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WEBINAR TRANSCRIPT

What Is Actually Wrong With the American Grid?

Recorded September 1, 2026 | 90-minute expert panel

Presented by the Security and Sustainability Forum in partnership with

GW Environmental & Energy Management Institute
School of Engineering & Applied Science

ASF Alliance for a Sustainable Future
THE GEORGE WASHINGTON UNIVERSITY

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ABOUT THIS RESOURCE

A transcript for practitioners, decision-makers and educators

This document presents the full transcript of the September 1, 2026 SSF webinar, formatted for reading, citation and teaching use. The discussion examined grid age and reliability, accelerating electricity demand, transmission constraints, market design, affordability, microgrids, distributed energy resources, resilience, regulation and the practical choices facing utilities, regulators and large electricity users.

Editorial note
This transcript was prepared from the webinar's auto-generated captions. Punctuation, paragraphing, proper names and a small number of obvious captioning errors have been corrected for readability. The substance and sequence of the speakers' remarks have not been intentionally altered. Where speaker attribution in rapid panel exchanges was not certain from the caption file alone, the transcript is presented by timestamp rather than assigning a potentially incorrect speaker label.

Hosts and partners

Security and Sustainability Forum (SSF). SSF convenes expert, fact-based conversations and professional education on energy, climate adaptation, security and civil society.

GW Environmental and Energy Management Institute (EEMI). A research and applied learning institute at the George Washington University School of Engineering and Applied Science, focused on the technical, policy and management dimensions of the energy transition.

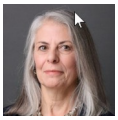
GW Alliance for a Sustainable Future. GW's university-wide initiative convening research, teaching and public programming across disciplines on sustainability, energy and climate.

Panel

Scott Sklar
Moderator and panelist. Sustainable Energy Director at GW EEMI; adjunct professor at GW; President of The Stella Group; SSF energy faculty.

Matt Haupt, PE, CEM, CPP
SSF energy faculty. Former Energy Director for the Navy and Marine Corps; retired U.S. Navy Civil Engineer Corps officer.

Peter Fox-Penner
Principal at The Brattle Group; Chairman, Impact at Energy Impact Partners; founding director of the Boston University Institute for Sustainable Energy; former senior official at the U.S. Department of Energy and White House OSTP.



Donna Attanasio
Managing Director, GW Alliance for a Sustainable Future; Professorial Lecturer in Law at GW Law School; formerly Assistant Dean for Energy Law at GW Law and Partner at White & Case.

Follow the conversation by topic and time

Timestamps refer to the webinar recording and are included throughout the transcript for easy navigation.

Time	Section	Lead voice
0:00-2:15	**Welcome and introduction**	Edward R. Saltzberg, Security and Sustainability Forum
2:15-6:03	**Framing the grid challenge**	Scott Sklar
6:03-17:19	**Opening perspective: a grid built for another era**	Matt Haupt, PE, CEM, CPP
17:19-27:08	**Power-sector economics and the investment challenge**	Peter Fox-Penner
27:08-35:11	**Law, regulation and behind-the-meter flexibility**	Donna Attanasio
35:11-50:34	**Distributed energy, resilience and grid modernization**	Scott Sklar
50:34-1:00:20	**Panel discussion**	Scott Sklar moderating
1:00:20-1:28:47	**Audience Q&A**	Edward R. Saltzberg moderating
1:28:47-1:32:35	**Closing perspectives**	Peter Fox-Penner, Donna Attanasio, Scott Sklar and Edward R. Saltzberg

Note: The moderator and lead voice are identified where clear. During rapid exchanges, timestamps are prioritized over uncertain speaker attribution.

FULL TRANSCRIPT

What Is Actually Wrong With the American Grid?

September 1, 2026 | Security and Sustainability Forum, GW EEMI and GW Alliance for a Sustainable Future

0:00 - 2:15

Welcome and introduction

Edward R. Saltzberg, Security and Sustainability Forum

0:01 Thanks for joining. I'm going to give this just about 30 seconds or maybe a little bit less because it takes a couple of minutes, or seconds at least, for people to roll into the session. So just take a breath or two and then we'll get started. Good afternoon from Washington, DC. This is Ed Saltzberg. I'm the Executive Director of the Security and Sustainability Forum, and welcome to What is Actually Wrong with the American Grid? We're pleased to present this webinar with GW's Environmental Energy Management Institute and the GW Alliance for a Sustainable Future.

0:42 Scott Sklar is our moderator. You have bios for everyone. When you signed up, you saw their bios, and I'm not going to spend time on that now. But please add questions to the GoTo Webinar window, download the handouts, including the webinar slides, and please take the exit survey. Gitesh, next slide, please. One more slide forward, Gitesh. Thank you. And one back. Okay. I just wanted to let people that are new to SSF know that we've relaunched SSF, and even people that have been with us for a while.

1:28 With expanded research, you can sift through over 300 webinars, explore defining voices, which are the leaders in the field, and find our new professional education and resilient energy certificate program. This is a new program for us that we are rolling out. And Matt Haupt is one of our speakers, leads the first live session on electricity markets. Gitesh, next slide. I'm going to turn this over to Scott, and then he'll introduce the panelists and we'll have a panel discussion. We're going to leave a lot of time for audience questions, panel summary, and then I'll close it out in less than one minute or so.

2:11 So with this, let's turn our cameras off except for Scott.

2:15 - 6:03

Framing the grid challenge

Scott Sklar

2:15 And Scott, let me hand it off to you to kick us off. Thank you very much. Honored to be with this great panel, be part of it. We have jointly between 120 and 150 years of experience in the field, in the regulatory and law, business, and analytical roles on electricity generation and electricity efficiency. In this first few minutes here, my job is to sort of put this whole webinar in context. And the way I look at it, the data that you

need probably all know, but I want to make it clear and make sure you know, roughly 70% of the transmission and distribution grid lines in the US are 25 years old or older, placing them into the second half of or nearly the end of their typical 50-year life. Roughly 55% to 70% of distribution transformers are approaching or have exceeded their expected service life of 33 to 40 years, and 30% of large substation power transformers average 40 years of age. That shows we have a creaky grid.

3:31 Electricity generation demand growth. US electricity net generation hit a record in 2025, with an increase of 2.8% from 2024. 2026 projections from US Energy Information Administration and independent analysis project US electricity generation and demand to grow between 2.7% to 3.3% in 2026. Residential and commercial rates on average in the US rose nearly 5% in 2024 and 2025, an additional forecast increase of 4% between 2025 and 2026.

4:14 Outages. National surveys. A recent nationwide utility survey indicated that 45% of commercial and residential customers experienced a power outage in 2025. US power customers experienced power interruptions nearly 11 hours during 2025, and it is now increasing in the first half of 2026. So we have a creaky grid. So the next two things I want to just let you know is the numbers that reflect reality. Solar and battery storage accounted for roughly 80% of new US power generation on the transmission grid in 2025, and more than three-quarters of grid capacity additions through the first five months of 2026. So there we do.

5:08 And they're doing this primarily because they need to advance projects' cost of underlying economics, speed of deployment, and operational performance. Lastly, my parting thought is it's always less expensive to save energy than generate electricity from any source. Meaning we must maximize building industrial infrastructure and generation technologies and systems that are efficient through every single possible venue, codes, standards, rewards at the federal, state, and local government levels. We cannot ignore efficiency, and we cannot generate electricity out of our problems that we're experiencing.

