Transcript of Smart Grid Dialogue with Timothy Schoechle, PhD., Author of "Getting Smarter About the Smart Grid" and Camilla Rees, MBA

CAMILLA: We're here with Dr. Timothy Schoechle, who is the author of the new report called *Getting Smarter About the Smart Grid*, published through the National Institute for Science, Law and Public Policy. Dr. Schoechle is a long-time telecommunications expert and specialist for many decades in home automation, including energy efficiency and energy management within the home. Welcome, Dr. Schoechle.

TIM: Well, thank you.

CAMILLA: Today, what I'd like to focus on initially is what is the purpose of the "smart" grid? There seems to be some confusion out there. In your own words, could you tell us what is it aspiring to do?

TIM: That's a really good question. There are a lot of definitions out there. You know, a lot of people… everyone seems to have a slightly different perspective on it. But basically, I think that the most basic function of the "smart" grid is to *apply* information technology—that's computers and communication technology—to the problem of managing supply and demand of electricity.

CAMILLA: Yes. Now, is there a problem with managing supply and demand today in terms of the demographics? Are we over-exceeding our capacity at times to supply energy?

TIM: Yes. Well, you have to keep in mind that the electric power grid depends… electric power… the supply must match the demand every *second*. And it has to be completely balanced or the grid will… would just stop working. So what that requires is a very careful regulation of the supply—usually to match a demand, or being able to predict a demand, or in some cases being able to maybe *control* the demand as well as the supply. And typically, that has been done by utility companies…and there have been technologies around for 20 years that would allow them to, in various ways, control what they call "demand side management." In other words, not just the supply but also sometimes the demand reaches peaks at certain times of day or certain times of the year; they just can't meet the demand, so they can apply technology… information technology to try to tell demands to turn off. It's called "demand response" these days; it used to be the general term "demand side management. But "demand response" is an active process of turning off loads as an alternative to turning *on* supply.

CAMILLA: Now, is this capability presently located in the *meter*, or is it at the substation, or where does this capability reside?

TIM: Well, it has never had anything to do with the meter. It has to do with signaling between the utility—in some manner—and devices in the home or loads in homes and buildings. It has

been widely applied in industrial and commercial applications where it's easier to do because they… they have computer systems that control their heating, ventilating, air conditioning, energy-using in big buildings and big operations. But in consumers, you see it sometimes with radio-based signaling systems that will signal air conditioners to… to turn off on a hot summer day or turn off for a few minutes. This…. or in some parts of the country, pool pumps or pool heaters for certain times of the day can be remotely—by the signaling from the utility—turned off and then turned back on. And that has been… that's a technology that has been around for, you know, 25 or 30 years.

CAMILLA: So they already have the ability to deactivate temporarily our appliances in order to match the supply and the demand.

TIM: Well, they have been able to do that. But the problem is that those systems are… are expensive and they… they're not very user-friendly. And so what we've been trying to do for the last 10, 15, 20 years is to make it smarter. And the… the "smart" grid is really about using this information technology signaling to homes and buildings *from* the grid to balance supply and demand. And it used to be…. Well, by having "smart"… "smart" devices, or "smart" appliances, home-automation systems in the home…. You know, back in the late 80s I did an experiment: built a test platform, and published papers in cooperation with Southern California Edison to use home-automation systems. And price signals sent *to* the home-automation system over the telephone line to actually control the loads in a home. And that actually was quite successful.

CAMILLA: So what is the status of home-automation systems today?

TIM: Well, there are quite a few. But there's a problem of standardization among them…They use networks inside the home—home networks—then there's a lot of lack of interoperability between those home networks, there's a lack of standardization among the products, and there's a lack of standardization on the signaling between utilities or, you know, service providers outside the home and the equipment *in* the home. So a major effort has been going on—that I've been very deeply involved in on a national and international level—to create technical standards that coordinate… *create* interoperability between the networks and interoperability between the signaling that tells the home-automation systems or the home energy-management systems what they need to be doing—leaving… leaving the actual control in the hands of the consumer in the home, and just providing signals that reflect the load on the… on the grid or the supply and demand. Usually, in recent times, it takes the form of *pricing* signals or what they call "transactional control signals" that say, "You know, the price of energy is… is really high right now, you might want to turn off some of your loads and enjoy maybe a lower price for electricity." That's kind of what the signal would say. And *also*, with the advent—and this is very important—the advent of *renewable* energy and the… and the economic feasibility of… of rooftop solar, and storage, battery systems, electric cars, and now small windmills and distributed energy… what we call "distributed energy resources," we're getting to the day where every *user* of electricity in the home or commercial can also possibly be a *supplier* of electricity. So the balancing of that… of the supply and demand doesn't just

take place between the utility and the user; it takes place *among* all of the users and… and generators.

