Data and Modern Grid Workgroup

Facilitated by:

Final Report by EnerNex to PUCO

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Section 1 **Introduction**

In 2017, the Commission announced a program entitled PowerForward to advance a comprehensive grid modernization strategy. PowerForward is built upon the pairing of two pillars: (i) innovation, and the concept that this innovation should serve to (ii) enhance the Customer[1] electricity experience. PowerForward consisted of three open meeting phases:

- Phase 1: A Glimpse of the Future
- Phase 2: Exploring Technologies
- Phase 3: Ratemaking and Regulation

Over the duration of these three phases, 127 industry experts provided approximately 100 hours of education to the PUCO Commissioners and members of the PUCO Staff (Staff) regarding a variety of grid modernization topics.

On August 29, 2018, the Commission released "PowerForward: A Roadmap to Ohio's Electricity Future" (Roadmap).[2] The Roadmap makes a number of recommendations about the future of the distribution grid, and further recommends the creation of a PowerForward Collaborative (Collaborative) along with two additional workgroups, the Distribution System Planning Workgroup (PWG) and the Data and Modern Grid Workgroup (DWG). The Collaborative, PWG and DWG will not only serve to continue the robust discussion had during the three phases of PowerForward, but they are also meant to address specific tasks articulated in the Roadmap and to make recommendations to the Commission after deeper discussion between Staff and interested stakeholders. Specifically, the Roadmap noted that "standardized access to customer energy usage data (CEUD) for CRES providers and other third parties should be viewed as a fundamental and core component of the platform, along with the deployment of advanced customer metering" (page 16). The Roadmap also observed: "As foundational grid architecture investments are planned, designed and implemented, the data generated needs to be used to better enable customer choice to inform customers of their energy consumption and costs so they can manage their energy usage, adopt technologies that provide benefits and drive systemic benefits for the grid" (page 31).

By Entry issued on October 24, 2018, the Commission established the DWG.[3] The DWG is focused on addressing the following tasks:

i. Create protocol for data privacy protections;
ii. Drive toward real-time or near real-time data becoming available to Customers;
iii. Prescribe methodology for Third Parties to obtain CEUD, including a method for competitive retail electric service (CRES) providers to obtain total hourly energy obligation (THEO), peak load contribution (PLC), and network service peak load (NSPL) values.

[1] This draft adopts the convention of capitalizing stakeholder names and defined terms.
[2] See https://www.puco.ohio.gov/industry-information/industry-topics/powerforward/powerforward-a-roadmap-to-ohios-electricity-future/
[3] See http://dis.puc.state.oh.us/TiffToPDf/A1001001A18J24B41834A03586.pdf

With the creation of the DWG, a charter[4] was defined to delineate the areas of focus for this workgroup. Figure 1 shows this alignment.

[4] See https://www.puco.ohio.gov/industry-information/industry-topics/powerforward/powerforward-collaborative-and-workgroups/data-and-modern-grid-workgroup/DWG-Charter/

