BEFORE
THE PUBLIC UTILITIES COMMISSION OF OHIO

In the Matter of the Application of Duke Energy Ohio, Inc., for an Increase in Electric Distribution Rates.	)	Case No. 17-0032-EL-AIR
In the Matter of the Application of Duke Energy Ohio, Inc., for Tariff Approval.	)	Case No. 17-0033-EL-ATA
In the Matter of the Application of Duke Energy Ohio, Inc., for Approval to Change Accounting Methods.	)	Case No. 17-0034-EL-AAM
In the Matter of the Application of Duke Energy Ohio, Inc. for Approval to Modify Rider PSR	)	Case No. 17-0872-EL-RDR
In the Matter of the Application of Duke Energy Ohio, Inc. for Approval to Amend Rider PSR.	)	Case No. 17-0873-EL-ATA
In the Matter of the Application of Duke Energy Ohio, Inc. for Approval to Change Accounting Methods	)	Case No. 17-0874-EL-AAM
In the Matter of the Application of Duke Energy Ohio, Inc. for Authority to Establish a Standard Service Offer Pursuant to Section 4928.143, Revised Code, in the Form of an Electric Security Plan, Accounting Modifications and Tariffs for Generation Service.	)	Case No. 17-1263-EL-SSO
In the Matter of the Application of Duke Energy Ohio, Inc., for Authority to Amend its Certified Supplier Tariff, P.U.C.O. No. 20.	)	Case No. 17-1264-EL-ATA
In the Matter of the Application of Duke Energy Ohio, Inc. for Authority to Defer Vegetation Management Costs.	)	Case No. 17-1265-EL-AAM
In the Matter of the Application of Duke Energy Ohio, Inc., to Establish Minimum Reliability Performance Standards Pursuant to Chapter 4901:1-10, Ohio Admin. Code.	)	Case No. 16-1602-EL-ESS

DIRECT TESTIMONY OF
MICHAEL MURRAY
ON BEHALF OF
OHIO ENVIRONMENTAL COUNCIL AND
ENVIRONMENTAL DEFENSE FUND

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I. INTRODUCTION

Q. PLEASE STATE YOUR NAME, TITLE AND BUSINESS ADDRESS.

A. My name is Michael Murray. I am President of the Mission:data Coalition ("Mission:data"). My business address is 1752 NW Market Street #1513, Seattle, WA 98107.

Q. PLEASE BRIEFLY DESCRIBE YOUR EDUCATIONAL BACKGROUND AND YOUR RELEVANT PROFESSIONAL EXPERIENCE.

A. I co-founded Mission:data in 2013 and have led our efforts to intervene at public utility commissions in 14 states as well as the District of Columbia on issues of advanced meters, data privacy and the benefits to ratepayers of electronic access to energy usage data. Prior to Mission:data, I led an unincorporated coalition of innovative companies called the Open Energy Network that in 2012-2013 intervened at the California Public Utilities Commission to successfully institute the first state-wide implementation of Green Button Connect My Data, further described below.

Since 2012, I have authored publications and presented at conferences on the value of energy usage data. In December, 2017, I published a report titled "Energy Data: Unlocking Innovation with Smart Policy." I co-authored "Got Data? The Value of Energy Data Access to Consumers" in 2016 which includes an analysis of numerous states' policies governing access to smart meter data. I also co-authored "New Smart Meter Policies Yielding Data (and Savings) for End Users," published in 2016 in the journal *Natural Gas & Electricity*. I have presented at dozens of conferences on state developments in energy data access. In 2012, I presented at the White House with former

Secretary of Energy Steven Chu and former U.S. Chief Technology Officer Aneesh Chopra on Green Button.

I began my career in 2004 as co-founder and CEO of Lucid, an energy management software company for commercial buildings, where I grew the company from zero to over 40 employees, raised $10 million in venture capital and recruited board members from Apple, Intuit and Bear Stearns. Lucid offers a cloud-based service that analyzes real-time meter data from thousands of commercial buildings across North America to support energy efficiency. Lucid's customers include over 350 organizations such as Google, the City of Orlando, eight of the eight Ivy League universities and others. I hold two U.S. patents relating to energy data collection, sharing and analysis, #8,176,095 and #8,375,068. I earned a B.A. with highest honors from Oberlin College in 2004.

Q. ON WHOSE BEHALF ARE YOU FILING THIS ANSWER TESTIMONY?

A. I am filing this answer testimony on behalf of the Ohio Environmental Council and the Environmental Defense Fund, intervenors in this case.

Q. WHAT IS THE MISSION:DATA COALITION?

A. The Mission:data Coalition, a non-profit organization, is national coalition of more than 35 technology companies delivering consumer-focused, data-enabled energy savings for homes and businesses. The exciting new industry our companies represent is based on advances in computational capability that did not exist a decade ago. For the residential sector, the real game changer is the availability of continuous energy usage information made available by Advanced Metering Infrastructure ("AMI"). Our members – with sales in excess of $1 billion per year – have developed innovative services leveraging smart

meter and utility bill data that benefit consumers and utilities. Our companies are focused on bringing energy efficiency solutions to a national market. To realize that objective, it is vital that we empower consumers with convenient access to their own energy data in a consistent manner from state to state and from utility to utility. Mission:data works with industry and policymakers to advance customers' ability to quickly and conveniently share their meter data with energy management companies of their choice. More information about Mission:data is available on our website at http://www.missiondata.org/.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The deployment of AMI offers significant operational benefits for utilities and the potential for significant energy savings for consumers. Between 33% and 66% of the potential benefits of AMI may be customer benefits, as I explain below. A major lesson from prior state deployments of AMI is that full realization of consumer benefits from efficiency or time-shifting of usage will not occur unless consumers have convenient access to their own energy data made available by advanced meters. It is also critical that such policies are timely and consistently implemented. Duke Energy Ohio has deployed AMI and I am making recommendations to ensure that consumers receive their share of the benefits of AMI – specifically, access to the energy data generated by advanced meters, along with accompanying cost information, as further described below. My objective is to provide guidance on the specific steps that must be taken so that these consumer benefits are fully realized for Duke Energy Ohio's customers.

Q. HAS MISSION:DATA HELPED DEVELOP DATA ACCESS POLICIES IN OTHER STATES?

A. Yes. Mission:data, which focuses on empowering consumers with convenient, easy access to their energy data, has engaged in more than a dozen states across the country and offers experience on lessons learned, from which Ohio can benefit. Mission:data has filed comments or otherwise provided information for proceedings in the following states: Arizona, California, Colorado, Illinois, Maryland, Massachusetts, Michigan, Minnesota, New York, North Carolina, Pennsylvania and Texas, as well as the District of Columbia. Copies of our comments or other filings are available on our website at www.missiondata.org.

Q. PLEASE SUMMARIZE YOUR RECOMMENDATIONS.

A. To ensure that Duke Energy Ohio's (the "Company") electricity customers have convenient and secure access to new data-enabled technologies and services to help them save energy and money, and otherwise realize value from the AMI deployment, I recommend several steps:

1. **To be eligible for cost recovery, the Company should provide consumers easy access to the best available information about their energy usage through two interfaces**, including (i) energy usage information transmitted through the Company's Field Area Network ("FAN") and back to the Company's information technology systems and provided to the consumer and authorized third parties via the utility's information technology ("IT") systems; and (ii) real-time information directly from the Home Area Network ("HAN") radio in the advanced meter to a device controlled by the consumer.

   To promote competitive markets for "behind the meter" services, the data collected by advanced meters should be provided in a standardized protocol in order

to support innovative new technologies, as a component of basic utility service. Meter data transmitted through the FAN should be provided to the consumer via the Green Button Connect My Data standard, further described below. The HAN radio contained in each meter should be enabled as meters are deployed so that customers can experience immediate, tangible benefits. The Company should provide a "Bring Your Own Device" ("BYOD") offering to allow customers to easily connect any HAN-compliant device to the smart meter.

2. **In order to recover the costs of AMI and related IT systems, the Company should provide customers and authorized third parties with access to historic billing information in a machine-readable, automated manner**. Access to billing data is important so that new digital services can provide information to consumers on the exact bill impacts of their energy decisions. Historical bills should also be able to be transmitted directly from the utility to any authorized third party electronically via a standardized XML format.

3. **The Company should provide consumers and third parties with rate information in standardized, machine-readable formats**. Utility rate schedules should be published in standardized, machine-readable forms because it allows new technologies across the U.S. to easily calculate the bill impacts of certain decisions regarding energy efficiency or other distributed energy resources. Most people care about dollars, not kilowatt-hours. Providing innovative companies with access to the Company's approved rates in a standardized, machine-readable format, maintained in a centralized database, is important because it takes human beings out of the cost-calculation process and lets software do the work, regardless of how complex rates

may become. The Commission should require Duke Energy Ohio to maintain accurate and up-to-date rates in the National Renewable Energy Laboratory's Utility Rate Database so that software applications can easily convert kilowatt-hours or therms into dollars and present customers with accurate options for cost-saving measures.