CAMILLA: So, we've got the demand side and supply side. And on the demand side, we've got the customers' ability through home-automation systems to change their usage based on pricing. And you've got the… the utilities' ability to turn off air conditioners remotely, or pools. So then on the supply side, you're talking about what *may* come to be when… when there's distributed energy generation at the level of the homeowner, and everybody is contributing into the grid, and the balancing will need to happen then. But right now, what… what can the utility do on the supply side? What happens when, say, a coal plant is operating and all of a sudden there's more demand? Tell us about the backup systems to address the peak demand. Besides the demand management side, on the supply side what can be done?

TIM: Yes. Well, you're referring to the daily fluctuation in demand. And typically, the… the… most of the electric power in the United States—and all over the world—is really produced at the moment by coal-fired power plants or in many cases nuclear power plants. And those are what they call "base load generating systems." They operate at a certain optimal output level, and they are… they don't like to be turned up or down; they don't like to be turned off or… or… they're just not flexible. So when the demand may jump up, you know, say, at five o'clock in the evening and everybody comes home and turns on their stove or their… or their oven, or their tv set, or something like that, then something has to be done. And typically, what the utility industry has done is used what they call "peaking plants." These are usually gas turbines or gas-fired generating systems that can be turned on very quickly. And some of them are actually kept spinning all the time; this is referred to as "spinning reserves." They spin but they don't generate electricity, but they can in… very quickly in a matter of seconds come back online and start generating. Now, those are very expensive compared to the base load generators, and so the utilities, they like to use the… the most… the more efficient base load generators. But the problem that we get into *now* is if we try to put…. And that works okay. But if we try to put in renewable energy—in other words, utilize wind and solar energy, which tend to be very unpredictable—this sometimes will *overload* the system. Like where you may have a strong wind blowing in the middle of the night where—and the base load is generating power at a fixed level—and then all of a sudden you get a surge of power coming in from the windmills, what do you do with it? You… the preference of the utility industry is to just turn off the wind. They call it "curtail" the wind. Because… and it's wasted, basically, because the ratepayers have already paid for both the wind generation, presumably, and also the base load coal generator. But the utility would turn off the wind. And this is… the higher percentage of renewable energy you try to put into the system, the more this problem is difficult to manage.

CAMILLA: So would you say then that utilities are disincentivized to add renewables because it's going to, in the end, increase the price to the ratepayer if they're paying for both systems?

TIM: Well, it's… the other… there's another reason too. And that is that…. What you said is true, of course. But the… another maybe bigger reason is that the utility industry, their income

model, their business model is based on the return on the capital investment from the investments they make in large generating facilities and transmission facilities. And that *doesn't*… that doesn't include your… the solar panels on your roof or a windmill in your backyard, perhaps. And so they generally… in this State they get 10.5 per cent return guaranteed by the public utilities commission from the ratepayers for every… all that… the systems they've constructed—this transmission and generation. So they want to use the… they want to make the most use of that. So they… basically, the solar and wind will take a backseat often.

CAMILLA: I remember you once saying that in Canada things are different because they work on hydro, and that it might be easier to integrate the renewables there because they don't have the same problems with the base load generation economies of scale issue.

TIM: Yes, that's true. Where you have the luxury of having a great deal of hydro. Hydro is both base load *and* peaking, because it can be turned on and off very quickly—*generally*. I mean, there's… that's maybe over-simplifying things a little bit, because if you're running the Grand Coulee Dam, you've got a lot of other considerations than just *energy*. You've got fish to worry about, and the farmers, and all the other things associated with these big dams. But generally speaking, it's much more flexible. And that's true in Europe too, and in certain parts of northern Europe their… they have that. And it makes the job easier, but it's… it's still a challenge. And so we're… that's why we have this great interest in demand response and in… in the "smart" grid. Because what the "smart" grid does is it uses the exchange of information between these various generators, and various storage devices, and various energy-using devices, all… whether they're in your home, or whether they're in a utility, or whether they're somewhere, you know, else. It coordinates all of that, and makes it… it can improve the *balance* between the supply and demand dynamically.