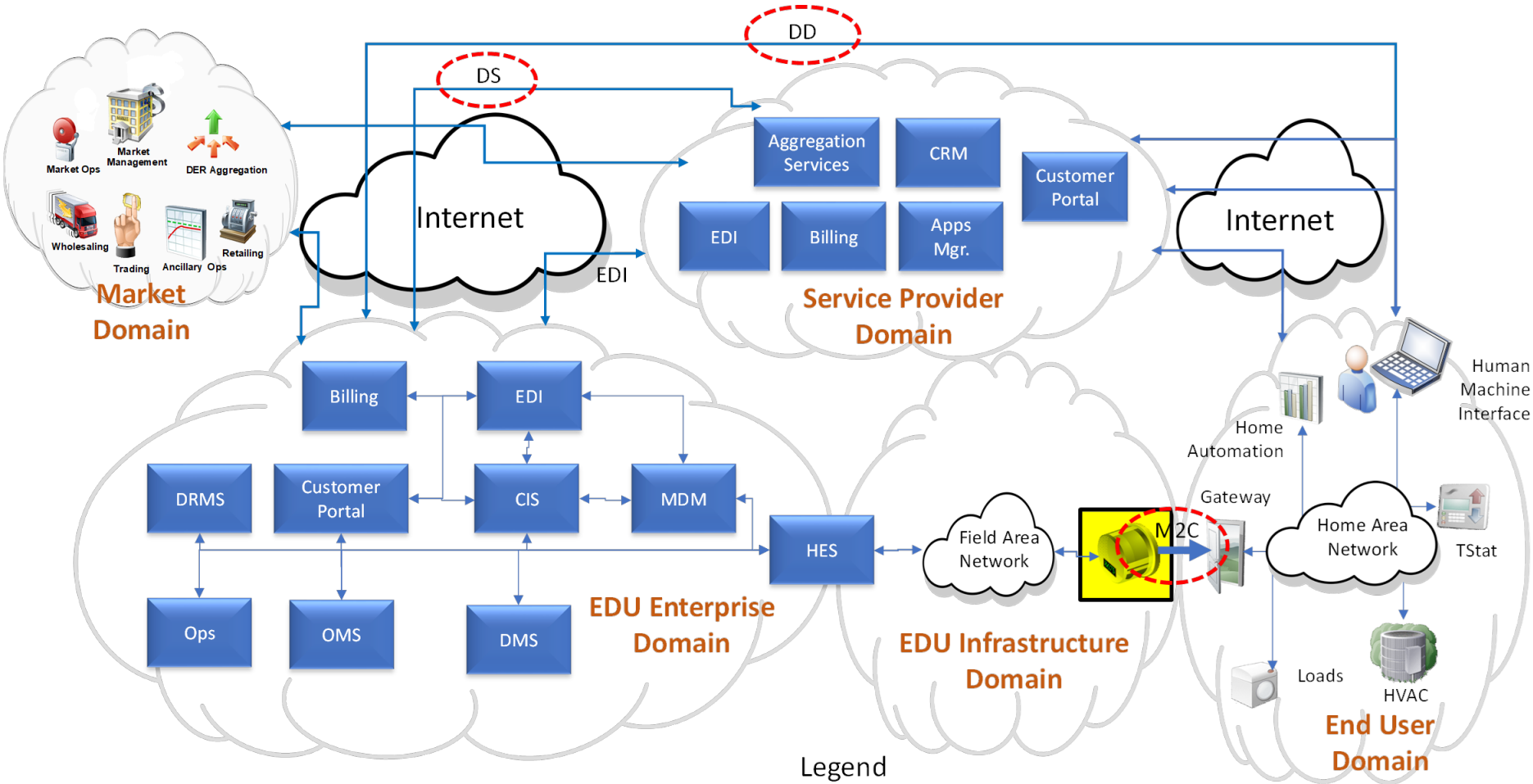

Figure 1: DWG Domains and Areas of Focus

Section 2 **Executive Summary**

The DWG stakeholder meetings were conducted between March and September of 2019 and consisted of face-to-face meetings and web-based sessions. This report captures the key elements, discussions and recommendations gathered as a result of these meetings and ongoing work of the Commission Staff and EnerNex. The PUCO website[5] contains the agenda, minutes and presentations for each public meeting.

The DWG meetings were well attended (approximately 35-40 participants) by four identified stakeholder groups: 1) Electric Distribution Utilities (EDUs), 2) Customers and Consumer Groups, 3) CRES Providers, and 4) Third Parties, including, environmental non-profit organizations and vendors of energy-related products and services. All stakeholders were given an opportunity in public forums to voice their view and to understand the various perspectives of other stakeholders. Additionally, targeted breakout sessions were included to permit more close interaction and engagement in a focused manner. Various inputs were provided to aid and assist the stakeholders during the process, including:

- Educational opportunities to learn about use cases, cyber security, and anonymization methods;
- Facilitated discussions addressing key issues, including privacy concerns, access unification and standards.

EnerNex's role as an independent consultant is to fulfill the following commitment:

"T*he consultant will coordinate DWG meetings in an effort to achieve consensus on tasks identified in the scope of work below, develop recommendations to the Commission on those tasks, including prioritization of those tasks, and manage the addition of new tasks, as appropriate."*[6]

Additionally, "*where this is no consensus or partial consensus on prescribed tasks, the facilitator should make a recommendation for the Commission's consideration to move the issue forward, based on the workgroup discussions, positions of various stakeholders, and independent expertise on the topic."* [7]

The focus of the DWG was to examine practical and feasible **technical considerations** to achieve the goals stated. Nothing in the DWG Final Report shall be binding upon the Commission in this or any future proceeding nor shall it serve to supersede any previous Commission Order or directive. However, given that unanimous consensus was not found (only partial or no consensus) on multiple topics, various stakeholders suggested that the findings of this report should be presented as an EnerNex recommendation. Therefore, this report is written as a set of recommendations made by EnerNex for the Commission's consideration. Recommendations are presented for each use case contained in Section 4 and are summarized in Section 5.

[5] https://www.puco.ohio.gov/industry-information/industry-topics/powerforward/powerforward-collaborative-and-workgroups/data-and-modern-grid-workgroup/

[6] http://dis.puc.state.oh.us/TiffToPDf/A1001001A18K28B40139D03839.pdf, Entry, p.2

[7] Ibid, RFP, p. 8

Additionally, cost considerations were not in the scope of the DWG. Accordingly, cost considerations, including cost recovery, from any investments made as a result of this proceeding would be addressed in a subsequent appropriate proceeding. It is also possible that the report may result in the need to establish subsequent consumer protections, policies, rules, and/or laws to fulfill the requirements suggested herein.

Areas of general understanding

The following areas of general understanding guided DWG discussions:

1. Ohio's current electronic data interchange (EDI) process will maintain focus on the mechanics of billing and reconciliation of Customer consumption data and is not part of the DWG focus.
2. The focus of the DWG is to utilize the functionality of advanced meters that can capture and report CEUD and other information to enable customers to make informed decisions about their energy usage.
3. EDUs and CRES Providers are bound by the privacy and disclosure rules surrounding sensitive information (e.g., account number, granular energy usage data) as defined in OAC 4901:1-10-24 and 4901:1-21 and through approved tariffs. Third Parties are not. Therefore, providing CEUD, including related PII, to Third Parties raises concern for some stakeholders.
4. Data containing PII transmitted by EDUs and CRES Providers shall be transmitted in a secure manner.
5. CRES Providers and Third Parties have an obligation to protect individual CEUD once a Customer has authorized the release of that data from the EDU to the CRES Provider or Third Party. New PUCO rules may need to be established to form a framework to provide oversight of Third Parties to provide appropriate protection of CEUD. It is recognized that there is currently limited jurisdiction over these parties.
6. A secure, standards-based machine-to-machine method to exchange CEUD through authorized mechanisms is important for all stakeholders.
7. To realize the greatest value for all parties, the EDUs should examine ways (e.g., conduct a technical working forum) to coordinate their various information platforms in a manner that would provide CEUD to authorized CRES Providers and Third Parties in the most consistent way possible, including but not limited to a single, centralized online platform.

The DWG tasks listed below were the foundation for developing and socializing use cases summarized herein and were the driver for the set of recommendations detailed in this report.

