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ILLINOIS COMMERCE COMMISSION

Commonwealth Edison Company	)	
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Approval of the Energy Efficiency and Demand-Response Plan Pursuant to Section 8-103(f) of the Public Utilities Act	)	

Direct Testimony of

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ON BEHALF OF

ENVIRONMENTAL LAW AND POLICY CENTER

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I. INTRODUCTION

Q. Please state your name and business address.

A. My name is Curt Volkmann, Environmental Law and Policy Center ("ELPC"), 35 East Wacker Drive, Suite 1600, Chicago IL, 60601.

Q. By whom are you employed and in what capacity?

A. I'm employed by ELPC as a Senior Clean Energy Finance Specialist. I currently provide technical and financial advice on a variety of clean energy, water, transportation and natural resource protection issues. I have experience as an electric distribution planning engineer in the US and have advised utilities in many countries on performance improvements for their electric transmission and distribution operations. My full Statement of Qualifications is attached as an Appendix to this testimony.

Q. What are the purposes of your direct testimony?

A. My testimony focuses on the following issues with respect to the Commonwealth Edison Company ("ComEd") 2014-2016 Energy Efficiency and Demand Response Plan ("Plan 3"):

1. The need to better integrate ComEd's Advanced Metering Infrastructure ("AMI") and Energy Efficiency/Demand Response ("EE/DR") programs to more quickly achieve customer energy efficiency and peak demand reductions. I believe there are significant opportunities during the Plan 3 period (2014-2016) to utilize ComEd's AMI investments to begin delivering EE/DR benefits and cost savings for customers. The opportunities I will

discuss include Voltage Optimization, Smart Device Enablement, and enhanced AC Cycling.

2. Reallocation of portfolio-level budgets associated with Plan 3. I believe there are unnecessarily high portfolio-level costs that should be redirected to fund the AMI and EE/DR integration.

II. INTEGRATION OF COMED'S AMI AND EE/DR PROGRAMS

Q. Please describe your understanding of ComEd's AMI program.

A. The Illinois Energy Infrastructure Modernization Act ("Act") requires ComEd to invest over $2.6 billion on AMI deployment, Smart Grid technologies, and grid modernization over the next 10 years. I understand that ComEd plans to install more than 1.2 million smart meters and the associated two-way communications during the Plan 3 period (2014-2016), and over 4 million meters by the end of 2021.

ComEd's vision statement for AMI says "The network of advanced meters and communication systems can collect and distribute timely and accurate information to customers and other parties, expanding customer choice, empowering customers to take advantage of new energy and money saving technologies … ComEd is, therefore, committed to tracking tangible measures of our success in enabling the robust growth of efficient demand response, energy efficiency, and distributed generation using the Smart Grid … ComEd's vision is of informed and educated customers who will have sufficient knowledge to benefit from their new AMI meters immediately after they are installed."[1]

[1] ComEd Revised Smart Grid Advanced Metering Infrastructure Deployment Plan, April 1, 2013, pp. 2-3

Q. Why is it important to integrate ComEd's AMI and EE/DR programs?

A. First of all, the Act explicitly defines the benefits of AMI to include "avoided consumer power, capacity, and energy costs, and … other benefits associated with energy efficiency measures, (and) demand–response activities."[2]

Secondly, given the magnitude of the expenditures under the Act and the proposed expenditures for EE/DR under Plan 3, I believe it is important for customers to begin realizing these expected efficiency benefits as soon as possible. ComEd's vision for AMI reinforces my belief with its commitment to help customers benefit from their AMI meters immediately after they are installed.

Q. Is the integration between ComEd's AMI and EE/DR programs already happening?

A. Yes, but not fast enough in my opinion. I believe ComEd intends to more tightly integrate the programs at some point in the future but is currently managing them somewhat independently. I believe the AMI team is very focused on successfully installing smart meters and associated infrastructure, and the EE/DR team is very focused on successfully implementing their programs. I believe there are immediate opportunities to begin integrating the programs to achieve more energy savings and demand reductions as the AMI meters are deployed, and that is the focus of my testimony.

[2] 220 ILCS 5/16-108.6(a)

Q. Are there other reasons why the AMI and EE/DR programs are not more tightly integrated?

A. Yes. I believe the nature of these regulatory proceedings makes it difficult to integrate the programs. AMI and EE/DR have separate dockets and are therefore evaluated independently by the parties. Additionally, there are several other dockets dealing with related issues such as Docket No. 12-0484 regarding ComEd's Peak Time Savings program, and Docket No. 13-0506 regarding sharing of AMI data with third parties, just to name two. There are separate stakeholder advisory groups for Smart Grid/AMI (the Smart Grid Advisory Council or "SGAC") and EE/DR (the IL Energy Efficiency Stakeholder Advisory Group or "SAG"). The result is that it becomes very difficult for any of the parties, even ComEd to some extent, to maintain a holistic view of all the various AMI and EE/DR activities and their dependencies.

I believe it's important for the Commission to increasingly view the AMI and EE/DR programs as tightly integrated and interdependent with the ultimate goal of achieving energy/demand reductions and associated cost savings for customers, together with operational improvements and associated cost savings for ComEd.

Q. Please explain how ComEd's AMI program can be used to enhance their EE/DR programs.

A. I believe there are three key areas: 1) Voltage Optimization, 2) Smart Device enablement for homes and businesses, and 3) enhanced AC Cycling.

A) VOLTAGE OPTIMIZATION

Q. What do you mean by Voltage Optimization?

A. I consider Voltage Optimization (VO) to be a combination of Conservation Voltage Reduction (CVR) and Volt/VAR Optimization (VVO), intended to primarily reduce end-use customer energy consumption and peak demand, and secondarily to reduce utility line losses. CVR and VVO are often used interchangeably but I will distinguish between the two concepts.

