the utility and legal restrictions to create projects. The utility isn't going anywhere, so continue to do one micro-grid at a time and more rooftop solar, more solar farms. The utility can coexist and work as a larger umbrella with many microgrids operating with it as well as working independently. I say just do it! If there's a possibility to do a project with energy efficiency or renewable energy, just do it. Do it with whatever the law allows. There are lots of ways to go, and sooner or later the utility is going to have to decide whether they keep fighting or join. One process we clearly need to fix is interconnecting small generators to the grid. The current system is designed for a much smaller range and quantity of systems interconnecting. There is a need for collaborating between all parties involved, and the key to this is outreach and education.

Cutler Cleveland

Cutler Cleveland is an Associate Director of the Boston University Institute for Sustainable Energy and Professor of the Department of Earth and Environment. Dr. Cleveland's research and teaching focus on the connection among energy, climate change, and sustainability. He recently served as the principal investigator for Carbon Free Boston, a technical assessment of strategies to assist the City of Boston in reaching carbon neutrality by 2050. He currently serves on the Advisory Board for Project Drawdown and is an Affiliated Researcher of the Center for Antiracist Research. Dr. Cleveland's research on the valuation of ecosystem services, funded by the National Science Foundation, is highlighted in NSF's Top Discoveries series. He has been a consultant to numerous private and public organizations, including the Asian Development Bank, the United Nations Commission on Sustainable Development, the Energy Information Administration, and the U.S. Environmental Protection Agency.

KB: What is your vision for the future of a clean, safe, efficient, reliable energy system?
CC: Well, I think the vision is exactly that in broad terms. It's affordable, accessible, safe, access to energy services, not energy, per se, but energy services for everyone. We tend to focus a lot on sources. So what we're really interested in is access to the services of energy. So we want thermal comfort, refrigeration, mobility, and lighting that is safe, acceptable, clean, and affordable, which is closely related, but a different issue than, you know, talking about the sources per se, because there are many ways in which you can illuminate a computer screen. So I think that's an important starting point.

The challenge is to develop a set of criteria that enables you to judge one supply chain to supply a particular energy service, it somehow incorporates all those issues. There's economic efficiency issues, there's environmental issues, there's cost issues, and there's equity issues. And unfortunately, there's no single metric that one can use to plug in that particular energy service, and it gives you the right answer. So I think you need multiple endpoints that you're shooting for, for a particular energy service, and then have the ability to calculate and assess those metrics over the entire supply chain of energy.

So I think that's one of the biggest challenges, then you're forced to recognize or answer the question, what is clean? Are you talking about carbon dioxide only, or all greenhouse gasses, which is increasingly what people are focused on. But there are all kinds of other issues associated with cleanliness, due to all the emissions to air, land, and water associated with any particular supply chain. So you need to define which things you're going to be most interested in. Because you can't optimize overall all the different criteria. Then you need to be able to evaluate economic costs in a consistent way and have some agreement on how you're going to actually calculate costs, which is relatively straightforward, but also deal with external costs and the extent to which you're going to deal with externalities and subsidies, how to measure those and

how are you going to include those in your analysis? And then on the equity front, you know, what are the equity outcomes that you're interested in? There are all types of equity issues, income, race, and ethnicity, the obvious ones, and there's also gender issues. There's also issues related to the age of populations, for example, that are more susceptible and more vulnerable to certain supply chain issues.

And then there's the intergenerational issue. What weight do we give future generations when we're making assessments? So I think while in principle, it sounds nice to say clean, accessible, affordable energy for all, what does that really mean? I think from a general perspective, that's how I think about things. Now, in terms of actually getting down to the nitty gritty, I think quite clearly, given all those qualifications, there are clearly some no brainers in the sense that across many environmental endpoints renewable forms of energy, particularly wind, solar, geothermal, and hydropower are clean in terms of their impacts on emissions, and also impacts on land and water and so on, compared to fossil fuels. So I think that's a pretty clear take in regards to greenhouse gas, and with nuclear also, at least from a carbon perspective. And also in other important metrics, like work or health and safety, it's far more dangerous to be working somewhere along the oil and gas supply chain, on average, than it is the nuclear supply chain.

But of course, then there's the assessment of risk that's associated with accidents that is challenging to measure, and people are going to weigh that differently. So I think we can clearly say from a cleanliness perspective, renewables, particularly in electricity generation, are cleaner. The cost issue also becomes challenging, but there are also some pretty broad trends that we see there. You know, wind and solar have dropped dramatically in their costs, due to research and development and learning by doing and increasing deployment. So most parts of the world are as cheap or cheaper than fossil fuels, certainly cheaper than coal, and competitive with gas. So yeah, the cost opportunity is there. The challenge there is also how you're going to deal with subsidies. And this is an issue that's, I think, important for people to consider. Historic subsidies have favored oil, gas, and nuclear, and more recently renewables in a big way. People need to be explicit about how they're going to factor that into their assessment and account for current and historical externalities or subsidies.

The equity issue is key. When it comes to race in the US, it’s all about what you do about past historical injustices that have produced the current pattern that we see? And what could you do in the future to avoid those mistakes and hopefully rectify past mistakes? There, you know, a clear criteria has to be some equity metrics. I refer specifically to climate action plans by cities, states, companies, whatever it might be, whoever the Climate Action Plan is for, how does it specifically address equity, whatever you're going to put in that bucket of categories, whether you're concerned about people of color, low income, elderly, non English speaking, whatever it is, how are you actually going to measure the impact on equity from a particular action taken? So that's one important issue. And you also want to make sure that, you know, those populations are

included in the decision making process in some tangible way. And not just as a kind of window dressing, “Oh, we're gonna have a town meeting, please come hear us” kind of thing. And then act on those equity goals, and incorporate them from the very beginning of your planning.

KB: What are the barriers to getting there? And how might we address those barriers?
CC: Well, I think the largest barriers are not technological. I think there's a lot of money to be made in clean, affordable, accessible energy systems and services such that the incentive will be there to develop them and the right policies can accelerate the deployment of technology. So I think the real challenge is in the social and political realm. And that’s not to say there aren't technological challenges, you know, large scale grid level storage is a challenge, how do we get the cost of electric vehicles down? So they're affordable for everybody? How can we accelerate the efficiency of PV cells and so on, but I think those are surmountable. I should also mention carbon capture and sequestration is another one that needs more technological development.

But to me, the real challenges are, you know, political, cultural, and social. And in the political realm, you know, you have a real imbalance of power, even in democracies, between people with vested interests in the status quo, people in companies that have their own short term economics, self interest, and who lie about their commitment to equity, and so on and so forth, just because they have to. There's also a fair amount of corruption in almost every government related to energy. A big issue is, well, the influence of corporate money and lobbying, regulatory capture, which is a big problem, where the utility or industry being regulated and the regulated agencies are way too cozy with each other. We saw this in the Deepwater Horizon accidents, when we really lifted up the rug and looked at this horrible regulatory capture within the Department of the Interior and the oil industry, the Fukushima accident, and revealed regulatory capture on the part of the utility and the government regulating eight entities. So you know, cleaning up government corruption and mismanagement is a big challenge. And fossil fuels have the issues related to that, in part, because there's so much economic rent to be gained from the extraction and sale of oil, there's huge motivations to behave in nefarious ways. Those issues go down a bit with renewables, but it's inherent in human nature.

And the other issue is really about the consumption side. And, you know, in the developed world, it's really about consumption. And a lot of these energy issues diminish in magnitude if we just need a lot less energy. That's tied directly to consumption. And, you know, in America, we’re not even close to grasping that as a culture, looking at our material consumption habits, and the implications for climate change, natural systems, and inequity. Trying to have a conversation about that, I think would be very important and useful.

KB: Do you think that [political issues causing the U.S. to lag behind in the energy transition] is going to have any sway in terms of how much power the utilities will have going forward? As you know, they resist more distributed generation and many people don’t really care about

energy issues, so there may not be enough pushback against the utilities for opposing distributed generation. Is that anything that you think about in terms of the role of utilities?
CC: Good question. You know, I think distributed generation is a great thing. It can save people money, it can reduce emissions if it's focused on renewable energy, and there are efficient heat pumps and so on. But I don't think it's a panacea. I think that, you know, we need to restructure the way in which utilities are incentivized so that supporting distributed generation is in their best interest. And that can only be done by laws, which alter the mission of utilities to do that. We saw that with energy efficiency some decades ago, where they kind of had to be forced to deal with that and now it's become kind of normal. Distributed energy is the same way. And we need enough enlightened lawmakers and people pushing them to stand up to the utilities and their great cloud they have in the halls of government to change the policies and the way in which we think about supplying electricity to people.

But I also think that, you know, moving to the developing world, talking about electrifying Africa and South Asia and Latin America. I think there's definitely a case to be made that distributed generation is good. But I'm not convinced that it's universally always the right answer. There are certain economies of scale associated with large scale central power generation, which could come from solar energy or wind, that could, under the right circumstances, benefit consumers with reliable access and low prices. So I think it's wrong to just have this knee jerk reaction against centralized utilities, because there are some good economic reasons why in the right form, they could be good in the right circumstances.

