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BROADBAND AND ENERGY EFFICIENCY

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Keynote Speaker:

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Panelists:

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P R O C E E D I N G S

MR. WEST: I'm Darrell West, vice president of governance studies and director for the Center for Technology Innovation at the Brookings Institution and I would like to welcome you to our forum on broadband and energy efficiency.

We are webcasting this event so we're pleased to welcome viewers from around the country and we also attract viewers from outside the United States. We have set up a Twitter hashtag at #techCTI, that's #techCTI for those of you who want to offer comments or pose questions during the actual event and when we come to the audience Q&A we will take questions both from the live audience here in our auditorium as well as our webcast audience.

Broadband providers are considering how they think about power consumption. With the development of high-speed Internet connections and video-on-demand, they're looking at how their equipment, services, and network operations are designed.

As is true in many industries, energy is a big part of the business model and part of sustainability, so we need to think about how to design our networks to focus on long-term energy requirements and sustainable systems. Power consumption has to be an important part of that planning and design process.

Today we're pleased to have several distinguished guests with expertise in this area. We will start with a keynote address by Mark

Coblitz. Mark is senior vice president for Strategic Planning at Comcast. In that job he is responsible for the development of new business opportunities emerging from new technologies and thinking about long-term issues facing broadband Internet providers.

He is a member of the CableLabs Technical Advisory Committee and he chairs CableLabs Open Cable Business Committee. He has been the recipient of the National Cable Television Association's Vanguard Association for Science and Technology. He also was chosen as CET Magazine's man of the year and Communication Technology's Broadband Innovator. He's a member of the Federal Communications Commission's Technological Advisory Council.

After we hear from him, we also will have a panel of other experts. Charlotte Field is senior vice president for Infrastructure and Operations at Comcast. She has been a long-term engineering and operations professional. She leads the organization in supporting national infrastructure for enterprise and customer-facing networks and products. This includes the National Network Operations Center, data centers, and desktop support for the Comcast center.

She's held a number of positions at Comcast and prior to that at AT&T Broadband. She has received the Women in Technology Award from ComScope, WITC, and the Society of Cable Telecommunications Engineers. She also has been named as one of the top women in technology within the cable industry and she also is a

member of the FCC's Technology Advisory Council.

Lorie Wigle is general manager of Eco-Technology at Intel. She focuses on sustainable manufacturing and energy efficiency. In that capacity she drives external programs related to client, server, and data center efforts including Intel's participation in green grid and the Climate Saver's Computing Initiative.

Prior to that position, Lorie was the director of Server Technology and Initiatives Marketing for Intel. She's been with the company for 24 years in a wide variety of roles and has managed their Internet Imaging Services Group.

Elizabeth Colleton is vice president of NBCU Sustainability. Beth is responsible for developing and implementing NBC Universal's comprehensive, company-wide corporate social responsibility strategy. Her areas of focus including environmental sustainability, diversity, philanthropy, and pro-social initiatives.

Since 2008, she has served as vice president of Green is Universal, an initiative that focuses on sustainability among NBC Universal's entire organization but what really impresses me about her is that prior to joining NBC Universal, she was head of corporate social responsibility for the National Football League. Now, that's a good job.

Finally, Pietro Nivola holds the Douglass Dillon Chair and a senior fellow in governance studies at Brookings. He has written widely on energy policy, regulation, federalism, and American politics. He is the

author of a number of books including *The Extra Mile: Rethinking Energy Policy for Automotive Transportation, The Politics of Energy Conservation,* and also a book called *Managing Green Mandates: Local Rigors of U.S. Environmental Regulation*.

So, we'll start with Mark. I'd like to welcome him to the Brookings Institution.

MR. COBLITZ: Thank you, Darrell. I'm happy to be here at Brookings and I appreciate this opportunity to talk about the topic of energy and the broadband economy, specifically the long-term industry initiative that Comcast has launched to help us stay ahead of the energy demands that we foresee in the years ahead.

Energy issues pervade our public policy discourse because they are at the core of the economic, strategic, geopolitical, defense, and environmental concerns. Globally, the race is on to meet the demands of growing populations and growing economies. No source of energy is being overlooked. Public and private investment is flowing into innovative, sustainable, renewable sources. There are powerful motivations to improve conservation and to make energy grids smarter and more efficient.

The Internet, unquestionably, is a part of the solution to the energy challenge. It is digitally displacing long established but less energy efficient forms of distribution from books, magazines and newspapers, to CDs, DVDs, and paper medical records. It is substituting online

consultations in conferences for transportation to meetings and appointments.

Digitally delivered broadband powered applications are replacing a wide range of physical goods from cameras to GPS devices to media players.

By transmitting bits instead of people and parcels, the Internet can help reduce overall energy consumption, but at the same time, the Internet has created its own demand for energy and the demand for power associated with this growth of broadband should come as no surprise to us. We've watched as companies like Google and Amazon create giant data centers as repositories of unfathomable amounts of information and creative content, data centers that require large amounts of both real estate and energy.

As a company that builds and operates the broadband networks that are the foundation for all the Internet brings to homes and businesses, Comcast is focused on the growing demand for bandwidth and with it the growing demand for energy.

People are doing amazing things using our broadband networks. As we all know, there is a boom in streaming video entertainment and information, user generated content, video conferencing, there's an accelerating shift toward cloud-based computing and storage, which moves a lot of processing and storage costs away from end user devices but puts a lot more pressure on our networks.

We are right at the cusp of phenomenal growth in the Internet of things, billions upon billions of processors connecting everywhere, your thermostat, your car, your heart, via the Internet, generating and streaming and aggregating and processing dizzying quantities of information every minute of every day.

Meanwhile, the next great wave of demand will be driven by what we call machine-to-no one uses, such as security cameras that transmit data day and night with no human actually watching, or preloading content so it's there for when the user wants it.

But all of these Internet connections are just a part of what cable networks are used for. Our millions of traditional cable customers can get hundreds of channels of video as well as huge libraries of video on demand over these networks, and we have rolled out next generation phone services that use internet protocol, the same delivery mechanism that the Internet uses, and next generation IP based cable services are next.

Outdoor Wi-Fi is expanding rapidly as a complimentary service for high-speed data customers, which generates even more traffic to be processed on our local wire line networks. And the growth in 4G cellular services will give wireless network operators the incentive to offload traffic to wired networks as quickly as possible to conserve scarce spectrum.

So, when we step back and assess all of these uses of our

broadband networks, you realize that we are operating an amazing, big bandwidth machine and this machine, like all machines, runs on energy.

A cable company's energy needs differ from those of, say, Google or Amazon in one important way. When a Google or Amazon wants to build a data center, they can choose where to site it based on factors such as energy availability and cost. They have a lot of geographic flexibility. We don't have that choice.

If we run a local broadband network in Boston or Chicago or San Francisco or in any of the thousands of other municipalities and counties we serve, with local head-ends and local servers, our energy needs are very local. We need to source reliable energy locally in every community and we need to focus efficiency everywhere.

So far, meeting our local energy needs has proven largely manageable, but as we project out all of the various sources of future demand and we see an impending risk several years down the road, the possibility that without taking some important steps we cannot always be assured of a sufficient and reliable supply of locally available power.

For the past decade, Comcast has seen a minimum annual growth rate of 40 percent a year in Internet usage with some years substantially higher than 40 percent. This has required our company to install more and more equipment, over 3,000 physical servers in our more than dozen data centers last year alone.