4. **The customer authorization process should be easy for consumers to use and require the least number of steps.** Signing up for third party energy management services should be easy, like downloading a smartphone "app." By simplifying the user experience online and minimizing the number of customer actions required, i.e. the reducing the number of clicks, the Company can ensure that customers can immediately gain additional value from their smart meter with numerous software applications now available on the market, which I further describe below. Customer authorization processes that require many inputs from customers or that require many steps will result in significantly less adoption of data-enabled energy management services and fewer benefits for consumers from the AMI investment.

Q. WHY IS DATA ACCESS IMPORTANT FOR HELPING CONSUMERS SAVE ENERGY?

A. The opportunity for consumers to save energy and save money with smart meter data is based on advances in computational capability that did not exist a decade ago. With energy efficiency efforts, one fundamental problem has been the expense of evaluating how much a home or building is wasting energy and identifying appropriate steps needed to reduce that waste. In the industrial and large commercial sectors, the amounts of energy consumed are large enough to justify significant investments in customer-owned

submeters on electric circuits and information technology systems to analyze energy use (even though those investments are often unnecessary in theory because the utility's advanced meters collect the same information). However, in the residential sector, loads are much smaller and more diverse, meaning that efficiency solutions that depend on usage data have been severely limited up until recently because of a multi-hundred-dollar cost per home in metering equipment, communications systems and installation is necessary when advanced meter data are not easily accessible.

A real opportunity in the residential sector is the availability of continuous energy usage information in a secure, standard electronic format made available by AMI. Energy usage patterns vary greatly across households – very few homes are alike. A detailed analysis of each home's use opens the door to tailored and highly effective strategies for managing energy use and helping consumers save money. Research and experience in other states shows that energy conservation solutions that use granular and real-time data generate bill savings more effectively and in many instances can cost ratepayers significantly less than traditional energy efficiency programs.

Q. WHAT ARE THE BENEFITS TO OHIO OF USING PROVEN TECHNOLOGY STANDARDS DEVELOPED FOR A NATIONAL MARKET?

A. A vibrant, competitive national marketplace is developing to take advantage of consumers having access to their own usage data and the ability to share that data with energy management providers, also known as "third parties," of their choice. In the past, it was necessary for many energy efficiency solutions to be tailored to each utility. With over 3,000 utilities across the country, an approach to energy efficiency that focuses on custom-built solutions for individual utilities results in a balkanized, fragmented market

that fails to take advantage of the economies of scale enabled by software and inexpensive computing power. Thus, the kind of Internet-based consumer innovation that has transformed mobile communications is largely absent in the electricity sector.

To realize timely, tangible consumer benefits from AMI deployments, it is important to undertake several specific steps to provide consumers with convenient, reliable and secure access to their own data. Five states – California, Colorado, Illinois, New York, and Texas – have led the way in empowering consumers with such access on a statewide basis. These states represent a total market of over 32 million data-enabled AMI meters – almost half of the 70 million advanced meters deployed (or soon to be deployed) nationwide.[1] Maryland is also considering whether to implement these "best practices" statewide.[2] In two other states – Colorado and New Jersey – the Commissions have approved settlements in which the utilities (Xcel Energy and Rockland Electric Company) have agreed to adopt data access policies. In addition to leading the development of a national market for low-cost energy management offerings, I believe that the aforementioned states provide valuable lessons from which Ohio can learn, namely how best to leverage AMI to help consumers save money, spur adoption of clean, distributed energy resources, and enhance the state's technology leadership and economic growth. I discuss later in my testimony specific standards that should be adopted to ensure maximum value from Ohio's AMI investments.

Q. PLEASE DESCRIBE THE BENEFITS FOR CONSUMERS AND STATES OF CONSUMER DATA ACCESS ENABLED BY ADVANCED METERING?

[1] Adam Cooper, Electric Company Smart Meter Deployments: Foundation for A Smart Grid, Edison Foundation Institute for Electric Innovation, September 2016 at 2.

2 Maryland Public Service Commission, Public Conference 44. Staff report from the customer choice workgroup, June 30, 2017.

A. While data access at scale is relatively new, the initial results are very promising and impressive. Data-driven energy savings generated by third party energy management solutions can save consumers between 6% and 18% of their energy use.[3] In one example in California, energy management technologies are knocking up to $20 per month or more off residential utility bills.[4] Adjusted to the average Ohio rate for residential customers of 12.15 cents/kWh, that would equate to $13.01 per month bill savings.[5] Companies are developing low-cost, innovative ways of engaging consumers, such as a new service that helps parents direct monthly bill savings to college savings accounts for their children.[6]

Harnessing competitive market forces can provide consumers with many more choices of offerings and yield energy savings much more cost-effectively than traditional, utility-run efficiency programs, thus avoiding the need for ratepayer subsidies for new programs and technologies that may already exist. In one case involving analytical software and weekly energy reports, a software program that based its individualized recommendations to consumers on 60-minute usage data delivered energy savings averaging more than 5% across all participating households – comparable to those delivered by a traditional non-targeted efficiency program investing in equipment and structural retrofits – at 1/25th of the cost.[7]

3 Michael Murray and Jim Hawley, "Got Data? The Value of Energy Data Access to Consumers", Mission:data Coalition and More Than Smart (2016), *available at* http://www.missiondata.org/s/Got-Data-value-of-energy-data-access-to-consumers.pdf.

4 *See, e.g.*, http://www.wattzon.com/wp-content/uploads/2016/07/PartnerStudy_Livermore_061015.pdf.

5 Average residential electric rates in Ohio are 12.15 cents/kWh, and California is 18.68 cents/kWh as of February, 2017. *See* EIA Electric Power Monthly, at Table 5.6.A, Average Price of Electricity to Ultimate Customers by End-Use Sector by State, Apr. 25, 2017.

6 *See, e.g.*, http://www.wattzon.com/news/clinton/.

7 City of Mountain View, Acterra and Home Energy Analytics, "Energy Upgrade Mountain View Final Report", Jan. 2015 at 3, *available at* http://corp.hea.com/results/.

Q. IS IT POSSIBLE TO QUANTIFY THE CONSUMER BENEFITS OF BILL SAVINGS DUE TO ENERGY EFFICIENCY RESULTING FROM ADVANCED METERING AND DATA ENABLEMENT?

A. Yes. Several utilities in other states have provided estimates for their AMI investments. In 2007, Southern California Edison Company ("SCE") submitted its application for AMI. In that case, operational benefits alone were not sufficient to fully offset the costs of five million AMI meters. Southern California Edison worked with the Office of Ratepayer Advocates to develop estimates of consumer benefits and determined that, overall, consumer benefits would total about $816 million, compared to operational benefits of approximately $1.1 billion. As for consumer conservation benefits specifically, SCE estimated a minimum of $164 million in benefits. To reach this estimate, SCE made a number of assumptions regarding residential consumer adoption of both real-time information feedback technology and historical information provided through SCE's website. SCE assumed residential customers who adopt real-time technology can achieve a 6.5% reduction in energy consumption. SCE assumed 10% of new homes constructed in their territory will be equipped with in-home displays with real-time data, while existing homes will have an initial adoption rate of 0.5% and an annual growth rate of 0.05% for in-home graphical displays. SCE also assumed computer-based graphical displays using near real-time data would have a 1% initial market penetration with an additional 1% of growth each year thereafter. SCE anticipated residential customers that use interval data provided through their website can achieve a

2% reduction in their energy consumption.[8] Unfortunately, SCE implemented Green Button Connect My Data and the HAN years behind schedule, a mistake we can avoid here in Ohio. As a result, the benefits projected by SCE were not realized in the early years of AMI deployment.

Industry is continuing to develop more effective methods of engaging consumers and studies suggest that savings of similar magnitudes can be achieved. I believe that estimates based on this type of methodology offer a reasonable basis to quantify the consumer-side benefits of AMI, with the important proviso that standards-based data access via the two interfaces I have discussed is promptly implemented by the Company.

Ameren Illinois Company also quantified the consumer benefits of energy savings as a result of enhanced access to information made possible with AMI. Ameren calculated the benefit of energy efficiency to be $23.7 million, with an associated $10.3 million in carbon reduction benefit as a result of energy saved.[9]

Q. IS IT REASONABLE FOR UTILITIES TO ADOPT DATA ACCESS "BEST PRACTICES" TO ENABLE CUSTOMERS TO OBTAIN THE FULL ENERGY SAVINGS RELATED TO AMI DEPLOYMENTS?

A. Yes. Customers almost always pay for the full cost of AMI in rates, so utilities should adopt data access "best practices" to enable customers to obtain the full potential of energy savings that can be obtained with AMI. Several independent studies have validated the notion that consumer energy savings can be quantified and achieved in an

[8] Opening Brief, Southern California Edison Company (U 338-E), in A.07-07-026 (filed July 31, 2007), April 4, 2008 at 3 (in support of settlement agreement with Office of Ratepayer Advocates and others regarding SCE AMI deployment). For assumptions regarding adoption rates, *see* settlement agreement, p. A-1 filed in the same docket.