KB: What could a deal be to get the utilities on board with less centralized power generation? What's their incentive to go along with this?
CC: Well, the incentive is that we allow them to continue to exist. I don't see it in the Constitution that regulated monopolies have a God given right to exist. There's a social contract that we have developed with utilities, which realizes that at least in the past, there was a social benefit to not having ten different power lines strung down the street. So we give them this ability to monopolize the delivery of the service in return for regulation that prevents them from gouging the public. So I would say, behave appropriately and we will continue to let you do that.

And I don't think it's a question of making less profit, I don't know whether they're making too much profit or not. But we have to realize that these people have capital, and they are weighing different returns. Where they could cluster capital down, you could be making shoes or generating electricity. So you have to be competitive with other rates of return. So it's important to keep that in mind. And I think that we have to use the criteria that we began talking about, as setting the framework for "Here is the regime that you have to operate in. And we're going to keep your big pipeline network underneath the city. We're skeptical, but show us a way that you can, in an environmentally sound way, an economically efficient way, and an equitable way, put some type of gas through that system that will meet all these close criteria. And demonstrate that

it is cost effective versus electrifying everything." So things like that, I think you have to constrain the choice because many of them will try to set their own choice and use that as a measure of what's fair, or not fair, but they work for us.

And so we have to, or ultimately the Department of Public Utilities has to set the terms of engagement. And I think that they have a lot of smart economists and engineers and so on, and they'll figure out a way to deliver these energy services that operate within those guidelines. And if they can't, they go bye bye. And other people will step up.

Gerry Braun

Gerry Braun is an energy technology generalist with decades of energy R&D and business leadership, he advises on technical and economic issues of local energy integration, collaboration and planning. He directed early national and utility renewable and gas technology programs. Later, he led solar PV industry efforts to commercialize new PV panel technologies and open markets for grid-tied systems. He served as Director of the California Renewable Energy Center at UC Davis until 2012. While at UC Davis he founded the California Integrated Renewable Energy Systems (Cal-IRES) collaborative, which is now the IRESN non-profit business league. He serves on the Valley Clean Energy Community Advisory Committee, the City of Davis Utilities Commission and the Gas Technology Institute Public Interest Advisory Committee. Gerry advises and advocates for integrated planning and operation of local energy services in support of community economic and environmental goals.

KB: What is your vision for the future of a clean, safe, efficient, reliable energy system?
GB: My vision is to achieve an energy economy that integrates renewable energy into existing energy infrastructure in the best way depending on local circumstances. I envision increasing collaboration between energy utilities and service providers with cities, counties and local energy retailers to achieve the best possible integration of decentralized renewable energy supply and storage projects. I'm becoming convinced that this is where the emphasis needs to be. You can lose sight of the importance of putting the puzzle together and making them fit when there's so much attention being given to the individual puzzle pieces. That's very conceptual and vague, I know, but also critically important.

I guess the second component is that we need to recognize that changes in energy systems have historically been pretty slow. But now the big challenge is obviously climate change. It's moving fast. The big challenge is, how can you step on the accelerator to make things move faster, make the transition to zero carbon or near zero carbon resources as fast as possible, and recognize that you're talking about a global energy system which is enormous. How fast can you change the direction of a supertanker? It's a good metaphor. In the energy sector we have two main concerns which are speed and scale. How do you make a transition to zero carbon or low carbon and low GHG emissions? How do you do that faster, because fast is not how the direction changes for either supertankers or energy systems.

So, my vision is to recognize that the one thing that we've learned about energy sector speed and scale is that we are, fortunately, now moving very fast with the technologies that are modular and can be manufactured and then deployed, like solar panels and wind turbines and batteries. The reason we can move fast with those technologies is that, when you put them into production, you almost automatically are driving costs down, because you're learning how to make them on a mass basis. And you have economies of scale in manufacturing, whereas the historical energy systems, electricity in particular, have relied on economies of project scale.

Scaling up manufacturing scales down costs and motivates faster investment. Obviously, solar and wind projects and battery banks can be very large.

But the key to their low costs is not the fact that the projects are large, but the fact that the component pieces of the projects are being manufactured by the thousands and millions. High volume manufacturing can be very, very efficient, because the processes involved are so repetitive, and because you learn more every year, you can drive costs steadily down toward the basic cost of required materials.

KB: How do we get there? What are the barriers to getting there?

GB: Well, that's where my theme of renewable integration comes into play. The general barrier is that existing energy networks are designed to transport electricity and natural gas long distances. Energy transport systems have been fine tuned over 100 years or more and now work very well and reliably. So, we have an energy infrastructure that is basically focused on complex and pervasive transport systems and heavily relies on them. How do you integrate more modular technologies, solar panels and wind turbines and batteries, into a system that was invented and perfected before anybody ever thought of them? How do you re-integrate them so that you are drawing on the strength of both the transport systems and the new resources and the new generation components and supply components? The answers explain why I say renewable integration is so important. Because when you connect solar to the electricity grid, solar doesn't act like the other things that used to produce electricity that were very compatible with the transport system. Not only did they produce energy on demand, whenever the transport system wanted it, they could produce it 24/7. They didn't cause the transport system to have to adapt.

For example, thermal power plants were a perfect fit to electricity grids, because they had a lot of inertia, and so they enabled the electricity system to be very stable. Now you have solar projects that produce electricity when they can, or when the weather allows them to. You can stabilize that input by adding batteries, and so forth. But where do you put the batteries? That's a renewable integration question. Do you put the batteries next to the solar array, or do you put them somewhere else on the transport system? How you do it makes a big difference from the point of view of affordability. That's why I say renewable integration is so important. It's especially important because solar energy is so important. Solar is the universal carbon free renewable source that you can tap just about anywhere. But it's more or less cost effective depending on local conditions. So, you have a general renewable integration issue. That is, every place you try to bring variable renewable sources into play has a different set of constraints on how you do it, and at what scale you do it.

For example, consider New England versus California. California is barreling down the road doing huge solar projects, and also huge wind projects. (It also has by far the most rooftop solar arrays of any US state.) But solar arrays and wind farms don't fit very well in places where you may not have huge areas that are environmentally and otherwise suitable for such projects. So,

in some places you need to scale down the projects, and do more of them, and find the right places to do them, still feeding their output into the electricity transport system, aka "grid". In California you have a robust electricity transmission system. So, you can put a large renewable project pretty much anywhere the transmission system is close by. But when you're doing lots and lots of small to medium size projects, integration becomes more complicated.

So, I think an important barrier is lack of experience integrating solar into existing local grids and accounting for (this is the really hardest part) all the rules and all of the demands on the existing transport infrastructure. At all sizes, solar changes how we do things. Grid interconnection rules exist because of course they once made sense, but they can also be daunting barriers to integrating smaller and more numerous power sources. They sometimes force things to go in unnecessarily costly directions.

We must learn very quickly how to avoid unnecessary renewable integration costs. California wants to get to zero carbon electricity. I worry that the current approach of just building big projects and connecting them to the big grid may be increasingly costly as we approach the goal of full statewide decarbonization by relying so much on large projects. We may need to think about feeding solar electricity into the grid closer to where the electricity is used. Because doing so reduces the overall cost of electricity service. But this is not a familiar, easy approach that relies on what we already know how to do. We know how to connect a big power plant to the transmission system.

We haven't yet learned the best and most affordable ways of connecting lots and lots of smaller sources to a system that is designed to bring electricity to buildings from afar. It's not designed to absorb a lot of electricity from buildings and neighborhoods. These are general, easy to explain barriers. There are other, more subtle barriers to integration at all levels. For example, at the local level, you need engineers who understand local gas and electric distribution systems. I look around my area of California, and I can guess the number of folks who really are good at that. We don't have near enough.

KB: How do we address those barriers?

GB: To tackle the barriers, you need to have a realistic vision of how much time you have. To be late is to be irrelevant. You have to have a vision of what the steps along the way are to your goal. I think California is doing a pretty good job of that without being able to accurately estimate the final cost. There are all kinds of studies that show what the mix of supply will be in the long term. What we don't know is how the vision will be realized as we get closer to net zero carbon.

One fundamental strategy is to recognize that we have to re-purpose the energy infrastructure we have rather than aim to replace it. We don't have time or money to start over. Basically, we have energy that is produced and delivered in different forms. Right now, in California at least, we're

very climate conscious. We want to electrify transportation, we want to stop burning fossil fuels, natural gas included. And it's easy to say, “Oh, let's make this simple, let's just electrify everything.” Certainly electrification is a foundational element of overall strategy. But as for fuels, gasoline, natural gas, etc., we have infrastructure for fuel transport and delivery that is crucial to making the electricity system work.

To address the barrier of getting renewable electricity on stream really fast, we need these other components of the existing energy infrastructure to keep working while we are transitioning to cleaner sources. Specifically, we need to retool our gas transport infrastructure to handle renewable hydrogen, which, when you burn it, doesn't produce CO2. In order to do what we want with the electricity infrastructure and electricity supply, we need fuels that are basically zero carbon or "carbon negative", and we need to avoid leakage of methane into the atmosphere. Fortunately, proven commercial technology exists to use electricity to split water into hydrogen and oxygen and store the hydrogen for use in producing electricity when the sun doesn't shine and the wind doesn't blow. Hydrogen is its own unique technical challenge from the perspective of energy transport. Unfortunately, the existing gas fuel transport system isn't the right system for the future because it is designed to transport natural gas, a fuel having properties much different than hydrogen. You can blend hydrogen and natural gas.