And every time we increase the speed of our broadband

services, and these increases have been continuous, demand jumps and we see another significant usage bump. Demand will grow even more as we close the digital divide in our nation.

Let's assume that we reach the very important goal of getting every American home, business, and institution connected to the Internet. Well, given that two-thirds of Americans are connected today, getting everyone connected could easily translate into another 50 percent increase in demand and a demand from that expanded base that will continue to grow at 40 percent per year or more.

Turning back to services we provide directly to consumers, let me give three examples with bandwidth and energy implications, first the digital video recorder. Today, if you use our DVR service, you save your shows to a hard drive in your home. These consume lots of energy. Even the next generation of solid-state devices that might replace hard disc are significant energy users.

But there's another way to do this, by centrally storing the shows you choose to record and serving them up from centralized servers to your home, the so-called network DVR. But even here we face an interesting potential legal barrier to energy efficiency.

Today, to meet the current requirements of copyright law and programming contracts, a separate copy of each piece of content that an individual household might want to record must be stored and maintained separately. If 100 people in a neighborhood all want to DVR

the same show, there literally must be 100 separate copies made and stored.

If, on the other hand, you could legally store one or a small number of copies for delivery and backup, a true network DVR, it would be much more energy efficient. How much more? Well, let's assume the entire industry supported 30 million set tops were connected devices with a network DVR based service across multiple providers and storage locations. I think that's a very reasonable assumption of DVR penetration. And let's assume consumers may be recording as many as two million different titles. To store all that content today, we estimate it would require about 300 megawatts of power, but if we could do a true network DVR with a few copies of each content asset per provider, we estimate it would only take 5 megawatts.

Consider that an average coal fire power plant generates 545 megawatts and an average nuclear plant generates 1,000 megawatts, so the difference in energy consumption between set top box like network storage versus a true network DVR equates to nearly a third of the output of a nuclear power plant. And these numbers jump if you think about energy requirements for all the rapidly growing cloud-based services.

The continuing amazing improvements in the resolution of video services we deliver has also bandwidth and energy implications. Today, most cable content is delivered in 720p or 1080i -- 720 progressive or 1080 interlace -- but almost every TV and computer monitor in the

market today displays 1080p, which requires lots more data, as much as 25 to 30 percent more, even with improving compression and processing. And then there's 3D and 4K and 8K and their 3D versions, as well, on the horizon.

A third example, the number of devices that operate as remote controls, DVR programming devices, search and retrieval devices, and so on, is booming. Beyond the TV this includes whole home energy management and security solutions with gateways that feed a class of set tops that are less expensive and more energy efficient.

More bandwidth is needed not only to transport content, but also to process the billions of individual transactions over tens of millions of set tops and connected devices, and every one of these devices will become a cable supported device on top of millions of more Internet devices, all demanding bandwidth from the network, which in turn demands energy.

So, to summarize everything I've just said, from a business perspective, this is really, really good news because it means our broadband networks are more useful and more valuable to more people in businesses. And the hybrid fiber coax able architecture our industry has deployed is standing the test of time and will continue to adapt to this extensive growth.

Through careful planning and intense research, we continue to come up with cost effective ways to provision the bandwidth the future

will require. Now we need to dedicate the same kind of planning and research to provisioning the energy that this future bandwidth will require.

Given the demand I've described, we are concerned that someday, certainly not immediately, but foreseeably in the next five to ten years, we will be faced with the reality that our ability to grow will be constrained by the quantity and timing of obtaining electrical power.

In March, I took my case to the Society of Cable Television Engineers, known as SCTE, to their conference in Philadelphia, where I presented the strategic rationale for how we can best ensure our energy requirements will be met in the face of this rapidly growing demand. I proposed that we develop a process to define and address these issues for the long-term and I called on every stakeholder -- operators, venders, content and app developers alike -- to play an important role in the process.

I conceded that this kind of planning that requires us to look down the road a few years, never easy for business people who need to worry about the next quarter's results, but as an industry we've done it before with great results.

Perhaps the most compelling example in our industry is our industry's early decision to adopt IPV6 Internet addressing to get ahead of future demand. In the middle of the last decade we looked down the road and saw a time -- that a time would come when IPV4 address space would be exhausted, which could have severely limited our ability to

introduce new IP based devices into our networks.

When our industry first started discussing the IPV6 challenge, there were divergent points of view on tactics and timing, but with determination, hard work, and a common end goal, industry thinkers ultimately coalesced around the idea that adoption of IPV6 was a strategic imperative to continued growth.

Comcast and others in the industry recognized the need to establish leadership positions in IPV6, we accelerated plans to integrate the protocol into our networks, we specified its inclusion in products we bought, we trained and prepared our engineering and operations teams to ensure a seamless implementation.

So, our industry took the lead in the migration to IPV6 and last year, Ican announced that the last available blocks of IPV4 address space had been delegated to regional Internet registries, the supply was exhausted.

We took the long view, so we were ready.

Now it is the time to take the long view about energy. We are already seeing growing incidents where available local power is not keeping up with the demands for our growing networks and this, frankly, is our biggest concern. Even if the cost of energy were to moderate, the real challenge is guaranteed local availability where and when we need it.

If we figure out how to need less, we reduce that risk.

The cable industry has already been focused on managing

its energy demand. We've improved processing power to watts expended, reduced heat loads, deployed more efficient cooling methods -- in fact, Comcast's latest data center uses 70 percent ambient air for cooling. By applying virtual machine technology to more efficiently use servers and software, we can shut down whole areas that are not needed at particular load levels. This conserves power and the greater efficiency lets us reduce the total number of servers we need to install.

Moreover, chip manufacturers have been focusing on better power performance capabilities for years and these improvements show up in servers we buy today. Through these efforts we're making progress in both peak load and ongoing consumption.

We're also working on industry standards that can vary power consumption based on network traffic demands as well as for predictive alarming that can provide notification and diagnosis of impending equipment problems.

And SCTE has created and deployed at its own facilities a hardened business service backup system that leverages clean technologies -- solar panels, fuel cells, and high capacity storage batteries -- to maintain power for up to seven days in the event of an outage on the grid.

These efforts have been terrifically helpful and important, and if they were enough, we could call it a day and go home, but we can't.

Today, just as in IPV6, energy sufficiency is a technical issue

that we can work to solve, but tomorrow it could become a real business issue and that is our motivation to act.

Here is what I propose: the single most important thing we need to do is to change the way we think about energy. We can no longer specify new designs without factoring in energy requirements up front. To cop a popular meme, we need to think in terms of energy efficiency by design, and by "we" I mean the entire set of players including ISPs, venders, programmers, app developers, and content providers.

As my friend Kip Compton, the VP and CTO of video and collaboration from Cisco says, "Power consumption and efficiency needs to be more than just a spec on a data sheet. It needs to be a part of the fundamental design of the product starting at the silicon and architectural level all the way through product design."

In the weeks since I called upon the cable industry to take this new forward-looking view of energy, we have had some promising developments. Inside of Comcast, we have begun the effort for mainstreaming energy efficient thinking and planning. SCTE has begun to develop a common set of metrics or a language that we can use to communicate and compare levels of energy utilization.

Leaders at CableLabs, our industry R&D consortia, have taken steps to ensure that energy leadership is part of our specification design, and along with Cisco, other major venders to our industry, like Intel and Arris, have also stepped forward and said they want to be part of

the solution.