Q. What is Conservation Voltage Reduction (CVR)?

A. In the US, electricity is supplied to residential and small commercial customers at a nominal voltage of 120 volts. However, the American National Standards Institute (ANSI) defines an acceptable range of voltage delivery at the meter to be 114-126 volts at all times and between 106-127 volts for short periods. The Commission's Administrative Code allows a variation between 113-127 volts for short periods.[3]

Utilities have historically found it easier and more profitable to operate at the high end of the ANSI voltage range. Voltage decreases as the distance from the substation increases, so operating at the high end of the range at the substation ensures that minimum voltages are maintained at all points of a feeder. Utilities are also incented to maintain higher voltages since this increases energy consumption and associated revenues.

[3] Illinois Commerce Commission, Administrative Code Part 410, Standards of Service for Electric Utilities and Alternative Retail Electric Suppliers, Section 410.300 Voltage Regulation

CVR refers to maintaining voltages as close as possible to the lower end of the ANSI thresholds at all points on a feeder to reduce feeder line losses, reduce peak demand, and reduce customer energy consumption. This is typically achieved using load tap changers at the substation and line voltage regulators at various points on a feeder.

Q. How does CVR reduce customer energy consumption?

A. Most electrical equipment works equally well and uses less energy at lower voltages, with the amount of savings dependent on the load type. Inductive loads such as motors in fans, refrigerators, air conditioners and other appliances offer the most savings. They typically operate at a lower mechanical load than they are rated to handle and higher voltages generate stronger magnetic fields and wasted energy. Resistive loads, such as lighting, also use less energy at lower voltages.

Q. What is Volt/VAR Optimization?

A. The electricity delivered by utilities consists of usable real power (measured in Watts) and unusable reactive power (measured in Volt-Amperes Reactive or VARs). VARs occur when there is a phase shift between the voltage and the current in an alternating current system. A higher phase shift means more VARs, a less efficient system, and degraded power quality. By reducing the amount of VARs flowing on a feeder, utilities reduce line losses and improve the voltage profile along the feeder. Managing VARs is often accomplished by installing capacitors or reactors at strategic points along the feeder.

Volt/VAR Optimization (VVO) refers to the active management of reactive power at all points of a feeder to minimize losses and improve the voltage. When VVO is combined with Conservation Voltage Reduction (CVR), acceptable levels of power quality are maintained, distribution system losses are minimized, and customer energy savings and peak demand reductions are maximized.

Q. How much does VO reduce energy and peak demand?

A. The Department of Energy's Pacific Northwest National Laboratory (PNNL) published a report in 2010 in which they estimate a peak load reduction and annual energy reduction of 0.5 to 4% from CVR.[4] As part of the Electric Power Research Institute (EPRI) Green Circuits project, Alabama Power and Duke Energy recently conducted field trials of VO. Results suggest they could achieve energy reductions between 1.2 and 2.4% just on the utility side of the meter. My understanding is that customer end-use efficiency savings would be in addition to these savings.

Q. Does VO save energy for the utility, end-use customers, or both?

A. Both. However end-use customers realize most of the energy savings from VO. In the PNNL study and report, they concluded that 98-99% of the change in energy consumption from CVR occurs in the end-use loads, while only 1-2% of the reduction in energy consumed can be attributed to line losses. Other studies have attributed at least 80% of the energy savings from VO to end-use customers.

[4] Evaluation of Conservation Voltage Reduction (CVR) on a National Level, Pacific Northwest National Laboratory, July 2010, p. 1

Q. Are there other customer benefits of VO?

A. Yes. Optimizing voltage also substantially lessens equipment maintenance costs and extends equipment life. This is because unnecessarily high voltage levels increase the operating temperatures of equipment and shorten their service life.

Q. Will all utility feeders benefit from VO?

A. No, not all feeders benefit equally. VO experts indicate that feeders that are primarily residential tend to see the biggest impact, followed by feeders with many small commercial customers. The 2010 PNNL study I mentioned earlier determined that 80% of the potential benefit from VO can likely be realized by implementing it on only 40% of a utility's feeders.

Q. Is this a new idea?

A. No. The California Public Utilities Commission ordered the California utilities to launch a Conservation Voltage Reduction Program in 1970s, requiring them to reduce service voltages to less than 120 volts. By the mid-1980s, the program was saving almost 3 billion kWh/year. The final program report in 1987 called it one of the most effective electricity conservation programs in California.[5]

Utilities in the Pacific Northwest began testing CVR in the 1990s. A 2007 study by the

[5] http://tdworld.com/test-monitor-amp-control/trending-toward-distributed-voltage-optimization-simple-solution-overlooked

Northwest Energy Efficiency Alliance found that end-of-line voltage control methods achieve 2-3% energy savings and 3-3.5% peak demand reductions at a cost between $0.02 and $0.05 per kWh.[6]

Q. Why don't more utilities implement VO?

A. As I stated previously, most utilities have a financial incentive to maintain higher voltage levels, deliver more energy and generate more revenue. Furthermore, there is a fundamental business-model conflict from VO in that utilities incur the full costs while customers receive the majority of the benefit.

There have also been technical limitations – voltage levels at locations on a distribution feeder outside the substation are typically modeled or calculated, not measured directly. Due to this lack of visibility, utilities typically maintain voltages at higher-than-necessary levels to prevent end-of-line locations from falling below 114 volts.

Q. Have other utilities used VO as a way to reduce customer energy consumption and peak demand?

A. Yes. There are several examples in addition to the California and Pacific Northwest utilities I mentioned previously.

Both Baltimore Gas and Electric or BGE (one of ComEd's sister companies) and Potomac Electric Power Company or PEPCO have included VO programs as part of their EmPOWER Maryland energy efficiency portfolios.

[6] Distribution Efficiency Initiative, Northwest Energy Efficiency Alliance and R.W. Beck, December 2007, p. E-1

Dominion Virginia Power explicitly included the customer energy savings from VO in its business case for AMI, projecting over $1 billion of customer energy savings.[7] Dominion has subsequently created a subsidiary called Dominion Voltage Inc., patented their VO software, and is offering their VO planning and implementation services to other utilities.

AEP conducted a smart grid VO demonstration project in Ohio that delivered a 2.9% reduction in energy and 2-3% reduction in peak demand. They have also deployed VO in their Kentucky, Oklahoma and Indiana service territories, and have proposed to expand their VO deployment to 80 more circuits in Ohio[8].