6:03 - 17:19

Opening perspective: a grid built for another era

Matt Haupt, PE, CEM, CPP

6:03 And I want to leave us with that thought. And now we're going to run through the four of us who are panelists, starting with Matt Haupt. Matt. Thank you, Scott. Do appreciate it, and welcome to the listening audience here. I'm going to start off with nothing's wrong with the grid. It's at this moment you should be saying, "Matt, are you off your meds again?" Let me finish. There's nothing wrong with the grid. It is functioning as it was designed, planned, and constructed for 50 to 80 years ago. The electrical grid is one of the largest, most complex machines ever built, a vast interconnected system that delivers electricity almost in real-time across the US. However, a better way to really look at it is it's a century-old machine being forced

	to perform modern miracles.
6:51	A system that was initially built before the airplane is now expected to power data centers and supercomputers. So it's not necessarily broken, but it is fundamentally misaligned with the demands being placed on it right now. And that mismatch is what's causing a lot of the problems. As Scott just alluded to, I'll get into some of the issues that he was talking about, but a little bit about how did we get here? Next slide, please. All right. No, go back one. Thank you. So my name's Matt Haupt. I was the former energy director for the Navy Marine Corps, and now I've joined Scott in the panel here to provide you a little bit of information in what I see wrong with the grid today. Next slide, please.
7:50	So as you can see here, I'm not going to go over a lot of the history, but as they say, if you don't know where you were, you don't know how to get out of the problems that you are. 1880, Edison brought in the Pearl Street Station. You bring in Tesla and Westinghouse, they brought us AC, then you have the transformers and the electric meter that came into play, corporate greed, and a little bit of government governance coming out of there. So with that being said, you can see from about 30 until 1980, 1930 to 1980, we had the Klugenshuit site, which is the happy times.
8:30	Transmission was planned and predictable off of the loads that were planned and predictable. Centralized generation, transmission meeting the loads that are out there, and as Scott said, low electricity rates. Biggest point right there is it was predictable. So rates were falling, generation transmission were meeting the demand. There was joy in the world. We come into the '80s, the '70s and '80s, you had some blackouts, some black eyes. The government said, "Hey, you know what? Let's add a little bit more chaos to this." And we got into the 1990s with deregulation. Now that's fracturing a little bit of the responsibilities.
9:12	So this is kind of the calm before the storm. As you can see, the load that we're looking at kind of levels off And people say, "Ah, deregulation was part of that fractured responsibility." However, one of the biggest things is deregulation split generation, transmission, and distribution into separate entities. So instead of being a vertically integrated utility, you now have regulated systems, deregulated systems, the breakup of large utility monopolies, things like that. This did create some competitive markets, innovation, lower prices, but no single entity responsible for the resilience of the grid.
9:51	So we developed a governance structure that was really a group project where everybody else is hoping somebody will take the hard choices. Right now, the grid is governed by 50 public utility commissions, or PUCs, and you got to be careful when you say that. Nine ISOs, RTOs, 3,000 utilities, federal agencies, permitting, things like that. So as you can see from about '80 to 2020, I'm getting closer to where we're sitting at right now today, we're looking at a policy labyrinth, where modernization really moves at the speed of the slowest stakeholder. And if you have government involved, that can be very slow.
10:33	So the grid is not so much technologically constrained as it's procedurally constrained along with being a physical constraint.

	So this is the calm before the storm. Next slide, please. So here's the storm. The left-hand panel, you can see electricity demand growth. As Scott was alluding to, the demand is just skyrocketing. And why is that? Well, we're plugging in cars, we're plugging in trucks, planes, ships, automobiles. Almost everything is now being plugged in. You've heard of the electrification of the grid. So we're taking a lot of efforts on the transportation side to plug them into the electric grid. In addition, we're also taking building construction and making it more electrified, too.
11:24	So you're getting rid of natural gas as heating, and you're putting that on the grid. Additional, you have industrial reshoring and process electrification. So demand is accelerating faster than at any other time since the post-World War II industrial boom. The second panel here is kind of an opposite story. At the same time that demand is growing, well, you know what? Transmission is not. And really, when you remember the load was kind of plateaued. Why build more transmission? Why build more generation? If your car is going well, you don't change out the oil and the engine.
12:07	If your house is doing okay, you don't change out the foundation. So right now we have two to three times more transmission needs than previously accounted for, and we're only building about 1% per year. Now, I'm not good at math, but that's about 200 years to get to where we need to be for transmission. Transmission also costs about three times as much and takes up to 12 years to get a transmission route design planned and constructed. So to me, this is the single biggest structural failure that we have for the transmission. Result, under-built transmission, overstressed distribution, and massive regional disparities. The third panel Scott alluded to also. U.S. grid is getting old. Aren't we all?
12:58	The load growth is accelerating. The physical grid is both undersized and now it's aging, and a failure. Scott brought it up, but I'll reemphasize it. In 1960, we had about 5% of the entire grid, both transportation... I'm sorry. Forgive me. Blame the last. Generation, transmission, distribution in 1960, about 5% was over 50 years old. Today it's about 30%. 2040, 2050, it's going to be about 60% that are 50 years old or older, way past its design life. As an engineer, that's no bueno. That's not good. So an aging infrastructure increases failure rates, outage risk, maintenance cost. The grid is aging into obsolescence faster than we can rebuild it. And to summarize, you know what?
13:49	If that's not enough to scare you, we also have transmission bottlenecks, distribution choke points, base load retirement. We're getting rid of the coal and gas generators and nuclear, but we're not replacing it fast enough. What Scott said is absolutely correct. Solar and wind are coming into the generation systems, but it's not enough to replace what we're losing in retirements of both nuclear and coal. Well, that in itself provides, forgive me, reliability gaps, frequency instability, emergency imports, and obviously, blackout risks. So this is another misalignment.
14:34	We're very short of the generation side of the house. In addition, we have regulatory paralysis, as I went over before. Transmission lines take seven to 12 years to build. Data

centers take about 24 months. Now, that math doesn't really work. I'm going to also bring in cyber-physical security vulnerabilities. The ICSOT systems that are built today were built for reliability, not necessarily security. Modern threats are now outpacing the legacy defenses that we have. Again- Matt, you're hitting your seven minutes, so move- Roger that.

15:12

Yep. I will go to the next slide, please. Slide number three. Now for the 800-pound gorilla in the room, once it goes there. All right. Electrical growth is increasing, but where? It's not in the industrial sector, it's not in the residential sector. It's in the AI data centers. And this is important because this is a structural shift in the grid compensation and the consumption out there. The grid's not necessarily failing because it's old, but it's challenged because its architecture no longer matches the alignment of the mission. Next slide, please. So all is not lost. I'm not a doom and gloom guy, and hopefully you're not the slicing your wrists open and sitting in bathtub, because you can see there are ways to get around this. They're short-term, and AI is being charged with all these negative things, but AI can also be our savior.

16:09

It can come out with better grid efficiencies. It can come out with better grid maintenance and modernization. So I'm actually looking for the AI to help us get over these problems. As you can see, there's short, middle, and long-term solution sets that are out there. So again, the grid is not necessarily broken, but it's working as it was designed for, predictable planned growth and loads, and centralized generation. Today we face explosive load growth, extreme weather volatility, bi-directional power flows from DERs, cyber protection, and rapid electrification. So this mismatch, in my opinion, is what's wrong with the grid today.

16:50

Now that I've pulled that pin on the grenade, and I've thrown it into the room, I unfortunately have to depart the webinar, but I'm leaving you in the very capable hands of my colleague, Scott Sklar. So with that being said, Scott, the floor is yours, sir. Peter Fox-Penner. Are you Peter Fox Penner? You're up. Mute, so you just have to hit that microphone. Oh, sorry. There you go.

17:19 - 27:08

Power-sector economics and the investment challenge

Peter Fox-Penner

17:19

Yeah, sorry. Hey, everybody. Pleasure to be with you today, and be part of this august panel and talk a little bit about electric industry issues. I'm just going to go over a couple of my slides. Speaking only for myself, not for anyone else in Brattle, or our clients. But I'm going to maybe go to the next slide, Denise. I'm going to give a little bit of maybe a context to what Matt just talked about. I first want to start with maybe a little bit of a contrarian view or just a little bit of a different reframing. I do think the grid is facing the electric industry and the grid it operates, because let's remember there is a big ecosystem that operates this grid. It isn't just a grid sitting there.