DWG Tasks:

i. Create protocol for data privacy protections;
ii. Drive toward real-time or near real-time data becoming available to Customers;
iii. Prescribe methodology for Third Parties to obtain CEUD, including a method for competitive retail electric service (CRES) providers to obtain total hourly energy obligation (THEO), peak load contribution (PLC), and network service peak load (NSPL) values;

Regarding task one, EnerNex recommends that industry standards for encryption be followed for any information that contains Personally Identifiable Information (PII), and that the data be secured both in transit and at rest. Reference was made to existing Ohio law in that regard, and the U.S. Department of

Energy's (USDOE) DataGuard Energy Data Privacy Program was discussed as a framework for Ohio to ensure proper privacy protection.

Regarding task two, EnerNex recommends that methodologies that utilize the capabilities contained in advanced meters and home area networks (HAN) be used in cases where near-real-time information is desired, and that customer portals be used for customers to access historical data consistent with the EDU's collection and processing routines, typically making data available within 24 hours.

Finally, for task three, EnerNex recommends that Green Button Connect My Data (CMD) [8] should be the methodology for CRES Providers and Third Parties to obtain CEUD for existing and prospective customers. Green Button CMD should be implemented through upgrades to existing EDU Business Partner Portals. As compared to other application programming interfaces (API), Green Button CMD is standards-based. As detailed in Appendix B, the North American Energy Standard Board's (NAESB) Energy Services Provider Interface (ESPI) standard, Retail Energy Quadrant REQ.21[1] serves as the basis for Green Button technology by providing a model for business practices, use cases, and an eXtensible Markup Language (XML) schema for the standard.

Further, Green Button CMD permits Customers to authorize CRES Providers and Third Parties to obtain the Customer's CEUD directly from the EDU in a business-to-business fashion using secure web technologies. The data is also protected through a number of assurance methods around authentication, privacy, and security with defined mechanisms (strong public key HTTPS[3] certificate, TLS1.2 and TLS 1.3,[4] and FIPS 140-2, L1 [5]) to secure information in transit. The data requests require proof of authorization using unique, OAuth 2.0[6] "access tokens" and a corresponding requirement to authenticate both the Customer and the requested data elements prior to creating that token.

For CRES Providers to access wholesale settlement values (THEO, PLC, NSPL), EnerNex recommends that the use of existing methods be maintained, i.e. PJM's Market Settlements Reporting System, Business Partner Portals, Electronic Data Interchange, and the Pre-Enrollment List. Through the DWG discussions, it became clear that *access to* the wholesale settlement values is not the issue; instead, the issue is the EDU using generic load profiles when interval CEUD is available. Therefore, EnerNex recommends that each EDU update its systems and processes to calculate wholesale settlement values for THEO, PLC and NSPL using individual usage information for all customers with advanced meters.

Use Cases

A set of use cases formed the basis for codifying the needs and interactions of the various actors required to deliver the services and data access desired, and this proved to be a very effective tool to focus efforts. The use cases are detailed in Section 4 and include:

- Use Case #1 - Customer connects a device to the meter's home area network (HAN) interface

[8] https://www.greenbuttonalliance.org/

[1] https://www.naesb.org/ESPI_Standards.asp

[3] While HTTP/S is an application layer protocol, the addition of a secure socket layer (SSL) certification can render HTTP into HTTPS. See https://www.globalsign.com/en/ssl-information-center/what-is-an-ssl-certificate/

[4] TLS is "transport layer security". See https://www.globalsign.com/en/blog/ssl-vs-tls-difference/

[5] Federal Information Processing Standards Publication 140-2, "Security Requirements for Cryptographic Modules," where L1 refers to Security Level 1. See https://nvlpubs.nist.gov/nistpubs/FIPS/NIST.FIPS.140-2.pdf

[6] Open Authorization, an open standard for token-based authentication and authorization. See https://oauth.net/2/

- Use Case #2 – CRES Provider or Third Party requests access from the EDU to a Customer's meter data
- Use Case #3 – Customer, CRES Provider, or Third Party requests an on-demand reading
- Use Case #4 – CRES Provider or Third Party requests anonymized data from EDU

Section 3 **Meeting Notes and Background Information**

3.1 Workshops

The first DWG meeting on March 5, 2019, laid the foundation for subsequent DWG meetings and was geared towards enabling all participants to operate from a common knowledge base. A draft charter was presented to establish how the workgroup would operate and to establish the discussion topics that would be both in and out of scope for the workgroup. The EDUs presented information about their advanced meter deployments or their future plans for advanced meters to provide a background for the workgroup to understand the current availability of Customer metering data.

CRES participants presented background information on how they use CEUD now, primarily through the EDI interfaces with the EDUs, and how they would like to use CEUD in the future. The primary focus of discussion centered around:

a) A desire by the CRES Providers and Third Parties to support enhanced Customer choice by making it as easy as possible to sign Customers up for CRES or other related services and data sharing programs;
b) Making new interfaces from EDUs to CRES Providers and Third Parties as standardized as possible and consistent with other efforts nationwide; and
c) A desire by the CRES Providers and Third Parties to provide accurate information to Customers to enhance their ability to understand their program options (e.g., price, rate) and the impact of those options, and to support the Customer's decision-making process.

Other discussion points for the day included:

a) Recognizing that Third-Party entities are bound by general business laws and regulations, but are outside the scope of PUCO regulations;
b) The EDI interface is an older standard used for billing and settlement purposes between the CRES Providers and EDUs and is likely NOT appropriate for large amounts of advanced metering interval data or Customer consent processes that the CRES Providers and Third Parties would like to have access to; and,
c) A general understanding that the Customer "has rights to access their own data" and that providing a means to share CEUD between authorized custodians of the data can provide innovation and value to both Customers, CRES Providers and Third Parties.