We need their breakthroughs in technology and power architectures and whole new ways of integrating these technologies and architectures into products and delivery services, and cable operators, in turn, need to purchase hardware and software that drives the economics of that innovation.

Each cable company's plan will reflect the very challenges distinct in its footprint. For example, it's likely that power availability, distribution plant capability, and potential service interruptions in the northeast will be far different than those in San Francisco, which will be far different from those in Houston.

There is only one way to make all of this work and that is through open collaboration. Working together with industry organizations, operators, vendors, content and app developers, we need to make energy considerations part of the long-range vision. We need to reach out to universities, government labs, start-ups, and others where the best thinking is going on and take advantage of it, and we need to get the power utilities on board, they have to be part of the solution.

We know this won't be done overnight. That's okay if we start now. Take my IPV6 example. In 2004, we at Comcast were predicting the exhaustion of IPV4 addresses in 2011 or 2012. It turned out we were awfully close. But we headed off a business issue then and our goal is to head off a business issue now by thinking, planning,

collaborating, and doing. And by doing so, as we grow, we will be able to make these newer energy efficient devices and tools a part of our network through natural addition and replacement cycles.

The challenge of managing our future energy consumption is a good problem to have. It means our broadband businesses will see incredible growth. It means jobs, investment, and a central role of our networks in our economy and our society.

In a recent article, Leslie Ellis, one of our industry's top technology writers, quoted a TED Talk by Professor Donald Sadoway of MIT who's developing new liquid-based batteries to store massive amounts of power. Of our nation's broader energy challenge Professor Sadoway said, "If we're going to get this country out of its current energy situation, we can't just conserve our way out, we can't just drill our way out, we can't bomb our way out, we're going to do it the old-fashioned, American way, we're going to invent our way out working together." And that's exactly the way the cable industry will get ahead of its long-range energy challenge, the old-fashioned, American way, by inventing our way forward working together.

I really appreciate having the chance to talk with you about this important issue and I look forward to a lively discussion with this panel. Thank you.

(Applause)

MR. WEST: Our next speaker is Charlotte Field, the senior

vice president for Infrastructure and Operations at Comcast. She has a PowerPoint presentation, so we'll be bringing our slide down, and, Charlotte, if you can come up.

MS. FIELD: I promise this will be very quick.

What I wanted to do is talk a little bit about Comcast and really our network and on the left side, my left side over here, your left side, you can see all the kinds of different facilities that we have, and this is just a sub-sample of what exists.

This is really what the Comcast Network is all about, and sometimes people actually think about things like the backbone, they think about things like the data center, but as Mark said, that's not really where the big challenges are. There are challenges in those areas, but we're working them, but the 22nd and Elm example that he gave is a perfect one.

And so if you look at this picture and, you know, again, it's demonstrative, but if you look at where we say nodes -- and this is the -- right here -- we have 120,000 plus nodes in the network and they actually provide, basically, the connectivity between them and the homes with RF plant. They have optical receivers, transmitters, et cetera, and they actually have a kilowatt usage of about 550 kilowatts per month, which, I have a vacation home in Colorado, and that's about what I use on my vacation home in Colorado when I'm there.

If you actually move to the next location, the hub, which is the blue, basically, area next to what we call the Comcast Regional Area

Network, we have 1,800 plus of these in our network, and essentially, basically, they actually have a lot more equipment that's located in them including more receivers. Sometimes we have what we call the Cable Management Termination System, which actually provides the Cable Modem Management Service, and basically we see them using about 108k -- 108,000 kilowatts per hour per month, and with, you know, peak demands that occur.

And then you go into, really, our master head ends, which exists, which says HE, and these are -- this is where we have the big metal, you know, that's there. We have a lot of the CMTS, but we have a lot of the return receivers and splitters. It basically is where we connect our Comcast Regional Area Network into the backbone.

We essentially have approximately 300 of those across the country. Now, one of the demands that we see, and, you know, if you go back down to the node, when I started in the cable business around 2000, essentially, you know, we basically passed around 2000 or more homes, and it depended upon what MSO you were in. In our footprint today, that's down to 250 to 430 homes passed that we're providing services to. And one of the reasons is the demand is growing, and as Mark said, it continues to grow, and essentially we need to provide that capability.

And that's really where the problem is. The problem is at the node, making sure we have power to deal with that situation, at the hub, and then at the head end. Again, less so, really, in the Internet -- the

backbone portion of the Internet that we're providing as well as, you know, the other data centers.

By the way, we've also seen a tremendous growth in our data centers. When I started we only had a couple and, you know, now we have about tripled that number.

So, this just gives you a representation of what some of the buildings look like and some of the retrofitting that's going on. We have a clear focus on power, whether it's basically renegotiating contracts, whether it's basically putting alternative power sources in, et cetera, but you can see, we're in Wallingford, PA, you know, the 22nd and Elm of Pennsylvania, Mechanicsburg, and you can see the activity that's happening from a power basis.

Grantsville, we have a lot of power initiatives that are happening throughout our country, but we actually are just showing a few. This is used in Texas, this is a head end used in Texas, and you can also see Mishawaka, South Bend, Indiana. So, you know, where Comcast is, we have to actually make sure that we have the power sources to provide the services.

Here's Bristol, Connecticut, and, you know, Boston, Massachusetts. So, and then lastly, Brunswick, Maine. So, we're putting a lot of money into transforming our ability to provide services in every single aspect of the Comcast footprint.

So, with that, I'm going to turn it back over to Darrell.

MR. WEST: Okay. Thank you, Mark, and thank you, Charlotte, for sharing those thoughts with us.

So, we're going to bring the rest of the panel into this conversation. So, Lorie Wigle, you handle eco-technology for Intel. So, as part of the Climate Savers Computing Initiative, you've reduced emissions rather dramatically. So, how did you achieve that savings?

MS. WIGLE: That's a great question, Darrell. So, in 2007, Intel, along with Google, Microsoft, World Wildlife Fund, and most of the computer makers, formed an organization called Climate Savers Computing Initiative. And we took on an audacious goal, when we did that, that we would reduce the emissions from computing in 2010 by 54 million tons.

And so, what we set out to do, I think, is a collaboration very much like what Mark is proposing here for the broadband industry where we defined a big goal and then we decomposed that into some specific actions.

We were focused on power delivery, so making power supplies more energy efficient, as well as driving a greater adoption of power management, letting your PC or your server go into a lower power state when it wasn't in active use.

And the other thing that we did as part of this effort was we aligned with government policies, programs like Energy Star and the equivalents around the world, bringing together, again, industry, the

purchasers of equipment, as well as NGOs and policymakers. We didn't quite hit 54 million tons by 2010, but we got to 44 million tons. So, we're very, very proud of that, and I think you can think of that carbon emission reduction very much as a proxy for big gains in energy efficiency.

MR. WEST: Okay. Beth Colleton, you're vice president of NBCU Sustainability. In that job you deal both with consumers and the company infrastructure and you run what you call a customized value proposition looking at the motivations of people to engage in innovation, sustainability, and environmental protection. So, what are you doing to promote energy efficiency?

MS. COLLETON: Yeah, I think the key point of what you just said is we learned early on that -- is we use the expression, it's not what you're selling, it's what they're buying. When it comes to the environment, it comes to energy or, five years ago, the (inaudible) green, it doesn't mean the same thing to everybody and the way a company moves this solution forward is by looking in the workforce to identify the solutions.