Q. Does ComEd's other sister company PECO have experience with VO?

A. Yes. Philadelphia-based PECO included CVR as one of the 18 programs in its 2009-2012 EE/DR plan. The initial plan projected 110,000 MWh of annual energy savings by 2012 from CVR with a Total Resource Cost benefit-to-cost ratio of 26.7.[9] According to the May 2013 quarterly update, CVR has delivered 89.3 MW of demand reduction and 320,373 MWh/year of gross energy savings across all customer classes since program inception. PECO's entire portfolio of EE programs has delivered 1,459,251 MWh/year,

[7] Utility Case Study: Volt/VAR Control at Dominion, presented at EUCI Volt/VAR Optimization Conference, June 11-12, 2012, p. 19

[8] In the Matter of the Application of Ohio Power Company to Initiate Phase 2 of its gridSMART Project and to Establish the gridSMART Phase 2 Rider, Case No. 13-1939-EL-RDR, September 13, 2013

[9] PECO Energy Efficiency and Conservation Plan (Program Years 2009–2012), revised August 18, 2011, pp. 184-186

and CVR contributed 22% of the energy savings[10]. My understanding is that PECO achieved these energy savings for less than 2 cents per kWh.

Q. Has VO, as an EE/DR measure, been addressed by other State public utility commissions?

A. I'm not familiar with the point-of-view of all state commissions on CVR or VVO. However, I do know that the National Association of Regulatory Utility Commissions (NARUC) issued a resolution in November of 2012 (see Exhibit 2.1) encouraging State public service commissions to:

- Evaluate the energy efficiency and demand reduction opportunities that can be achieved with the deployment of Volt-VAR Optimization (VVO) technologies
- Work with State legislatures and other agencies to certify energy efficiency and demand reductions associated with the deployment of VVO as qualified resources in meeting Energy Efficiency Resource Standards.
- Avoid implementing policies that result in unnecessary barriers to the deployment of VVO technologies

Q. Does ComEd have prior experience with VO?

A. Yes. In the 1980s, the Commission ordered ComEd to evaluate the impact of CVR on its distribution system. I understand that ComEd was able to achieve an average reduction of 1.6 volts and an estimated energy savings of 1% overall.[11]

[10] Quarterly Report to the Pennsylvania Public Utility Commission (Preliminary Annual Report) For the Period March 2013 through May 2013, July 15, 2013, pp. 16 and 25

[11] D. Kirshner, "Implementation of Conservation Voltage Reduction at Commonwealth Edison", *IEEE Transactions on Power Systems*, 1990, Volume 5, Issue 4, pp.1178-1182.

ComEd also has an operational tracking measure for its Smart Grid program related to the use of AMI meters for voltage and VAR control.[12] This leads me to believe that ComEd may already be considering the deployment of some form of VO, but I recommend that ComEd explicitly include the EE/DR impacts of VO in Plan 3.

Q. Do you believe that the AMI technologies adopted by ComEd are well suited for VO?

A. Yes, I do. ComEd has selected Silver Spring Networks (SSN) as its advanced networking and two-way communications solution for their AMI deployment. SSN also offers (together with Dominion Voltage Inc.) a solution that utilizes the meters and other modules in the AMI network to monitor voltage and to enable continuous voltage and reactive power management. This solution is intended to help utilities take advantage of their AMI investment to realize the EE/DR benefits of VO.

Q. Why should ComEd include VO in its EE/DR portfolio now?

A. ComEd indicates in its proposed Plan 3 that it will not be able to meet the electric energy savings targets while staying within the mandatory spending limit. Including a very cost-effective measure such as VO could allow ComEd to achieve more energy savings and peak demand reductions for the same budget.

Furthermore, VO energy savings and peak demand reductions:

- Are easily implemented

[12] ComEd Revised Smart Grid Advanced Metering Infrastructure Deployment Plan, April 1, 2013, p. 39

- Impact every customer on the feeder
- Are immediate, predictable, measurable, persistent and scalable
- Require no behavioral change on the part of customers.

Finally, as I stated previously, ComEd has an operational measure in their Smart Grid plan related to using AMI for Volt/VAR control. Since ComEd will already be doing VO, it's logical to capture the EE/DR benefits as part of Plan 3.

Q. Is AMI necessary to implement VO?

A. No, but AMI can make VO more efficient and effective.

Q. How can AMI make VO more efficient and effective?

A. As I stated previously, one of the technical limitations of deploying VO is the reliance on modeled, not measured, end-of-feeder voltage. With AMI, this limitation goes away since voltage levels are now known at every customer meter and multiple points along a feeder.

The two-way communication infrastructure associated with AMI can also be utilized for VO. The distribution devices I mentioned earlier for VO (load tap changers, voltage regulators, capacitors, reactors, etc.) can be linked with AMI two-way communications to work more effectively.

B) SMART DEVICE ENABLEMENT

Q. How else can ComEd's AMI program improve its EE/DR portfolio?

A. As I stated previously, the expected benefits of the AMI and smart grid investments under the Act include expanded energy efficiency and demand response offerings, dynamic pricing, and other innovations to help customers reduce their energy use and peak demand. These expanded offerings often require additional hardware on the customer side of the meter. I earlier referred to this hardware as Smart Devices, and enabling them is critical for fully realizing the benefits of AMI.

Q. What are examples of Smart Devices?

A. These include smart thermostats, plugs, power strips, switches, appliances, smart chargers for electric vehicles, gateways, and in-home displays that can communicate with the AMI network, can connect to a wireless home area network (HAN), and can be controlled with smart phones, tablets, and computers. A HAN can use Wi-Fi or other wireless standards such as ZigBee or Z-Wave. ComEd refers to many of these devices as Home Energy Management (HEM) devices in their Smart Grid plan.[13]

Q. Are these Smart Devices available today?

A. Energy management devices that can connect to a HAN and can be controlled with smart phones and computers are widely available today but none that I'm aware of have been enabled to communicate with a ComEd smart meter or ComEd's AMI network. I recommend that ComEd enable these Smart Devices to communicate with their AMI network.