Information was provided and discussion held on the following topics, to serve as input to the DWG process and work:

a) Green Button Connect My Data (CMD) and Download My Data (DMD)

b) Advocacy for near real-time access, a simple authorization process, and aggregated, anonymized data
c) Access to 12 months of historical data, down to the smallest time interval collected (minutes/hours), and monthly billing determinants
d) Historical query access via standardized APIs
e) Access to behind-the-meter data[9] (via proper process/authorization)

For the second DWG meeting held on April 24, 2019, the facilitation team provided a set of high-level use cases which provided context for how data could be shared and used. The session began with an overview of the process and methodology for creating industry standard use cases. Following that discussion, four specific use cases focused on the DWG tasks were discussed. These included:

1) Connecting a Customer's device to the meter's Home Area Network (HAN)
2) CRES Provider or Third Party requests access from the EDU to a Customer's meter data
3) Customer, CRES Provider, or Third Party requests an on-demand reading
4) CRES Provider or Third Party requests and gets anonymized data from EDU

The use cases are each a scenario or "story" of how something gets done to meet the goal of a particular user or stakeholder. Use cases are well established as a tool to uncover technical, business, and policy requirements, as well as to clarify what is being discussed to frame the scope of discussion. The use cases are detailed in Section 4.

The third DWG meeting, held on May 23, 2019, focused on privacy, security, and PII. Key roles and responsibilities for PII for Customers, EDUs, CRES Providers, and Third Parties were discussed. Also, the group received information about PII and how data could be secured both at rest and in transit using Green Button mechanisms. Other discussion points included:

a) A recognition that the EDUs, CRES Providers, and Third Parties all have responsibility for encryption of Customer information and CEUD during transit;
b) A consensus that privacy protections and cyber security issues are complex and additional work would need to be done outside the scope of the DWG and should follow the general information protection policies and regulations in the state of Ohio; and,
c) The EDUs need to further investigate the security requirements for the HAN interface with the meter.

A presentation was made to advocate using a framework similar to USDOE's Voluntary Code of Conduct[10] regarding Customer data privacy to ensure a Customer-focused approach is used. The framework includes: Customer notice and awareness, Customer choice and consent, CEUD access, data integrity and security, and enforcement.

A presentation was made to provide a perspective based on the State of California's use of anonymized data.

[9] Behind the meter data for instance could include individual appliance load information
[10] https://www.energy.gov/oe/downloads/data-privacy-and-smart-grid-voluntary-code-conduct

3.2 Stakeholder Focus Web Meetings

Additionally, it was decided to hold a set of individual stakeholder meetings to further discuss issues related to the DWG's topic areas. Three sessions were held with the following parties: city and regional planning advocates, EDUs, and CRES Providers.

The first breakout session was held on June 6, 2019 with the City of Columbus and the Mid-Ohio Regional Planning Commission (MORPC) and focused on the need and desire for planners to have access to aggregate consumption data for economic and energy efficiency analysis. Use Case #4 was identified to be the appropriate vehicle to gather anonymized information to meet these needs.

The second breakout session was held on June 18, 2019 with the EDUs and focused on their need for internal use of metered information for planning and operational purposes, as well as for supporting the informational needs of CRES Providers and other Third Parties.

The third breakout session was held on July 9, 2019 with representatives of the CRES Providers stakeholder group. This meeting discussed CRES Provider use case scenarios which were generally variations of Use Case #2 with added CRES-focused business processes. Example scenarios include the CRES Provider using CEUD to provide Customer specific rate quotes and the CRES Provider using CEUD to improve their billing processes or market interactions.

3.3 Current State

EDUs in Ohio have made interval meter data available to large commercial and industrial (C/I) Customers that have interval data recorders as well as to all Customers with advanced meters. For residential Customers with advanced meters, interval meter data is available through web portals hosted by the EDUs, which include options to download the data.

For billing purposes, a utility meter data management system (MDMS) sends raw interval meter data through a validation, editing, and estimation (VEE) process, e.g., resolves issues with missing data or data exceptions, and produces data that can accurately be used for billing. The bill-quality data is transmitted via EDI transaction using the standards and procedures established by the EDI Working Group. Ultimately, this data is used by the utility and CRES Providers to collect revenues through retail rates for end-use Customers.

Important to the cost of serving a Customer, total hourly energy obligation (THEO), peak load contribution (PLC), and network service peak load (NSPL) are PJM values used for wholesale market settlement purposes to allocate the costs associated with the energy, capacity, and transmission needed to provide retail electric service to end-use Customers. Currently, Customer-specific data is used to calculate these values for large C/I Customers, i.e. Customers with demands greater than 200 kW, participating in retail choice. However, residential and small commercial Customers are settled using generic load profiles, even if those Customers have an advanced meter.

Aside from billing, bill-quality, interval data could also be used by CRES Providers to develop products and services for both existing and prospective retail Customers. Currently, CRES Providers can access this data via EDI for large C&I Customers (current and prospective). For residential and small

commercial Customers, limited access is available through business partner portals and developing through expanded EDI options and the implementation of API. [11]

Third Parties do not currently have access to CEUD in Ohio, unless a Customer directly provides the data downloaded through the EDU's website or shares their customer bill.

Section 4 **Use Cases and Recommendations**

The workgroup explored four use cases relating to advanced meter data access by Customers and authorized Third Parties. The use cases were numbered to permit the stakeholder to identify them during conversation and were presented in the order 1 to 4.