What I think we've probably all found is when you create a sustainability group and you heavy load it with people and put it in a corner, people assume that's where the work is going to come from. What we've found is, again, we've got a really smart workforce, they know what they're doing, and we needed to create a customized value proposition. Create value in the energy equation in terms that they understood that had value for their part of the business and let them ideate and solve for there.

So, you know, we have 26 different business divisions. Our theme parks, there's certain value that they have there, our production folks, we need to change our vernacular and change our approach to make sure that, again, they can look for those efficiencies but still deliver the quality business they can.

I think that would be consistent with any company and where those of us who are on the green side need to temper and balance our approach that -- who doesn't want to be energy efficient? I mean, who doesn't want to help the environment in general? But if it comes at the risk of your business and the quality you're offering to your consumer and customer, it's for not. It will never be sustainable in the other definition of what sustainability is.

So, I think we need to understand sustainability becomes sustainable when you make it part of the core business and breed it very deeply into the DNA. The other important reason of doing that is then it stands the test of time, whether the economy is up or down, whether it's top of mind or not, it sticks because, again, it becomes omnipresent and part of the business equation that is just comprehensive, the same way you look for quality to customer, the ability to monetize, the ability to deliver cost effectiveness, what I think we're all at that transition point is finding -- and how do we get -- and does it factor in the context of energy as a standard, I think that's when we're really starting to move the bar forward.

MR. WEST: Thank you. So, Pietro is my colleague here at Brookings and he has written extensively about energy policy and energy conservation. So, I just wonder if you could kind of step back from these industry considerations and just tell us a little bit about the broader policy context in which companies operate and how that affects the way in which you think they should think about energy efficiency and sustainability.

MR. NIVOLA: Well, to begin with, I think that the essential element in the context is whether businesses are receiving the right price signals to be able to plan their investments sensibly.

It's kind of hard to make suitable investment decisions, whether it's on the supply side, the production side, or in terms of conservation energy savings when you have major fluctuations in energy markets and energy prices.

So, there is a role for public policy to play here and it hasn't been a stellar role so far.

I think the other thing -- there are a couple of other points here, there are too many regulatory uncertainties facing businesses making these decisions. Let's just take the example of smart grids. Ideally, to meet the requirements that Mark Coblitz was describing earlier in his speech, what we ought to do is maximize the efficiency of our existing grids, make them smarter, make them more coordinated. That involves an ability to wield power from places that have a surplus to places that have excess demand.

To do that though we have to overcome literally hundreds of regulatory barriers at all levels -- the federal, but also, very importantly, state and local. The final thing I would say, Darrell, is that, you know, there's been a lot of indecision here in Washington. We know about the gridlock here. What that has meant, though, is that the states have stepped into the breach. In many cases that's a good thing, setting renewable portfolio standards and the like, or as in California, greenhouse gas emission standards. These types of things are good.

But it also creates a lot of variability that the states have to worry about -- sorry, that businesses have to worry about as they operate in different states.

MR. WEST: Thank you. Mark, I want to come back to your speech. You gave this very provocative example of DVR storage requirements and how if you're having to store hundreds of copies it takes 300 megawatts of energy. If you could just save one copy it takes 5, and so the need for change in copyright policy -- you also talked about how the industry is moving towards common metrics on energy utilization.

What do you see as the biggest barrier to change at this point? Because, you know, at one level one might say energy sustainability, it's a no-brainer, we should be doing it, but obviously we haven't been doing it. What's the problem?

MR. COBLITZ: Well, if I can, let me actually give two answers to that. So, let me talk about one, which is sort of the motivation

that people have in order to do this, and we've talked about it a little bit here, and people have talked about being motivated because they're -- they want to be green or sustainable. It's part of conservation. They feel this is a good thing to do, that's a wonderful motivation.

There are some people who do it because of cost, and that was part of what you talked about in pricing structures and things like that, and they're driven by the cost of what they have. There are other people who talk about what regulatory or legislative kind of world there happens to be, and what I'm actually saying in this particular case is a different motivator, and the different motivator is one about strategy and risk mitigation. It's a different place in a company where people think about that type of thing.

The way we did IPV6 is a good example because had we not done IPV6 and you wanted to add the next IP device, call that a cable modem, you know, call that a smart TV, whatever that is, and we couldn't add it because we couldn't address it, that would have put an amazing impediment into the growth of our businesses, into the growth of the Internet as a whole, and particularly because Comcast is such a large network, a large provider of services to so many people, we were seeing that issue very early on.

So, that same motivation, a strategic motivation to grow, is extraordinarily powerful inside a company and it gets, you know, all of us at the senior level very focused on doing this irrespective of price and the

actual cost level, although that's really important and there are people in our company that that's the most important thing to them.

But I think this other motivator is so powerful as to why I can make the next statement, which is the other part of the answer, and that is to get everyone in the company actually focused on it, not just our company, but our industry as a whole.

We have thousands of engineers. If you add to that our venders and people who write applications and other things that have implications on the network that we're using, it's hundreds of thousands of people, maybe even on a worldwide basis millions of people who are focused on this and are making decisions, which, every day, have energy implications and we have had no particular reason for them to focus on energy as one of those, and I'm not suggesting that it is the penultimate, it is the only thing that one should consider.

But energy has always been a fall out. Tell me what you need to have done and I will give you a system to do it. And, oh, by the way, here's how much energy it's going to take. As opposed to, you know what, let's make some tradeoffs here. Can we do this a different way? Can we have innovation at a different place? Can we think about it differently to use less energy because that's important to us?

And what that means is people have to take time and their resources to actually do work that they weren't doing before and if the only reason for that is one that your business doesn't consider to be, you know,

the penultimate, then people aren't going to spend the time doing it, people are people and they will focus their efforts where the returns are.

So, the thing that we are doing now, the biggest thing we're doing now, is to change the mindset of people in our industry as much as we can. We certainly can do that within Comcast, and it is already happening. You don't get an RFI to a vender at Comcast today without energy implications being a part of it. It doesn't happen anymore.

And that's spreading through our industry and I believe it's going to spread through everyone that looks at this particular issue because it's part of risk mitigation, a whole new driver for why we make these decisions.

MR. WEST: Interesting. Charlotte, so, build on what Mark was just talking about. I mean, oftentimes when people are thinking about energy policy, they think more at the consumer level, you know, like what consumers can do to save energy -- lowering the thermostat and so on. I think what you're doing is interesting in the sense you're focusing on what businesses can do and particularly in the broadband industry, how they can build their networks in ways that would save energy.

So, what do you see as the biggest challenge to encouraging companies to adopt more sustainable networks?

MS. FIELD: So, I think, as Mark said, is people have to understand that there is the strategic benefit, because if you do not have enough power and you don't build the most efficient equipment, you won't

be able to provide the services that your end user customers want.

I think that, as Mark said, and I reflect back on the IPV6 adventure, because I've been on it a long time as well, we had a lot of kind of naysayers along the way that basically didn't think there was going to be a problem because there were other people that were holding IPV4 addresses and you could buy them and all that.

So, I mean, I think that just like the IPV6 adventure for Comcast was a seven-year adventure, we want to make this a lot less because we think that the need is more, so we're actually looking at it, like Mark says, you know, we are experimenting with alternate fuel in California, which has one of the highest costs from a power perspective. We have a solar array that is actually providing all the power that's needed to a specific hub site.