[9] Direct Testimony on Rehearing of Dr. Ahmad Faruqui. Illinois Commerce Comm. Docket No. 12-0244, Ameren Ex. 5.6RH (June 28, 2012).

AMI deployment. A report by Dr. Ahmad Faruqui, et al. in 2011, authored for the Edison Foundation's Institute for Electric Efficiency, found that consumer bill savings, either from load-shifting or conservation as a result of the information provided by AMI, account for 33% of total AMI benefits for a hypothetical "cautious" utility and 66% of total AMI benefits for a hypothetical "pioneer" utility.[10] In order to model these potential benefits, Faruqui, et al. conducted a detailed analysis that considered four different archetypal customer segments (the "Saver," "Green," "Comfort" and "Basic" customer), methods of customer engagement to achieve savings ("Passive," "Active," "Set & Forget," "Utility Automation" and "Energy Partners"), and a variety of different assumptions about the utility's electric rates for each customer segment.

In addition, a guidebook for cost benefit analysis published by the Electric Power Research Institute ("EPRI") in 2012 states that quantifying consumer benefits is necessary because it is such a large potential value. EPRI writes that, while calculating consumer benefits can be complex,

> ...a large part of the value of some Smart Grid investments is derived from other technologies whose use they enable. Assessing the value of Smart Grid investment must address the functions it enables, as well as the value that it provides directly.[11]

Duke Energy Ohio should strive to provide customers with the full range of benefits associated with AMI, even though the exact value may not be certain.

[10] Ahmad Faruqui, et al. *The Costs and Benefits of Smart Meters for Residential Consumers*, The Institute for Electrical Efficiency, The Edison Foundation (July 2011) at 27.

[11] *Guidebook for Cost/Benefit Analysis of Smart Grid Demonstration Projects: Revision 1, Measuring Impacts and Monetizing Benefits*. EPRI, Palo Alto, CA: 2012. 1025734. *Available at* http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001025734.

By providing customers with meter data access, Duke Energy can achieve not only energy efficiency savings but also peak demand savings. Many researchers have studied the conservation impacts of time-shifting behaviors on the part of consumers. One notable study in *Public Utilities Fortnightly* considered whether efficiency and demand response were "twins, siblings or [merely] cousins." The authors found an average 4.0% conservation effect as a result of dynamic pricing across 23 different utilities. Long-term conservation effects were found even though dynamic pricing was intended to address only certain peak hours – likely because consumer habits inevitably bleed into off-peak times.[12] The causal factor of bill savings – enhanced information and pricing signals that change consumer behavior – can be attained through both efficiency and demand savings.

Q. WHAT IS YOUR ESTIMATE OF THE MAGNITUDE OF THE CUSTOMER ENERGY SAVINGS AND PEAK DEMAND SAVINGS THAT DUKE ENERGY CAN OBTAIN BY ADOPTING DATA ACCESS "BEST PRACTICES"?

A. I cannot conduct a rigorous analysis because I lack information such as the appropriate market segmentation data of the Company's customer base. However, it is possible to broadly apply the findings from other studies to Duke Energy Ohio in order to see that the benefit could be very significant and deserves further consideration.

A valuable reference point is Faruqui, et al.'s (2011) analysis mentioned previously. Faruqui, et al. estimate a customer efficiency benefit of $100 per customer for a "cautious" utility and an efficiency benefit of $150 per customer for a "pioneer" utility. These benefits are experienced over a 20-year time horizon. Assuming Duke Energy has

[12] "Twins, Siblings or Cousins? Analyzing the conservation effects of demand response programs." Chris King and Dan Delurey. *Public Utilities Fortnightly*, (March 2005) at 54-61.

500,000 residential electricity customers in Ohio, the magnitude of projected customer benefits would be approximately $50 million to $70 million.[13]

Ameren's potential customer efficiency benefit of $23.7 million was derived from Faruqui, et al. (2011) but with different assumptions on customer segmentation, time-of-use rates and other variables.[14] Again, I cannot say which analysis is more accurate or appropriate for Duke Energy Ohio. But the potential magnitude of customer benefits is quite large. My recommendation is that the Commission require the Company to thoroughly examine customer benefits of energy savings, using the methodologies demonstrated in the literature I have cited, prior to allowing cost recovery of AMI and related IT costs in rates.

Q. HAVE ANY OTHER DUKE ENERGY OPERATING COMPANIES IMPLEMENTED GREEN BUTTON CONNECT?

A. As of today, no. The Duke Energy Carolinas ("DE Carolinas") in North Carolina recently filed a settlement agreement with the North Carolina Utility Commission that would have required DE Carolinas to propose implementation of Green Button Connect within six months.[15] However, the North Carolina Commission just punted the issue of Green Button Connect back to the Smart Grid Technology Plans docket, which has made little progress in the past several years in advancing third party access to customer usage data. As a result, customers in Duke Energy Carolinas territory are missing out on significant benefits that would have resulted from speedy implementation of GBC.

[13] Faruqui, et al. (2011) at 27.
[14] *Ibid*. at 11.
[15] Duke Energy Carolinas' Proposed Stipulations and Settlement Agreements. Docket E-7, Sub 1146. North Carolina Util. Comm. (June 1, 2018), *available at* http://starw1.ncuc.net/NCUC/ViewFile.aspx?Id=d6757e5f-91f2-4c5d-81b1-e253d08f9f2a

Q. PLEASE DESCRIBE THE STIPULATION AND RECOMMENDATION SIGNED APRIL 13, 2018 BY DUKE ENERGY OHIO AND OTHER INTERVENORS AS IT RELATES TO DATA ACCESS.

A. Parties, including Duke Energy Ohio, Commission Staff, the City of Cincinnati, Ohio Partners for Affordable Energy, Ohio Energy Group, Ohio Hospital Association, and People Working Cooperatively, signed a Stipulation and Recommendation ("Stipulation") on April 13, 2018 to resolve issues raised in the following proceedings: Case No. 17-32-EL-AIR, Case No. 17-872-EL-RDR, Case No. 17-1263-EL-SSO and Case No. 16-1602-EL-ESS. The Stipulation would, if approved by the Commission, require Duke Energy Ohio to implement several improvements to its CRES portal in order to better serve CRES providers, as detailed in Attachment F of the Stipulation.

Q. WOULD THE IMPROVEMENTS INCLUDED IN THE STIPULTION BENEFIT THIRD PARTIES WHO ARE NOT COMPETITIVE RETAIL ENERGY SUPPLIERS?

A. No. The improvements are limited to CRES providers.

Q. WHAT ELSE DOES THE STIPULATION SAY ABOUT DATA ACCESS?

A. On page 17, the Stipulation says, “If a third party other than a CRES expresses an interest in receiving CEUD [Customer Energy Usage Data], the Company shall develop a proposal for providing historical interval CEUD to third parties when authorized by customers.”

Q. DOES THE ABOVE LANGUAGE SATISFY YOUR CONCERNS?

A. No, it does not, for several reasons. First, the language in the Stipulation is very vague. It is unclear whether the Company would be required to develop a proposal for

Commission review, or whether the proposal would go to the third party only. Second, there are no technical requirements guiding such a proposal for providing interval CEUD electronically to third parties. The Company could propose any number of technical methods for transmitting interval CEUD that are idiosyncratic and that do not comply with nationally-recognized standards and best practices, resulting in increasing costs of processing such data to third parties. Third, there is no timeframe by which the Company must make a proposal. From my perspective, the lack of these important details means that the part of the Stipulation on page 17 cited above is virtually meaningless.

Q. WERE DISCOVERY REQUESTS SUBMITTED TO THE COMPANY WITH REGARD TO THE STIPULATION'S PROVISIONS CONCERNING DATA ACCESS?

A. Yes. OEC-EDF submitted an interrogatory, OEC-EDF-INT-01-001.

Q. DID THE COMPANY'S DISCOVERY RESPONSE ADDRESS YOUR CONCERNS?

A. No. In fact, the Company's response supports my argument that the Stipulation's provision concerning third party access to interval CEUD is vague and ineffectual. In the response dated June 15, 2018, the Company provided only minimal responses to questions. In response to the question, “Will any ‘proposal’ developed by the Company in response to third party interest in receiving customer energy usage data (‘CEUD’) be provided to the Commission and the third party, or just to the third party?”, the Company replied without directly answering the question, saying, “The Commission will need to determine what it wishes to review.” In response to the question, “Will proposals developed by the Company in response to third party interest in receiving CEUD be

publicly available?", the Company responded simply, "Unknown at this time." In response to the question, "If any such proposal is developed by Duke and accepted by the third party and/or the Commission, does this provision commit Duke to moving forward and implementing the proposal?", the Company responded simply, "Unknown at this time." The lack of meaningful requirements in this provision of the Stipulation mean that the Stipulation does not accomplish anything of substance in terms of providing interval CEUD to customer-authorized third parties.