From the April workshop, Table 1 enumerates the use cases and titles.

Table 1: Use Case Enumeration

Use Case Number	Use Case Name
#1	Customer connects a device to the meter's HAN interface
#2	CRES Provider or Third Party requests access from the EDU to a Customer's meter data
#3	Customer, CRES Provider, or Third Party requests an on-demand reading
#4	CRES Provider or Third Party requests and gets anonymized data from EDU

However, during conversation with the stakeholders, a priority order of addressing the use cases and subsequent requirements and recommendations in this report was derived to be 2, 4, 1, and 3. Hence, the use cases are presented in that prioritized order as renumbering them would lose traceability through the DWG process. The use case description and narratives from the document used for the use case workshop are used as the foundation for this final report; however, in some instances they have been modified for clarity. In addition, modifications for editorial consistency (such as capitalization, grammar, punctuation) were made. To account for stakeholder input, a "discussion" section for each use case that captures the salient points is also included.

As noted above, the entirety of this report is a collection of recommendations from EnerNex to the PUCO for the three identified DWG objectives; however, it employs certain terms that may seem at odds with this assertion. In particular, this report adopts the definitions taken from an international standard[12] for the following terms:

> **Shall:** "This word means that the definition is an absolute requirement [of the specification]." *We use this to indicate an item is an absolute requirement to satisfy a need.*

[11] Appendix A provides an overview of the current, or recently authorized, methods for CRES Providers to access CEUD and PJM values (THEO, PLC, and NSPL).
[12] See https://www.ietf.org/rfc/rfc2119.txt

Should: "This word, or the adjective "RECOMMENDED", means that there may exist valid reasons or circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course." *We use this to indicate an item is recommended to satisfy a need where other approaches exist.*

May: "This word, or the adjective "OPTIONAL", means that an item is truly optional." *We use this to indicate an item is optional to satisfy a need.*

4.1 Use Case #2 – CRES Provider or Third Party requests access from the EDU to a Customer's meter data

4.1.1 Summary

To stimulate competitive offerings, there is a desire for CRES Providers or Third Parties to gain access to individual Customers meter data that are authorized by an executed agreement and authorization process such as a Letter of Authorization (LOA). This data would be supplemental to the meter billing data that is provided using the established EDI process.

The meter data can include daily consumption, interval readings and other related usage information that is provided by the Customer's advanced meter. This information would either be provided by the EDU to the CRES Provider or Third Party on a scheduled basis or could be provided on request through a machine to machine (M2M) interface. Information transferred could include Customer account information.

4.1.2 Narrative

To initially establish this connection, a sequence of coordinating events must take place among the various actors and domains. These domains include the EDU, the CRES Provider or Third Party provider[13], and the Customer.

The Customer must inform the EDU of their desire to extend this information to the CRES Provider or Third Party and execute the required authorization with the EDU to share meter data with the designated CRES Provider or Third Party. As an alternative, the CRES Provider or Third Party may be able to secure the authorization from the Customer and then contact the EDU on the Customer's behalf to establish the data sharing agreement.[14]

Information that is provided via this link will be provided directly from the EDU to the CRES Provider or Third Party. This information will be presented at a prescribed periodicity (repetition rate), or upon request, and will have a defined information content level (e.g., what registers and scale) and with a level of security consistent with the EDU's security policies and terms and conditions that would be

[13] A Third Party who may be establishing a data sharing agreement includes: demand response service providers, DER aggregators, etc.

[14] Another alternative is to use a technical means to temporarily pass the Customer to the EDU to provide the authorization and then return the Customer to the Third Party's system.

associated with the release of this information. The CRES Provider or Third Party will be responsible for protection of any PII such as Customer address, account number and consumption information.

4.1.3 Use Case #2 - Actor Interaction Diagrams

In this diagram the key pathway for the authorized CRES Provider or Third Party to access a Customer's data would be for each CRES Provider or Third Party to have a connection to each respective EDU. Thus, for instance, for a CRES Provider to access a Customer who is served by a specific EDU they must establish a connection with that EDU. To access a Customer served by another EDU, the CRES Provider would need to establish a connection with that EDU.