[13] ComEd Revised Smart Grid Advanced Metering Infrastructure Deployment Plan, April 1, 2013, pp. 55-56

Q. What do you mean by enabling communications between Smart Devices and AMI?

A. To fully realize ComEd's vision of smart grid-enabled customer energy efficiency and demand reductions, market participants (ComEd, ARES, municipalities, other third parties) must be able to send electricity price and consumption information and other messages or signals to smart devices that control energy usage. Smart devices must also be able to send signals or messages back to the market participants to verify their operation, report actual energy usage, etc. It is the enabling of the two-way communication between the Smart Devices and the market participants that I'm really referring to and AMI is one link in the chain.

Q. Do market participants need AMI to communicate with Smart Devices?

A. No. Market participants are currently communicating with Smart Devices without AMI. For example, it's very common today for Curtailment Service Providers to communicate with industrial/commercial customers' load control devices independent of AMI. Residential customers can buy a smart thermostat today (from Nest, Honeywell, Iris, etc.), enroll in the manufacturer's internet service to monitor their heating and air conditioning, and easily connect the thermostat to their HAN to begin controlling the device with their smart phone or computer. The Iris home management service available from Lowe's includes smart thermostats, plugs and switches and the Iris hub can communicate using Wi-Fi, ZigBee or Z-Wave. Comcast and AT&T both offer smart thermostats as part of their home management bundled services and these devices can also be controlled with smart phones or computers, independent of AMI or a smart meter.

Q. So why do we need AMI for Smart Devices?

A. First of all, I believe ComEd will rely on AMI and smart meters to communicate with these Smart Devices. As ComEd develops and implements its Peak Time Savings program (or other dynamic pricing programs), it will increasingly rely on AMI to communicate with any smart devices it may install as part of its load control strategy.

Secondly, market participants will benefit from receiving electricity price signals delivered through the AMI network, along with interval usage or load profile information as measured and stored by the smart meter. I believe that once ComEd makes it clear and simple for market participants to utilize this information, the ARES and other market participants will begin to develop new products/services to help customers and municipalities save energy and costs.

This is particularly important in Illinois where ARES are currently supplying large blocks of residential and small commercial customers due to municipal aggregation. I believe the fastest path to significant energy efficiency and demand reductions for customers in Illinois requires ComEd to enable as many devices and market participants as possible to utilize the AMI network and associated energy and price information.

Q. ComEd is intending to enhance their website to provide customers more detailed information on their electricity usage. Is this sufficient?

A. No. My understanding is that the enhanced website will provide hourly usage and cost information within a day of the actual usage, along with tips and tricks for using less

electricity based on a customer's actual interval usage patterns.[14] While this can be a helpful way to raise awareness, it does not enable customers to anticipate and respond to demand reduction opportunities as they occur in near real-time. Enabled Smart Devices, communicating with AMI, provide this opportunity and maximize the potential EE/DR from AMI.

Q. Should ComEd be providing these Smart Devices under Plan 3?

A. At this time I don't think ComEd should be adding additional costs to install and maintain hardware under Plan 3. I recommend that ComEd confirm the interoperability standards for Smart Devices to communicate with the ComEd's AMI network and be willing to verify and register devices that a customer may purchase and install on their own. I also recommend that ComEd consider offering discounts or other incentives for these Smart Devices in communities where its smart meters are installed.

Q. Has ComEd established an interoperability standard for its smart meters?

A. I believe ComEd has adopted the ZigBee Smart Energy Profile (SEP) standard for its smart meters to communicate with devices in homes and businesses. My understanding is that ComEd's smart meters include a Silver Spring Networks chip or interface card to enable communications with Smart Devices using SEP.[15]

As I stated previously, there are many Smart Devices available in the market today that are HAN-enabled (using Wi-Fi, ZigBee, or Z-Wave) and use the Internet for

[14] ComEd Revised Smart Grid Advanced Metering Infrastructure Deployment Plan, April 1, 2013, pp. 53
[15] *Ibid.*, p. 24

communicating with customers and market participants. I believe the commission should order ComEd to expand its approach to allow many HAN-enabled devices to access the energy price and usage information available through AMI and not just rely on ZigBee.

Q. What do you mean by verifying and registering a Smart Device?

A. Customers who purchase a Smart Device would register the device on ComEd's website and associate the device with their ComEd account number. ComEd would verify that the device is compatible with the smart meter and/or AMI and activate the communications. From that point on, any use of the device is the responsibility of the customer.

Q. How would customers know which devices are compatible with ComEd's smart meters?

A. I believe the Commission should order ComEd to work with manufacturers and retailers to modify packaging or signage to indicate a device's compatibility with their meters and AMI. Customers should be able to walk into any hardware or home improvement store and shop for Smart Devices that are clearly labeled as compatible with their smart meter or AMI network. At minimum, ComEd should maintain a list of verified and compatible devices on their website and commit to educating consumers about the benefits of these products.

Q. Have any other utilities followed this approach?

A. Yes. San Diego Gas & Electric (SDG&E) recently implemented a program that allows its customers to register devices they purchase themselves to connect with their smart meter. Devices that SDG&E customers have registered to-date include thermostats, in-home displays, and gateways. SDG&E has validated a total of nine devices that are now available for purchase by customers.[16] ZigBee Smart Energy Profile 1.0 or 1.1 is SDG&E's established standard for devices to communicate with their smart meters. SDG&E maintains a list on their website of devices that have been tested and determined to be compatible with their smart meters.[17] In some cases, discounts for the certified devices are available on the website.

Austin Energy has a similar program where Internet-connected thermostats from six different providers are listed on their website as "approved."[18] Customers can purchase these thermostats from retailers or online, receive an $85 rebate from Austin Energy, and begin saving money by participating in the utility's demand response programs.