Q. IN YOUR VIEW, SHOULD THE STIPULATION BE APPROVED BY THE COMMISSION?

A. No. The Stipulation is wholly inadequate. While approving cost recovery for significant AMI and information technology investments, the Stipulation does nothing to benefit non-CRES third parties, whom customers in Ohio can use to reduce their energy usage and monthly costs. The Stipulation does not provide any pathway for customers to benefit from new technologies that are supposedly enabled by AMI. For these reasons, the Stipulation should be rejected.

II. ACCESS TO ENERGY USE DATA

Q. PLEASE DESCRIBE YOUR FIRST RECOMMENDATION THAT DUKE ENERGY SHOULD PROVIDE CUSTOMERS AND AUTHORIZED THIRD PARTIES WITH BOTH HISTORIC AND REAL-TIME ENERGY USAGE INFORMATION.

A. There are two distinct interfaces by which utilities can provide customer energy usage data to customers for their own use. First, historic interval data collected by the meter and transmitted through the utility's Field Area Network (FAN) should be made available to consumers and authorized third parties as soon as possible after it is collected by the utility. Energy usage data should be provided through a nationally standardized and

automated method, "Green Button Connect My Data" ("GBC"), also known by its technical name, the Energy Services Provider Interface or the North American Energy Standard Board's REQ.21. A principal advantage of GBC is that consumers can automatically transmit data to third parties without having to purchase equipment for their home or building. The energy usage data is typically provided after some delay to the consumer's authorized third party because it must go through the utility's FAN and information technology infrastructure. Second, real-time data should be provided through the Home/Premises Area Network (HAN) radio contained in the smart meter and transmitted directly to a device on-site owned by the consumer, typically called a "gateway," in-home display or other device capable of receiving the signal from the meter. Real-time data access can unlock a host of new applications and services, but only if the Company enables the HAN radio on the smart meter and makes it easy for a customer to connect their HAN device with their meter. In my experience, HAN radio hardware is included in virtually all advanced meters available on the market at no additional cost.

A. ACCESS TO ENERGY USAGE DATA WITH SOME DELAY (AS OPPOSED TO REAL-TIME)

Q. WHAT IS GREEN BUTTON?

A. Green Button refers to an industry-led standard, ratified by the American National Standards Institute ("ANSI") accredited North American Energy Standards Board ("NAESB"), for downloading and sharing customer usage and cost data. The standard was developed by the National Institute of Standards and Technology ("NIST") and the Smart Grid Interoperability Panel. Green Button has its roots in the American Recovery and Reinvestment Act of 2009 ("ARRA"), which directed the Federal Communications

Commission to develop a national broadband plan to include digital strategies for "energy independence and efficiency." Goal number six of the National Broadband Plan states, "To ensure that America leads in the clean energy economy, every American should be able to use broadband to track and manage their real-time energy consumption."[16]

Federal support for the deployment of advanced meters in America stemming from ARRA included the development of interoperability standards for grid investments, such as customer energy usage data. NIST, as well as the Smart Grid Interoperability Panel, coordinated the standard's development over many years with input from many stakeholders, including utilities. Green Button uses common Internet web services methods and modern information technology standards such as XML. More than 50 utilities nationwide, including American Electric Power, have implemented Green Button "Download My Data," a subset of the standard that is limited to the particular file containing energy usage data. The complete version of the Green Button standard, known as "Green Button Connect My Data" ("GBC"), has been deployed by investor owned utilities across the states of California and Illinois, and in Washington, D.C. In New York, the Commission has required its regulated utilities pursuing advanced metering to implement GBC. In Colorado, Xcel Energy will provide GBC to all customers in 2020 as part of its AMI deployment. Of the 70 million smart meters in the U.S., over 32 million currently have, or will soon have, access to data via the GBC standard.

[16] Federal Communications Commission (2010). "Connecting America: The National Broadband Plan," at xiv-xv, *available at* https://transition.fcc.gov/national-broadband-plan/national-broadband-plan.pdf.

Q. PLEASE EXPLAIN THE DIFFERENCE BETWEEN GREEN BUTTON DOWNLOAD MY DATA AND GREEN BUTTON CONNECT MY DATA.

A. Green Button Download My Data ("DMD") allows customers to manually download their electricity usage information in a standardized file format known as XML. This file can be uploaded by a consumer to third party software applications. DMD is useful, but it requires customers to manually log into their utility's website, download the Green Button XML file, and manually import it to another software tool each time they want to access or use their data. DMD is helpful for one-time uses, such as sending the file to a solar installer to get a price quote. But DMD is too burdensome for ongoing data collection to be useful. Most applications for energy efficiency require ongoing access; therefore, DMD is considered very limited in terms of overall usefulness.

The real breakthrough, critical to enabling the kind of ongoing monitoring and control that consumers expect with modern apps, is GBC. With GBC, the utility hosts an automated web service through which developers of energy management software can, with customer authorization, automatically and securely retrieve meter data in their software. There is no need for the customer to repeatedly log in to the utility's website and download files. These authorizations are valid for an agreed upon time and can be revoked at any time by the consumer. These data can then be accessed and analyzed with third party software, including mobile applications.

While the term "Green Button" can refer to both DMD and GBC, it is important to understand the differences between the two. The stark contrast of usefulness between DMD and GBC to utility customers was recognized by the Edison Foundation in 2012. They wrote:

> Green Button [DMD] requires customers to download their energy usage data to a computer and then manually upload it to a third party application. The downloading process is a barrier. As the Green Button movement matures, an automation process, known as "Green Button Connect My Data," where the customer clicks a button to push the data to a third-party, will become the norm.[17]

Q. WHAT STANDARD SHOULD BE USED FOR EXCHANGING CUSTOMER USAGE DATA FROM THE UTILITY'S IT SYSTEMS?

A. I recommend the Commission require Duke Energy Ohio to implement GBC as a condition for recovering AMI costs. Any implementation of GBC should be compliant with the most current NAESB standard and documented best practices. Furthermore, the Company's GBC implementation should be subjected to periodic certifications by an independent third party, the Green Button Alliance, a 501(c)3 non-profit organization, to provide assurances that it is fully compliant. Some utilities across the country have non-compliant DMD implementations, for example, which fragments the marketplace. Finally, non-compliant implementations that do not pass the certification process should be promptly remedied, with fines or penalties imposed for prolonged non-compliance.

Q. WHAT IMPACT WOULD ADOPTING GREEN BUTTON CONNECT HAVE ON THE CURRENT EDI SYSTEM USED TO EXCHANGE DATA BETWEEN UTILITIES AND COMPETITIVE RETAIL ELECTRIC SERVICE (CRES) PROVIDERS?

A. None. The current EDI system should remain intact. Utilities and CRES Providers have already invested significant sums to implement EDI. Green Button Connect was designed to facilitate customer energy management activities with non-CRES Providers,

[17] Edison Foundation IEE Issue Brief, "Green Button: One Year Later." (Sept. 2012) at 7, *available at* http://www.edisonfoundation.net/iee/Documents/IEE_Green%20Button%20Report_Final.pdf.

and GBC should be implemented alongside EDI to serve parties other than CRES Providers.

Q. WHAT ARE THE CUSTOMER BENEFITS OF GREEN BUTTON CONNECT MY DATA?

A. Commercial and residential buildings make up approximately 41 percent of total energy use in the U.S.[18] – the single largest energy-consuming sector. In 2010, the American Council for an Energy Efficient Economy's (ACEEE) review of 57 studies concluded that timely consumer access to granular energy data yielded household energy savings of between 4% and 12% or more.[19] Even the more modest savings identified through the use of delayed information feedback approaches identified by ACEEE are significantly larger than the savings that many demand-side management customer engagement strategies are attaining today. As new energy efficiency services evolve and improve, potential savings are likely to increase. In my 2016 report, I found an additional 12 studies beyond those identified previously by ACEEE in which the savings ranged from 8% to 17%.

As an example, in Alameda and Santa Clara Counties in California, the use of data-access functionality now available broadly across the state has demonstrated significant household savings: a study in Alameda County found electricity savings of 7.4% for electricity and 13% for natural gas, and another in Mountain View found 5.5% savings in electricity and 16.4% savings in gas – at a cost per household a small fraction

[18] U.S. Energy Information Administration, State Energy Profiles, *available at* http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_sum/html/rank_use_gdp.html.

[19] Karen Ehrhardt-Martinez, Kat Donnelly, et.al., *Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities*, American Council for an Energy Efficient Economy (aceee.org), Report Number E105 (June 2010), at iii.

of the cost of traditional efficiency programs.[20] In one recently-implemented program in Livermore, California, using Green Button Connect, consumer utility bill savings are averaging about $20 per residential customer per month.[21] Adjusted to average Ohio residential rates, that would be $15.00 per month in savings.[22] Moreover, these gains are extremely cost-effective because data analysis parses the individualized usage patterns of each building and can identify targeted strategies that are the most relevant.

Q. WHAT ARE SOME SPECIFIC EXAMPLES OF NEW PRODUCTS ENABLED BY GREEN BUTTON CONNECT?

A. While Green Button Connect has been fully deployed in California only since 2016 and the market remains nascent, a number of companies have already developed free and/or low-cost apps and software offerings. Mission:data as an organization does not endorse specific products, but I offer the following examples of the innovative offerings being developed for consumers.