18:15

But that whole industry, that whole ecosystem is facing, I do

think it is not an exaggeration to say the largest challenges in history, just the number of crosscurrents. But I want to give a shout-out to the folks who do roll the trucks every day and fix the wires, even in really bad storms under dangerous conditions, and the folks in the control room, and the folks even sitting at their desks shuffling papers, because the grid we have is still a very amazing, reliable system. And electric power is still quite reliable, and even by world standards, it is relatively affordable.

18:57 It has been going up in price, and I'll talk a little bit more about that. But still it's- On a national average, it's still something like under 2% of the average household's budget. The average household. It's much worse for low-income households, and that's a big problem. So I do want to note that tip of the hat to the folks that are keeping the grid going. A lot of it's aging, but a lot of it has also been replaced and is being replaced. So I'm not as doom and gloom as Matt's current assessment or even forward-looking assessment, but I do think we should be clear-eyed about the challenges. Okay.

19:42 And here they are, rising costs and affordability. As I mentioned, the wallet share, the share of household budget, has been going up. Affordability is a much bigger challenge than the electric industry. It's a challenge on American households generally, and it's the increase in all the costs of living versus very anemic wage growth that is really squeezing folks and making electric bills unaffordable, more so than the growth in the electric bill itself. However, electricity costs are going to keep going up, partly outside the industry's control. And that's the rising supply chain costs you see on the right of supply. I'll show you something about that.

20:31 Demand growth, Matt talked about that. That is the highest it has been recently, but it's not at a level that should be unmanageable were it not for a lot of the supply chain costs and constraints. But it is growing quite quickly, especially for data centers. There's climate resilience, climate change, and decarbonization and reliability risks from severe weather. Those are all imperatives, including decarbonization, and that produces additional challenges that we must respect. And I think Matt mentioned planning and permitting is a big challenge for the grid.

21:11 Okay, next slide. Connect. I mentioned supply chains. This is in the deck that is going to be available to all of you. This is really new to the industry in the last five years. Copper prices have gone up 40% in just since 2021, and they're projected to double by 2030. Many other commodities, rare earth minerals, just about everything that electric systems are made out of, except for labor, the labor that goes in is going up faster than inflation and is predicted to continue to increase.

21:57 And the supply of critical minerals is a whole geopolitical issue that is getting good attention, I think, by this administration and others, but it's a long-term issue. Next slide. There's a very, very large increment in capital spending. Partly it's driven by the fact that the equipment costs more, partly it's driven by the aging infrastructure and the need for strengthening systems, and then it's driven by low growth.

22:35 So all of those reasons are driving spending. You can see that spending, there's almost a doubling in utility outlays in the last

10 years, and it's continuing to go up to $1.1 trillion in total 2024 to 2029. And you can see that that spending is spread across distribution systems, transmission systems, generation systems, and even gas-related systems, which unfortunately is exacerbating decarbonization challenges. So we have a very, very large CapEx cycle that is consistent with the third panel that Matt showed you. Next slide.

23:31

Matt mentioned data centers have... Look at the rapid increase in data center demand. There are some forecasts showing data center demand doubling by 2030. That's putting a tremendous amount of strain on certain parts of the grid. Data centers are really not distributed evenly across the country, this is something important to understand, so that in many parts of the center of the country, demand growth is modest, rate growth is quite modest and below inflation even. But in places where data centers are really being added or other places where costs are going up for other reasons, you have affordability challenges. But in certain places, the Mid-Atlantic, and in the Southwest and Texas, where data center growth is great, you have very, very high demand growth and it's putting great strains on the whole ecosystem.

24:32

Next slide. And Peter, you're hitting your seven minutes. Okay. Yeah. I've got last slide here, Scott, and then I'll be done. Thank you. I'm just going to tick off a number of measures that me and my colleagues at Brattle are working on every day, and what I want to say is there are a lot of tools that the industry has to address these challenges, but it is going to take every one of them, and that's why this challenge is so big and broad. It can't be solved by any one of these. Everyone's needed, and it's very hard to do 10 big things at once. But that's what the industry needs to do.

25:12

Large load policies and rate protections where data centers are coming in, transmission planning, and regional grid reform. Matt mentioned this, our transmission planning is very, very slow. Our permitting is slow. We're nowhere near best practices worldwide in planning, although some regions are really starting to get better. Reduce reliance on short-term markets. That's very important in places like PJM. Load flexibility, co-location, and bring your own generation. We have a lot of reports on how that can help. Increased energy efficiency and grid utilization, perhaps prompted by greater use of performance-based regulation. This is really a neglected issue.

25:55

I've been talking about this with Scott and others. We have really neglected energy efficiency, and it's really an important resource to focus on. Increased solar and wind generation, removing policy headwinds, Scott mentioned this. Solar and wind together are the largest grid additions, even with policy headwinds. They're also the cheapest. Even with policy headwinds, they could do more and they need to do more, and that goes hand in hand with interconnection and transmission planning reform. Stronger supply chains and, let me reemphasize, load flexibility and demand of distributed energy resources, all within a framework of keeping affordability guardrails on, reducing carbon emissions, which the industry up until now has led all other industries in carbon emissions reductions. It needs to continue that, and it can continue that with sightlines to net zero by 2050, and of course, maintain

reliability.

27:00

So thank you very much. That's a quick overview. There's a few more additional slides you can check in the deck. And, over to Scott. Thanks, Peter. And now, Professor Attanasio, you got it.

27:08 - 35:11

Law, regulation and behind-the-meter flexibility

Donna Attanasio

27:13

Great. Thank you so much. Donna's not using slides, so if you would just unshare your screen for now. Oh. Yeah, so- Great ... I'm here at the end as the lawyer. My focus, of course, is going to be on what can energy regulators do about it. I appreciate you including me, and I'm happy to have such a great audience today. So there's limited areas, obviously, I don't disagree with anything that Matt or Scott or Peter have said. But there's limited areas in which energy regulators can actually have a decisive decisive positive impact. Certainly, there are some, and it is a heavily regulated area, and we've certainly seen actions in a lot of different places.

28:01

But I really want to focus today on one area in particular. I should preface this by saying I'm in PJM, which is the area experiencing the highest increase in data center load, new load. So this demand supply issue is a really big one for me. We typically describe our generation system in terms of its generation, transmission, distribution, which is a very accurate description of the way we built it, all to respond to consumer demand. But it's really important that we also focus now on what is happening behind the meter. This idea of consumption that can be flexible, that can help enhance grid reliability rather than simply be the subject of the grid.

28:42

Sometimes, of course, consumption is referred to as demand, load, customers, end users. I'll probably use all of those interchangeably, but that's where I'd like to focus a little bit today. And part of the reason is because as we see this increase in demand on the system, it is, as several of the others have noted, it's pushing this upward pressure on price, so we really have to be aware of consumers and what they can afford, and it's also creating some risks. If you are the utility and you're looking forward, and you're at the grid and you're thinking, "What do I need to do next?" Well, first of all, is all the demand that we're seeing from data centers really going to materialize where we think it's going to and at the rate we're going to?

29:23

We're seeing efficiencies in computing, we're seeing improved grid operations. We're seeing other changes on the grid, such as energy efficiency and conservation, things that I think are really, really important that we pay attention to. We certainly see community opposition to data centers, which may change where they're located. But overall, we have this moving target, which creates uncertainty into planning and financing. So we have to be aware of those things. So thinking about how we're going to address some of these problems, is there any one particular thing where I think regulators should really focus?