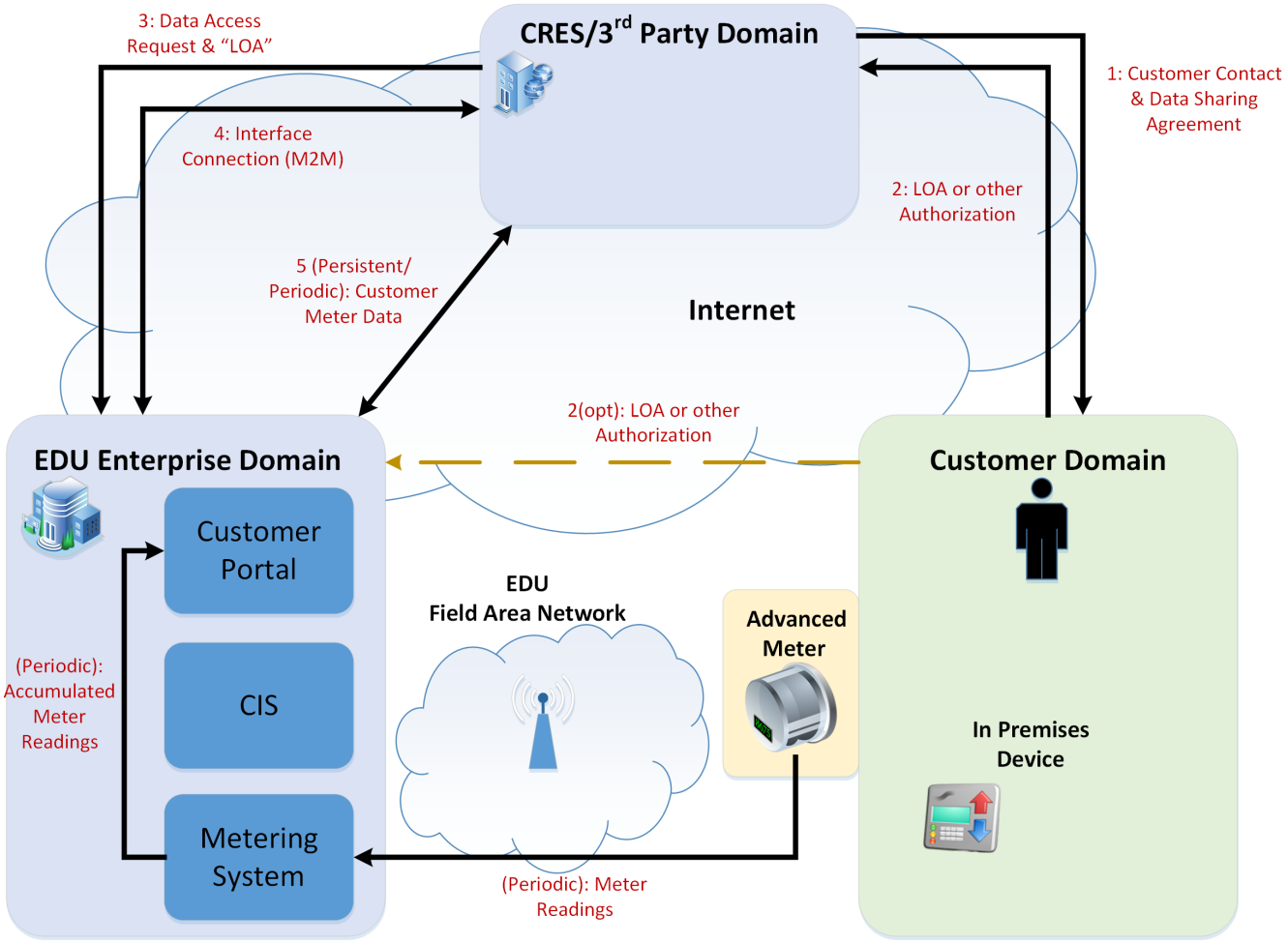

Figure 2: UC #2 - Customer Authorizes CRES Provider or Third Party to Access Data

4.1.4 Alternate Scenario

There is a business value for CRES Providers and Third Parties to have a common or standardized interface with the EDUs for both the authorization process and for accessing Customers' data. The diagram below (Figure 3) introduces a centralized meter data store (this is based on the Smart Meter Texas[15] model) which creates a common single interface between the EDUs, Customers and CRES Providers and Third Parties. Thus, for example, if a CRES Provider wants to access information from a

[15] See https://www.smartmetertexas.com/CAP/public/index.html

Customer that is served by a specific EDU, there would be only one interface to the common provider who in turn has captured information from all EDUs, thus eliminating the need for a specific interface connection with each EDU.

A variation on the above scenario would be a centralized interface intermediary (replacing the centralized meter data store as shown) which would provide a common front end to the CRES Providers or Third Parties (and possibly Customers). This centralized interface would pass the authorization and data requests to the various EDUs. For example, a CRES Provider would use this interface as a simplification of a connection service, thus eliminating the need for the CRES Provider to have four independent interfaces (one for each EDU). This alternative still requires additional costs and management but does not require a centralized data storage system.