Unfortunately, the payback for that is about six years. We also have to drive the solar industry to a better price point, and I think that will happen as, you know, we see more solar arrays being implemented.

But I think the other thing is is that we're not looking at this as just one area, we're focusing a lot on the access network because the access network is so big and so distributed, as was said in Mark's speech, that we have to make sure that we have power everywhere that we need it to provide the services to our customers, and that means Chattanooga, Tennessee, that means San Francisco, that means Chicago, et cetera, et cetera.

But we're also looking at things that we can do internally. You know, we essentially have a PC turnoff program that is projected to save 1.8 million a year, okay, which is basically just saying, lots of people just leave their PC on when they leave the work, and if you have 90,000 PCs within your company or 90,000 Macs, it doesn't really matter, and you can turn them off after people leave and you can turn them on before people get there so that they don't complain about the boot up time, it's a good thing, right?

We also are looking at -- we've renegotiated a number of our rates with alternate suppliers in a couple of locations. That's actually driven us to approximately a $2 million savings and we think there's a lot more opportunity.

And the third is, as Mark indicated with the RFIs, is we actually go look at space and people who are going to build spaces for us, we actually make it a requirement for them to think about how efficient can you get there. And a lot of people say, well, it's no big deal, you know, here's our first cost. No, it's not about first cost anymore, it's really about total cost of ownership.

So, those are the things that we're doing, Darrell.

MR. WEST: I'd like to ask one more question for the panel as a whole, then we'll move to the audience for questions. So, I'll throw this out, any of you who want to jump in. So, a lot of what you've been talking about so far are basically voluntary actions on the part of

companies, but we are in Washington, DC. We're thinking about the policy world. Mark mentioned the copyright issue of an area where we needed change.

So, I'd like to ask each of you to become a federal energy czar, which means you can make like one or two changes, however you want. You know, we like czars in Washington, DC. So, for the panel, when you're thinking about federal regulatory policy or legislative actions, if there were one or two things that you think would make a big difference, that would encourage companies to adopt the action that you think, what would it be? Anybody who wants to jump in.

SPEAKER: I'll start.

MR. WEST: Okay.

SPEAKER: I basically say deregulate all power in all states so that, you know, that -- you know, I think as was said previously, you can take power from Virginia and you can move it up to New Jersey without a problem because Virginia has one of the lowest costs of production.

SPEAKER: I was just going to say, I'm a big fan of marketplace too because I think sometimes if you put the right regulation in then the marketplace can solve for it, so I think particularly whether it's with the deregulation or with some product lines, then you can get that scale of consumer, but the marketplace can solve for that product innovation in a way that we get the actual movement we need on the

issue, but the consumer also isn't suffering any less because, again, I think our businesses, our American businesses, our global businesses, again, know how to respond to a regulated market.

MR. WEST: Lorie, you want to jump in?

MS. WIGLE: Yeah, and again, I think in the Climate Savers Computing case, we had an instance where we were industry aligned very well with the EPA, in this case, to set a common measurement for energy efficiency so that we could unleash innovation and everybody could tackle it in the same way against the same goal.

So, I think a policy that helps us align innovation and a measurement of success is very helpful.

MR. WEST: Pietro?

MR. NIVOLA: Yeah, I agree about price deregulation, but I also think that it may be necessary to try to bolster the market price a little bit. That's really what creates the baseline on which -- I mean, creates the sort of dependable market signal that businesses sometimes need to make investments that otherwise they fear might get stranded when prices collapse.

MR. WEST: Mark, czar for a day?

MR. COBLITZ: Czar for a day. Well, the thing that would probably help the issue that I'm talking about the most would be the kinds of things that have been proposed in smart grid in the distribution plan, back bone too, but really in the distribution plant because the issue that

I'm really talking about is getting power to those locations.

So, you could solve all of these other issues and at the end of the day, if you didn't have the right distribution plan to get there, it wouldn't help. So, I'll throw that into the mix.

But I do want to add one other thing. I said in my talk that we need to get the power utilities involved in this, and this is not really to say a lot of negative things about the power utilities, this is just sort of real life in our world about risk mitigation, but they have to be a part of this. And one might argue, if you had enough planning with the power utilities, if you could plan far enough in advance, and it's the reason I picked the thing that I did, to be able to distribute power that they have, then this problem would not be something that we might have to deal with, but we just don't see that we want to bet our business on it right now.

MR. WEST: Okay. Why don't we open the floor to questions and comments from the audience? Christine is running our Twitter hashtag at #techCTI, so those of you watching the webcast who want to submit questions, feel free to submit that to #techCTI.

Christine has a question from one of our webcast viewers.

CHRISTINE: Thank you, Darrell. Jason Llorenz, who's the executive director of the Hispanic Technology and Telecom Partnership here in Washington wants to know -- wanted to ask the panel, which mayors, state legislators, local leaders, are out on front at efficiency, sustainability in this area?

MR. WEST: Good question. Who's exercising leadership? It's a really good question, it stumped our panel.

SPEAKER: It's a good question. Well, it's a good question, but it's not the area that we're actually focused on, so -- and that's not a place where -- I mean, maybe Beth, you have some information there.

MS. COLLETON: Yeah, I mean, I'm in New York and Bloomberg has -- and because he's got a businessman background, I think he's put some interesting things in place that are understanding the scalable effects that businesses can have, again, if they're proactive and going out front on this stuff.

With, at least what we've found, decent enough timelines, we can respond to what he just put in some new legislation where all New York based corporate buildings have to have an energy audit, but he put it on a 10-year schedule, so you know it's coming, you can plan for it, it's gone back and forth whether you actually have to implement these audits done by -- the findings of these third party audits, but at least in the peer groups I've been a part of, they've recognized what he's trying to do in the context of it, but he's also -- he and his policymakers have had the vision to understand the pressures that the business have.

They're operating those cities to, again, have many years to plan for, to know what their considerations are on cost, that you can't just come in blindly and look at it singularly through the energy efficiency, or as Mark said, the environment, and that's not how businesses operate, it's

got to be a part of our strategic growth and approach and integrated into that fashion.

But I would just say that's one example of a mayor who's out front.

MR. COBLITZ: I don't want to actually say exactly where this was, but I will say sometimes it goes the other way, so one example we have of where it was energy inefficient had to do with where a municipality basically said when we were trying to put in expansions in our data center that they wanted us to take the trench that was there where all the power was going and fill it in every night and do all kinds of other things that made it cost prohibitive to do the kinds of things we needed to do, and at the end of the day, we ended up with a suboptimal distribution of servers because part of it was the municipality, part of it was how fast the utility could get there, but, you know, you try to plan, but when you're in a world that's growing, if you say it's growing 40 percent and all of a sudden it grows 60 percent, and by the way, remember, these are very local areas, so it could be just in this one place in some city somewhere, you sometimes have to get things really quickly and the way to mitigate that is to use less than you otherwise would.

I also don't want to give the implication that somehow we're going to use less than we do today. You can't grow at least one order of magnitude, and probably, you know, multiples of that -- probably not two orders of magnitude, but somewhere, you know, beyond ten times over

the next ten years for sure, and not use more. It's just to find ways --

SPEAKER: But I think that's a good reason why I think for many years companies didn't go out front in talking about what they were doing, again, previously labeled as green, now energy efficiency because they were worried about what attention they would bring because they said, we're not perfect yet. Well, nobody's perfect in this area. We're all learning as we go, which is why we're forming collaborations.