	And I'm going to identify one of them. It's not going to be permitting reform. There's nothing else I can add to that discussion. It's been going on for years.
30:04	Yes, we need it. There's nothing else I can say about it. I also do want to send some applause in the way of FERC for their work on interconnections. It's been a long time in coming. Order 2023, which is now several years old, it does seem to be having some effects. We've recently seen PJM clear their backlog. What Order 2023 did was help push the projects that were most ready to be interconnected up towards the front of the queue, increase some of the transparency and information flow. And we're also seeing entities like MISO using AI, as something else that Matt touched on, as a way to help cut down the study time.
30:46	So I think those are all really positive things. I'm really happy we're going in that direction. So the question is, what else can law do? And I'd like to focus on state law regulation. So the states regulate retail sales and distribution. And one of the things that we have talked about, and you've seen some references already, is this idea of new loads, new big loads coming onto the grid and bringing their own generation. So I'd like to focus on microgrids, because one way in which you can co-locate the generation and the new load is with a microgrid. It's defined as a group of interconnected loads and distributed energy resources that are within a clearly defined electrical boundary that acts as a single controllable entity relative to the grid and can usually operate in both grid-connected and as an island, either mode.
31:39	So these little mini electric systems, they tend to be very costly, but they have an ability to provide a lot of reliability, benefits, and flexibility in terms of how they integrate and manage load. So sounds like a great idea. Why don't we do more of it? Well, the problem is, is that these are, as I said, at the retail level, state regulated, and if you have a single entity that owns the microgrid, the generation, they own the load, they own the wires, it's all on one parcel of land, not really a big problem. We have a lot of those around the country in many different configurations. But some of the ideal configurations might also include having a third-party expert to operate the microgrid.
32:23	You could have multiple owners of large loads that all want to be using the same microgrid. You could have loads on non-contiguous lots, and any time you get into any of these more complex multi-user microgrid type configurations, you run into the problem that you may become a public utility. In some states, there's strict franchise laws that regulate who is the public utility, and no one else can operate in those areas. In other cases, it's simply that the regulations would be somewhat onerous. Rate regulation, reporting obligations, financial and organizational regulation, all those can be problems. Those all are important things to have.
33:01	They protect consumers. But if we're talking about large consumers, sophisticated consumers, we could conceivably create safe harbors that allow them to operate by contract, come on the grid, and create these little mini electric systems. It would probably take legislative change in some states, regulatory change in others, and some flexibility on the parts of utilities. We do have a lot of these in the country. Usually,

utilities are interested in owning the wires, being involved in them. But in some cases, as we see with some of these large data centers coming online, they could do this themselves, take some of the risk off of the utilities, off of the other consumers that are dependent on that utility, and do some of this themselves. Why is it a good idea? First of all, data centers are willing to pay a lot of money for electricity because it's worth it to them.

33:52

And so this costliness of the microgrids, they are the ones that are able to invest in these, and their investment could help bring the cost down for others. It aligns the risk of building the new generation with the entity that the large loads that are coming on. It helps bring in private capital and takes on some of the debt. And overall, microgrids have the ability to help us learn how to manage the grid better. They create islands that can survive through outages, continue functioning. They can help integrate renewables, distributed energy resource, so that the grid is seeing one node that it's interacting with, and so helps relieve some of the stress on our aging infrastructure, which we've also heard a lot about.

34:37

And it's not just data centers. As microgrids get more sophisticated, we'll see them used in a lot of other contexts. So, for example, we've already seen a lot of efforts to create these town center type microgrids, useful in emergencies, where you're integrating emergency providers along with maybe shelters, other places that people can go for services. And those types of things are often still getting stymied by these very same laws, that if we create the safe harbor, learn how to use it, experiment a little, I think we have an opportunity here that could help on a lot of these different fronts. So I'm going to stop there.

35:11 - 50:34

Distributed energy, resilience and grid modernization

Scott Sklar

35:11

Thank you, Donna. Right on time. Good job. Thank you. Didn't even have to remind you. Good job. Well, I'm the next presenter, so if it could bring up my PowerPoint. We're trying to move this along so we can get as many questions answered as possible. Okay. That's not me, that's Brattle. I'm the GW. Yep, that's me. Okay, thank you. Is that the first slide? Back up to the first slide, please.

35:54

Cover slide. Thank you. No, back to the GW slide. Thank you. So I'm professor at GW. I teach three interdisciplinary courses at GW under different schools. I'm also sustainable energy director of GW's Environment and Energy Management Institute, EEMI. So I'm an educator and energy analyst. One of my courses is the first course in the country on sustainable energy and critical infrastructure, which is a resiliency course. Next slide. I also have a 25-year business. No, the Stella Group, please. Back up there. And that business started in 2000, so 25 years.

36:38

It's a global business, and it is, I am brought in, I sell nothing. I guide end users, either beyond the grid, infrastructure,

commercial, industrial, and US military predominantly, and local governments. And I have projects on every continent, including Antarctica. But I'm also hired by utilities at the end of the line who have electric power quality, meaning surges and sags, which ruin equipment and appliances, or fluctuating currents, or just not enough current. So we'll get into that.

37:18 The next slide, please So this one now gets into what I wanted to sort of brief you. And I included these articles with their links because I want you to read them. And this is a great article, "We're running a trillion dollar grid with 40% utilization." While, yeah, we have a very sophisticated grid, we're seeing grids coming online all over the world that have a 70% utilization. They really know how to do it, and they do it with the use of blockchain, AI, sensors, controls, staged efficiency, distributed storage of all kinds, pumped hydro, batteries, compressed air and liquids, flywheels.

38:12 I work with them all. And then of course, all different kinds of distributed generation. All the renewables, not just solar and wind, geothermal, biomass. The hydro marine technologies are not dams, in-stream. Fuel cells, tiny gas turbines, very efficient. So we're seeing a whole chain in that, and it's really that integration of all those things that can make the grid of the future. Next, please. The next thing I wanted to raise with you is, and some people did it, but I did a whole bunch of slides on there, is we're seeing right now the utility prices going way up, and that's a continuing trend. We need to be very smart on this.

39:05 The public actually is not going to stand for it. The individual ratepayers, the administration, correctly, and some of the governors have pretty much put out the word to data centers, the biggest part of the growth curve, generate yourself, and we'll see how that plays out. Some of the utilities are very nervous about that, and there are issues on letting them generate themselves rather than integrating with the utility. And we're going to have growing pains on it. Next slide. So this is an article with a quote from NextEra CEO, John Ketchum, by the way, who's a big natural gas guy, I know him.

39:54 But he says in this article, quote, "To get your hands on a gas turbine right now and to actually get it to the market, you're looking at 2030 or later," Ketchum said. The cost of gas-fired generation has gone up more than threefold. That is a fact. Next slide. And the reason, people, I get called by local utility companies is not because of my beard, not because I'm a professor, but waiting now four and a half years at 300% is just not acceptable for what the challenges are. And so this is GE Vernova gas turbine backlog climbs to 116 gigawatts, taking reservations for 2031. So now we're talking five years.

40:42 Next slide. It's coming, I hope. We also have a global transformer backlog. No, back. You got it right, back to that one. So, at the start of Ukraine War, and because of the Ukraine war, we went to two and a half years transformer backlog because obviously, the Russians were attacking their grid and the free world wanted to give some of our transformers. Well, now, not only because of that, but we have old transformers and frankly, harsh weather patterns predominantly caused by climate change, not all of it, and we're losing transformers, and they're old.