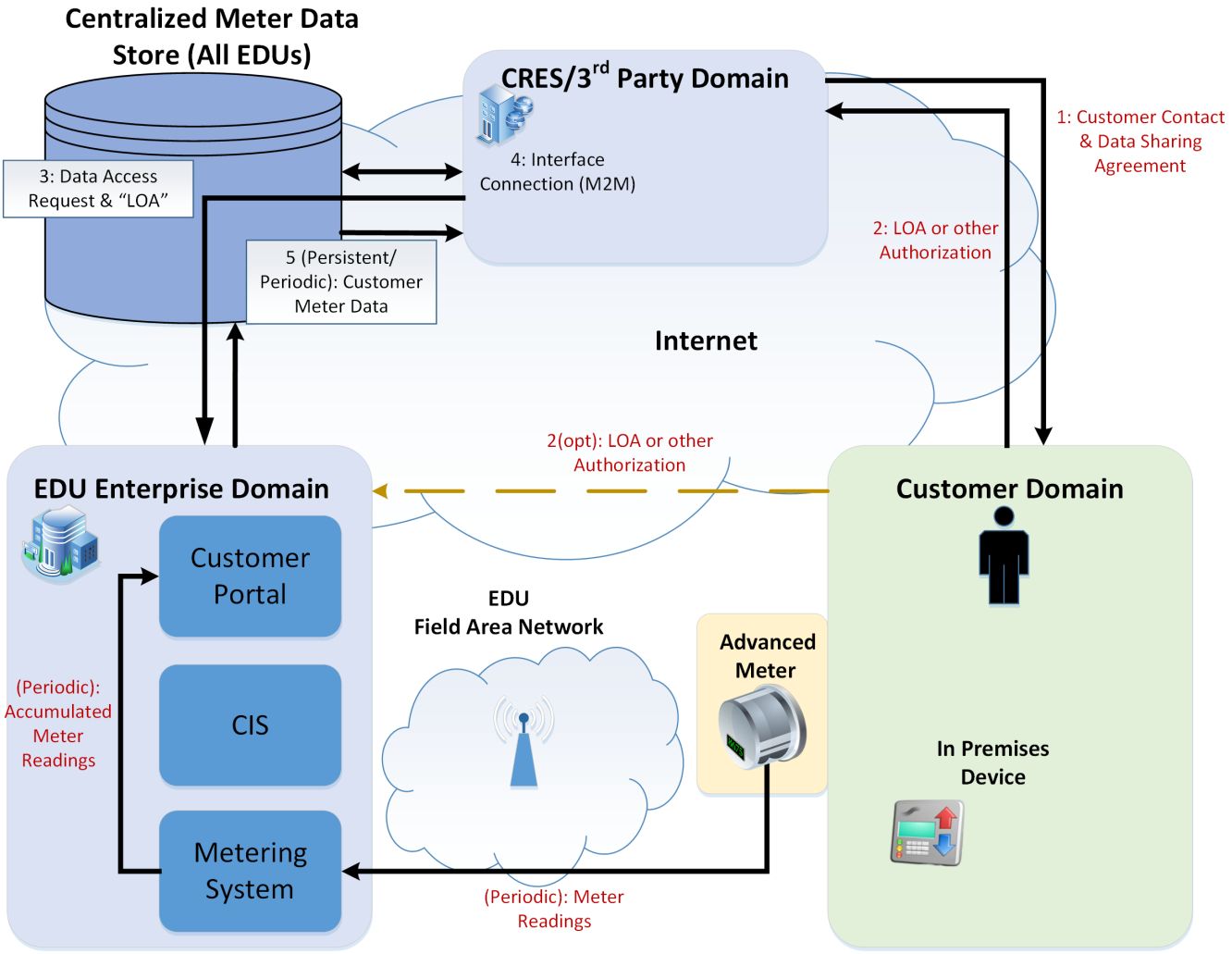

Figure 3: UC #2 - Customer Authorizes CRES Provider or Third Party to Access Data (Alternate: Centralized Data Store)

4.1.5 Discussion

Workgroup discussion noted that some EDUs have already invested in systems that they believe would be part of the data flow described by this use case. There is a need to identify the places where technical decisions and deployments by EDUs have already been made, and to understand and define

the performance and economic impact of possible future changes (e.g., adding Green Button Connect My Data if not originally planned). For example, the existing EDI does not include any Customer authorization capabilities and EDI does not include all of the datasets described above. The workgroup also discussed the importance of protecting Customer information and CEUD and privacy mechanisms that could be used to ensure proper protection. The USDOE's DataGuard Energy Data Privacy Program was discussed as a framework for Ohio to ensure proper privacy policies.

Additionally, there was discussion about the role of the EDU when a Third Party that is not under the jurisdiction of the PUCO receives information that contains PII. While statutory provisions exist regarding the general protection of consumer information, e.g. Title 13 Commercial Transactions Chapter 1354[16], there is not explicit language within Title 49 for Third Parties.

Although outside of the DWG charter, the original use case description included the possibility that additional information (e.g. detailed circuit information) to help the CRES Provider or Third Party participate in locational services such as solar or other services may be available based on EDU circuit analysis (i.e. hosting capacity analysis). Discussion also included other information that could be provided to CRES Providers or Third Parties to assist in business transactions, including billing period information, service addresses, and supply contract information.

First Energy provided information on the method that Pennsylvania is attempting in order to solve the intent of this use case, see http://www.puc.state.pa.us/filing_resources/issues_laws_regulations/electronic_data_exchange.aspx.

The advantage of the Alternate Scenarios might be that integration costs for CRES Providers and Third Parties could be reduced because they would access a single API interface, rather than one for each EDU. It may be necessary to have a single, centralized solution in order to make the Ohio market cost-effective for many CRES Providers and Third Parties. The potential drawback is additional costs and management to duplicate the EDUs' Customer meter data into a centralized repository.

The next phase of the process should include a detailed benefit-cost analysis of the proposed approaches.

4.1.6 Recommendations on CRES Provider and Third Party Access to Customer Energy Usage Data

1. Each EDU shall provide access to CEUD for CRES Providers and customer authorized Third Parties. The CEUD shall, at a minimum include the time stamped interval of measurements and summary data that is collected by the EDU from the Customer's meter. For each Customer, the information provided shall include meter id and/or account number or other unique identifier associated with the Customer's account, which is considered PII. The measurements shall include power (kW), energy (kWh), and any other measurements used to calculate a Customer's bill. The recommended interval period for energy intervals is 15 minutes but should be, at minimum, aligned with PJM's current energy market settlement. The mechanism for adoption should be the Green Button Connect My Data (CMD) methodology.[17]

[16] http://codes.ohio.gov/orc/1354

[17] Appendix B has further technical information about Green Button.

Basis for Recommendation:

a) Customers shall be able to authorize CRES Provider or Third Party access to their own CEUD as defined above at any time.
   - There is no reason to limit Customers authorizing access to their CEUD as defined above.
   - This is consistent with House Bill 166[18] of Ohio's 133rd General Assembly to: "Encourage cost-effective, timely, and efficient access to and sharing of customer usage data with customers and competitive suppliers to promote Customer choice and grid modernization."

b) Customers shall have a secured method to authorize access to their CEUD as defined above.
   - Securing the authorization process is a basic requirement which would be supported by the recommended solution. Green Button CMD uses OAuth 2.0[19] which is a standardized protocol for authorization.
   - The EDU role in this area should be limited to informing the Customer that the utility is not responsible for enforcing any Third Parties' data security practices or Third Party use, treatment, sharing, or sale of the data.