Chai Basic: Chai allows the consumer to keep a close watch on energy usage and costs. By collecting energy data directly from the utility, it can predict the consumer's next utility bill, help track your energy savings and even pay the consumer to save energy. The consumer will also receive customized energy conservation tips and savings opportunities based on actual energy use. Chai currently supports these three utilities: Southern California Edison, Pacific Gas & Electric, and San Diego Gas & Electric.

[20] Rebecca Brown, Bringing It All Together: Design and Evaluation Innovations in the Alameda County Residential Behavior Pilot (Presentation to the Behavior, Energy and Climate Change Conference), Dec. 8, 2014; City of Mountain View, Acterra and Home Energy Analytics, Energy Upgrade Mountain View Final Report (Jan. 2015).

[21] *Available at* http://www.wattzon.com/wp-content/uploads/2015/06/Partner-Story-Livermore.pdf.

22 Based on a California average residential rate of 16.99 cents/kWh and an Ohio average residential rate of 12.80 cents/kWh. See Energy Information Administration form 861, Table 5A, *available at* https://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf.

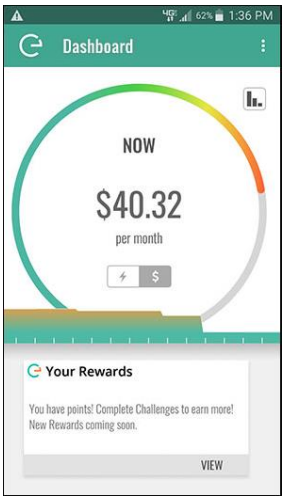

Figure 1: Screenshot of Chai Energy smartphone application (used with permission)

Dr. Power (Home Energy Analytics, Inc.): Dr. Power helps consumers understand home energy use, identify problems, and prescribe solutions. Dr. Power was created by residential energy experts under a grant from the California Energy Commission. Dr. Power is a free app for all Californians and works with Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric. Dr. Power helps users identify energy wasting loads and appliances, reduce consumption, and save energy and money.

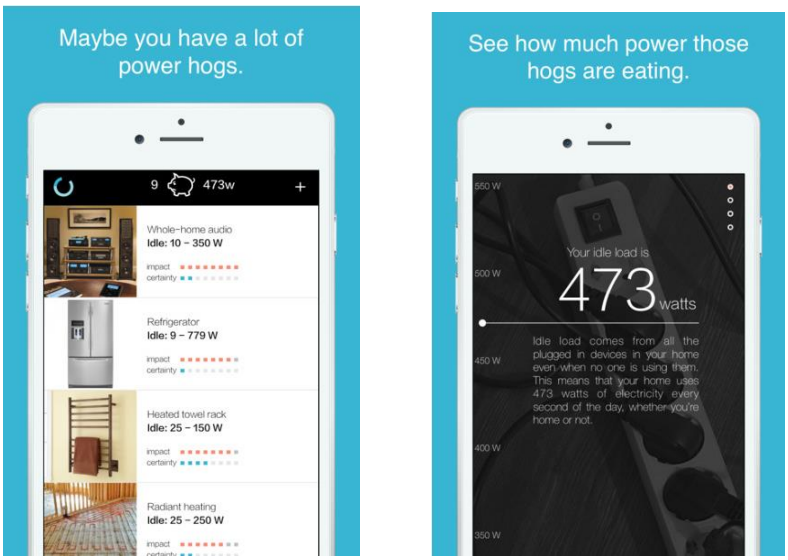

Figure 2: Screenshot of Dr. Power smartphone application (used with permission)

OhmConnect: OhmConnect alerts the consumer when he or she should save energy, and pays them to participate. To get started, the consumer (1) connects his or her utility account by authorizing using GBC; (2) participates by turning off lights, the TV, adjusting the thermostat, or holding off on other energy intensive activities; and (3) if he or she has smart devices, connects them and OhmConnect will automate their energy savings. Consumers may refer friends to participate, in which case both the user and the friend earn $20.

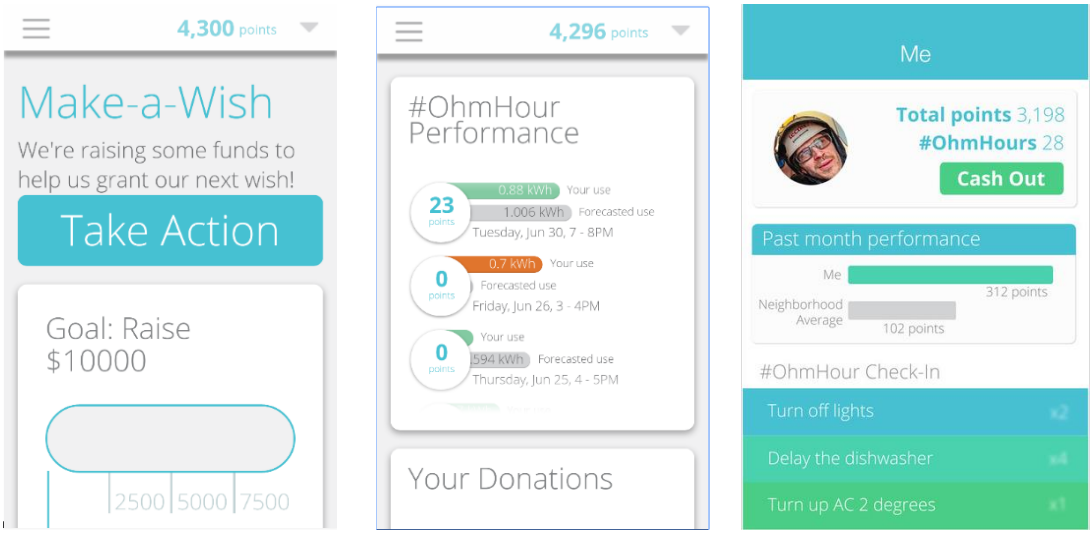

Figure 3: Screenshots of OhmConnect smartphone application (used with permission)

OhmConnect is a free service. If the consumer can't participate, they opt-out of events they cannot or do not want to participate in. OhmConnect needs the smart meter information to measure energy savings. If the consumer reduces during events, called #OhmHours, OhmConnect is paid by California's electricity market. OhmConnect passes those earnings back to the consumer: to date, OhmConnect has paid its customers more than $2 million for their participation. Most OhmConnect users choose to receive #OhmHours via text message or email. Some users with wifi thermostats or electric cars

have connected their devices to OhmConnect to automate their participation, but that is not required. If consumers are interested in purchasing a smart device, they can visit the OhmConnect Store to see available products that OhmConnect sells and finances through their earnings.

Q. HAS DUKE ENERGY QUANTIFIED OPERATIONAL BENEFITS FROM CUSTOMERS RECEIVING ENHANCED ACCESS TO THEIR ENERGY USAGE INFORMATION GENERALLY, OR FROM GREEN BUTTON CONNECT MY DATA SPECIFICALLY?

A. No. Duke Energy has not quantified these benefits.

I strongly recommend the Commission require the Company to quantify these benefits because, as I have argued, they are substantial.

Q. IS GREEN BUTTON CONNECT MY DATA COSTLY TO IMPLEMENT?

A. No. In Colorado, Xcel Energy indicated that the cost to implement Green Button Connect in its multi-state service territory was $1.5-2.0 million.[23] This equates to a one-time cost of $1.00 to $1.30 per meter. I submit that GBC's cost is very modest compared with its potential benefits.

In addition, the costs of GBC to Ohio ratepayers would be further reduced if and when Duke Energy affiliates in other states adopt it.

Q. IS GBC A BEST PRACTICE IN PROVIDING ENERGY USAGE DATA TO CUSTOMERS?

A. Yes. Prior to 2013 when California became the first state to mandate GBC, it would not have been possible to say that GBC is a best practice because there was no large-scale

[23] Settlement Agreement between Company and Mission:data Coalition, Colorado Publ. Util. Comm., Case No. 15A-0789E (Apr. 25, 2016).

deployment in existence. But today, over 32 million meters across the United States have, or will soon have, the ability to transmit information to third parties via GBC. The Edison Foundation stated in 2013 that GBC would take over as "the norm." Utilities around the country such as Commonwealth Edison have praised GBC as a best practice, saying, for example:

> "We are pleased to offer our customers the latest in data analytic technology bringing more opportunities for them to leverage their smart meters and manage daily electric usage…Today, ComEd customers are enjoying record power reliability and they have greater insight and control over their own energy usage through smart meter-enabled programs like Green Button Connect. We are proud to deliver on yet another smart grid promise and look forward to continuing to deliver even more value to our customers in the future," said Val Jensen, senior vice president of customer operations for ComEd.[24]

Q. IS THERE ANY OTHER STANDARD BESIDES GREEN BUTTON CONNECT MY DATA THAT COULD CONSIDERED BE A NATIONALLY RECOGNIZED STANDARD AND BEST PRACTICE?