Q. Doesn't ComEd already have an established process for enabling these Smart Devices?

A. Yes, but it's not sufficient in my opinion. ComEd proposes to conduct its own technology market assessment, conduct a technology provider analysis, and "conduct

[16] http://www.marketwatch.com/story/new-home-area-network-devices-available-to-help-sdge-customers-save-energy-2013-09-19
[17] https://www.sdge.com/residential/about-smart-meters/home-and-business-area-network
[18] http://www.austinenergy.com/energy%20efficiency/programs/Power%20Partner/index.htm

pilots to learn how to best enable (technologies) for the benefit of customers."[19] This will likely be a long process and can lead to ComEd picking winners. I do not believe it's ComEd's role to solely determine which devices customers can use to interact with their smart meter and AMI. I believe it's ComEd's role to quickly enable a wide variety of devices to interact with the AMI meters and to let the market determine the winners and the losers.

ComEd has also established a Smart Grid Test Bed to allow third parties to evaluate their products' compatibility with the AMI network. Participation in the Test Bed is off to a slow start, with zero applications received to participate in the Test Bed through the first two quarters of 2013.[20]

I recommend that the Commission order ComEd to develop a plan to accelerate the compatibility testing of a variety of Smart Devices with its AMI meters and actively notify customers who have a smart meter of the availability of these devices.

I also recommend that the Commission order ComEd to develop a plan to more actively draw traditional device manufacturers and non-traditional market participants to the Test Bed to certify Smart Devices. I believe it would be a helpful step toward market transformation in Illinois if ComEd certified that the Comcast, AT&T, Honeywell, Nest, and Iris devices, together with many others, are compatible with its smart meters and

[19] ComEd Revised Smart Grid Advanced Metering Infrastructure Deployment Plan, April 1, 2013, p. 78
[20] ComEd Quarterly Test Bed Reports, May 15, 2013 and August 8, 2013

AMI network. I believe SDG&E and Austin Energy are good models for ComEd to learn from as it develops its plan.

Q. Are there certain devices that are particularly important?

A. Yes, I believe smart thermostats, called Programmable Communicating Thermostats (PCTs) by ComEd, are very important to enable.

Q. Do programmable thermostats and PCTs really save energy?

A. Yes, they do. I'm aware of skepticism in the market about the energy savings associated with standard programmable thermostats. This skepticism stems from that fact that most consumers don't actually program the thermostat or don't program it correctly. I believe this problem can be partially remedied through increased public education and pre-programming of thermostats.

Smart thermostats or PCTs, however, are different in two important ways. First, they are controllable remotely from smart phones, tablets and computers making them easier and more convenient to program or adjust; secondly, they can respond to price signals and messages sent from utilities or other market participants and can automatically adjust to varying time, temperature and electricity prices. I believe PCTs, communicating with AMI for price signals, have significant potential to save energy and costs for customers.

Q. Why are PCTs particularly important?

A. There are several reasons. First, PCTs control space heating and air conditioning, two of the largest end-uses of energy for residential customers in northern Illinois. Residential air conditioning load also contributes significantly to peak electricity demand in ComEd's service territory.

Secondly, a PCT receiving price signals and messages from the smart meter or other market participants is a key to innovative dynamic pricing programs from ARES and other third parties, leading to significant energy and cost savings for customers.

As I mentioned previously, PCTs are also increasingly available on-line, in retail stores and through bundled offerings from third parties. I know at least one of the ARES serving Illinois already offers a free Nest thermostat if you select them as a supplier.

Finally, the gas companies in ComEd's service territory (Nicor and Peoples/North Shore Gas) are both planning single- and multi-family residential efficiency programs, jointly with ComEd, that include the installation of programmable thermostats.[21] This is an ideal opportunity to synchronize these programs with the AMI rollout and make PCTs available to program participants who also have a smart meter.

[21] Nicor Gas Energy Efficiency Plan, ICC Docket No. 13-0549; North Shore Gas and Peoples Gas Light and Coke Company Second Triennial Energy Efficiency Plan, ICC Docket No. 13-0550.

Q. Does this approach raise any concerns about cyber security or privacy of customer usage data?

A. It should not. I believe ComEd has already taken steps to alleviate these cyber security concerns by selecting SSN for its AMI network and by the technical requirements factored into its network design. Regarding data privacy, customers will effectively opt-in or grant their permission for their electricity consumption to be accessed by a device when they register it with ComEd.

Q. Why is this a preferred approach?

A. As ComEd proceeds with its AMI rollout, there will be a segment of customers who will want to begin interacting with their smart meter and AMI immediately. While this segment may be small initially, it is part of ComEd's obligation to encourage customers to take advantage of new opportunities. This approach satisfies these customers without adding significant costs to Plan 3.

Secondly, utilities are typically reluctant to assume the liability and overhead costs associated with installing and maintaining devices inside a customer's home or business. This approach eliminates this concern.

As I stated previously, I believe this approach may lead to innovation in the marketplace as ARES and other third parties would have the ability to bundle these enabled Smart Devices with other products, services and pricing programs offered to customers.

Finally, this approach is consistent with the vision and commitments made in ComEd's Smart Grid plan which states "Many of the functionalities unlocked through ComEd's deployment of AMI will be available to the customer as soon as the AMI meter is installed at the premises and activated … ComEd's AMI meters will unlock key functionalities … including:

- Suppliers' ability to offer dynamic rates
- Wireless communication from the AMI meter through the ZigBee standard."[22]

Q. What are the benefits for ComEd with this approach?

A. As I stated previously, I believe this is a relatively low-cost approach for allowing customers to begin realizing the benefits of AMI and provides ComEd a low-cost way to begin delivering the benefits more immediately.

This approach allows ComEd to maintain visibility into the impacts of these devices through their AMI network that otherwise would not exist if customers purchased and installed the devices but did not register them.

The approach also allows ComEd to directly market their own current or future EE/DR programs, such as Peak Time Savings, to the customers with registered devices. The AMI two-way communications network available to ComEd will increase the efficiency and effectiveness of its future EE/DR programs.

[22] ComEd Revised Smart Grid Advanced Metering Infrastructure Deployment Plan, April 1, 2013, p. 78

Finally, this approach will help ComEd more efficiently monitor market demand for and technical viability of Smart Devices, which can inform future decisions on potential EE/DR programs.