But I think what has worked for a lot of companies is to then dialogue with your government officials to explain what it's like from that business perspective, to explain the context of how our decision making is happening, and to look for solutions in communities collaboratively, because I know, you know, several peer companies or in peer groups I've been a part of have gotten nipped a little bit by not saying anything and all of the sudden, whether it's an outside NGO, whether it's a government group coming in, and, again, without any context of understanding their business saying, we think this will work beautifully for you, and then wondering how could they come up with that. I said, well, they don't understand your business. How are they supposed to inform that into their process?

SPEAKER: I would like to just add one thing which is it's really -- I don't know who really was the driver of it, but around the San Francisco area, the smart grid implementation and the savings associated with that, now, this is where we actually have two things that are colliding,

you know, one is smart grid, which is really, really important, but it's all about machine to machine transactions, and guess what, you know, in machine to machine transactions you need IPV6 or IPV4 addresses, and that's one of the challenges is making sure that the industries that support the smart grid, the wireless, the Wi-Fi, whatever you're going to deal with, wire line, basically, you know, can support that technology.

But I'd basically say if you're looking at San Francisco and looking at the implementation that they had, they have about two million devices right now according to the manufacturer and also according to someone who used to be working at Comcast that now runs (inaudible) out there and they've seen increased savings associated with it as well as a reduction in theft.

MR. WEST: Okay, questions from our audience. Right here on the aisle. We have a microphone coming up. If you could give us your name and your organization, please?

MR. HERSHEY: I'm Bob Hershey, I'm a management consultant. To what extent have you been able to work together and have meetings over the Internet and make decisions on joint things?

MR. COBLITZ: Well, I guess there's sort of two pieces to that. For this particular endeavor, this got kicked off in March, so there hasn't been a lot yet because this is May, but what has happened is that people, like Lorie representing Intel, and Cisco, which I mentioned in my talk, and Arris, and we think a couple others, are starting to coalesce to

figure out a way to see where the great innovations might come from.

Part of the interesting issue with this is that it's so broad in the kinds of things one can do, but also at the same time very focused on where the real value can get created, and I think we're focused very heavily on where that value can get created.

So, I'm sure we will use the technologies that we have to bear that we all support in order to minimize travel and to do work together, but it's really pretty new. So, the places where we've been able to take action right away are like those I talked about inside Comcast, that's happening inside the Society of Cable Television Engineers, that's happening, CableLabs, that's happening, and now some of the companies that are starting to be involved.

In fact, what's interesting -- what I found actually fascinating was that there is not yet a single engineer in any company that I have talked to, and I have talked to a bunch, you know, as I've been developing this over the last six months, who doesn't think this is an incredibly great thing to do. Gee, why has it taken us so long to figure out this problem?

And part of the reason is that everybody's so busy doing so many different things, and we have done a lot of stuff to reduce energy usage. I mean, one of the things I didn't talk about because it's not about our network is that, you know, the cable industry has done an incredible amount of work to reduce the amount of energy in set top boxes in peoples' homes. Some of that work will transfer it into the network, we

now need to do it in the network, but there's a lot of work and a lot that's happened in the networks themselves.

And there are technologies that we've seen, but what we haven't done is step back and said, do we need different architectures? How do we think about all of those different architectures? And cloud computing actually puts a really interesting issue on the table because if you think about what a PC really is, it's really got sort of four components to it, it's got processing, it's got storage, it's got outputs that are for you that you're using, and it's got a bus that connects them all together, and we have spent, I don't know, since the invention of the PC in about '83, so we're coming up on 30 years, optimizing that mix inside that device.

And now what we're doing is we're separating it, we're saying, okay, compute out here, store out here, outputs are still here, right, and now we've got the network in between. Well, how do we make that be efficient both for the operation but also for the energy? And we have examples of people who have done that. Think about your Smartphone. Smartphone you have an energy budget. Why? Because as a consumer you're basically saying, I want this to run all day and I don't want to have to recharge it until I get home at night.

And so people have had to work really hard on all of that. Well, we need the same kind of efficiency that's starting to develop there in the way we do this now on the grand scale. That's going to take a lot of work and, yes, we will use our technologies, but we're just starting.

MS. FIELD: You know, I think that what Mark talked about, the Sustainable Energy Management Initiative that's being run by the SCTE is a really good example of cross vender, cross MSO, cross partner relationships. It got kicked off, really, last year and there's been a number of different things that have been happening, you know, where I think people have been much more transparent about what's happening in the industry and what needs to happen, you know, for the businesses, whether it be our partners' business or our business.

I think the one thing that is very interesting, they also have another initiative, which, you know, I'm as Mark said, you've got to innovate out of here somehow, they have an Adaptable Power Initiative, where what they're trying to essentially do is say, you know, all of those servers that we may be running in a data center may not necessarily need all the computing power 24/7/365, and so is there an ability to actually shed -- you know, think about virtualization of power, that's what it really is, virtualization of power, and is that something that is a possibility that we can work together in the SEMI initiative with our partners and ourselves?

MR. WEST: Okay. We have a question here in the front row. We have a microphone coming over to you.

MS. WERTHEIM: I'm Mitzi Wertheim with the Naval Postgraduate School and I'm thrilled to hear what you guys are doing. We're working at the PG school on developing a course for Navy leaders on how they think, feel, and behave about energy. The real challenge is,

how do you tell the story? How do you get this emotional commitment? And listening to some of what you were saying, I started getting excited because if it can come from the outside rather than having come from the inside of the Navy, that would be much better.

For me, the issue is how you tell the narrative, and when you were talking about the regulations -- I know this is complicated, I know it takes a long time, but I'm a great believer in mapping things out and the more complex they are, the more important it is to map them out so you can see where those hiccups are. I mean, you have to understand which are the regulations that are really causing the problem. If you just say, "there are regulations" -- nobody knows where to go.

So, if we could develop a team of people -- I've always had this fantasy tat I would have a group of college students -- teams of college students who -- their project for the year, and I'd have all of them work on the same thing but in different teams so you could see, in fact, which ones seem to make the most amount of sense.

But because of the complexity of this, if you don't get people drilling down to the things that really cause the problems, I don't think we're going to move very fast. I have to tell you --

MR. WEST: If we could get to your question, just so we could get a response from them.

MS. WERTHEIM: So, the question is, how do we get you engaged in doing -- my vision when I got into energy was I wanted

everyone in the nation to feel the way I felt as a child about World War II, that I was helping to win the war by working in our victory garden and counting our coupons. How do we get the nation and all of our citizens to feel we're helping to make this happen?

MR. COBLITZ: Well, it's a great goal. I don't think I know the answer to that. What I think I know the answer to is how to get 100,000 people at Comcast engaged, and I think beyond that, a broader sense throughout our industry, and maybe that will help. But, you're right. The word that I feel for it personally and I know is shared by everybody that I've been working with is, we're passionate about this and because we have that goal of what we need in our business and we are passionate about, in our case, Comcast, and what we are delivering to consumers, we do have that.

But it is the hardest thing to do to imbue in people that feeling. I'll tell you, one of the things that we're doing inside Comcast in about three weeks is that a group of us, including myself, our CTO, our Chief Network Officer, some people from the field, are going to be doing our own internal webcast -- you asked about if we're using our own technology -- our own internal thing to people in the field all throughout Comcast and getting them on board with us, starting the process through Comcast University -- because we have our own internal mechanism to do that, and get people engaged, and we'll get lots of feedback from folks, but I also know that we're going to get an incredible amount of support

because people really do want to do this, they just needed the driver to make it happen.