A. I cannot think of one. Perhaps the best answer to this question comes from Consolidated Edison (ConEd). In its testimony concerning a 3.5 million smart meter application that was approved in 2016, ConEd testified:

> Q. Has the Company [ConEd] identified any alternatives to GBC that should be explored?
>
> A. The Company is not aware of any alternatives that provide the functionality, standardization, and customer-driven authorization protocols inherent in GBC… the Company [ConEd] believes that GBC is the appropriate protocol for transferring customer usage information. Development of an alternative would be costly and duplicative, and not based on a nationwide standard.[25]

[24] Press release of Commonwealth Edison, dated May 24, 2016. *See, e.g.,* http://www.businesswire.com/news/home/20160524006420/en/ComEd-Customers-Green-Light-Share-Energy-Data.

[25] New York Public Service Commission, Case No. 16-E-0060. Customer Operations Panel testimony of Marilyn Caselli, Michael Murphy, Christopher Grant et al., dated Jan. 29, 2016. Consolidated Edison Company of New York, Inc., at 45-46. *Available at* http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7b18A56129-99CB-445B-9FC3-209A60FE9393%7d.

B. ACCESS TO REAL-TIME ENERGY USAGE DATA

Q. PLEASE DESCRIBE IN MORE DETAIL THE ADVANTAGES OF ACCESS TO REAL-TIME DATA THROUGH THE HOME AREA NETWORK (HAN), THE SECOND INTERFACE METHOD YOU ARE RECOMMENDING.

A. According to the American Council for an Energy Efficient Economy study, programs with real-time, highly-granular data produced the most powerful savings for consumers: As ACEEE observed "the implementation of real-time plus feedback programs is likely to generate the most dramatic energy savings across a given community."[26] In the ACEEE study and others, consumers saved up to 12% or more when the data is real-time, compared to lower savings rates from delayed interval data.[27]

Customers have extremely high expectations in 2016: they expect seamless services, push notifications on their smartphones the instant an event occurs, and an effortless interaction with service providers online. Bringing digital experiences from other industries such as personal banking or health and fitness trackers to the energy industry offers tremendous potential to benefit consumers, but only if real-time data are available, and only when such access is technologically consistent across the nation.

The exciting trend – made possible by ever cheaper computing power and individual consumption data in standard electronic formats – is the development of customer energy efficiency products and services that are specifically tailored to their

[26] Karen Ehrhardt-Martinez et. al. Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities, American Council for An Energy Efficient Economy Report E105 (June 2010) at iv.

[27] *Id*.; *see also* Armel, Carrie; Gupta, Abhay; Shrimali, Gireesh and Albert, Adrian. "Is disaggregation the holy grail of energy efficiency? The case of electricity" *Energy Policy* 52, (Jan., 2013) at 213-234. *Available at* http://web.stanford.edu/group/peec/cgi-bin/docs/behavior/research/disaggregation-armel.pdf.

own energy use patterns and development of individual strategies and provide prompt feedback.

These tailored offerings are more effective than mass market programs and produce greater energy savings. For example, virtual energy audits that address a customer's specific energy use can be prepared without a visit to the customer's home. What used to cost hundreds of dollars with an on-site home visit can now be performed for $5 or $10, or less. Also, comparative benchmarking can be performed to compare the energy use of the customer's appliances against normal energy use for the same appliances using statistical disaggregation and machine-learning techniques.

Providing highly granular real-time usage data also enables: (a) diagnosis of large energy loads in real time, by allowing the customer to turn off certain appliances and immediately see their impact; (b) rapid and immediate verification of load reduction, which is required for some demand response applications; and (c) non-intrusive load disaggregation, which is the use of algorithms to differentiate energy loads without measuring them directly, thereby enabling customers to understand how individual *devices* are consuming energy. As previously discussed, disaggregation offers a virtual "itemized bill" and the development of automated, personalized recommendations and alerts, such as "stove left on," or "window AC unit left on with windows open." Hourly interval data can enable very basic disaggregation, but the most powerful disaggregation tools require short-interval data of the sort generated through direct consumer access to the meter via activation of the HAN radio.

Q. MORE SPECIFICALLY, WHAT IS THE HOME AREA NETWORK?

A. The HAN refers to a communications network in a home (or commercial building) wherein a smart meter can transmit read-only information about instantaneous or historic energy use to a customer-owned device. Generically speaking, a HAN can enable devices to communicate with one another, such as in home automation applications, and utility meters are not necessarily part of a HAN. But nearly all other utilities that have implemented the HAN in advanced meters have offered the ability to receive read-only, real-time readings directly from the meter, and the control functions from the utility to in-home devices are not supported.

Q. WOULD YOU PLEASE GIVE SOME EXAMPLES OF FREE SERVICES THAT CONSUMERS CAN USE TO ACCESS THEIR USAGE INFORMATION IN REAL-TIME VIA THE HOME AREA NETWORK?

A. To obtain real-time information from the HAN radio in the advanced meter, there are two steps that must occur. First, the utility must have activated the HAN radio and develop a consumer-friendly process to allow a consumer to securely "pair" his or her own receiving device, called a gateway, so that his or her device can securely receive the signal. This is a process similar to pairing a Bluetooth device to a cell phone. Second, the consumer must purchase a standards-compliant device that can receive the signal.

While Mission:data does not endorse specific products, some examples of free or low-cost apps that use real-time data are as follows. Gateways can be purchased online today for about $90, but that price is expected to drop over time. Gateways can also be integrated into other technologies that consumers might purchase for other purposes, such as a set-top box for watching cable television, which would have the effect of further reducing prices.

Chai PRO: The consumer can upgrade to Chai Energy Pro with a HAN device that talks directly to the utility's smart meter and collects energy data approximately every seven (7) seconds from the smart meter for real-time energy tracking. Chai Pro has advanced features that point out the inefficiencies in the consumer's house and the best solutions to address them.

EnergyVUE (Rainforest Automation): EnergyVUE allows the consumer to view his or her smart meter's real-time energy usage via a gateway, currently about $90. It shows the whole home's instantaneous usage, Day/Week/Month/Year graphs, and can transmit text message alerts.

Q. TO FURTHER EXPLAIN IMPORTANT DETAILS, WHAT ARE THE TWO HOME AREA NETWORK STANDARDS?

A. "Zigbee" is actually a collection of different standards for wireless communication in homes or buildings. Some Zigbee standards are tailored for home automation or indoor lighting control purposes, but the particular standard designed for smart meter-based HANs, and implemented elsewhere across the country, is known as Zigbee Smart Energy Profile 1.1 (SEP1.1). SEP1.1 allows a narrowly-defined set of information (such as kWh usage, kW demand, voltage readings, pricing signals and clock synchronization information) to pass between smart meters and in-home devices.

SEP1.1 communication occurs in the unlicensed 2.4GHz spectrum, similar to Wi-Fi or Bluetooth, and has a range of approximately 150 feet. It was originally designed for low-bandwidth applications such as HANs and uses a fraction of the transmitting power of Wi-Fi. The non-profit Zigbee Alliance, with the participation of utilities, product

manufacturers and others, manages the development of SEP1.1 through a stakeholder process. SEP1.1 was last updated by the Zigbee Alliance in December, 2014.

Zigbee SEP1.1 communication is much simpler and pared down than the wide array of internet traffic most consumers are familiar with. The Internet Protocol (IP) suite for internet traffic supports all types of communications such as http (worldwide web), ftp (file transfer) and imap (email). Zigbee SEP1.1, however, is quite limited in contrast, carrying only a few pieces of information having to do with energy usage over a low-bandwidth wireless network. Whereas IP can be used to transmit any piece of information, SEP1.1 supports only the single purpose of conveying energy usage and related information.

As the Zigbee Alliance developed its standards in the period 2008-2013, a different set of needs was identified for controlling grid-connected devices such as electric vehicles, batteries and smart inverters. Since Zigbee SEP 1.1 was intentionally limited in scope and did not support more sophisticated controls and inter-device messaging, the Zigbee Alliance set out to create another standard for this purpose. This standard, known as IEEE 2030.5, uses the breadth of the Internet Protocol to support robust controls not available in the simple, single-purpose SEP1.1. Simply put, SEP1.1 is a very small subset of the functions available in IEEE 2030.5.

It should be noted that while SEP1.1 is tied to the smart meter and wireless networks operating on the 2.4GHz wireless spectrum, IEEE 2030.5 could be used over any wired or wireless network and does not need a smart meter to delivery functionality. For example, certain control functions of electrical devices could be invoked via an electric customer's broadband internet connection. Smart inverters and electric vehicles

can be controlled using IEEE 2030.5 independent of the smart meter, so long as there is an internet connection on the premise. Of all the utilities of which I am aware, only one or two are considering IEEE 2030.5 controls for smart inverters, electric vehicle chargers and the like are planning to do so through the customer's broadband connection and not the smart meter, and none are in operation today.