Q. Do you have any further thoughts on ComEd's role regarding Smart Devices?

A. Yes. There are policy questions regarding the role of the utilities in getting customers to use the Smart Devices to reduce energy consumption and demand, as opposed to just allowing the competitive market to work. I believe a key issue is determining the best way to get customers to use Smart Devices and to transform the market. AMI and Smart Devices not only help individual customers save energy, but they also have the potential to significantly affect wholesale market prices. Therefore, the Commission needs to determine whether ComEd should be providing customers with Smart Devices in order to accelerate market penetration, or whether it should just let the market evolve. I believe some combination of the two is required as I describe in my testimony.

I also believe that there should be a public education component of ComEd's Plan 3 encouraging customers to correctly use smart thermostats. I believe customers need education on the level of energy savings (both gas and electricity) they can achieve from properly programming their thermostat, and the societal benefits that can be achieved in terms of lower wholesale electricity prices from lowering peak demand. I encourage the Commission to ensure that there is adequate public education to fully realize the benefits of this technology.

C) ENHANCED AC CYCLING

Q. What do you mean by enhanced AC Cycling?

A. ComEd currently maintains a central Air Conditioning ("AC") Cycling program that allows customers to earn bill credits by allowing ComEd to cycle off their AC compressor during hot summer days. ComEd is currently managing the program in "maintenance mode" which, according to ComEd's response to Data Request NRDC 2.03, means that they will not fund new participants in the program through Plan 3. I also understand that ComEd considers the AC Cycling program, in its current form, to be expensive and not cost-effective.

Enhanced AC Cycling refers to utilizing the AMI two-way communication network to more efficiently and effectively manage the program. The AMI network may lower the cost of AC Cycling and may increase the reliability of demand reductions by allowing ComEd to more effectively verify that switches at customer locations have operated and load is reduced. Enhanced AC Cycling may also allow ComEd to generate additional revenue by bidding more of the verifiable demand reduction into the PJM Interconnection ("PJM") capacity auctions.

Q. Do you believe that the AMI technologies adopted by ComEd are well suited for enhanced AC Cycling?

A. Yes, I do. As I previously stated, ComEd selected Silver Spring Networks (SSN) for its AMI network. SSN also has a solution for utilizing the two-way communication network to activate load control switches and to verify their operation.

ComEd is planning a Direct Load Control ("DLC") pilot in conjunction with its Peak Time Savings program. A recent pilot progress report states, "ComEd wants to analyze load curtailment switches designed for AC units. ComEd has significant experience with such DLC devices from its AC Cycling program. However, ComEd's advanced metering infrastructure network provides new opportunities for such switches to communicate directly with that network. ComEd will analyze whether these AMI-enabled switches would be valuable to the DLC pilot. Specifically, the AMI-enabled switches will potentially enable ComEd to directly integrate DLC switches into its existing systems and potentially lower costs."[23]

Q. Can the DLC pilot help accelerate enhanced AC Cycling?

A. Yes, I believe it can if the pilot's objectives are modified. I believe the pilot should emphasize the need to find a more cost-effective and reliable way to communicate with the switches of current and future AC Cycling participants. I also recommend that ComEd develop a plan for deploying the more efficient and effective AC switch communication technology to geographically follow the deployment of the AMI network. This may lead to a more cost-effective approach for existing AC Cycling participants and potentially allow ComEd to enroll new AC Cycling participants as measurable, verifiable demand reduction resources in the shortest time possible.

[23] ComEd Direct Load Control Pilot Design and Pre-enrollment Research Progress Report, August 21, 2013, pp. 4-5. ICC Docket No. 12-0484

Q. ComEd is already exceeding its statutory demand reduction targets, so why is this important?

A. I understand that ComEd believes its proposed Plan 3 will result in ComEd significantly exceeding its statutory peak demand reduction targets from the demand impacts of its energy efficiency programs.

PJM recognizes both demand response and energy efficiency as capacity resources in their Reliability Pricing Model ("RPM") forward capacity market. Since ComEd is a PJM market participant, it can (and does) bid additional demand reductions into RPM auctions to generate additional revenue to fund existing or new EE/DR programs.

As long as the costs of a program to achieve the additional demand reduction (in this case, the cost of enhancing and expanding the enhanced AC Cycling program) are less than the revenue received from an RPM auction, it makes economic sense for ComEd and its customers to pursue. This is particularly important for ComEd as it faces a constrained budget for its EE/DR programs.

According to ComEd's response to Data Request No. NRDC 2.03, ComEd had 110 MW of potential demand reduction capacity enrolled in its AC Cycling program in PY5. According to ComEd's response to Data Request No. ELPC 3.01, ComEd is bidding this demand reduction into the RPM auctions, but it's not clear from the response if ComEd is realizing the full revenue potential of this resource.

By utilizing the new AMI network and perhaps new AMI-enabled switches, ComEd may be able to improve the cost-effectiveness of this program, expand it to include more participants and peak demand reductions, and generate more revenue from the RPM auction to offset program costs and potentially fund more EE/DR programs.

I recommend that the Commission order ComEd to revise its approach to the DLC pilot to prioritize the need to find a more cost-effective and reliable way to communicate with the switches of current and future AC Cycling participants. I also recommend that the Commission order ComEd to develop a plan for deploying the more efficient AMI-enabled AC switch communication technology to geographically follow the deployment of the AMI network.

III. REALLOCATION OF PORTFOLIO-LEVEL COSTS

Q. What are your thoughts on the portfolio-level budget in the proposed Plan 3?

A. There are three categories of portfolio-level costs in ComEd's proposed Plan 3 that seem unreasonably high: Education/Outreach, R&D/Emerging Technologies, and Labor (non program specific). These three budget categories total $39.4 million over the Plan 3 period and represent 11% of ComEd's total Plan 3 portfolio costs.

Q. Why do you consider the Education/Outreach costs to be unreasonably high?

A. The table below summarizes budget and actual costs for Education/Outreach in proposed Plan 3 compared to prior Plan periods. ComEd provided this data in their response to Data Request No. NRDC 2.18_Attach 1.