CAMILLA: So where does the "smart" meter fit into this picture of a "smart" grid?

TIM: Well, that's a really good question. Because I… you know, I was involved in developing equipment… some of the first "smart" meter… metering systems, myself, back in the early 90s—and the standards that are used today, called "AMI." They really don't have anything to do with this. Their… their main benefit of remote meter-reading—which is what we used to call it—is that it allows the utility company to get rid of meter-reading staff or people driving around reading meters, cut their labor costs, and to streamline their back-office operations on billing systems. And so it's internal efficiencies for the utility industry. It doesn't have anything to do—that I can figure out—with managing supply and demand. Now….

CAMILLA: Does it have anything to do with sustainability and moving our country towards sustainability?

TIM: I don't think so. You know, the best that I've heard is that maybe with… with fewer meter-readers and… and fewer trucks driving around with meter-readers in them, they… they create less CO_2 emissions. But I think that's a pretty poor reason. No, I think it has been

oversold. The concept of the "smart" meter has been grossly oversold. Because the… it's a commonsense notion that (inaudible) we put this remote-reading meter, and we install a network, we put it in your house, and then we can… you know, we have this *communication* path between the meter and your home, and then it maybe becomes a communication gateway to other devices in your home. But the problem is that these meters don't do that; they don't work that way. They're really designed to be *read* for reading data *from* the meter to the utility; they're not full two… two-way communication… in most cases, they're not full two-way communication networks. They're very clunky for that. And… and they… if they do it at all, they don't do it well. And they're slow—especially the *wireless* networks are very slow. Not well suited for transmitting data downstream to the home. Really designed to suck the data up *out* of a meter from the home. And what you really need to do 'true' demand response is you need a full-way two… two-way communication. Even if you send data *to* the home, you need to send data to the energy management system in the home that is coordinating all those gadgets and… and energy-using devices and perhaps energy-*generating* devices in your home. And they can't do that with the types of protocols and communication systems that have been built around the "smart" meters. But I think that what… what happened was that when everyone got interested in the "smart" grid and the *potential*, they rushed out to try to spend some stimulus money on it—and a lot, you know, billions of dollars—and there wasn't much on the shelf that they could pull. Because the home-automation systems, the heart… what they call… what we would call the "heavy-lifting"—the home-automation systems, the energy management systems, and protocols to support them, and home networks, all the interoperability that's needed to make that complex systems… those systems work—just wasn't in *place* yet, and the commercial products weren't off-the-shelf. The only thing that was off-the-shelf was a meter—the remote-reading meter. So they went… went crazy buying those and putting… putting them in. But it doesn't help the basic purpose at all.

CAMILLA: So would it be better for people to just stick with the old analogue meters, or is there some other kind of meter or technology that ought to be employed to really move us toward sustainability?

TIM: Well, I…I don't think the "smart" meters do the… do anything other than the billing. The… the utilities need a way to bill you for your electricity, but they don't have to read the meter every 10 seconds, or 10 minutes, or 15 minutes, or even every *day* to do that. It's just those features just kind of come along with the meters for the ride. It's the classic story of technology looking for something to do. You know, we can… we can… we do it because we *can*, and then we figure out what the economic value of it might be, oftentimes. But basically, the emphasis should go away from the meters and go to true communication to homes, and networks in the homes, and equipment in the homes. And the meter becomes ancillary. We should really do what they… I think they're doing in Germany and The Netherlands, which is to make the meter another home appliance that is really under the control of the… at least the *data* in the meter under the control of the user. And that would eliminate the privacy problems, use existing networks to communicate with the meters—already existing networks like cable tv networks, or DSL, other… and fiber networks, there's a lot of stuff already there, many homes… a huge number of homes already have these capabilities, they don't need to build extraneous

or extra overlay metering networks. They only do it because they get this 10.5 or 10 per cent return on investment and the stimulus money that comes with it—the matching funds. And so that has created this perverse incentive to put in all these meters. And… and the… the public and… and most of the policy-makers, the lawyers, and the… and the… the economists, and everybody talking about it doesn't really have the technical knowledge to know that it's not doing what… what the rhetoric has represented.