41:30	Now we're at four and a half years to get a utility scale transformer. And now the administration, I think, actually correctly, is saying, "Hey, you got to be careful what kind of transformers for national security you're going to pick." And they're made obviously from rare earths and other kinds of metals that are all inflating. The cost of these are going up and they're late. So relying on transmission-based transformers and frankly even distribution-based transformers is not necessarily a game strategy for the next five-year short term. Next slide, please.
42:16	So this is heat map, and this says surging demands are pushing high-capacity electrical transformers to four years. Next slide. We're going to get to good news, I promise. This slide is small modular reactors are having a moment, and I'm hearing a lot about modular reactors. And there's potential there, I'm sure, but it's not really going to happen fast. We have none of them that are really operating for long terms.
42:54	We have none of them that have assembly lines, and with new technologies coming on, you have to have a really test period. Of course, there are quirks in new technology. And by the way, I worked in the Senate for 50 years, and part of that was on the Nuclear Regulatory Subcommittee. I have a lot of experience in it. So this is not a short-term game at all, and not particularly quick intermediate either. So yeah, it's an option, but not a playable option at the moment. Next, please. And Bank of America has derated all the nuclear stocks. Next please.
43:39	The modular nuclear reactor stocks. So, Bloomberg just put out, and this is June 30th of this year. And so France's nuclear output dropped to the lowest in nine months because of the heat wave. We in the United States have stopped reactors because of the heat wave. So our summers are getting hotter, and if the water gets hotter, it does not help to be a coolant. So you're seeing nuclear capacity dropped out, and that has happened in Georgia, that has happened in the TVA region, and it has happened in the Midwest.
44:22	So we're going to see more of that just because our summers are getting hotter, and these are the big reactors. So we have to plan for this and understand it and rely on technologies that are not so heat and cold sensitive. Next, please. We're going to get to good news, I promise, in a second here, hopefully. So, this came out just a little while ago on May 11th, and the International Energy Agency has said that solar and wind will outdistance coal worldwide in this very year. And so the same of what's happening on the US grid is really happening on the global grids.
45:14	And while solar and wind are getting, again, the highlight because they're a little more advanced in the market, and by the way, I ran the Solar Trade Association for 15 years in the United States and also the Biomass Electric Trade Association side by side. But again, geothermal, biomass, and the water technologies, and I'll even add waste heat as a renewable, are also growing very fast and will make their US footprints and global footprints. In fact, the small, agile geothermal electric power industry is really having a renaissance right here in the United States, and well deserved. I want to remind you that we have an amazing amount of geothermal capacity heat underground, not only in the West, but also under the

	Appalachians. In fact, MIT did a study that shows that the Appalachian, the older mountain chain, has half the heat we need.
46:18	So this could be a very exciting new innovation of 24-hour power baseload. Next, please. So these are the capacity additions and retirements in the US. Obviously, solar going up, not retiring. Energy storage, we're putting in about six to eight gigawatts a year. We are one of the largest markets for grid-scale battery storage of all different types. These are not all lithium-ion. Now, lithium-ion phosphates, sodium, vanadium, nickel, aluminum. I'm working with all of them. It's so exciting.
47:03	Wind is going in, and of course, sort of at the end, gas. And of course, old gas is retiring and old coal is retiring. But the issue is, we want to see these capacity additions, but we want to time together. By the way, starting three years ago, 60% of large solar installations or large wind installations had wind or solar as part of it, and then batteries. So give them more full capacity flexibility. Again, solar runs in the daytime, when we use most electricity, of course. Wind goes from very late afternoon to after midnight, and of course, batteries make up for rainy, non-windy, and evening time.
47:45	So, and again, doesn't have to be batteries, can be pump storage and the whole range of technologies. And that's happening. It's good news. Next slide. I'm almost done here. I know I'm at my seven minutes. I answer all questions to my business email. You can send me it. I have more studies, analytics, and peer-reviewed articles and papers, probably than anyone alive on these issues. I want to add one point. I am called in mostly to bring in microgrids, blended renewable solutions with energy storage at the end of distribution lines, where the power gets low or gets shaky, and that means you have bad power quality, or you have areas where line voltage congestion, meaning you're getting so much pull because of the hot or cold temperatures, that the lines can't hold it.
48:41	So we augment it at substations, primarily distribution substations, though I do larger ones as well. I've done 100% renewable energy data centers, five of them around the world, I've overseen. And with immense energy efficiency, energy storage, and a blend of renewables. Microgrids, since the Puerto Rico grid was ripped down and then the Louisiana grid after Ida, and Superstorm Sandy, and of course, the big forest fires in California and the super freeze in Texas that brought down the entire state, almost. All those are driving on-site mixed electricity, some tied just to the end users, some intertied with the grid. And I want to do one more pitch that no one mentioned on my team of the presenters here. But what we learned in Puerto Rico is that we can, on the grid, also have technology that allows the grid itself to drop off parts that are not working, to preserve the stability of the rest of the grid, and then have
49:55	reclosers, where when the other part of the grid's up, they can automatically reconnect. So you have small distributed power systems be able to do that, either connect to the grid or detach. You have the grid itself being able to do it with these reclosers. So we need to move in that direction so we have self-healing grids, as we have in telecom, we have in data with the internet. We need to drive to the electric grid. I'll leave with that. And Ed,

you have to decide whether we go right into questions since we're over three o'clock.

50:34 - 1:00:20

Panel discussion

Scott Sklar moderating

50:34

We're doing okay, Scott. Let's do some discussion questions. So can you tell- Okay. So everybody in the panel, show your pictures. Get back on. Hit your camera. Great. And I think the first part of the grid... There's Peter, thank you, and Ed. So I think the first question I have for you is if you were the head of a regulatory commission in any state and had the power to do anything you wanted, within reason, Donna and Peter, what would be your first opening to basically set the tone to the challenges we have now? Peter, you start.

51:24

Thanks. There's two things that spring to mind. The first one is I would really ask the utilities to take a comprehensive look at their distribution system planning and their use of distributed energy resources of all types and try to accelerate the cost-effective use of those, not for distribution system deferral, but also for just grid services, aggregating those and using those. And the second thing I would do is prevail upon the utilities, this is something that involves FERC, but I would try to really change regional transmission planning to make it much more agile and forward-looking.

52:15

Those would be the two top of my list. Okay. That's good. Donna? Well, I've already answered the first part of that question, which is I think- You did ... we should create safe harbors for microgrids. But that reinforces part of what Peter's talking about. How do we use what's on the distribution edge more effectively? I would also promote more on energy efficiency, as we talked about previously. I think that that's a really important area that does not get nearly enough attention. And I would look at more ways in which we can integrate flexible load, and help be able to integrate that into the system and have people compensated for doing that. So I think those are a few of the things, but also the transparency into the distribution planning, as Peter mentioned, I think is really critically important.

53:00

Yeah. Scott- One of the trends- ... could I just second her emotion on energy efficiency? Oh, you can second the emotion if you want. Yes, we've done that. Let me just- So the following issue is we're seeing, in grid flexibility, some interesting trends. The three I like to highlight is the use of virtual power plants, where companies come in and either look at buildings and industrial sites that have battery banks and get them to sign an agreement, of course, get the regulators to approve, which can then be offered up to the utilities or large end users to meet demand if there's a shortage on the grid, or lower peak cost or wheeling electricity costs during the summer or the winter. I think virtual power plants are being used around the US, but not uniformly. I also see, back to what Donna started about the microgrids, the same thing.

54:02

We're starting to see about 10 states rapidly deploy them,

either allowing local governments dealing with their sectors in fire, ambulance, and police, first responders, and healthcare taking first, and then other important things to the economy second, such as food processing, cold chain, and healthcare and food. So I'm seeing that. And the third thing I'm seeing is a big, big move to co-locate lots of generation sources together to see if you can get some harmonies. And I'm seeing more and more of that. And of course, I'm getting called on those kind of projects. So that's my answer to their two.

54:53 The next question I have for you all- Hey, Scott, can I just- Yeah ... chime in there? Sure. Yeah. You mentioned virtual power plants, and one of the questions we got in was what is the difference between a virtual power plant and a microgrid? Obviously, both have a lot of advantages they can bring. You've already described a virtual power plant as connecting all of the different generation resources and operating them in harmony with one another. Or storage resources. Or storage resources. Any kind of grid resources. Right. The difference with the microgrid is that you also have the load, so you're combining the generation and the load all within one electrical boundary. So it's interacting at one point with the rest of the grid, so it's a controllable load that has a little bit more flexibility.

55:35 So both ways- Not only that, I'm glad you raised that, Donna, because one of the things I hear about, and I have speakers in my class about that, you have different parts of your economy where again, you have industrial sectors and agriculture sectors where certain times of the year, everybody's working at once, which strains the grid, particularly if it's midsummer or midwinter. And so by being able to have something on site that helps moderate that so that it doesn't strain the rest of the grid or bring up electric rates high for everybody else is really important now. So I share that. That's a great point you raised.