But then you have a political problem. “Well, good, you are substituting some hydrogen for natural gas, but you're still emitting a lot of greenhouse gasses.” The reality is you need to manage a transition from one fundamentally important fuel to another fundamentally important fuel that requires a new and different infrastructure or a totally retooled existing infrastructure. The big unresolved strategic question is "what is the fast and realistic pathway?" Because not knowing what that pathway is, is a barrier in itself. And not being able to agree on the pathway is a huge barrier. The truth is that the pathway goes through every home and community and each of the little pathways needs to be affordable and smart. How do we do that? People are stepping up but their cities and counties also need to get on board.

KB: I think another thing that I've been seeing throughout past conversations with people is another huge strategic question, which is what we do with the utilities in this? I'm curious what your thoughts are on what the role of the utility would be in this new future?

GB: I'm really glad you asked that question. Because another thing I've been working on for about 15 years is Community Choice. We have Community Choice in California, and basically, it is a way that cities and counties can take a role in sourcing electricity. Also in making local energy supply more resilient to disruption and better adapting to local conditions. I'm not suggesting community choice as a silver bullet, because at the moment. It's not. There is no silver bullet. But it does open the door to locally appropriate initiatives and adaptations. Focusing the utility industry's attention on local climate action and adaptation is essential if you're going to decentralize sources of supply. Decentralization is going to be more important in some states than in others. Utilities are monopolies. Giving them monopoly franchises used to

be a very smart thing to do. Likewise, most of the services that cities and counties provide are also monopolies because you don't want to have to pay for more infrastructure than you need.

The fact that our energy utilities are used to being monopolies means that they don't want to work with other people to integrate things, they want to do the integration themselves. Or not. And when you start decentralizing energy systems, utilities will have to work with others, or decentralization won't happen. So, it becomes necessary for the utility model to adapt to become more collaborative, and less, shall we say, self-conscious. And that's a huge problem, because institutions don't like to change. They don't change quickly. Utility monopolies call the shots in California, where there's this pleasant myth that they're regulated by the state. In fact, they are so politically powerful that they pretty much regulate themselves, along with their regulators.

From their perspective change is risky. They can create barriers to change because they heavily influence the folks to whom they are supposedly accountable. And they erect barriers to things like rooftop solar, things like community choice. They are doing it now in California on both fronts as we speak. Monopolies eventually break down. But utility monopolies are slowing things down that need to speed up. They are slowing down the energy sector decentralization that needs to happen even as utilities must continue to do what only they can do.

KB: Is there any component of your vision or the barriers to your vision that you think are important that we didn't touch on yet that didn't really fall into any of the other categories?
GB: California is one situation, but every other state is different, every other country is different. The outlook for climate action, I think, is that this is gonna be a hard road, and you want to go fast. The best way to navigate is to strike the right balance between the existing infrastructure and the new infrastructure, the existing supply that you rely on, and the new supply that you'd like to rely on.

It's complicated by the fact that the new supply really wants to be more decentralized, the old supply really works well when it's centralized. And so you need the vision we talked about, and you need to try to strike the right balance between big stuff and small stuff. I mean between centralized infrastructure and resources and decentralized infrastructure and resources. So I harp on the question of balance. It's natural to ask, “But what do you really want people to do?” What I would like people to do at the state level, and at the local level, is to think ahead about the right balance between importing energy into your area, or making it inside your area and distributing what you make around your area. What's the right balance? For your county, for your city, for your state? For the United States?

Every city or county in the US will have a different preferred balance depending on what they know, what their locally accessible resources are, and what their infrastructure is capable of. It will depend on state policies, the funding behind them and whether powerful utilities have a

vision that aligns with state and local visions. I think a lot of cities and counties are going to emphasize local supply and decentralization, but not every local area is going to be able to go as far as fast. It depends on priorities and bandwidth. Most cities and towns have a lot of needs, and energy is only one. So, I think you probably need to think about striking a balance first at the state level. What's the right balance for Massachusetts? Probably very different from the right balance for California. The question of balance has many facets.

For example, between electricity and zero carbon fuels, between big projects and small projects, and between importing energy into your area versus producing it within your area. A city needs to consider what's good for its local economy. So economically beneficial balance, to me, is crucial, and it's not getting near enough attention right now, either locally or at higher levels.

Karl R. Rábago

Karl Rábago has more than three decades of experience in clean energy, electricity regulation, sustainability, and advocacy. He is experienced as a public utility commissioner, federal R&D executive, utility executive, advocate, and attorney. He is recognized as an innovator in electric utility regulatory issues relating to clean energy services and technologies. Karl serves as Chair of the Board of the Center for Resource Solutions, a San Francisco-based non-governmental organization that works to advance voluntary clean energy markets. He also sits on the boards of Solar United Neighbors (SUN), the Texas Solar Energy Society, and serves as an advisor to Commision Shift. Karl also runs his own successful consulting practice, Rábago Energy LLC. His past positions include Commissioner, Texas Public Utility Commission; Deputy Assistant Secretary at the US Department of Energy; Vice President of Distributed Energy Services at Austin Energy, the municipal utility for the City of Austin, Texas; Director of Regulatory Affairs for the AES Corporation and AES Wind; Energy Program Manager for the Environmental Defense Fund; and Managing Director & Principal of Rocky Mountain Institute.

He began with providing background to our discussion:
KR: When I taught energy law, I always presented a course koan:
In the largest, most successful free market capitalist society the world has ever known, why is one of our most capital intensive and important industries allowed to operate as a monopoly?
The answer, of course, is because it made sense when we did it. But that doesn't explain why it's still that way, today. And in the question itself, is the presumption that we're supposed to be capitalist. As President Biden said during his first State of the Union speech, “Capitalism without competition is exploitation.” And yet, we have accepted and adopted this model of monopoly provision of utility services. Understanding energy law is understanding the work we have done over the past several decades to introduce competitive market forces into the electric sector.

Once upon a time, the electric service was provided by government—the city, the state, the federal government; it was a service provided by the government, funded by taxes and fees and charges, provided on a universal service basis, and you were entitled to it because you were a citizen. So it was kind of a little bit like a co-op, where you have financial obligations that come along with the opportunity to obtain service. But then in the late 1800s, things began to change—we largely privatized electric service. If you haven't read it, you must read Samuel Insull’s speech from 1898. Insull argued that the privatized monopoly was the best model for electric service, that competition is not what we need. The pitch was that because we were trying to build out an electric infrastructure, we needed to attract and deploy huge amounts of capital, and because electric service was a business with declining marginal product costs, it was later explained by the courts, electric service was a “natural monopoly.” We largely bought the idea—at least in cities where there were lots of customers—the investor-owned utilities owned by large holding companies were the model we installed. The monopoly model worked—our

grid was built—and with help from the federal government in rural areas through power authorities and cooperative utilities—also organized as monopolies—we succeeded in providing nearly all citizens with safe, affordable, and reliable electric power. It worked, until it didn't.

The model was based on the idea that bigger was cheaper. Cheap electricity meant that everyone could afford the price, and that bigger power plants and infrastructure, which demanded huge amounts of capital, justified the continuation and expansion of the monopolies. The model stopped working, however, when we exhausted the economies of plant scale. Nuclear and coal-fired power plants were the biggest of all, and despite their size, they were quickly demonstrated to have major problems. They cost time and money to build, suffered construction delays, and posed massive and enduring environmental problems—like nuclear waste and global climate change.

Today, drivers of change are again at work in the electricity sector. Smaller, right-sized resources like efficiency, rooftop solar, home storage, and energy management systems have demonstrated superior economics through the economies of manufacturing scale. The more we made and deployed these resources, the less expensive they became—it is the economics of cars, not cathedrals. We demand environmental responsibility. We seek distributional equity and broad access to more sustainable energy technologies; we want resilience, especially in the face of economic and climate volatility.

With all the changes we now see in the electricity sector, we are again called upon to ask whether the monopoly model—one provider for all our needs—is still the best course. The grid needs modernization to host all the distributed resources coming our way. It needs intelligence and adaptability, and must deliver services that address structural inequities—such as the siting of polluting power plants in low-income communities and communities of color. There are some that believe, almost as a given, that we need economically powerful monopolies more than ever. The monopolies see widespread electrification based on renewable energy, including electrification of transportation and thermal energy systems, as a huge opportunity for growth. The "biggering," as the Lorax described in Seuss's book, is again the path to cheap energy and reliable service.

Once again, we are called upon to ask whether we should curtail competition in order to secure the benefits of infrastructure investment—this time at the distribution end of the system. In this country, the answer should be a "yes" only so long as competition cannot provide the benefits. This is because competition, not monopolies, will drive us to the marginal cost—the economically efficient price. It is important to note that even Samuel Insull said in his 1898 speech that the monopoly model only works if we also have a requirement that monopolies be comprehensively regulated, that they are never able to charge a price higher than what is just and reasonable and in the public interest. Regulators must serve as the substitute for the forces of

competition that monopolies do not face. In times of great system change, there is no room and even great danger in allowing unregulated monopolies to provide essential services or to control new technology transformations.