CAMILLA: So, in Germany, you say they established that the meter and the information in the meter is domiciled in the home. Was there a fight over that? How did that happen?

TIM: Well, no. I think, first of all, the issue… the key issue there is privacy. Now, there are several issues around all of this… there's… that have arisen and the controversy around these meters, and I put them in three categories. The cost of the meters, and the cost to the ratepayers of doing it, the… the privacy… potential invasion of their privacy, and the… and the potential health hazards that may be there from this electrosmog that we are creating for ourselves all around us and… and the unknown effects of all that. And we just… we just don't *know* anything about it. So why take these risks if there's no compelling benefit from it. And there's already a better way around; and that is to have a… use the existing communication pathways to the home, that I mentioned before—cable, DSL, whatever—and a *gateway*. And this is what they've done in Germany. You have a gateway box, which is like a firewall for the home. And it's a… it's more than a firewall. It's a… it's a platform… a communication platform that then can allow competitive market for appliances, smart appliances and devices in the home, and services that are protected by this… this gateway. And that includes the meter. The meter data is not allowed to go straight out of the home to the utility; it has to go through the… the gateway. And the gateway can decide through the… under the control of the consumer, the gateway makes the decision about what data goes out of the home and… and what *doesn't*. And there's really not much *need* to send data *out* of the home; the real need is to send data *into* the home. The data would be the price of energy or… and sort of an automated bidding system that has been experimented with recently that's very successful in a lot of research being done by the Department of Energy on this. And the Pacific Northwest National Laboratories in the U.S. is kind of the leading edge state-of-the-art; it's called "transactional control strategies." These are not just pricing signals, but they're a… a bidding… a real-time bidding system that allows every user of electricity and who may also be a generator to… or a storer of electricity to… to be dynamically either buying or selling electricity into the grid, depending on the circumstances in this… the balance of supply and demand and the price factors. That's where we want to get to the… go in the long-run, I think. And it's not about reading granular data, you know, miniscule measurements of your energy usage out of a meter; that doesn't help anything.

CAMILLA: Yes. Now, your point in the paper, and also here today, that there's no *need* for an extra network to be built because we… we have other options. We have cable, we have phone lines; we have other… other avenues that already exist, and there's no need for the utilities to be building these additional networks. Whose business is it to tell the utilities they

shouldn't be building an additional network and they ought to use these…these other options that are available to them? How does that happen?

TIM: Well, it should be the public utilities commissions; they should be smart enough to know this. In fact, it's fascinating. I had attended a lecture at the University here in Boulder just a… just a couple of months ago with… with the former Chairman of the PUC—the Colorado Public Utilities Commissions. And he… he made this very statement. He said it would make infinite sense to use existing networks and *not* build these extraneous networks, but there's this perverse disincentive that is created by this 10.5 per cent return on investment. And the utilities, if they were to use existing cable and DSL networks, they would only be passing through the costs, not making a return on capital. And so it's… it's… it's very difficult, you know, to regulate. It would take a lot of courage and regulatory authority to *do* that.

CAMILLA: Who does the PUC report to?

TIM: Well, who does it officially report to or does it *really* report to. Officially, it's appointed by the Governor; it's a political office in most states, some… and some states elect them. But in Colorado, they're appointed by the Governor. So it's very much tied into state politics and… and the wheeling and dealing that goes on with… between the Governor and the legislators, and a lot of these Commissioners are former legislators, or former *utility* executives, or lawyers that work for utilities. And so it's a good old boys' club. And basically, the… in effect, the… the regulators work for the *utility*. There's a whole body of literature on this in regulatory policy called "regulatory capture." It's the idea that regulators tend to become captured by those that they regulate. There's another name for it, that the… the Commissioner mentioned that I… I was… the lecture… at the lecture I was at, he referred to it: body of literature called "public choice theory." Which is really the tendency of… of state officials or public officials to serve their own personal interests rather than the interests of the public.