56:15 I want to raise an issue on low income. I'll call it low middle and lower income, I guess is a better term. So as electric rates rise and also gasoline rises, people are really getting to the point where between their rent and their mortgage and their energy and their food, that's it. There isn't anything else. Of course, that hits the broader US economy badly as well because we're an expendable income economy, but it's really making people's lives miserable. Some states have opened up for on-bill financing, where your meter, not you, your meter, you basically get a loan over the life of the energy efficiency or on-site renewables or storage, and you pay that off, and that monthly payment saves you more electricity, so you have net income.

57:16 And that's being used in about 17 states. Are there other kinds of things you've thought of or are seeing that can help have real impact on basically a third of our economy that's really getting squeezed? Whoever wants to start that one first. Well, Scott, first of all, I agree with you that this is the most pressing consumer issue in electricity. I'll just restate some of your statistics. More than one-third of American households say that they have to choose between paying their power bill, paying their medical bills, and their groceries and housing, all those necessities.

58:06 And electric disconnections for non-payment are at their highest rate in at least 25 years. So we have real warning signs

hitting them. I do think energy efficiency programs, which have been neglected, and which can be financed on bill, they can be financed by ratepayers, they can be financed by green bank community, finance institutions. Yep. I think every low-cost source of financing should be brought to bear right now for financing efficiency improvements, weatherization improvements.

58:55 It should be a massive national effort to try and both improve efficiency, lower emissions, and improve the health of the communities and lower bills. Well, I'd say bravo to everything that Peter said. I'd also like to say this is an issue that's been bothering me for over a decade. And I had a absolutely fabulous research assistant at one point, who is now a partner, I believe at Troutman Pepper, is the current name, Adrienne Thompson. And she wrote a article in the Energy Law Journal, this was probably about 2015, where she went through and looked at all the different things states were doing.

59:36 So I commend that. I still commend that article as, I think, providing a lot of opportunities. I'd also like to mention one other thing. I really love Peter's point about the efficiency and the need to do that. There are a few states, including DC, not a state, but DC, as well as, I think it's Vermont and Delaware, that have a sustainable utility, or sustainable energy utility, or energy efficiency utility. So rather than trusting the utility to implement energy efficiency measures, they're putting it in the hands of somebody who is a utility. So I think that's also really important to look at ways in which we can help bring down costs for those that can't afford it.

1:00:16 That's great. Ed, I want to turn it over for you to handle Q&A.

1:00:20 - 1:28:47

Audience Q&A

Edward R. Saltzberg moderating

1:00:20 Sure. Well, we do have a lot of questions. I had a follow-up question from what Peter had said in the beginning, if I could just do that first. Peter, you're talking about better transmission planning, looking at distributed energies, trying to put this together. Why isn't that just happening? Because it does make so much sense that we should step back, see where the problems are, and go address the problems. What's preventing us from just having a straightforward solution? We could do a whole webinar just on that, Ed. I'm sorry. It's not a technical issue, is it? Well, there are a lot of technical issues. Scott's right. This is really deep waters to dive into, Ed.

1:00:59 Yeah. And I'll just try and summarize very, very briefly. In one minute, please. Yeah. In one minute. Transmission planning, with the best of intentions, is extremely difficult, especially now, because you have very uncertain load scenarios, you have very high costs, and you have to plan the transmission system so it's redundant and you can lose even two transmission lines and still keep the lights on. So transmission planning has evolved from a utility-by-utility effort, which is not the best way to build the lowest cost interregional, well-connected grid, to RTOs.

1:01:45	But RTOs really don't have a lot of authority. Even the FERC doesn't have a lot of authority to insist on best practices. So that the practices for determining which lines are most beneficial and the process of getting agreement between many utilities, even between two regions, that process is technically complicated and it's administratively, small P politically complicated, and that, in a nutshell, is what makes- That's a great answer. Okay. We need to go to questions, Ed.
1:02:25	Okay. Well, let's see. Here is one from Rafael. We haven't spoken about power quality yet. Today, power consumption is increasingly consumed by sensitive equipment from medical, to data centers, to HVACs. What are the implications of grid operations dropping the voltage to meet peak demand, which is the typical response, due to EDR shortfalls? Well, power quality is the biggest set of calls I get. But it's really looking not on the grid itself, it's from the customer side, because the grid itself, it's still too old. And because of bad transformers and old wires, you're not going to really have the capability to do it on the grid in the short term. So we use capacitor banks and battery banks to take in the electricity, and then that really helps it on site.
1:03:26	Or we're doing electricity... I can't tell you how many private sector facilities I'm brought into and they say, "This third of our facility needs absolutely pristine power quality, and we want to generate it on-site, generally renewables with battery banks, and just dedicate a portion of our load to those battery banks," because they know they will be absolutely pristine power. That's a real trend. Wall Street Journal's actually had some articles on it as well. And frankly, I do that nonstop all over the world, including here in the US.
1:04:09	Next. Go ahead. Here's a question from David Yaffe. Assume you're advising a municipality or a county that is facing a proposed data center project with, say, 150 megawatt peak load. What would you advise the municipality to demand of the data center from a grid perspective? Donna or Peter, pick that one up. I'm just not sure it's the municipality or county's job. While they're certainly an affected entity, practically speaking, unless the municipality is also the power provider, I think you really have to be talking with the grid providers. I think honestly, the inability of the grid to deliver electricity is going to be a constraint on the growth of data centers.
1:05:01	Mm-hmm. Correct. Okay, Ed, next one. Okay. Well, here's a question similar to what I had asked before. Maybe we don't want to delve too deeply, but can existing institutions be adapted to govern continuity, or does it require building something new? I think it requires new tools, and I think the panelists here describe a lot of tools. One is using AI and blockchain way more effectively than we do now. One is putting more sensors and controls along the grid, and also the end users. I have technology now, I can put little sticker transmitters on absolutely every circuit in a building.
1:05:48	And so I can actually read a building from the circuit breaker, which is astounding. And I can do it, and it can be done in a day. And I can look at it in detail, 24 hours a day. And I have lots of funny stories on that and what happens on a corporate campus or an institutional campus, because half the time they don't know. But the point being is we have so many tools now,

because of this new generation of internet sensors, controls, transmitters, AI, blockchain. Now we just have to figure out how to use them elegantly, and we're not. There are some promising examples, I can tell you many of them, I teach them. But I haven't seen it in a format, and I'm hoping people like Peter Fox-Penner and Brattle drag the industry to do this stuff, kicking and screaming.

1:06:42 I wouldn't accept that metaphor at all. But on this point, I do want to mention something which, for full disclosure, it's an EIP investment which I'm associated with, but it's called Sense. And it is appliance sensing, load sensing, advanced AI-driven technology. And this is a big step forward. It has been directed and is being installed in every meter automatically in Rhode Island and Massachusetts. I think those are the two states that have adopted it.

1:07:22 So as soon as that installed base gets significant, the utility will have visibility into load control and load flexibility that it's never before had. So it really is a bit of a breakthrough, and it goes automatically built into the meter. There's no special installation or hardware or truck rolls that you have to do. And so it really could be a game changer in terms of grid intelligence. Absolutely. Grid intelligence. Exciting. Well, that is exciting. So you are doing that. I was right. Thank you. Ed, go on.

1:08:02 I've got a question from Joy, and after that, Donna, if there's a question you see you would like to serve up, let's go to that one. This is from Joy Love. She said, "Please speak to the potential for performance-based standards for utilities to address some of the issues raised, particularly as they might affect ratepayer costs." That's a great question. In fact, I ask my students to do examination, what's called SAIDI and SAIFI data, meaning the duration of outages and the number of outages in a set period of time, and then the power quality, the surge, the sags, and the transients at the end of the line.