So the history of electricity regulation is the history first of building up the monopoly. And since at least the 1930s, and more actively since the 1970s, we have been ratably trying to extinguish the monopoly as technology and economics allow market forces and competition to take hold. And now we are also more consciously focused on ensuring energy equity and justice. Equity and justice are hard to work into a monopoly environment, especially with average rates and large scale infrastructure. Today, the organizing question for regulation might fairly be posed as: What is the least possible monopoly we can have and still ensure equitable, adequate, reliable, and affordable service?

In order to address the question, we need to keep a few other concepts in mind:

- In the U.S., we have a system of blended jurisdiction, in which both federal and state governments play an increasingly overlapping role.
- Utilities used to forecast and assume demand, then build supply to suit. But we can manage demand as well, and much more cost-effectively than we can manage supply.
- Customers are no longer purely passive price takers of utility service. Increasingly they can generate, control the timing and level of usage, and even store energy. They are prosumers who can impact the grid in ways that create both benefits and challenges.
- When customers can produce as well as consume, the utility becomes a super-competitor with customers and non-utility competitive service providers. Utility actions must be judged on whether they are properly regulated against abuse of their market power.
- It used to be enough in managing market power to use tariffed rates—contracts that are negotiated by regulators and that are binding whenever a qualified customer uses the service. The market power remains, but the environment is changing. If customers get competitive options, should utilities get pricing flexibility, too?
- Once upon a time, the lowest price was the result of the biggest power plant and utility system. But those low prices came with high costs, and there was no real focus on value. The advent of affordable distributed energy resources compels a reexamination of the economic fundamentals that the utility system and rate regulation were built upon. We've tried the "cheap energy" model, but it now appears to cost too much.

KB: What is your vision for the future of a clean, safe, efficient, reliable energy system?
KR: My vision is for Sustainable Energy for Everyone, Today and Tomorrow. At heart, this is nothing more than a restatement of the Brundtland Commission definition of sustainability anyway. I also believe in Triple Bottom Line sustainability as a tool for sharpening our focus. And I am always mindful, perhaps because of my military background that while sustainability is about meeting needs today in a way that does not compromise the ability of future generations to

have their needs met, so too Security is about freedom from fear of privation or want.

KB: How do we get there? What are the barriers to getting there?
KR: Well, since we built an entire system and infrastructure to accomplish something that is now no longer needed, I can safely say that we are not likely to get there the way we got here. We do need to build a new kind of grid. The answer is transformational change, we have to figure out how to ratably extinguish the worst of the old monopolies and the monopoly function, substitute for that with competition where possible, and at the same time enable new technologies, justice, environmental responsibility, and all our other design criteria. Nothing less than transformational change will get us there. Though we can't jump the chasm in two jumps, we must start building the bridge to a sustainable energy future even if we don't yet know how we will complete the most difficult center span. We must start the work and take the steps we know how to take. And then the politics and strategy and tactics are about making sure those steps are irreversible.

As for barriers, there are many. It seems to me the biggest challenge is the inertia in the system we have to displace. It's capital inertia; it's institutional inertia; it's mental inertia. The guy who invented the Polaroid camera, Edwin Land, once said that in order to have a new idea, sometimes we just need to stop having an old idea. To me, there are three steps in overcoming old mindsets: you educate, you demonstrate, and then you outplay the past. You know, you learn, you educate people, and you build constituencies. And you practice leadership, which is defined as convening people around a common agenda; you demonstrate, do it, even if you do a small step up, you do it, you do it again, do it again, you demonstrate that it can be done. And then you learn their game so well, that you're going to play them. I was so lucky that Governor Ann Richards and the Senate of the State of Texas gave me the opportunity to serve as a utility commissioner in Texas when I was just 34 years old. It gave me the grounding and experience and knowledge that I could build on over the next 30 years. A series of incremental steps all facing in toward the same goal of transformation, a goal that I envisioned and adopted for myself all those years ago. Since the goal is so big, I am glad that I started early, and have been able to stay in the field for all this time.

KB: What role will the utilities play in this energy future?
KR: Utilities, whether publicly or privately owned, are going to always be a great way of ensuring universal access to a basic and necessary service in modern life. They are well-positioned to deliver the public goods aspect of electric service. The use of the words "electric service" means that I fundamentally reject the notion that utilities with franchises should ever pursue an agenda of turning electric service into a commodity; commoditization of electric service has proven to be largely inconsistent with objectives of equity, environmental responsibility, innovation, and, in my best view, the broader public interest inherent in electric service.

I also believe that in doing only what a monopoly can do better than any other structure could do through competitive markets, the utility of the future will have the highest and best function as a platform for service delivery and for animation of markets for distributed energy services of all kinds.

We now have an amazing opportunity to increase competition to diversify resources to address environmental problems and to improve energy justice. But such transformation will not happen quickly or fairly with a top-down approach. I think we now need to focus on replacing the monopoly from the bottom up, with distributed energy resources. These DERs, as we call them, can be fast, flexible, and fair. DER providers are rapid innovators. DERs can be sized and targeted and sited in a way that provides not only economic efficiency and right-sized solutions to the changing demands for energy services, but also in a way that addresses energy justice. Numerous studies of this potential are available at Local Solar for All's website (localsolarforall.org) One study that we performed in New York shows that a high DER world maps nicely onto economically disadvantaged areas, meaning that if we simultaneously target the benefits of distributed energy resources and the jobs they create into the areas where we want to deploy these resources, we can uplift these communities and meet justice goals. This is something that can't be accomplished with utility-scale resources alone.

So is there a future for the utility? Yes, but a very different kind of electric utility, and one that the next generation will have to ensure comes into existence. We are starting the process with an approach called "Performance-Based Regulation," or "PBR." With PBR, instead of just paying utilities profits for getting bigger and spending more money, which increases customer bills, we pay for performance against predefined metrics—measures of outcome.

PBR is easy to describe, but it's going to be hard to implement successfully. And we still don't have a proven recipe. Utilities have to look hard at their staffing and organization, and we all need to have a serious conversation with Wall Street. Regulators will still need to regulate, and must do so with a high level of professionalism that creates public confidence that regulators are putting the public interest first. We need to engage with and understand customers to a degree of detail that we never have. And we need to learn from technology and service providers about what energy innovation really looks like, and what it needs to thrive. New insights await us every day, if only we stop for a moment and allow ourselves to stop having an old idea, and to instead have a new one.

I have long been frustrated that in big utility rate case proceedings, there is often a battle between customer classes. Large industrial customers and data centers don't want to pay for low-income programs, energy efficiency, or the energy that comes from rooftop solar. Multifamily housing owners want general service or business rates, because those are their customer classes—even if it means raising rates for residential customers in single-family homes. This battle arises because

when we set rates, we first define the size of the “pie”—the amount of money that the utility needs—and then we force customers to fight out who has to pay, and how much, for the slices.

We put the interests of utility shareholders first. Then we allocate the burdens. But it doesn’t have to be that way.

We could start by asking what is a fair bill for safe, responsible, and reliable electric service—for everyone. Then we can figure out how much budget the utility will have to work with, and how they should prioritize their spending—just like a market does.

My point is that there is an opportunity to think differently—to rethink. Not only to rethink the technologies that we use, not only to rethink who provides the service, but also how we calculate the costs and benefits of the service we want people and businesses to be able to receive. This rethinking is just starting, but it is going to make these next few decades some of the most exciting and important in the electricity industry in quite a long time.

Lorenzo Kristov

Lorenzo Kristov is an independent consultant with decades of experience in the energy industry. Between 1999 and 2017, Kristov worked at California ISO (CAISO) as a market design and infrastructure policy principal. He was a lead designer of the locational marginal pricing (LMP) market system the CAISO implemented in 2009, and was project lead in redesigning CAISO's transmission planning process and new resource interconnection procedures to support the growth of grid-scale renewable generating resources. He currently works at the state, national and international levels to advance the power system transition to integrate high levels of renewable generation and local distributed energy resources.

KB: What is your vision for the future of a clean, safe, efficient, reliable energy system?
LK: My vision starts with a bottom-up consideration. There are three pretty broad goals that the power system must serve. One is sustainability, but more specifically decarbonization of the electric system and electrification of fossil-fuel using activities generally. Second is resilience, as the near term impacts due to disruptive events will get more frequent and intense. Third is environmental justice and equity, because the system really loads externalities on marginalized communities and with the way energy assets are owned and managed and controlled it's another device for siphoning off wealth to a small percentage of the population and not serving community interests. When you look back at the 20th century and at the electricity industry structure, none of those three things were a concern. Going back to the end of World War II, the focus was on massive capital investment to expand the power system and build U.S. industry and suburbia. The large-scale centralized infrastructure was based on the utility model from the early 1900s. Today, we still care about electricity being affordable, reliable, and safe which represents the standard requirements of the 20th century, but we also have the new goals of decarbonization, resilience and equity and no longer have the expansion of infrastructure goals.

KB: How do we get there?
LK: So, how do we focus on those big three goals? To that end, I position the capabilities being created by new distributed technologies alongside what those needs are. For 100 years, the electric power system had no competition. If you wanted electricity, you had to buy it from the grid through the utility system. Even with the introduction of competition and wholesale markets in the 1990s, it did not change the paradigm that people need to get electricity from the grid, mostly from large-scale generators. Now, with distributed generation (DG) and other types of scalable distribution-side resources (DER), any customer can choose how much they rely on the grid and could go totally off the grid and rely on onsite equipment, if they have the money to do it. That means the grid can't keep customers captive anymore because they have cost-effective alternatives.