CAMILLA: So, there are state legislatures across this country that want to do the right thing. And they have citizens that are up in arms fighting these meters and asking for opt-out clauses. What advice can you give to them in terms of what they ought to be—and city councils as well as the Governors—what should they be getting behind? And exactly what have they been misled about such that they are now, many of them, in support of the wireless network rollout and "smart" meter rollout that's happening today? What advice do you have for them?

TIM: Well, we've seen that in a few states. In particular, in Connecticut we've seen it, and we've seen it in… in Illinois. We've seen it in various places where the regulators or state officials will stand up and say, "Wait a minute. This is costing too much money." I mean, that's where they often start. You know, the health issues are… you know, there's… there's controversy over that because… and it's the usual, you know, scientific issues, its a really poorly understood area. But one thing that *is* understood is the threat to privacy and the… and the cost. And then on top of that, the fact that the… none of this stuff *does* what really needs to be done. So these… these officials need to be asking the hard questions. They need to be *encouraged* to take a critical view of the… the return… return to the public—the return on

investment to the *public* not to the utility company. And, you know, for… for investments in… in *any* kind of equipment or…. There's a role… a role for the "smart" grid, and that is, I'd say, primarily in the distribution grid where they use it for improving the control of substation monitoring, and transformer monitoring, and balancing of supply and demand and the transmission… between transmission and distribution. But to… when you get down to the homes where it impacts consumers directly, where they're visible… where it's visible to consumers, the metering is a… is a disaster. And… and I think it's just they… they need to take a critical look at those and say, "Where… where's the real return to the public on installing this stuff? And if that isn't going to work, why don't we focus our investment on the in-home devices and that… that are really going to help?" And to get those… and they're maybe too expensive now. They need to be… and this lack of standardization. Well, let's get those things done. Get the…. And there's… this is work that is being done; it's just it takes longer to do than going out and buying a bunch of off-the-shelf meters and putting them in. They have to… they actually get the… the protocols developed to… to make these in-home devices work. And... and… and then they need to be mass-produced. And they need to become consumer electronic products and appliance products—not utility products. I think the… one of the most important things that the regulators can do and the… in the legislatures is to… to do what they did 20 years ago in the telecommunications industry to create a competitive market by *separating* or creating a demarcation between the user—whether it's a commercial or a residential, the home or building, the user space—and the network—the wires and poles. And also a separation between the wires and poles delivery service to the… the network services.

CAMILLA: Is that a state level initiative or is that a federal level initiative?

TIM: Well, it… it… it is a little bit of both. The… in the telecommunications industry it happened at the federal level, because that was where the… the… the issue was that the entire system—from… from all the way from your home telephone to the long-distance network—was controlled by one, huge, single monopoly, AT&T. And it was sued by the Federal Trade Commission and broken up. And in the process of doing so, they… they created this demarcation between the home and the network. And they… the little box on the side of your house—called the "demarc" or the "network interface"—where inside the home could become a competitive market where you could buy your phones, or fax machines, or televisions, or whatever you bought that used the phone network would be bought in a competitive consumer electronics market and not… not manufactured by AT&T or Western Electric. And then likewise with the network services that—what would be analogous in the electric power grid to generation, which would be a network service—was also separated and made competitive. So the only thing that wasn't competitive—that it was the monopoly—was the… actual wires that hooked your house to the central office. And that's where we need to get to with electricity.

CAMILLA: So at the state level what can be done and on a federal level in terms of the utility issue today?

TIM: Well, the utility industry… the electric utility industry, tends to be more… a much larger compound of state regulation. In fact, it's almost… most of the rates and… and services are

regulated at the state level first. And the federal regulatory role is more having to do with long… interstate transmission. And that's where it comes from. So the federal… the federal—what they call FERC—the Federal Electricity Regulatory Commission is concerned primarily where issues of transmission of electricity are concerned. But they… they still have an influential policy-making role. And the state level is where the real… the real demarcation needs to be drawn—where the… the states need to… to morph the regulatory system from just supporting anything that utilities want to invest in to re-shaping the business model of the utilities—decoupling it from the delivery of electricity as a commodity, and decoupling it from the capital investment because that's the perverse incentive that has created the… the problem.

CAMILLA: Okay. Well, Dr. Schoechle, thank you *so* much for being with us and for the wonderful work on the paper *Getting Smarter About the Smart Grid*. It has been a pleasure to have you.

TIM: Thank you very much for the opportunity to do it.

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