ComEd Education/Outreach Costs

	Plan 1	Plan 2	Proposed Plan 3
Budget	$6,505,000	$7,267,214	$16,700,332
Actual	$4,907,495	$7,994,052*	

* - PY4-5 only

The proposed Plan 3 budget for Education/Outreach is $9.4 million or 130% greater than the Plan 2 budget. ComEd's response to Data Request No. ELPC 1.40, which asks what ComEd intends to do differently in Plan 3, states "ComEd expects to continue the same marketing approach it currently employs, using the knowledge obtained over the past several years to refine our efforts."

I know there have been many conversations between ELPC and ComEd about expanding its Education/Outreach efforts but it's not clear to me why a 130% increase in spending is necessary if ComEd intends to use the same approach as prior Plan years. As I stated previously, I believe it's very important to provide customer education on the benefits and importance of Smart Devices, particularly smart thermostats. I also believe it's important for customers who have a smart meter to understand the availability of Smart Devices that are compatible with their smart meter and ComEd's AMI network.

Absent any further details from ComEd on their specific plans for expanding Education/Outreach in Plan 3, I recommend that the Commission order ComEd to cap the budget for Education/Outreach at 50% above Plan 2 levels ($11 million), which would

free up $5.7 million of this proposed budget to fund the Smart Device Education/Outreach recommendations I describe later in my testimony.

Q. Why do you consider the R&D/Emerging Technologies costs to be unreasonably high?

A. The table below summarizes budget and actual costs for R&D/Emerging Technologies in proposed Plan 3 compared to prior Plan periods. ComEd provided this data in their response to Data Request No. NRDC 2.18_Attach 1.

ComEd R&D/Emerging Technologies Costs

	Plan 1	Plan 2	Proposed Plan 3
Budget	$5,359,544	$7,640,301	$10,689,750
Actual	$3,041,543	$2,116,205*	

* - PY4-5 only

The proposed Plan 3 budget for R&D/Emerging Technologies is $3.05 million or 40% greater than the Plan 2 budget. ComEd's response to Data Request No. NRDC 2.05, which asks for the results achieved from R&D efforts in prior years, states "There were no kWh savings generated from R&D programs for PY1-PY4." Furthermore, ComEd has consistently under-spent this category in every Plan year. ComEd's response to Data Request No. ELPC 1.46, which asks for the goals and outcomes expected of the Emerging Technology Team during Plan 3, states "ComEd has not yet specified goals and outcomes for the Emerging Technology Team at this time."

Given historical under-spending by ComEd in this category, the lack of specific results from prior R&D efforts, and the lack of clarity on expected R&D outcomes for Plan 3, I

consider these costs to be unreasonably high. I recommend that the Commission order ComEd to redirect 100% of this proposed budget ($10.7 million) toward the AMI/EE/DR integration recommendations I describe later in my testimony.

Q. Why do you consider the Labor (non program specific) costs to be unreasonably high?

A. The table below summarizes budget and actual costs for Labor (non program specific) in proposed Plan 3 compared to prior Plan periods. ComEd provided this data in their response to Data Request No. NRDC 2.18_Attach 1.

ComEd Labor (non program specific) Costs

	Plan 1	Plan 2	Proposed Plan 3
Budget	$6,747,434	$5,572,890	$11,967,337
Actual	$7,768,235	$5,963,889*	

* - PY4-5 only

The proposed Plan 3 budget for Labor (non program specific) is $6.4 million or 115% greater than the Plan 2 budget. ComEd's response to Data Request No. ELPC 1.48, which asks for a breakdown of full time equivalent (FTE) headcount and labor costs for this category, shows a headcount of 18 FTEs with an average annual cost per FTE of $222,000. ComEd's response to Data Request No. NRDC 2.18, which asks for an explanation of the cost increase from Plan 2 to Plan 3, states "The primary drivers for the increase in the non-program specific labor costs in Plan 3 versus Plan 2 are as follows: (1) headcount increased during Plan 2 and (2) Plan 3 corrects an omission in Plan 2 to ensure that payroll costs are fully reflected."

I don't know what the "omission in Plan 2" is, but I consider these Labor costs to be unreasonably high. I recommend that the budget for Labor (non program specific) be capped at Plan 2 actual levels, which I estimate to be $9.2 million (assuming PY6 Actual spend in this category is $3.2 million, equal to PY5). I recommend that the Commission order ComEd to reallocate the remaining $2.8 million of this proposed budget toward the AMI/EE/DR integration recommendations I describe later in my testimony.

IV. RECOMMENDATIONS

Q. What specifically do you recommend for VO?

A. For VO, I recommend that the Commission order ComEd to conduct a feasibility/potential study to determine the impact and costs. The experience of ComEd's sister companies PECO and BGE will provide valuable input into the analysis. As I stated previously, experts believe that 80% of the benefits from VO come from 40% of the feeders, so the focus of the study should be on the highest-potential circuits with primarily residential and small commercial load and should geographically follow the planned AMI deployment.

I also recommend that the Commission formally certify the energy efficiency and demand reductions associated with VO as qualified resources in meeting IL EE/DR standards, and commit to allowing recovery of prudently incurred costs.

I recommend that the Commission order ComEd to use the results of the VO feasibility/potential study to reprioritize the programs under Plan 3 and submit the revised

plan to the Commission by June 1, 2014. I believe VO is a very cost-effective energy efficiency and demand reduction resource and, if incorporated into Plan 3, will allow ComEd to achieve significantly more energy savings and demand reductions for the same constrained budget.

I recommend that the Commission order ComEd to work with PJM to allow bidding both the energy efficiency and demand reduction achieved by VO into the PJM RPM auctions and to use the associated revenue to offset the costs of the VO deployment.

Finally, I recommend that the Commission order ComEd to work with the SAG and the SGAC to develop an appropriate measurement and verification methodology for VO.

Q. What specifically do you recommend for enabling Smart Devices?

A. I recommend that the Commission order ComEd to develop and implement a comprehensive plan, involving manufacturers, retailers and other third parties, to enable Smart Devices to interact with ComEd's smart meters as I described previously and to make it easy for customers to identify and purchase these devices. The plan shall include:

- An approach for ComEd to accelerate the compatibility testing of a variety of Smart Devices with its AMI meters and to actively notify customers who have a smart meter of the availability of these devices.