This is a very different way of thinking. Today's legacy utility business models all assume customers are captive to the grid and focus on big transmission and big power plants. The money was in building big assets. DER changed that framework because now, customers can leave. There are options to decentralize not just the technology but also the ownership of assets. This is important for today's equity goals, because communities and neighborhoods can own their local power systems and recirculate energy revenues locally. Localization of energy assets is part of the bigger picture strategy of increasing local self-reliance. As we think of the turbulence of the 21st century and beyond due to climate change and political disruption the root causes of problems with dealing with climate comes from the excessive centralization and monopolization of just about everything. In my view, localization of the means to meet almost every basic human need is the pathway to survive and thrive in the 21st century, and a key component of that is local energy.

What does that look like? The future electricity system, from a whole-system perspective, will be a bimodal system with a participatory distribution side which is of equal importance to the bulk power system. The distribution side is built from the bottom up by going to the root of the sources of need for electricity at the local level and looking for the opportunities to meet those needs with local DER. Large numbers of cities are passing climate goals and electrifying transport or municipal buildings, converting from gas to electricity. A lot of change for the overarching three goals will be coming from local governments and Native American tribes taking control of their energy future. There are pilot projects doing these kinds of things, for example the EcoBlock project in Oakland which retrofits urban residential areas by creating solar and storage systems on individual blocks to serve all buildings on the block, have a single interconnection point to the distribution utility and can separate as an island like a microgrid when the utility grid has an outage.

The key is to use the technology that's available today in a way that responds immediately to the needs defined at a local level. What that will take is improving the energy planning capacity of local governments. They do urban planning but they aren't used to doing energy planning because that gets left to the utility. One of the needs in this future is greater integration of energy planning into urban planning as well as more outreach to local community organizations who can start to think more collectively about how they meet energy and resiliency needs. To go back to the bimodal idea of bulk power systems and the distribution side, energy needs start with local demand on site, so if we start by deploying local DER to meet local needs then what we get from the grid will supplement community level resources. Solar that just meets the needs of a single house is a silly idea, we want to preserve tree canopy so we should put more solar where there is good exposure and use storage to plan electricity on the level of one block, one subdivision or an entire community. Then, design the local system so that subdivision can island from the grid for resiliency when the utility grid experiences an outage. We start designing from the bottom up and the first source of electricity can be what you have on site, the second level is what we get from

the community level that still needs distribution wires which the utilities operate, then there is the supplemental bulk power system for accessing more distant renewable energy resources.

KB: What are the barriers to getting there? How can we address those barriers?
LK: How do we build the diverse participatory distribution system? That is where legislative action to remove barriers is needed. The mindset around electricity is around centralized management of assets and building big things like high voltage power lines and generating plants. That mentality stalls legislation needed for change. CAISO says it will cost $30 million for transmission to decarbonize the grid and then if you ask, "What's the participation of DG in that scenario?" there's almost nothing. The utility scale mindset is dominating the planning landscape.

That leads us to the net metering debate in California. Last December the CPUC proposed a huge fixed charge of eight dollars per month per kilowatt of installed rooftop solar. That charge would be totally divorced from performance or other improvements a customer might make such as adding battery storage. This is really a policy that suppresses DG rather than enabling it. Another aspect of that mindset is that DER are seen as an operational or a utility revenue problem and not as the source of the solution! This plays into the preference for big infrastructure because if the distribution utility is doing distribution planning and they see people adopting rooftop solar and electric vehicles (EVs) and they assume all those devices will operate independently with no aggregated coordination, the utility gets to plan for the worst case scenarios which justifies building the most expensive infrastructure. The guaranteed rate of return on utility assets is one of the biggest barriers, and regulatory agencies are generally biased toward protecting utility profits. Some of that is well meaning naivete and comfort with the familiar legacy utility model. So they ask, "How can we achieve a decarbonized future if we don't tell utilities to do it?" But if they take that approach, they will be biased towards large assets with high rates of return. There's a huge risk to ratepayers if you just build large scale energy assets without planning for all the potential benefits of local DER. Also, the technology landscape is changing rapidly. It's very innovative and there are lots of pilots and ideas and diverse DER and technology companies. If investment in new technologies is dominated by monopoly utilities and recovered in rates, then ratepayers take all the risks associated with new technologies. On the participatory distribution side, we want as many third party asset owners as possible, including both the technology providers as well as the communities and public agencies. To that end we must channel state funds into the planning capability of local governments and the funding of projects in marginalized communities to ensure that no community is left behind.

KB: What role will the utilities play in this energy future?
LK: What do we need? Reforms of the distribution utility model. The model I write about is the open access distribution system operator (OA-DSO), which is borrowed from Federal Energy Regulatory Commission (FERC) rules on open-access transmission service they adopted in the

1990s to enable the wholesale electricity markets. The OA-DSO model takes open access and applies it at the distribution level to distribution system operators.

Talking in terms of functions other than entities, today's utilities perform three functions that don't need to be bundled. One is operating a reliable distribution network. Two is being a load serving entity (LSE) that has to procure power and deliver it to retail customers over the utility network. Three is meter data management. Let's consider the functions separately before we say what the future DSO does. For distribution network operation, the utility today owns the assets and needs to maintain them. In the case of FERC's open access rules, the Independent System Operator (ISO) is the operator for the bulk system. The transmission-owning utilities in the ISO area continue to own, maintain and operate their transmission assets and are responsible for them, but the ISO open-access rules determine who gets to use the bulk grid and the ISO dispatches the generators through their day-ahead and real-time markets. So the core of the OA-DSO would be similar, to ensure non-discriminatory use of the distribution network and to reliably operate the network by coordinating the activities of all the participating customers and DERs, and interfacing with the ISO. That would be a regulated monopoly service. But the LSE function should be a competitive function, which is how it's done in Texas, UK and Australia, and should not be part of the regulated DSO. Similarly, the meter data management function ought to be a separate regulated function to ensure that all network users and network operators have appropriate timely access to the data they need for their activities. Similarly, owning and operating DER, whether they're Behind The Meter (BTM) on a customer's premises or in front of the meter on the utility wires, should not be part of the monopoly DSO function.

So the starting place is to design the OA-DSO and create its regulatory framework so its responsibility is operating the network and providing open access to those that want to interconnect to the network and access it. That's the core piece that enables the distribution side to grow in a way that maximizes choices for customers to build resources to meet local needs and maximizes opportunities for third parties to partner with them. The utility at the core operates the distribution network that provides open access service so they can't favor any connected parties and must provide service under the same rates, terms and conditions for all network users. If the utility's parent company wants to be in the DG or EV or LSE business, then they need to create competitive unregulated affiliates and receive the same distribution network service as everybody else. That, to me, is the core role of utilities in the future.

The bulk power system can stay how it is today to a large degree, the ISO allocating transmission service and dispatching grid resources using the utility-owned assets, but right now there is too much utility control over transmission. The utilities have been a barrier to the building of long regional transmission lines to travel interstate because they have more control over facilities in their own footprint. Transmission planning needs to incorporate credible DER growth and reflect the impacts of DER on reducing the need for transmission investment. In addition we need to

develop the rules for how the DSO and ISO coordinate at their interface points to ensure reliable, efficient performance of the system as a whole.

Following the design of the OA-DSO framework, the secondary story is that building the participatory distribution side is a truly bottom up enterprise where customers are driving it. When I talk to policy makers, many customers are realizing they have the power to leave the grid if they want to and have the financial resources to do so. For example, Google is starting a project in San Jose that won't use the utility grid, they will be largely self reliant for energy. So, if we don't build policy frameworks that enable bottom up development then the equity issues in our current system will get worse. All the customers with money will leave the grid while the grid gets more expensive. Wildfire-related and other climate-related regulations and investments will add huge grid costs that drive rates up. DER costs are going down and the DER technology is improving. Customers are asking, "Why do I need this expensive grid?" Regulators need to think about what the value proposition is now that the grid is facing competition for the first time in 100 years. What's the value proposition to get customers to stay? It has to come from the benefits of being in a network! Without a participatory network the customer gets the private value of a DER asset but there is little or no societal value, no opportunity for DER investments to earn revenues as network participants. We can architect the grid in a way that connected customers will help support the operation of the grid. For example, customers in residential areas with lots of EVs. If you coordinate charging you can flatten the load profile and reduce investment in additional grid capacity. Those customers should get paid for services to the grid which is an advantage to the customers to stay connected. Once you create an open access network you can also have the DSO operate a local market for distribution, where customers that are connected can now bid to buy and sell grid services and energy, and the OA-DSO can optimize energy supply and demand in local areas of the grid.