SPEAKER: Yeah, if I could just add to that. I think enlisting people and getting them passionate and committed to this is really important, but I also think this is an area where we have an opportunity to use technology to just make the right things happen without a lot of intervention as well, and so Mark alluded to this a bit ago in terms of the way that we architect the system, and I think what we really want to do in this collective effort is look at the system end-to-end and how we can change some of the fundamental technology so that it's just inherently more energy efficient so that the right things happen automatically.

MR. WEST: Pietro, did you want to jump in?

MR. NIVOLA: Just to you point about identifying regulatory barriers and drilling down, I just want to say that it's very important to realize that not all the solutions are right up here in Washington. I mean, we can -- I mean, the thing is, we overestimate what the federal government can do. In the case of nuclear power, we were able to figure out how to streamline licensing and permitting here and, you know, we finally got around to doing that, but a lot of the problem that these companies face, you know, with broadband and so forth, is at the state and local level and there you have the sort of not-in-my-backyard phenomenon and these barriers are really, you know, decisions being made at the state and local level, and there's an enormous variation in

them.

SPEAKER: But it's like American education.

MR. NIVOLA: It's exactly like that.

MR. WEST: Mark?

MR. COBLITZ: So, I know we're sitting here at Brookings and we have -- and there's public policy issues, which are important, but I think most of what I've talked about -- and you did ask me the question what might I change -- but most of this is actually in our own hands, and I think that's really what Lorie was trying to say there too.

It's a technology issue, it's something we can get our arms around, and we have time to get our arms around it. Yes, there are some things in the regulatory world that may help, but it's really for us to go do and, you know, my message really to all of you is that we're going about doing it.

MS. FIELD: Right. I think there's also a resonation point, you know, so the same answer -- I mean, what might be to you, Mitzi, that you care about may not be the same thing that somebody else cases about, so making in personal -- I would tell you that anybody in our data centers, okay, I mean, they've got it totally. Most of the facility folks that are in Comcast today, you know, they've got it.

I think one of the things that we wanted to get with on this ME Initiative is basically a shared perspective across -- making sure that our partners knew how important it is to us, and we recognize that it's not

a journey of a day or a week or a month, that this is -- you know, as best said, this is a multi-year journey, but if we don't get started, we won't get there.

SPEAKER: And that's why I used that phrase "customized value proposition" and people need to understand, that's just not external, it's internal. These companies represent hundreds of thousands of people, so just like you would externally market to a consumer to buy a can of Coke, if you're trying to drive behavior change for the decision makers, the innovators, the technologists, whoever it is with your company, you need to understand who they are as a group and build a value for this, again, something that resonates to their business, and work from there. That's, I think, one of the challenges with a lot of issues, we look at this big group -- I mean, our company is working on something with Hispanics right now with the election and voting. Hispanics in that large voting -- we said, okay, but let's break this down in demographics.

I mean, it's funny because the consumer/customer parts of our business use marketplace research to understand all their different demographic cuts and how to create value for each of them so that they were interfaced with our companies more, buy more product, feel better about us. That churns our business wheel, and we need to apply some of that same thinking to get our internal marketplace involved and solving for us, so then equationally it adds up to real success, not just for individual companies, but for the industry as a whole, and that provides an internal

scale right off the bat because among our companies there are similar functions, so if I basically cracked a nut at NBC Universal and Comcast with a certain demo set of people I need to innovate and create efficiencies, well then I can call Intel or they can call me and say, let's switch cards here. Give me your cheat sheet, I'll give you mine, and we get quicker scale and I think when someone asked the question of working across industries and peer sets, I don't think we necessarily feel this competition, hold the cards close, it's calling up, like, I need a little help, can we share and move the momentum that much more quickly.

MR. WEST: Okay, there's a question here in the front row. There's a microphone coming over here.

MR. PRIZNAR: Thank you, panel. This is Frank Priznar, Hitachi Consulting. You played right into my question. What I heard was a need to collaborate across the industry, across competitors, but I also heard that efficiency, energy efficiency, wise energy management provides a competitive advantage. I see a conflict, and I wonder, to the extent that you can share, what -- does that provide a barrier to creativity or innovation?

MR. COBLITZ: I don't see a conflict. There are many things -- areas that people compete. I think this is one that is sort of table stakes for all of us. So, I really don't see a conflict and I'm totally open, as I know everyone here is, to working, you know, both nationally and internationally on solving these issues and getting a bigger, broader, you know,

broadband opportunity for all of us.

Would you go through the process and have a thought? Could you possibly hold cards like this to yourself? It's almost impossible to do anyway. We buy these things from our venders. If we're going to come up with architectures that work better, everybody's going to be able to buy them. It truly isn't worth it, so you might as well just start from the beginning and say, you know, if you've really got something that can help us all, let's go do it and work with the folks who can make that happen.

SPEAKER: Yeah, and I think there's a number of initiatives where people are actually collaborating to say, what are the best ways to handle certain situations, and the best designs, and so -- and I would say, you know, there's a lot of debate, but the debate actually -- we're all trying to move in the best possible direction, and I also think that, you know, if you think about sourcing, whether, you know, sourcing for electronics that go into a product, you know, sourcing is global and all of the partners are looking for, you know, what the best source is for a specific element.

MR. COBLITZ: The one thing that is different is that the people in the more general sense of network operators use different technologies in certain parts of the network and common technologies in other parts of the network. We're all going to use the same kind of core routers, but when you come to something that Charlotte talked about, the Cable Modem Termination System, well, that's a cable oriented -- not just United States, other places in the world too -- but that's only cable

oriented.

So, to the extent that we do work there and we happen to make that more efficient, that's a good thing for the cable industry and it probably won't affect other people. But to the extent -- and to the extent that people and other network providers do things to make certain things in cell site operations better, that's not going to affect us directly.

But in the general sense of the way that things are done, I think it will -- that, I believe, is noncompetitive.

MR. WEST: Okay, in the very back there's a question.

MR. NIX: Hi. Michael Nix, and I work on sustainability issues now, but I've got about a 25-year history of working in -- across the spectrum on energy issues. Dr. West, thank you for putting together this panel, it's been an excellent panel. The question I have for you though is, you folks are all dealing with this from a consumer perspective, which I personally like. When you talk about collaboration, you're using energy; I've worked with a lot of people in my past who generate energy, mainly the investor-owned electric utilities.

How much input have you had from them? How much have they been collaborating with you? Dr. Nivola mentioned the regional regulation as (inaudible) and this type of thing. I remember working for a northern Wisconsin company, very committed to this, looked on it as this is a way of managing energy, would talk to my friends who are working for companies in the south and they said, why are you paying people to not

use your product.

Now, it's changed a little bit over the past couple of decades but I just kind of wanted to throw that out, and you folks are dealing with this from a consumer perspective. I love where you're coming from, but having worked in this area for about two decades, you're going to run into parts of the country where people aren't thinking about this the same way you folks are and I just wanted to know if you guys could comment on, you know, the utility response to your work?

SPEAKER: So, I mean, I think it's different by different places, as you said. I think that in some of the locales we've found that people are very willing to collaborate with us and understand what our objectives are and understand that we are continuing to try to be more energy efficient, but we also want to make sure that energy is available any time we need it, because that's what our consumers expect, our businesses that we support expect.