Q. DO YOU RECOMMEND THE COMPANY IMPLEMENT THE HOME AREA NETWORK WITH ZIGBEE SMART ENERGY 1.1 OR IEEE 2030.5?

A. I recommend the Commission require the Company to implement SEP1.1 as a condition of AMI cost recovery because it is widely used in 23.4 million smart meters across the country. The value to consumers of the HAN is largely dependent upon the Company's adherence to widely-established standards.

Q. HAVE OTHER STATES REQUIRED UTILITIES TO PROVIDE THE HAN?

A. Yes. Regarding data access on a real-time basis from the HAN, Texas in 2007 was the first state to require real-time access to data through the HAN[28], and California promulgated a HAN implementation order in 2012 directing that the investor-owned utilities be capable of supporting an unlimited number of HAN deployments.[29] In Illinois, Commonwealth Edison is already enabling use of the HAN radio where it has deployed advanced meters.[30] These states represent three of the largest four states in

[28] Rulemaking Relating to Advanced Metering, Texas Public Util. Commission Project No. 31418 (Order) (May 10, 2007), *available at* http://www.puc.texas.gov/agency/rulesnlaws/subrules/electric/25.121/31418adt.pdf.

[29] Order Instituting Rulemaking to Consider Smart Grid Technologies Pursuant to Federal Legislation and on the Commission's own Motion to Actively Guide Policy in California's Development of a Smart Grid System, California Public Utility Commission Rulemaking No. 08-12-009 (Decision 11-07-056) (July 28, 2011), *available at* http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/140369.PDF

[30] Investigation into the Customer Authorization Required for Access by Third Parties Other Than Retail Electric Suppliers to Advanced Metering Infrastructure Interval Meter Data, Illinois Commerce Commission Case No. 15-0073 (Proposed Order) (Dec. 23, 2015), *available at* http://www.icc.illinois.gov/docket/files.aspx?no=15-0073&docId=237768.

energy consumption in the U.S,[31] accounting for 23.4 million of the 70 million smart meters that have been deployed in the U.S.

Furthermore, Pennsylvania law requires certain large electric distribution companies to, "with customer consent, make available direct meter access and electronic access to customer meter data to third parties…"[32] Pennsylvania utilities with smart meters – along with utilities in the competitive areas of Texas and investor owned utilities in California and Illinois – each implemented the Zigbee Smart Energy Profile 1.1 standard.

National Grid in New York (also known as Niagara Mohawk Power Corporation) also filed an application recently for advanced meters that support Zigbee SEP1.1.[33] If approved by the New York Commission, National Grid would add 1.7 million smart meters with SEP1.1 functionality.

Q. DOES MISSION:DATA HAVE RECOMMENDATIONS AS TO WHEN GBC AND HAN (SEP1.1) SHOULD BE ENABLED FOR THE BENEFIT OF OHIO CONSUMERS?

A. One of the lessons learned from prior deployments in other states is that consumers should be provided access to their energy data concurrently with deployment of advanced meters or as soon as possible. The Company, the Public Utilities Commission of Ohio, and the consumer all benefit when the AMI deployment is timely and tangibly linked to empowering consumers with easy access to their own real-time data. AMI deployments

[31] U.S. Energy Information Administration, State Energy Profiles, *available at* http://www.eia.gov/state/seds/data.cfm?incfile=/state/seds/sep_sum/html/rank_use_gdp.html.

[32] Commonwealth of Pennsylvania Public Utility Code (66 PA. C. S.) Chapter 28, § 2807(f)(3) as amended in 2008 by House Bill 2200 (known as "Act 129"), *available at* http://www.legis.state.pa.us/WU01/LI/LI/US/HTM/2008/0/0129..HTM

[33] New York Public Service Commission, Case 14-M-0101. Niagara Mohawk Power Corporation d/b/a National Grid Initial Distributed System Implementation Plan, (June 30, 2016) at 74.

across the country were often predicated on the notion that customers would be empowered to use energy in the unique ways they want to. Customers are empowered and supportive when an upgrade from a regular meter to a smart meter comes with the tangible additional benefit for the user and the ability to use new data-driven services. Frustration and confusion have resulted in other states where no actual benefits of AMI were immediately apparent to customers.

In Illinois, ComEd is activating the HAN radio upon request as meters are deployed, a process that initially has been manual and will soon be automated. In New York, ConEd has activated Green Button Connect for all customers, even though the AMI rollout will not be completed until 2022. Other utilities in New York pursuing AMI such as Avangrid and National Grid are also required to offer GBC as part of AMI deployment.

III. ACCESS TO BILLING DATA

Q. PLEASE DESCRIBE YOUR SECOND RECOMMENDATION THAT BILLING DATA SHOULD BE AUTOMATICALLY ACCESSIBLE TO CUSTOMERS AND AUTHORIZED THIRD PARTIES.

A. Most consumers care about dollars, not kilowatt-hours. When third parties have access to bill histories upon customer authorization, third parties can help customers estimate cost and energy savings from potential energy efficiency improvements, later verify performance against actual energy data, and continue to monitor efficiency and savings over time. Similar to my first recommendation of providing customers with a way to share energy usage data with third parties, I recommend that the Company provide

electronic, machine-readable and automatic transfer of at least 18 months of historical bills to customer-authorized third parties.

Q. WHY DO YOU RECOMMEND AT LEAST 18 MONTHS?

A. Because many energy efficiency applications require historic monthly bills through one complete "heating season" and one complete "cooling season" in order to accurately assess energy savings after some retrofit has occurred. 18 months ensures that seasonal and meteorological effects can be properly accounted for.

Q. WHAT TECHNICAL STANDARD DO YOU RECOMMEND FOR EXCHANGING BILLING DATA WITH AUTHORIZED THIRD PARTIES?

A. I recommend Green Button Connect My Data because it has an extension that supports billing histories. Every line item of a bill can be captured with the same XML standard for securely transmitting energy consumption data. Line items of bills can include complex terms like meter charges, demand charges, time of use charges, fuel charges, program charges, franchise fees, taxes and other information. All of this information is important to companies that provide energy management and cost management services. A wide variety of billing line items and billing structures are accommodated in the GBC technical standard.

Q. PLEASE DESCRIBE THE IMPLICATIONS IF THE COMPANY DOES NOT PROVIDE ELECTRONIC BILLING HISTORY AS YOU HAVE RECOMMENDED.

A. Without standardized, machine-readable access to historical billing data, customers will not be able to access new services that depend upon streamlined, zero-cost electronic accessibility, including, but not limited to: cost analysis software, automated bill audits

that search for overcharges, financial benchmarking services against peers, and even certain financial products that allow customers to borrow money for efficiency improvements. It will also be difficult for customers to know whether investments they have made in distributed energy resources are paying off because distributed energy resource (DER) companies cannot easily access the customer's bills.

For commercial customers, including multifamily property owners, the lack of software-readable billing histories means that many such customers turn to the market and pay for bill digitization services. An industry in its own right, bill digitization serves the needs of many multi-site building owners or managers who must capture, understand, benchmark and ultimately pay dozens, hundreds or even thousands of bills from different utilities across the U.S. every month. The inclusion of 18 months of historical billing data, as well as ongoing bills as they are generated, in Green Button Connect My Data would significantly benefit these customers by avoiding the costs of bill digitization services and drastically reducing the time needed to process data and launch solutions for new clients.

While larger commercial customers have access to bill digitization to manage their utility expenses and track usage, these types of solutions are prohibitively expensive for smaller customers such as nonprofit low income housing organizations, small businesses, and individual owners and tenants. These customers cannot afford bill digitization and instead often use inefficient, paper-based processes. For these customers, access to detailed machine readable bill data means that it will become easier to monitor and pay their bills, save money, access new services, and track their carbon footprint.

Organizations such as property owners with a nation-wide presence want to perform analysis for properties across states, utility companies, and types of tariffs, for example by studying demand charges and peak kW demand usage. While these categories can be interpreted from bills, this is difficult and unreliable as utility companies use different names for usages and charges, sometimes between different tariffs of the same utility company. Including standard categorizations in Green Button Connect bill data will significantly decrease the time and money it takes to do this type of analysis and increase data quality for the users of these services. In addition, the bill digitization process can introduce inaccuracies, because optical character recognition (OCR) and other techniques performed to extract data from printed bills and bill images are not always perfect. Customers would benefit by having accurate representation of their bills available from the Company in an electronic, automated fashion.

Q. ARE THERE OTHER BENEFITS OF PROVIDING BILLING DATA IN AN ELECTRONIC, MACHINE-READABLE, AUTOMATED MANNER?

A. Digital bill data will open up the possibility for third party suppliers to provide richer, digital context to customers, for example via links to explain rates, or instructional videos for how to weatherize a single family home. With machine-readable bill data, software can be developed for vision-impaired customers to hear or feel their bills, giving them easy access to this information. Access to digital bill data will also make it easier for customers to use tailored third party services to pay their bill. With these types of services, customers can, for example, aggregate their bills and payments by property or by geographic area.