Larisa Dobriansky

Larisa Dobriansky is the Chief Business and Regulatory Innovations Officer at General Microgrids. In this role, she focuses on regulatory, institutional, and financial changes in the electricity and energy sectors that can leverage the beneficial capabilities of advanced microgrids to deliver integrated energy solutions to electric power systems and communities. She has previously held numerous high-profile positions in government, notably as former Deputy Assistant Secretary for National Energy Policy at the US Department of Energy, where she secured legislation to use loan guarantees to help move clean energy technologies out of demonstration and into the marketplace. Drawing on her expertise in the legal fields of energy, environment and finance, Ms. Dobriansky helps shape new financing mechanisms, market designs and electric utility and energy regulatory reforms to support the sustainable, efficient, reliable/resilient transformation of grid and community energy infrastructure to meet 21 st century demands. In particular, her efforts are aimed at incentivizing investments in advanced microgrids that optimize distributed resources, expand energy-sharing parameters and foster transactive energy markets. Below is a discussion of her energy vision for the future.

JO: What is your energy vision for the future? What are barriers in the way of reaching this vision? How has your career shaped this vision?

LD: My energy vision for the future is very much affected by my work to support the commercialization of advanced microgrids that have the potential to co-optimize benefits for customers, the Grid, markets and communities. Advanced microgrids can help to shape a digitalized, decentralized, democratized, and decarbonized Electric Utility Grid, along with accelerating the development of Advanced Energy Communities. Using smart technologies (information, communications and control technologies) and data analytics to support intelligent load and energy resource management, advanced microgrids can help forge a pathway to achieve a modernized Grid that fully integrates variable renewable energy (variable energy resources; VER) and distributed energy resources (DER), as well as to advance community energy and resource systems integration. Cost-effective deployment of these microgrids can help to configure a 21 st century dynamic, flexible, interactive, fractal and innovative Macro-Grid, one designed to leverage local integrated energy development and use. In particular, advanced microgrids would considerably reduce burdens on the bulk power system, while also improving power system asset utilization, power quality, and reliability/resilience, by increasing the independence, flexibility and intelligence for optimizing energy production, use and management within local energy networks and integrating local energy resources into a Smart Grid.

However, in order to re-shape Grid and Community infrastructure and operational parameters, as well as to accommodate an array of new players in the marketplace, regulators and other policy decision-makers will need to evolve economic regulatory and market frameworks that can move our society to a market, customer and data-driven paradigm. This will require fundamental

reforms in order to remove legacy regulatory barriers; create a level playing field for all resources; and capture the value of new resources. The legacy utility business model has served us very well in the past, but it was not designed to address our 21 st century challenges and opportunities, including integrating high volumes of renewable and distributed resources into the Grid. Converging technology advancements, policy directives and rapidly changing market conditions and customer expectations are stressing traditional electric utility system capabilities, while also calling for material changes in regulatory responses to meet new power system, customer and societal needs. A new electric utility regulatory paradigm is needed that can transition us out of the legacy centralized, linear-constrained and "static" Grid into an architecture that is adaptive, dynamic and interactive, consistent with the law of physics; out of a predominant focus on capital intensive asset development, based on historically incurred costs, to meet unmanaged peak demand to value creation that seeks to optimize capital and operational expenditures based on effective forward-looking planning and proactive network management; and out of the delivery of an homogeneous commodity based on flat volumetric rates to the delivery of heterogeneous services based on dynamic market pricing.

My work is centered on furthering regulatory innovations that can support these shifts and, in the process, shape a new grid operating system and utility distribution system model. Collectively, these changes would unleash innovative business models that can realize the benefits of renewable energy, distributed energy resources and microgrids; enabling smart technologies; and innovative network management strategies. For example, using advanced information, communications and control technologies, Advanced Microgrid Systems (AMS) intelligently manage and interoperate multiple loads, distributed resources and energy storage as an energy and resource-efficient system that acts as a single controllable entity with respect to the macrogrid at the point of common coupling. AMS balances demand and supply in real time; schedules the dispatch of resources; self-heals in the event of energy disruptions and builds resiliency by islanding from the macrogrid. Appropriate regulatory interventions, along with a new operating grid and utility distribution system model, would enable AMS to intelligently manage and provide performance-enhancing control of distributed resources within communities. Local energy networks, consisting of microgrids connected to each other and to the power system, could share generation, controllable load and storage capabilities over wider areas for optimal energy and risk management, supporting grid and community-interactive zero net energy strategies and maximizing the benefits of digitalization and electrification. In these ways, advanced microgrids could help diversify resources, provide optimal infrastructure to meet local energy requirements (power, heating and cooling); and support local control of resilience and sustainability. Microgrid services platforms would optimize flexible loads, thermal and other storage and renewable generation, providing integrated energy solutions to both the macro-grid and communities.

My work aims to advance regulatory innovations that can transition us to a customer-centric, data-driven network economy, effectively fusing power and information to expand the provision

and consumption of electricity services, as well as to support the economic growth and development of communities, increasing overall social welfare. Electric utility regulatory innovations are necessary to re-align utility financial interests with long-term consumer value and to redress outdated legacy system assumptions that customers have little role to play in addressing system and ratepayer needs; and that centralized generation and bulk transmission invariably yield cost effective results. I have been focused on regulatory interventions that are designed to engage the active participation of customers and third parties in the marketplace to support interactions between customers and the grid; and between customers, including providing services in both retail and organized power markets. My work also supports regulatory changes that can bring flexible load/demand side management in parity with energy supplies in the overall balancing of supply and demand. Examples of needed reforms to the utility revenue model and rate design include the following: Authorizing multi-year utility rate plans that are forward-looking and employ new tools and methods for forecasting load and DER growth, as well as for managing uncertainties and risks; Equalizing the treatment of capital and operating expenditures; Increasing reliance upon cost-reflective economic and price signals to motivate utility investment and operational decision-making and price-responsive customer behavior, moving towards dynamic pricing based on the marginal rate to the power system attributable to customer energy usage and investment decisions, consistent with grid constraints; and Reducing information asymmetries.

In particular, my work has centered on electric utility regulatory changes that can transition from a predominant reliance upon administrative processes to market-based solutions to provide resource and system flexibility in integrating renewable energy and DER; and to leverage the participation of new market players to deliver value and generate energy savings. I have been especially involved in the development of: (1) Performance-based regulation; (2) Benefit/Cost Analytical Frameworks to consistently verify and monetize DER/Microgrid services; (4) More granular spatial/locational and temporal valuation/pricing of DER/Microgrid net benefits; (5) Multi-sided market platforms that facilitate trading in energy-related products and services and support the maturation of customer and third party market participation; and (6) Transactive energy market mechanisms to coordinate and manage efficient energy usage and investment decision-making relating to DER/Microgrids and intelligent devices.

All of these kinds of regulatory changes will help to shape a new grid operating system, along with a new utility distribution system model. A new cyber-secure and physically-resilient grid operating system is essential for integrating renewable energy and DER into Utility planning, procurement/investment and operations; supporting “end to end” interoperability; and, overall standardizing VER/DER use throughout the electricity value chain. Twenty-first century challenges and opportunities also require a new utility distribution system model based on proactive network management by a Distribution System Operator (DSO) to respond to dynamically changing market conditions and manage customer-side resources. The DSO would tap into the net benefits of DER/Microgrids to bring flexibility to energy generation, delivery and

use, maximizing efficiency and minimizing the costs of delivering reliability/resiliency at all time and locational scales. In regard to all of these changes, I have promoted regulator support of "Sandbox Demonstrations" to generate lessons learned that can inform transitioning decision-making processes. Finally, my work has sought to "reformulate" community development by: (1) Incorporating "Energy Planning" into community land-use development planning processes to evolve integrated energy solutions; (2) Aligning utility and community resource planning and development processes; (3) Developing "community-scale" clean energy/energy efficiency/resiliency standards for land-use planning and development; (3) Recognizing as a new energy service provider classification, "microgrid integrated energy services provider and manager;" (4) Promoting utility/community/stakeholder demonstrations that interrelate new electricity sector tools and methods with local decision-making tools and evaluate alternative scenarios; and (5) Exploring new community-related governance structures.

Lynn Arthur

Lynn Arthur is Founder and President of PeakPower Long Island, a non profit that provides consulting and marketing expertise to municipal governments and others in the deployment of renewable energy policy, demand management strategy, constituent education, and more. It functions as a subcontractor for the town of Southampton, NY, in which she is also a sustainability consultant. After a successful career as a software engineer at IBM, she transitioned to work within the low-carbon economy. Through years of independent consulting, volunteering, advising, and becoming Energy Chair at the Sierra Club Long Island Group, she is focused on motivating Southampton residents to reduce their carbon footprint. PeakPower is funded by New York State Energy Research Development Authority (NYSERDA) grants issued to the Town of Southampton.

JO: What led you to a second career in the energy world? How has it shaped your energy vision for the future, and what barriers exist in the way of making it a reality? What role will the Utilities play in this energy future?

LA: My first job after college was a computer programmer with IBM. Working with electrical engineers was easy since my double major in Math and Computer Science enabled me to think mathematically. Later, when I moved to sales, I learned how to be a better communicator, a better writer, how to influence the buyer with the benefits of my proposal, and how to win an argument. Every job, every assignment you have, to me that's an engagement and an opportunity to learn. It's good though, because when you get emotionally involved or attached to whatever you're working on, you want to win. You work really hard to win. However, I've found that when you lose, you actually learn more than when you win.