1:08:42 And at the end of every rate year, their rate increase depends on the lowest number of outages, the shortest number of outages, and the highest power quality. And that's how they make their profit. So if they want anything extra, because it has to be performance-based. And I truly agree with that, and of course, rates and rate stability is another big issue. That's sometimes hard, particularly if you're using fossil fuels. These are global markets, and you didn't know there was going to be a war in Iran or when there was riots in Southern Africa on uranium, and uranium costs went up 20%.

1:09:24 There's no way to plan for that, so it's a little harder. In the end, that's the name of the game, and it's up to the utility to understand that it has to spread risks and mitigate risks on outages in length and number and cost. Donna, what do you think on that? Anything to add? Not to put you on the spot. No, I was looking at the queue here and trying to answer other questions. Okay, well answer other questions. I'm trying to pick what... We have a lot of questions here, so just let me apologize right now. I'm very intrigued by the person who is in Alaska and has, this is Emma Kramer, looking for opportunities to find financing to help connect communities. So Scott, that might be a question for you.

1:10:15 Yeah. Absolutely. Isolated communities, 40 cabins. How do they get themselves interconnected into a way in which they

	can be operating as a system rather than individuals? Well, there are a lot of places, and there's a lot of clean energy or distributed energy investors all over the place. Feel free, I gave you my email. I deal with a lot of them, and of course, Peter Fox-Penner's involved a lot of them. Hello. I nag from time to time. But depending on what your end use is and the size is really what determines who steps in. And of course, there's obviously some risks, the more remote places or the more intensity. You're in a hurricane alley or in a super cold climate or super hot climate, there's some risk issues.
1:11:02	But I have never had a project in the 25 years of my business where I could not find financing, and it worked out great for the end user. So, and frankly, the good news is at this stage of time, we have more of these companies and entrepreneurs and investors available than any other time in history. So that's all I can say to you, but they're there and there are lots of people that can help with that. One other group to check with is the Coalition for Green Capital. Great idea. Sometimes referred to as the US Green Bank. And just ask them, because this is kind of in their wheelhouse.
1:11:42	Yes, exactly. Good point, Peter. Thank you. And also the University of Alaska at Anchorage, I believe, has an energy center who might also have some ideas. Good point. Great. There's a supply chain question I want to go to, and we didn't mention it before, Matt is not on because he wasn't able to stay past his talk. We'll be getting him down for some other sessions. But this is about inverters, and I think there's really two parts to this question. You missed discussing the issues about inverters. Almost none are made in America. Add to that batteries, America is kind of shooting itself in the foot here in terms of our industrial base. So that's another big question, but Scott, let me serve it up to you and see who you think.
1:12:25	Yeah, I think so. First of all, we do have five, I think, or six US companies making inverters, so it's not like we don't make any. And now with the new rule the administration's put out, I think there's going to be quite a bit of, I'm already seeing a lot in the trade press of particularly European manufacturers coming in here and making them here in the United States. So in the end, I think we're going to be fine. And actually, in the short term, we're fine because we do have capacity, and I think that's going to work. Batteries, I don't want to get political here. The previous administration put out a lot of money for battery manufacturing.
1:13:06	The new administration sort of pooh-pooh'd that, but then allowed the tax credit to go through for batteries, which has kept a lot of battery manufacturing. We have several big plants that have already opened up, several more opening up. Again, we're at about eight gigawatts, eight nuclear power plants worth of storage on the utility scale a year now, which makes us one of the leading countries. That's going to continue. It's not going to go down. So I'm seeing it actually pretty rosy. It's a little bumpy right now, and of course, I do agree with the person asking the question. We could've done bigger and faster and actually control the markets, not just for ourselves, but do what the Chinese do, be the global leader that sells it to the world. So anyway, but I'm not gloom and doom on this at all.

1:13:56	I'm actually, since I deal with a lot of advanced batteries that are on the market, I'm actually feeling very hopeful. I'm going to ask a question on the efficiency theme, and Donna, if there's another one you want to serve up, that would be great. This is from Jack Metzenbach, "Would you recommend approval of the 2024 International Building Code efficiency to reduce energy consumption and grid demand?" And then just as a corollary How much are we gonna get out of energy efficiency in terms of reducing the pressure on what needs to be done for transmission and distribution of the additional energy that we need to meet demand?
1:14:37	Are we talking about 2% or 3% drop, or are we talking about a large percentage drop? Of course, that's depending on the speed and scope. But first, the first part of the question is huge. I'm a big supporter in building codes. I support the new building code. The crap that came out that said it would cost, first of all, $19,000 on a new home, it probably would be half that much, which is the analysis. But remember, houses last from 50 to 100 years. So doing these, you're setting what your electric needs are if you don't use building codes, and the most strictest ones, you're keeping us to a higher standard. Imagine now, with the war in Iran, that we kept the vehicle mileage at six to 12 miles a gallon that we had in cars in the 1970s when I was working in the Senate on this issue, rather than creating mileage standards for cars. Imagine having twice the number of cars we have now doing from under 15 miles a gallon. That's not acceptable.
1:15:43	So imagine having a house or any kind of building, a commercial building, that's not doing it. If you really go with what the Scandinavians and some of the European countries, Japan, you can get up to 18% reductions easy with 22% to 26%. That's huge, and it's also grid-stabilizing, and that's the other important part. So, that's my two cents. Peter, you can add context or disagree. I'm not following building codes, so I can't comment on that. Certainly, as I said, I think we need a big push in energy efficiency.
1:16:26	And building codes are what percentage of the overall demand in the United States? Is that something- The largest energy user in our society are commercial and residential buildings. So this is not trivial at all. This is not trivial at all. Great. Donna, anything in there that you think we want to bring up now? And I've got a few others here. Just an easy one because I think I might be able to answer it. There was a question from Jack Polinsky about whether or not microgrids should or would be held to the same liability standards as a public utility would. That's one of those very important protections that the public utility commissions are tasked with doing. So as I was advocating the safe harbor where everything's governed by contract, it's really up to the customers to hold themselves to their provider. That's why I said you start with big, sophisticated customers.
1:17:17	Through that, I think you learn a lot about the reliability of the microgrids, where the weaknesses might be, what regulators might have to think about as we enlarge them. So that's why you use this opening now to start working with them more. We have a lot of microgrids, but the more complex ones, the ones that are a little bit more, involve more people, larger areas, are ones where we really need to expand and learn more. And I

just have a fact for you. Over the last 25 years, I've been involved in guiding microgrids. I have over 790 around the world. I have never had one that has not worked in 25 years. So they at the moment, they're brought in because they actually have higher reliability standards than electric utilities have now.

1:18:02 The question is still important because as you start making it commonly available and every kind of company and technology can come in, the chance of having less pristine experiences could be higher. So creating standards for operability is very important. And also, I spend a lot of time working with companies who don't want this guidance, but because I'm hired by their customer, have to listen to me, and they don't like that, particularly with the beard, is that where they put components in these things so the things that break down the most are the easiest to get at.

1:18:43 So when you have service providers come in and opening up a shipping container or a wall cabinet or start going into a room in a basement, that the thing that is malfunctioning is not in the back, but right in the front and can be popped out. And there's information on the component immediately and the comparable replacement component if you can't get the exact component. And we need a whole set of operation rules that we actually don't have, and we're doing it in the military, but we need to do it universally. So, great question. Here's one for Peter. Suzanne Hunt wants to know if you're going to be updating your book.

1:19:24 Well, thank you, Suzanne. Actually, I am not thinking about that. But what I am doing is kind of doing a frequently updated slide deck that kind of is like a little poor substitute for that. And if you watch Brattle's website, about once a quarter, I put out an updated deck, that version of it. Maybe someday. Hey, Peter, what about a movie instead? Come on. I asked Matt Damon to play me, and he turned me down.

1:20:06 How rude. Can you imagine that? How rude. I wanted to switch to a question on energy security, and from the standpoint of how prepared are we for attacks on the grid, whether it's more natural hazards that are hitting the grid, any kind of impact. So this was a question from Robert Isaacson. Well, a very good question. Are these facilities hardened? Are they getting hardened enough? Well, first I'll let you know statistically, over the last 15 years, attacks or attempted attacks on our US grid have gone up fourfold in the last 15 years. Some of them have succeeded.