- An approach for ComEd to allow Wi-Fi and Z-Wave devices to access the energy price and usage information available through its AMI network in addition to ZigBee devices.
- A process for customers to verify and activate ComEd AMI-compatible devices that they may purchase and install on their own.
- An approach for ComEd to work with manufacturers and retailers to modify packaging or signage to indicate a device's compatibility with its meters and AMI. This may include discounts or other incentives in communities where ComEd smart meters are installed.
- An approach for ComEd to more actively draw traditional device manufacturers (Honeywell, ecobee, Nest, 3M, etc.) and non-traditional market participants (Comcast, AT&T, Lowe's, etc.) to the Test Bed to certify Smart Devices, with an emphasis on Programmable Communicating Thermostats (PCTs).

I recommend that the Commission order ComEd to submit a revised Plan 3 reflecting plans to enable Smart Devices and for drawing market participants to the Test Bed by June 1, 2014.

I recommend that the Commission order ComEd to work with Nicor and Peoples/North Shore Gas to modify their single- and multi-family residential efficiency programs to include the installation of ComEd-certified PCTs to program participants who have a smart meter.

Finally, I recommend that the Commission consider whether ComEd should develop programs to provide these Smart Devices directly to customers in conjunction with the AMI rollout.

Q. What specifically do you recommend for AC Cycling?

A. I recommend that the Commission order ComEd to modify its DLC pilot to focus on finding a more cost-effective and reliable way to communicate with the switches of current and future AC Cycling participants. I also recommend that the Commission order ComEd to develop a plan for deploying the more efficient and effective AC switch communication technology to geographically follow the deployment of the AMI network. Finally, I recommend that the Commission order ComEd to bid any incremental demand reduction from the enhanced AC Cycling program into the PJM capacity auctions and to use the additional revenue to offset program costs.

Q. How much will your recommendations cost?

A. ComEd's proposed Plan 3 falls short of achieving the statutory MWh reduction goals by at least 1.18 million MWh/year in each of the Plan years due to spending screen constraints.[24] Hypothetically, let's assume that ComEd is able to overcome the shortfall by deploying VO. Using the $0.02 to $0.05 per kWh estimated cost from the NEEA report for end-of-line voltage control;[25] this would cost $24 to $59 million to fully close the gap.

[24] ComEd 2014-2016 Energy Efficiency and Demand Response Plan, August 30, 2013, p. 16
[25] Distribution Efficiency Initiative, Northwest Energy Efficiency Alliance and R.W. Beck, December 2007, p. E-1

I cannot estimate the cost of the Smart Device enablement recommendations but I believe the incremental costs are low, since it requires a redirection or reprioritization of existing personnel already working on related smart grid activities. Similarly for AC Cycling, I believe the incremental costs are low since my recommendations also require a reprioritization of activity already underway (i.e., the DLC pilot).

Q. ComEd already has a constrained budget. How will it fund your recommendations?

A. As I stated previously, ComEd has an operational tracking measure for its Smart Grid program related to the use of AMI meters for voltage and VAR control. This leads me to believe that there is budget earmarked for VO in ComEd's Smart Grid plan but I don't know the amount at this time. I recommend that this budget from the Smart Grid plan be used for the VO feasibility/potential study and the VO implementation.

As I also stated previously, I recommend that the Commission order ComEd to:

- Reallocate $5.7 million of the Education/Outreach budget,
- Redirect the $10.7 million from the R&D/Emerging Technologies budget, and
- Reallocate $2.8 million of the Labor (non program specific) budget of its proposed Plan 3 to implement my recommendations.

In total, this reallocation of portfolio-level budget will free up $19.2 million to fund the AMI/EE/DR integration under Plan 3. ComEd may also receive additional revenues to fund the integration as it bids the demand reduction and energy efficiency from VO and enhanced AC Cycling into the PJM capacity market. Lastly, I believe my

recommendations accelerate the realization of AMI benefits and lead to a significant increase in energy and cost savings for customers under Plan 3.

Q. Does this conclude your direct testimony?

A. Yes

V. WITNESS QUALIFICATIONS

Appendix

Statement of Qualifications – Curt Volkmann

I graduated from the University of Illinois at Urbana-Champaign in 1984 with a Bachelors of Science in Electrical Engineering with an emphasis in Power Engineering. I also graduated from the University of California at Berkeley in 1992 with a Masters of Business Administration with an emphasis in Finance. From 1987 to 1995 I held a Registered Professional Electrical Engineer Certification from the State of California. I have been a member of the Institute of Electrical and Electronics Engineers (IEEE) since 1984.

I was employed from 1984 to 1993 by Pacific Gas and Electric (PG&E) in various roles including Distribution Planning Engineer where I developed system protection and voltage optimization schemes and analyzed the impacts from cogeneration on the distribution network. I also served in a Project Manager role where I evaluated the impact of demand side management programs on the need for distribution substation upgrades.

From 1993 to 1994, I worked for the consulting firm UMS Group where I led multi-utility benchmarking studies examining global best practices in electric transmission, distribution and fleet operations. Participating utilities were from the US, Canada, Australia, New Zealand, Europe and Africa.

From 1994 to 2013, I was employed by Accenture, a global management consulting and technology firm. I held several positions including Executive Director with client account leadership responsibilities for several gas, electric and water utilities in the US. In this role I oversaw several utility cost reduction, energy efficiency and smart grid programs. From 2010 to 2013, I was Managing Director in Accenture's Sustainability Services practice where I oversaw

energy efficiency and demand reduction projects for commercial and industrial clients across multiple industries.

I'm currently a Senior Clean Energy Finance Specialist at the Environmental Law and Policy Center where I provide technical and financial expertise on a variety of clean energy, water, transportation and natural resource protection issues. I am focused on opportunities to better utilize smart grid investments to accelerate energy efficiency, peak demand reduction, and renewable deployment.