I worked in banks and finance for years, and finally decided to leave and do something for the environment. At age 50 with no background or credentials, I applied to the MBA program at a local University in order to pursue an MBA in finance and the goal was to work for a company. I was recruited by the Sustainability Committee of Southampton and watched them try for several years to make policy changes. Fortunately, I convinced the committee to use the framework I was learning in my marketing class to help them put structure to support their efforts. Within six months we were able to pass a ban on single-use plastic bags. We were the first Town in New York State to adopt a plastic bag ban.

This effort taught us the power of public opinion. Harnessing public opinion and directing it is how you can make policy change. After the bag ban, the committee looked to me for leadership, and I went after energy. Long Island has a state owned vertically integrated Electric utility and monopoly called Long Island Power Authority (LIPA). There is no competitive market and electric rates on Long Island are amongst the highest in the country. The source of power is a centrally managed power plant that runs on compressed natural gas. Meanwhile, I attended a solar seminar to learn more about solar. I calculated that I would be losing roughly $150,000 in

the long term by not switching to solar when I factored in the compound growth rate of rate increases over a 30 year period. By utilizing New York state policy and federal incentives to get solar, I found out that solar on Long Island is a no brainer and the problem is that people just don't know about it.

Outreach in Southampton was awful. Communication was the key to getting knowledge out to the public. And that's how I started Peak Power. The direct-to-consumer outreach education tripled the number of solar permits in year one. With the continued growth, it really demonstrated the significance of outreach and marketing. I sell ideas. I communicate what it is, how people can benefit from it financially, how it helps the environment, how it aligns with State objectives, and how it helps the Town achieve its goal which is to be 100% renewable by 2025. It's a matter of all these things coming together: communicating with the public, making some money doing it, forming a company and influencing policy at the local level and communicating at the State level.

A few years later I learned about Community Choice Aggregation. I went to a seminar in Westchester where the results of the CCA pilot was presented, and loved the idea, so I brought it to Long Island. I led a group of individuals from the Town's Sustainability Committee. We lobbied the Town, the Town Board challenged me personally to go out and prove to them that there was substantial public support. I organized 30 presentations in 2 months, amassing 500 signatures, which was enough to indicate to the Town Board there was substantial support for this program. I presented graphs from the seminar, showed them how they can save on Long Island, and passed around a clipboard with signatures. The Board voted at a public hearing and we are now in the process of pursuing a CCA program.

In terms of the Utilities role, I'm of the opinion that utilities need to wrap their heads around the fact that they are in the transmission and distribution business and not in the energy generation business. Instead of throwing obstacles in our path the collective we need to figure out how to collaborate and agree on what the goals are until that happens, no progress will be made and a lot of energy will be wasted.

Policy work and strategy are key. It's also important to circulate the results so they can disperse useful information to the public and to the press. But real change happens through working with elected officials locally to make sure you have a plan to guide your path with measurement criteria to evaluate your progress and a lot of patience because the government moves at a glacial pace. Transparency is critical. It's important to listen and record questions and answers and share that with the public.

The Southampton website grabs people's eyes because of the marketing. As it relates to the future, in our spare time we are looking into Block-chain billing which is a mechanism for selling energy into a microgrid, acting as an accounting system that keeps track of transactive

energy sharing. Another obstacle is finding people who want to be in leadership positions. The future has very exciting possibilities if we can learn to get the public involved.

Moneer Azzam

Moneer Azzam has over 30 years of experience in the sustainable infrastructure and energy industry. With thousands of projects and systems around the world under his belt, he is striving to take on some of the technical challenges brought on by climate change. He founded SolarOne Solutions, Inc, a venture-backed company that was ultimately the largest solar lighting firm in the United States when he sold it on behalf of its investors in 2019. Moneer has served on boards and standards organizations, as well as advising several climate-tech firms, municipal, and community organizations. With inclusive projects, programs, and business models, Moneer is on a mission to offset greenhouse gasses in all facets of his life, ranging from his work with his latest venture, Beacon Climate, to his personal life and household. All of this is attainable through his approach of being community-minded, team-oriented, and dedicated to equity and inclusion. Below is a discussion with Moneer of his vision for the future of energy.

JO: What does your energy vision for the future look like? What barriers exist in the way of getting to this vision?

MA: In most US towns and cities, it's difficult to make progress in transitioning to a decarbonized energy system due to deeply entrenched interests and practices. In Masdar, (a zero-carbon city in the UAE) they were starting with a clean slate with relatively no restrictions. They were able to put up significant solar power plants and apply novel energy saving technologies and techniques with relative ease. It gives a window to what is possible with a clean slate. While offering helpful insights, it does not reflect the challenges of transition faced by most cities and towns in the US or across the world.

Energy is at the core of every aspect of our modern economy. We can't responsibly realize the vision of a just, resilient, and sustainable energy system without considering all those aspects in the transition from the status quo. Simply put, it's a lot to consider and that itself represents a daunting barrier to the energy transition. By design, the utility systems we have today were essentially built for us to forget about it, become so dependent, and really lose our understanding of it so that we lose our ability to guide where it goes. The history of how the utility came to be and the institutions that are here and have been our way of life for generations makes it hard to bring about change. However, with the existential threat of climate change looming ever closer, that doesn't mean we shouldn't be trying everything we can to responsibly make the necessary changes. If there is one thing that will spur this change, it is the emergence of a common mindset of determination to make the necessary changes and a common appreciation/tolerance that change is hard. In my vision, the development of community-centric decentralized distributed resources are at the tip of the energy transition spear.

There have been many energy transitions over civilization. Whale oil – you saw what happened with the depletion of an energy source. It was almost by luck that oil in the ground was discovered as a resource just as one was running out. In each of those cases, we were ignorant to

the sort of consequences of burning it or overfishing. This is different for a handful of reasons. Most importantly, we don't have the luxury of a very competitive setting of which to pursue a resource. With whale oil running out, oil was found in the ground and it enabled a relatively fast transition. There were no apparent consequences at the time, especially in the way capitalism works which encourages competition. Little did people then realize the harrowing stage that they were setting for future generations.

This transition, we must think very differently from past transitions. The hallmarks of those eras:competition and greed are luxuries we can ill afford this round. It has to be a cooperative for several reasons. For example, in the last energy transition, we left a lot of people behind. It was only decades after it started, with the Roosevelt administration and the New Deal, that the government had forced a full transition to bring energy resources to those people left behind. In today's situation, we can't leave large swaths of the population behind to continue polluting, nor can we take away their energy supply and see what happens. Another reason that cooperation must take precedence over competition is the level of interdependence across the globe. Interdependency is the only way that the planet can sustain 10+ billion people and not collapse. But with interdependency comes great responsibility. Experimentation, trials, pilots, small mistakes that we learn from and use to continually improve are essential to building a thriving interdependent world. Mistakes under the best of intentions or bad actions that are allowed to seep through the interdependent system can be catastrophic.

Massachusetts's current legislature has good intentions, but is raising the alarm bells across much of the climate tech community by putting all of the money in offshore wind. It still creates this centralized, highly dependent nature of one energy source which is what got us into this problem today. An idea for the energy vision is to take what's done at Greentown Labs and both deploy it and de-risk it (Greentown Labs is a collaboration of multiple sustainable oriented businesses working in the same space to reach solutions/make products for energy and environmental related issues). Innovate, incubate, try it out, send it out to people and see if it works. If it doesn't, then try again with a new or optimized product. Products like heat pumps and solar panels are tangled differences that make the everyday person excited. Offshore wind – no one really knows what's happening, whereas with distributed generation, people see the difference and know what's happening.

There's a term called "Agile Development " where you're getting things into the field, to the customer, getting their feedback, changing it, and then perfecting it. We can start with smaller things like energy storage and heat pumps. We can put them out in phases and see what's working and what's not working. Lots of these products have Artificial Intelligence (AI) and machine learning, so it starts interacting with how the customer uses energy. That's something you're not going to get in a lab, you have to do it in the field. And so in the process, you have amazing economic development because you're going to have a range of crafts and people studying what's going on and providing feedback. With offshore wind, the contracts are already

there, the money is already there. It's not as innovative, it's not changing the industry. The government is already there investing, but not the general public.

The politicians are influenced by the investors and the utility. We need to have the communities in charge of the utility like a municipality. It starts with a community centric energy transition. The State can be providing resources, but let the community drive. This way, we can develop a template that any given community can look at and see what works for them. Operate like Greentown Labs – collaborative, cooperate.

JO: What will the Utilities role in this vision be?
MA: I don't see the big utilities going away, but one alternative could be to change the approach to lead with the community and incentivize municipalities. Municipalities, with their own public utilities (referred to as municipal light plants) have all of their resources, they can make fast decisions, and most distributed generation (DG) is a comparatively small capital investment to utility scale projects. Municipalities can help get products out there, learn how they work, and the big utilities can follow. There are cases in Europe where cities are beginning to buy back the grid. The municipalities are community first and the Investor Owned Utilities (IOUs) are investor first.

JO: What do we need to do to make this transition happen?
MA: To drive the economic development of benefits, we should be stepping on the gas (ha) with distributed resources. Solar, wind, biogas, storage, and flexible loads. We need to do things piece by piece. In order to make this transition we need everyone. Someone who gets solar, or storage, or anything like that – they become an ambassador for that and help spread the word and idea. This is how it will be done. Phases of products going out and seeing how the public reacts to them, and then either develop more or develop something else. Transition is slow, but IOUs and the public need to make a compromise to create more DG.