Q. DO ANY OTHER UTILITIES ACROSS THE U.S. PROVIDE BILLING HISTORIES TO THIRD PARTIES IN AN AUTOMATED FASHION?

A. Pacific Gas & Electric ("PG&E") provides historical billing information as part of its Green Button Connect My Data offering. PG&E customers can choose to securely transmit their usage data alone, or in conjunction with, their 48-month billing history to a third party. Also in California, Southern California Edison and San Diego Gas & Electric have stated they will support historical billing data as their Green Button Connect My Data implementations are enhanced over time.

IV. ACCESS TO UTILITY RATE DATA

Q. PLEASE DESCRIBE YOUR THIRD RECOMMENDATION THAT UTILITY RATE INFORMATION SHOULD BE PUBLISHED IN STANDARDIZED, MACHINE-READABLE FORM.

A. Tariff information – including the prices that consumers pay for electricity and natural gas – is publicly available today for consumers with default electric service, since the Commission approves rates. However, owing to the complexity of modern rate structures, projecting a given customer's bill with consumption data in kilowatt-hours, given an approved rate in PDF form, is extremely difficult. It requires detailed knowledge of how the tariff works, a close reading of the legalistic language, and faithful translation of the text into correct mathematical operations to calculate a price in dollars. With time-of-use ("TOU") rates, careful analysis becomes even more important because customer bills can vary widely depending on when the consumption occurred. Re-packaging customer tariffs in a publicly-accessible, machine-readable form, rather than a PDF file, would thus make rate structures much more accessible and usable to DER providers.

Fortunately, much work has already been done in this area around standardization. The National Renewable Energy Laboratory ("NREL") has already developed the Utility Rate Database and last year engaged with California utilities on a pilot program to develop a uniform, web-based repository of machine-readable tariffs. This digital repository already exists today and contains over 40,000 rates from utilities across the country. But the rates are kept up to date only with the significant effort of NREL. If the Company's approved rates were maintained in the NREL Utility Rate Database, it would be possible for software applications to immediately and instantly create accurate cost estimates of energy efficiency or distributed energy. With more than 3,000 retail electric utilities in the United States, each of which may maintain dozens or hundreds of rate structures, it would be extraordinarily costly for DER providers to accurately maintain an up-to-date tariff database with nationwide coverage. There is also the issue of "reinventing the wheel" where each DER provider has its own mathematical interpretation of the rate structure. Without a central repository, cost savings estimates from DER providers may lack the accuracy and rigor important for household decision-making across the state of Ohio. It is not uncommon to see savings estimates from some companies based upon a flat rate per kilowatt-hour (i.e., $0.15/kWh) that masks the realities of TOU intervals, seasonal variations, tiers, demand charges, taxes and the like. Thus, a key benefit – both for consumers and DER providers – of a machine-readable central repository of tariffs kept up to date by the utilities is the accuracy of cost information provided to the marketplace at large.

NREL already has a head start with a draft machine-readable format and thousands of tariffs in its Utility Rate Database. Also, the utility's billing system already

calculates dollar amounts routinely. What I recommend is that Duke Energy be required to re-package the calculations of bills into a publicly-available form – both downloadable and accessible through an Application Programming Interface (API) provided by NREL – to make those accurate calculations available to DER providers.

V. EASE OF USE AND THE CUSTOMER AUTHORIZATION PROCESS

Q. PLEASE DESCRIBE YOUR FOURTH RECOMMENDATION THAT THE CONSENT PROCESS SHOULD BE ELECTRONIC AND EASY TO USE.

A. The Company evidently has a complex information technology (IT) infrastructure. In my experience as a software entrepreneur, it is easy for any IT manager to be overwhelmed by technical requirements and implementation challenges in a large-scale project and lose sight of the end customer. How does the customer actually share his or her energy use or billing data with a third party? Where in the process of using the Company's web portal will customers get confused and abandon the authorization process? Can the customer's tasks be completed in the fewest number of steps? How long does it take the customer to complete a common function, and can that time be reduced? These are the questions that are often forgotten when deadlines and technical challenges loom, but they are nevertheless essential because the benefits from GBC or the HAN, and thus many benefits from Duke Energy's AMI deployment, won't be realized if customers can't easily interact with the system and authorize the third party service provider of their choice. I note that Amazon.com is famous for its "1 click" purchase button. Customers are more likely to follow through with an online transaction – whether buying a product from an online retailer, or an energy management service – if the fewest number of clicks

is required. This lesson of simplicity should be taken to heart by the Company so that the maximum amount of users can take advantage of new technological offerings.

To quantify the impact of streamlining the online process for customers, a study by EnergyHub found dramatically different rates of consumer participation in demand response programs – 3% vs. 40% – among eligible customers when the enrollment forms were electronic, dramatically simplified and consumers could instantly sign up.[34] EnergyHub and other innovative companies rely on a streamlined process for their customers to share energy usage data, as well as to enroll in certain utility programs. The impact of ease of use can positively impact utilization of these offers by literally an order of magnitude. This is the reason why the California Public Utilities Commission recently ordered a "click-through" website enrollment process in which electronic signatures are accepted and "the click-through process shall begin and end on the third-party demand response provider's website."[35] More detailed technical recommendations and best practices can also be found in a report from the California click-through working group dated October 12, 2016.[36]

I recommend the Company should be required to hold stakeholder meetings to discuss and implement these recommendations for improving the GBC experience in Ohio.

[34] EnergyHub, Inc., "Optimizing the demand response program enrollment process" (Apr., 2016) *available at* http://www.energyhub.com/blog/optimizing-demand-response-enrollment.

[35] California Public Utilities Commission, Order Paragraph 1 of Decision D, Case No. 16-06-008 (June 6, 2016), *available at* http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M163/K294/163294060.PDF.

[36] Status Report Ordered by the Assigned Commissioner's Office During Discussions at the Oct. 5, 2017 Click-Through Workshop (Oct. 12, 2016), filed in Application Nos. 14-06-001, 14-06-002 and 14-06-003.

Q. PLEASE FURTHER DESCRIBE YOUR FOURTH RECOMMENDATION THAT THE CONSENT PROCESS SHOULD BE ELECTRONIC AND EASY TO USE.

A. In the case of GBC, the Company should provide a streamlined online sharing process that includes a minimum number of clicks. It is also very important for the Company to adhere to the authorization process element of the GBC standard known as OAuth 2.0. OAuth 2.0 is the standard process adopted by Facebook, Google, Twitter, LinkedIn and many other online services use for securely authenticating a customer's identity. Strict adherence to the standard is important, because consumers have a familiarity with OAuth 2.0 from other online services used throughout daily life, and deviations from what customers expect will result in confusion and reduced utilization of GBC. As I previously recommended, the Company should be required to attain periodic certification from an independent third party known as the Green Button Alliance. Such certification will help ensure an optimal customer experience, since OAuth 2.0 is incorporated into the GBC standard.

I further recommend that there should be alternative methods of authenticating users who do not want an online utility account. In this scenario, the utility can ask for the customer account number and other identifying information required as proof of the customer's authorization. But the customer would not have to create an online account, which is a barrier for many people who already have hundreds of online accounts for different services and do not wish to create new ones.

VI. SECURITY AND PRIVACY

Q. DO YOU HAVE RECOMMENDATIONS TO ENSURE SECURITY?

A. Adoption and implementation of solutions based on nationally recognized open standards offer the best opportunity to ensure robust security. One of the values of widely-adopted standards is that larger numbers of experts from across the country have studied, tested and evaluated the standards, and probed them for vulnerabilities. The Company can take advantage of that work for the benefit of consumers by adhering to widely adopted national standards.

With regard to real-time data, SEP1.1 is a secure protocol that should be used by the Company. Security concerns raised by activation of the HAN radio with Zigbee SEP1.1 are not of sufficient magnitude to deny Ohio consumers and the Ohio economy a significant percentage of the benefits of the AMI investment with access to real-time energy usage data. SEP1.1 uses symmetric encryption keys and strong 128-bit Elliptic Curve Cryptography (ECC) to prevent an eavesdropper from listening to the messages broadcast from the meter. Significant time and effort from the Zigbee Alliance – whose board of directors includes representatives from Philips, Samsung SmartThings, Itron, Landis+Gyr, Huawei and Comcast – have ensured that the latest security best practices are incorporated into SEP1.1. In fact, Duke Energy Ohio witness Mr. Donald L. Schneider, Jr. testified that the Company's Itron gas modules communicate with Itron AMI meters securely using Zigbee today.[37] As described above, numerous other utilities across the country have implemented SEP1.1 after having vetted the standard and concluded it is secure.

[37] Direct Testimony of Donald L. Schneider, Jr. June 1, 2017 at p. 4.

Further, I note that California, Illinois, Pennsylvania and Texas have all ordered utilities to activate the HAN radio for the benefit of consumers. I have carefully researched this issue and I am not aware of any security breaches or successful attacks on utility systems or consumers through the HAN interface.

Q. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes.

Summary: Testimony of Michael Murray electronically filed by Ms. Miranda R Leppla on behalf of Ohio Environmental Council and Environmental Defense Fund