You know, we built a data center in a particular location and the power company was extremely helpful, you know, so I think it's place by place. You know, I think some of the initiatives that are happening on the smart grid and with the power company in California is probably really, really good, but I think as Mark said in his conversation, we need to engage more the power companies in this activity so they understand exactly where we're heading, and not only for, you know, people like us that -- some of us represent MSOs and NBC Universal and Intel, but we

need to be on a much broader base with, you know, people like in the wire line industry et cetera.

Because think about in the wireless industry, think about the cell tower penetration, think about what's happening with wireless communications, you know, that's a big draw today and I think they're going to be very concerned about how can we ensure that there's enough power so that communications can occur regardless of what's happening in your particular environment.

MR. NIVOLA: Yeah, you know, I think my sense is that most utilities understand perfectly well, you know, what the National Academy of Science's report says, which is that energy efficient technologies, if widely deployed or fully deployed, are really the nearest term, lowest cost option for aligning supply and demand. But where utilities kind of part company a little bit with sort of the sustainability community is, you know, what does full deployment mean? You know, obviously if you have 100 percent of the housing stock or of all buildings in the country retrofitted properly and so on, you might be able to put off adding any new electrical generating capacity, at least for the near term.

But, you know, even if you take the Energy Information Administration's estimate that, you know, energy demand will be increasing by only .5 percent annually out to say 2035, that seems like a small amount, but cumulatively it's significant. And as was pointed out, I mean, there's strain placed on capacity in certain locations, so utilities are

saying, you know, we have to also look at the supply side here and we may have to add some capacity and some production.

SPEAKER: Yeah, and I would say, at the end of the day, our company is about growth, as are theirs, and we all share the same risk, which is a deficiency, because the consumer offering -- we want to create more offerings, but the other half of that is you have to have reliable delivery. So, we were talking earlier, said the equation of this scares me because we want to create demand, both companies do, we want to also create a certain dependency that people really can't do without, but right now, given this energy equation, what's left is a deficiency.

So, this is where, again, I don't think anybody is going to look long-term down the road that we as a country necessarily, when it aggregates out, are consuming less energy, but if we're going to add more stuff to it, all of the sudden those numbers start to go in the absolutely wrong direction.

So, working with the utilities, we're both trying to solve for this deficiency problem so we can both -- because, let's face it, service goes down, you know, you're not getting your service from Comcast, you're also pissed at the utility company because you're not getting what you need. So, we're both in bed together to solve for that to make sure that ultimately there's a consistency and reliability for everything we're putting out into the marketplace.

MR. WEST: Okay, there's a question back in the corner.

SPEAKER: Thank you. I'm a student from GW and I want to ask a technical question and to achieve the best energy efficiency, what is the technical trigger point for the next step? And whether it is hardware for all geo-location of the towers or the transmitters, the software of modulation schemes, arrangement of bandwidth, like in the CDME or something else? Thank you.

MR. COBLITZ: Well, first of all, if we knew the answer to that now we'd be off building it and we wouldn't be doing this. So, we know a lot of answers, but certainly not in the greatest -- particularly if you say what would be the one single thing, because I think at the end of the day it's going to be all of the above.

We know there are things that are being done both in companies and in labs that are changing the actual way that certain functions are performed and are doing so using a lot less electricity.

There was an interesting announcement, for example, out of a group that has a lot of members to it but is a lot in Europe called Green Touch and they announced something on a new fiber to the home mechanism that used dramatically less power for the delivery of bits to the home. They also said it would take about ten years to productize, but that being said, it was a whole new way of thinking about something than they had been doing before.

And that kind of thing is happening. It's happening labs and start-ups, et cetera, and then you suggested potentially some architecture

ways that are doing it or software things that can be done. We told you about some software things that either we already are doing in virtual machines or in adaptive power that are starting to be developed through SCTE and others.

So, it's really sort of all of the above and I think one of the things that we're trying to do here is to not limit ourselves to say, there's a way to do it or two or three things that we're going to do. This is a moment in time to actually look at the entire structure knowing that we are going to have dramatic increase in demand for IP-based traffic over networks and I don't think anybody can look at what's happening today and not say that it's going to be explosive, even more explosive than what we've seen before.

I know there are some people who look at this and say, well, can there be more video that's done this way, and video happens to be a large piece of the traffic today, and I would probably answer, we can see a lot of ways that video is going to increase dramatically as well.

So, let me just give you one example. I talked about network DVR and I said if we move it into the network we can reduce the amount of electricity that's being used, and that's true. And we also talked about the fact that today it's being done in set tops and if we pulled it into the network we could reduce the amount of electricity in set tops. In fact, the net to the entire system, if we pulled it into the network the way I described it, would be a dramatic reduction both to the consumer and in the network.

But I just put a lot of traffic across the network that I didn't include, which is all of the traffic to actually be that video, which is much more efficient to do the way I described it, which is why we would want to do it that way. But it does drive up the volumes, which means there's more equipment, which means there's other things to be done, and the architecture needs to be viewed in that totality.

So, that's really what we're looking to do and why it's going to take years for people to do this.

MR. WEST: We have time for one more question, right here on the aisle.

SPEAKER: Thank you. (Inaudible) is my name from (inaudible) Company, Washington office. Thank you very much for very informative discussions.

In your perception of the risk for the growth of network, besides energy, I think cyber security is one factor. And in your perception, which is eminent to stop, I mean, as a risk --

MR. COBLITZ: Which is sooner?

SPEAKER: Which is sooner, yeah? And for cyber security preparation, you may need redundancy, and that may consume extra energy. How do you counter to that? Thank you.

SPEAKER: So, I'll talk to the redundancy piece and let everybody else (inaudible). If we look at our network, our network is highly redundant, you know, and our backbone, essentially, we can lose

one leg and still carry 100 percent of the traffic. You know, that goes down into where we were terminating our routers that are facing the cable modem terminating system. Our voice network is totally redundant. You know, we have the capability in our old technology to bring up eight switches, which is about 10 percent of our technology. We're moving to another platform that essentially will allow, you know, redundant fail over that we've already tested and have customers currently on that.

So, we always think about redundancy in our applications, you know, essentially we have geo-diversity from an applications perspective on all applications that are significant to our internal capability, so we have that. We do have a chief infrastructure and information security officer and her organization is totally focused at cyber security and all issues associated with it, which include things like, you know, I work jointly with her to ensure that, you know, we have the right intrusion detection techniques, that we have the right processes in place, that we audit those processes on a continuous basis. You know, does that mean that there's never going to be a threat? Absolutely not, but what we've done is we've built a very highly redundant network over the past, you know, many years, that allows us to ensure that we can provide services to our customers, you know, at a 59 level.

MR. COBLITZ: So, it's always hard to answer either/or questions, you know, which one is best, but to answer the sort of -- today, we don't have this energy issue. This is like 2004 with IPV6. IPV4 was

fine for years. And today we have cyber security issues and we're doing a lot to deal with them and et cetera, so, which is sooner? Cyber security is sooner. But that doesn't make the energy issue in 2020 any less real.

MR. WEST: Okay, we will make that the coda on this discussion, but I want to thank Lorie, Beth, Pietro, Charlotte and Mark for contributing your thoughts, and good luck with your efforts. And thank you very much for coming out as well.

(Applause)

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