Richard Chase

Richard Chase is the Commissioner of the Princeton Municipal Utility in Princeton, Massachusetts, as well as President of his energy consulting firm, Chase Systems, LLC. He has worked to incorporate numerous clean energy projects across New England. In high school, he built a small photovoltaic (PV) project in his backyard and has been hooked ever since. He thought, "I wonder if we scale this up, how far could we go?" Through his work in both consulting and as commissioner of the municipal utility, he has been able to answer that question. Below is a discussion of his vision for the future of energy.

JO: What are the advantages and disadvantages of having a municipal utility as opposed to Investor Owned Utilities (IOUs) ?

RC: The Investor Owned Utilities (IOU's) provide approximately 85% of the power in Massachusetts while Municipal Utilities (Muni's) provide approximately 15%. Muni's may serve more than one town. IOU's are subject to plethora of regulations and pressures, whereas Muni's work solely for the local residents while maintaining compliance with applicable standards. (IOUs) are rewarded for investing in infrastructure (substations, transmission lines, etc.). They borrow money at a low rate and receive a much higher guaranteed return on investment, thus they are incentivized to keep building large capital intensive projects. IOU's take money out of the local economy, whereas local Muni ownership keeps the money in the local economy. They are non-profit and have no shareholders to pay. The IOU's incentive is to trim costs, including maintenance to increase profits.

JO: How does the Princeton Municipality function compared to an IOU?

RC: A municipal utility, is often directed by elected volunteers who hire the manager, The manager runs the operation. PMLD receives energy from the wind farm in Princeton and buys electricity from local and regional generation suppliers. It owns and maintains the wires and related equipment, thus is our own small utility. An electric distribution system is like a chain, it is only as strong as its weakest link. The IOU's purchased Municipal Utilities in the 1970's to create the large utilities of today. Some communities are starting to use consumer aggregation and/or buy the grid back from the IOU's.

JO: What do you think should exist for a grid system that covers these attributes, and what are the barriers of making this system a reality?

RC: The electric system should be a mix of all scales primarily of renewable generation along with storage. Distributed generation on suitable houses and buildings, nearby solar/wind generation, connection to a larger grid with the ability to buy and sell electricity with other customers on the grid. Economies of scale do have limits. Shipping electricity long distance incurs transmission losses. The IOU's incentive is for profit, and they use their technical and

political influence to create barriers in an attempt to maximize their control and profit from the electric system. In Germany, the electric utilities have only two hours to deny a residential solar installation and for only a very limited number of reasons. Rarely is a residential solar install denied. Hawaii uses Performance Based Regulations, which is a completely different business model than most of the United States IOU's. The utility doesn't get rewarded for investing more capital, instead they are rewarded for delivering affordable and reliable electricity. Having other states change to this is a huge challenge because you're replacing a century old IOU business model. We could have far more solar but IOUs making it difficult for more solar using the interconnection process. They have learned this is how they throttle the growth of solar. Today, Massachusetts is building approximately 400 MW of solar per year. To meet our stated Climate Goals, we need to be building 1000 MW per year! The IOU's like solar, wind and storage they own! Another option being explored is to repurpose the infrastructure and workforce. Current estimates are that the needed upgrades to the gas distribution system will be in excess of $9B, which will be a stranded asset before 2050 if we are to meet our climate goals. Instead the current gas utility workers could rebuild the old leaky gas infrastructure for renewable systems (replacing gas lines with "Network" or "Neighborhood" geothermal). Farmers are begging to "plant" solar, it is more profitable than other crops, especially on marginal land. They often can't because of the IOUs interconnection limitations. IOU's resist interconnection upgrades because the incentives don't encourage that.

JO: How do we get IOUs to adopt a Performance Based Business Model?

RC: To switch to a Performance Based Model is a legislative procedure. There are a number of organizations and groups working toward this. But it has to come through the legislative process of writing bills and getting them passed. Our Governor and legislators' vision needs to align with people's interest.

JO: If we can sum up your vision and how to get there, what would that look like?

RC: If we get the incentives right, the rest will follow. The current incentives for IOUs is to maintain the status quo. We have to keep advocating for better bills and vote for leaders who want to make the right change. Leadership is the only way out. We also need to keep development of renewable energy and storage projects going forward. All these issues are interconnected.

Sierra Dall

Sierra Dall is founder of the Municipal Sustainable Energy Forum. It was designed as a venue to bring experts together to facilitate the most effective Renewable Energy and Energy Efficiency solutions for communities, municipalities, utilities, and State. Everyone interviewed in this project is a member of the MSEF. After a successful attempt to persuade Michigan State University to stop using DDT on campus trees while attending college there, she realized that one person truly can make a difference. Ever since, she has been developing ways to facilitate collaboration and make positive change. Below is a discussion about her energy vision for the future.

JO: You've had major success in bringing people together to make positive changes in the world. What led you to create the MSEF?

SD: I have learned that persistence and collaboration are fantastic mechanisms for taking action. Essentially it was my facilitating experience that led to this evolving idea of the MSEF. I had many ideas and ways to go about it, many failures, and would throw out the bad ideas and work on the good ones. Over the years, it was a matter of keeping what works, discarding what doesn't work, and continually making changes. And I think that's what life is about, and I think that's what success is about. You're going to fail a lot, and you learn from your failures and that's really what makes the difference. I kept asking people what works and what doesn't work to build feedback. What I'm doing is bringing people together who are out there dealing with policy issues, technologies, and a wide range of policy changes.

JO: What have you learned from facilitating the MSRE? How has it shaped your energy vision for the future?

SD: I've learned a lot. People have to understand what's going on with the grid and how vulnerable it is. According to a recent 60 Minutes program, there are nine points of failure in the larger electric grid that would blackout large sections of the country if they went down. Meanwhile, there is a whole part of the country that is financed by the oil and gas industry, and politicians don't want to say anything that will upset their support. There's a large part of the public that doesn't understand that the (Oil and Gas Industry) talks about energy independence – drilling more wells, bringing more oil – that's not energy independence. You have a pipeline that's how many miles long? One bomb – what does that do to a pipeline? A good part of our energy supply is going down.

One solution to the problem is local energy, and related policy changes for local energy. Most people don't understand the vulnerability of the grid. It's a huge political issue because certain state, supported by oil and gas, and they don't want to mess with local energy. With everything going on with Russia, fossil fuels are going to be less desirable. Also, the fact of political instability in Russia – we don't know if Russia plans to attack us in the form of attacking those nine points of failure of the grid. This is a strong selling point for people to get out and spread

public awareness for local generation. Solar is the quickest and probably the most secure. Most areas are good for solar, and we could make more capacity overnight as long as the grid could support it.

JO: What's keeping this from happening?
SD: Utilities! They don't want to lose their connection with the oil and gas industry. They don't want to lose control – control over energy. So the answer is policy change. People have to understand the importance of elected officials in both government and within the utilities, and a reason to vote for somebody is whether they support energy safety and reduction of energy vulnerability. Both conservatives and liberals want to have control over their own power. The idea that that could be taken away from them needs to be brought out. Because of what's going on in Ukraine, it is the right time to start educating people on the vulnerability of the grid and that if you have local energy, (rooftop solar, community solar, even utility solar or wind at a local scale) it would be very hard for an outside entity to come in and interrupt the grid. The enemy would have to destroy all these small points of failure instead of those nine. Peer pressure and losing control are two huge factors in what might make people change. If all your neighbors begin getting solar, you will feel pressured into doing the same. Tying that together with vulnerability and the fact that you don't want to lose control of your energy source, people may begin to change.

JO: To sum up your energy vision for the future, what does your vision entail?
SD: My vision is I want to start working with the heads of large environmental organizations who have enough people to go out in their neighborhood to record the energy savings of owners of homes with solar integration. I want to find out what would be the most economical way to advance solar in that community since different states and cities have different policies. From there we can send letters highlighting the economic successes and the reduction of energy vulnerability of their solar neighbors with the hope of creating peer pressure that could facilitate change. The problem here is getting solar at a good price. We need a local scale grassroots effort and to get the government to support it by electing officials whose visions align with this. The utility is going to have to play a different role than its current role. With enough pressure, that's the direction things will go. We have to have the right policies in place to enable these things to happen. We need collaboration between utilities and communities. We need to keep pressure on State and local governments from citizens, and citizens need to be educated through marketing and research. We wouldn't have to worry about gas and oil prices if we didn't depend on them.

Conclusion

Based on the conversations we have had with energy experts throughout the course of this project, we are simultaneously hopeful and concerned. On one hand, it is genuinely exciting to see that these individuals are thinking very specifically about our energy and what we should do to change it going forward. They have specific, tangible suggestions for how to transition to a clean energy economy while keeping equity at the forefront. Their excitement is contagious and their ideas are clearly well considered.

On the other hand, their visions seem to call attention to the ways our current energy infrastructure is lacking. We are not moving forward quickly enough toward the common threads from these energy visions, and that is concerning. We sincerely hope that policy makers and activists across the country take note of these suggestions and codify them into policies that help us shift towards a renewable energy powered nation.

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