1:20:52 Again, I teach a whole class on this particular issue. Some are silly, but some are very smartly coordinated. We have done some, but we are very vulnerable. And here I live in Arlington, which is three miles from downtown DC. My substation, I could run a car through the fence and take down this area for three months, just by hitting the car into stuff. I wouldn't look good, but that would be the problem. So yes, we are very vulnerable. And terrorism is increasing and terrorist threats, and we're not even talking yet about drones, which we know is going to happen. So, we need to look at this.

1:21:40 We need to be far more serious, and it needs to be at the local, the city and county, and state level, in addition to the federal government. And the utilities have to take it. Just having four

	cameras around a substation doesn't solve your problem. And generally- What do you think, everyone has to do something here, but is this really a federal issue? Can- Well, it's a federal issue of enforcement and maybe catch-up and training. And the problem, as we've seen, and I used to work very closely with Homeland Security and FEMA during emergencies, when you train people, they respond faster, and they know what to do.
1:22:20	And we need a subset of that group focused on power lines and substations and places we store fuel. Natural gas tanks as an example. And because they are very vulnerable, and they go boom. And I have pictures of them blowing up. You take my class, it's very exciting. But the issue is, it's a real Achilles' heel. We've been complacent about it, but the world is changing, and the ability to do things horribly has gotten a lot easier, and that's what we have to be prepared for. So that's all I can say right now.
1:22:59	I just want to tie that back to one of the other things, though, that's been a big issue in the chain is cost. The problem is, you're right, we absolutely have to be doing these things. We have to build the grid smarter. We have to put in the microgrids for reliability. We have to do hardening. All these things are going to cost money. Yeah. And that comes back to the problem of affordability. Energy is essential. We need it to live. And things like lifeline rates aren't going to cut it. Often, larger families use more electricity, so even though they might be poor, you might have more people living in a house just because density. And so the way in which we are structuring our electric rates and protecting poor people are inadequate. And so that is still a very essential issue that we have to be paying attention to as we move forward with these other things.
1:23:49	100% correct. Peter had mentioned right in the beginning that the cost of energy for an average household is only around 2%, so not a lot. It could double to 4%, it would still be not a huge amount of money. And I agree, affordability, absolutely. When it's a bigger percentage, you've really got a problem. But is the issue really here, are we talking about energy supply and assurance here as being the real driver for upgrading the grid, as opposed to cost controlling the price of energy? What's the balance here? That's a real hard question because it's by end use sector and regionally, so I'm not sure how I answer that.
1:24:36	I just don't quite understand the question, Ed. What are we balancing? Well, there's the cost, but costs are not so high for households that they're a huge portion of their budget. So the focus on the grid and on energy is more assurance of energy supply and to meet the demand. So it's not having the energy as opposed to right now the cost of energy, even though it looks like it's going to be going up in the future. But we've got an energy assurance issue, which is probably the bigger issue than energy, the cost of providing the electrons themselves.
1:25:15	Well, actually, here's how I would look at it, and that is that the two are very closely linked and probably not really separable because it is in the places where demand is increasing quickly and supply can't keep up with demand, that the largest cost additions occur in the system. And one principle that I think even the data center industry and the White House and many, many people agree on is that the cost should be allocated to

those who are causing them.

1:25:56 And in the case that that's a data center, then they should pay their fair share. So, I do think they are very closely linked in this particular era. Mm-hmm. I'd just like to point out one thing we haven't really talked about is, really data centers ought to, in the long run, reduce the cost of transmission because you're using the fixed costs over more kilowatt hours. But we're seeing this short-term disconnect. Yeah. So just throwing that out there, load isn't bad. New load isn't bad, but it does impose a cost to bring it on.

1:26:37 And so part of this is managing it, and that comes back to how utilities, how they're allocating the costs and how they're spreading them out over time. And Ed, I want to correct you on one thing. Electricity cost for low income is 9.1% of their budget. Transportation costs above that are 8.7. So you're getting about 20% of their income now, and then you have these increases, and housing is the predominant part of the income. And then there's food. So those are the big three. There's not a lot of wiggle room. Yeah. I agree with Scott's statistics.

1:27:18 It depends on how you define low income, but it's a problem. One other point, though, if I could pick up on what you just said, Donna, and I'm glad you said that. We do quite a lot of analysis of the rate impacts of new large loads at Brattle, and there are definitely instances where those large loads are, even now, reducing average rates. But there are other instances where they're increasing them. There are a lot of factors that you have to look at. It's kind of a case-by-case basis. And it's also true, Donna, in the long run, the average effect, particularly because these are high load factor loads.

1:28:02 Long run, they ought to contribute to lower average costs. It's the short-run effect, though, where capital is being added that's really hard to pinch. Right. Good point. Scott, we're getting down to the end of the hour. We've actually got two more minutes. What I'd like to do is maybe go around the horn and ask you for some summary comments, something you'd like to leave the audience with. Maybe starting with Peter, and then Scott, for you to wrap the whole thing up for us. Okay. Donna? Peter? Starts with Peter.

1:28:41 Oh. Peter's fine. Go ahead. Peter, Donna, Scott. Okay.

1:28:47 - 1:32:35

Closing perspectives

Peter Fox-Penner, Donna Attanasio, Scott Sklar and Edward R. Saltzberg

1:28:47 My wrap-up comments are, first of all, thank you all for your attention, for a very interesting discussion, good questions. And I just want to just reemphasize that the folks running the grid are doing their best. We appreciate their efforts, but all of those items and even more on the toolkit, we need to lean into them, and that's a challenge for all of us. Yeah. Well, again, I'd like to join Peter in thanking our audience.

1:29:26 I know we didn't get to even a small portion of the questions. They were pouring in faster than we could read them. But

	thank you all for being so engaged. I think that the only thought I would leave people with is to get engaged. Find out what your local public utility commission is doing. There are things you can do at a local level that don't necessarily involve petitioning FERC, although certainly that's important, too. Find out what your utility is doing. I agree with Peter. They're doing their best. I've never met anybody working at a utility who doesn't view their time, their job is to keep the lights on. And they understand the affordability challenge, but they're working in very challenging times. And weighing in and saying what you think is important matters.
1:30:10	Of course, I want to thank everyone for sticking with us and hope you contact us more for questions. I want to start with what I started with. You cannot generate yourself out of this problem. And I'm hoping that everyone thinks about not what new electricity they can bring online, but an equal amount of electricity they can take offline. And then looking at generation, not everything has to be from a centralized grid. It can be at the end user side. And how do we do that? How do we balance that and encourage that? It's not a bad thing. Great thing. And so this issue of a more agile, self-healing set of grid, whether it's large or small, is exactly what we want.
1:30:57	And so, it was the fight between central station computers and desktop computers. We didn't even have laptop computers. And laptop computers were derided. Now, God, our cell phones have more power than the Pentagon had when these were developed. So, the point being, we can do the same thing here. So I think we have to, the US has been known to be a creative market. I know we can be a creative market. We are a creative market, and we can be creative on this, but not one technology or generation or energy savings is the answer. It's all of the above strategy, and it really has to be honest all of the above strategy. So I'll end with that. Thank you very much, Ed.
1:31:43	Yeah. Great place to end. And the energy grid is really infectious. When you get into it and you start to experience it or learn more about it, it really kind of gets into your blood. So those of you in the audience who just have a casual association with energy, take a look at this and you just see how interesting and important it is, just because of your own situation, paying the electric bill, or maybe for a career. So thank you all for a great discussion. I really appreciate it. Please take a look at the new SSF website, ssfworld.org, so you can see what new things that we're doing up there. And I thank the audience for sticking with us right to the end and to EEMI and for the Alliance for co-hosting this with us.
1:32:29	So thank you all. And with that, I'm going to end the session. Thank you. Thank you.

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