c) CRES Providers and Third Parties shall have a standardized method to access authorized CEUD as defined above.
   - There are many divergent methods across utilities for CRES Providers and Third Parties to access CEUD; however, using a standardized method like Green Button CMD and documented best practices would bring uniformity and minimize complexity for all stakeholders.
   - This is consistent with House Bill 166 of Ohio's 133rd General Assembly to: "Ensure that a Customer's data is provided in a standard format and provided to Third Parties in as close to real time as is economically justifiable in order to spur economic investment and improve the energy options of individual Customers."

d) The PUCO should establish a technical interface working group for EDUs, CRES Providers and Third Parties to discuss the technical details required for standardization of access to CEUD.
   - The EDI working group is a successful model for establishing a standardized interface for billing.

e) EDUs may limit the amount of data provided to a CRES Provider or Third Party at a single time (e.g., 30, 60, 90 days per dataset) and up to a maximum amount of historical data (e.g., two most recent years).
   - There may be practical limits to single data transaction transfers and to accessible history.

f) The mechanism for adoption should be the Green Button CMD mechanism.
   - This application is built upon secure standards that meet the above requirements.

g) There should be a centralized list of non-CRES Third Party "bad actors" to check, with a process to be removed if conditions warrant.

[18] https://www.legislature.ohio.gov/legislation/legislation-summary?id=GA133-HB-166

[19] Open Authorization, an open standard for token-based authentication and authorization. See https://oauth.net/2/

- The EDUs should maintain and provide to the PUCO a list of non-CRES Third Parties that have been granted Customer authorization to access Customer data. As a central collector of this information, the PUCO should maintain a list of non-CRES Third Parties and develop a process to maintain this list, including informing the EDU of any concern or complaints received about said Third Party. The EDUs may wish to access this information in order to restrict access to parties deemed to be in violation of good business practices.

Although Use Case 2 was focused on the interactions between Customers, the EDU, and CRES Provider or Third Party access to CEUD, the proposed recommendations would establish a technical mechanism and framework that is also applicable to the Customers downloading their own CEUD from the EDU. The historical efficacy of Customers using their CEUD is limited for smaller customers. In other words, most small customers won't see a benefit to downloading their data without access to tools to analyze the data and/or rate options (e.g., time of use, demand) or incentive programs (e.g., demand response, load control) which could incentivize different energy usage behaviors. With the above caveat, it is the recommendation of EnerNex that the technical capability used in enabling CRES Providers and Third Party access be extended to enabling Customer access to their own CEUD.

4.1.7 Recommendations on Customer Access to Customer Energy Usage Data

2. Each EDU shall provide access to CEUD for Customers served by the EDU. The CEUD shall, at a minimum include the time stamped interval of measurements and summary data that is collected by the EDU from the Customer's meter. The measurements shall include power (kW), energy (kWh), and any other measurements used to calculate a customer's bill. The recommended interval period for energy intervals is 15 minutes but should be, at minimum, hourly intervals to match PJM's current energy market settlement. Additionally, for each Customer the information provided shall include, at a minimum, meter id and/or account number. The mechanism for adoption should be the Green Button Download My Data (DMD) methodology.[20]

Basis for Recommendation:

a) Customers shall be able to download their own CEUD as defined above at any time.
   - There is no reason to limit Customer access to their own data.
   - This is consistent with House Bill 166[21] of Ohio's 133rd General Assembly to: "Encourage cost-effective, timely, and efficient access to and sharing of customer usage data with customers and competitive suppliers to promote customer choice and grid modernization."

b) Customers shall have a secured method to download their own CEUD as defined above.
   - Account access shall require registration and verification to ensure security and privacy is maintained.

c) Customers shall have a standards-based method to download their own CEUD as defined above.

[20] Appendix B has further technical information about Green Button.
[21] https://www.legislature.ohio.gov/legislation/legislation-summary?id=GA133-HB-166

- There are many divergent methods across utilities for Customers to access CEUD; however, using a standardized method like Green Button DMD would bring uniformity and minimize complexity for all stakeholders.

d) EDUs may limit the amount of data downloaded at a single time (e.g., 30, 60, 90 days per dataset) and up to a maximum amount of historical data (e.g., two most recent years).
   - There may be practical limits to single data transaction transfers and to accessible history.

e) The mechanism for adoption should be the Green Button DMD methodology.
   - This is built upon secure standards that meet these requirements and is widely adopted by a number of utilities in other jurisdictions.

4.2 Use Case #4 – CRES Provider or Third Party Requests Anonymized Data from the EDU

4.2.1 Summary

To enable CRES Provider or Third Party access to anonymous meter information, a CRES Provider or Third Party may request receipt of a set of anonymized meter data from the EDU. This information may be provided by selectable criteria such as by ZIP code, Customer type, rate class or other related characteristics.

4.2.2 Narrative

To initially satisfy this request, a sequence of events must take place among the various actors and domains. These domains include the EDU and the CRES Provider or Third Party requestor.

This use case defines the necessary steps of the various actors involved in this process. The information returned to the requestor will contain information based on the criteria specified; the content will be validated, edited, or estimated, through the EDU's Validating, Editing, and Estimating (VEE) process in the Meter Data Management System (MDMS).

The data request would come through a suitable EDU access port that is established between the requestor and the EDU. Authorization for anonymous data is not strictly necessary, although it may be suitable to restrict the availability of anonymous data to bonafide entities such as municipalities, state and federal agencies, researchers, and other parties having a valid reason to request and access such data.

An authentication process should be in place to ensure that the requestor has the appropriate privileges to make such a request. Upon execution of the request, this portal will provide the requested data in a secure manner.

4.2.3 Use Case #4 Actor Interaction Diagram

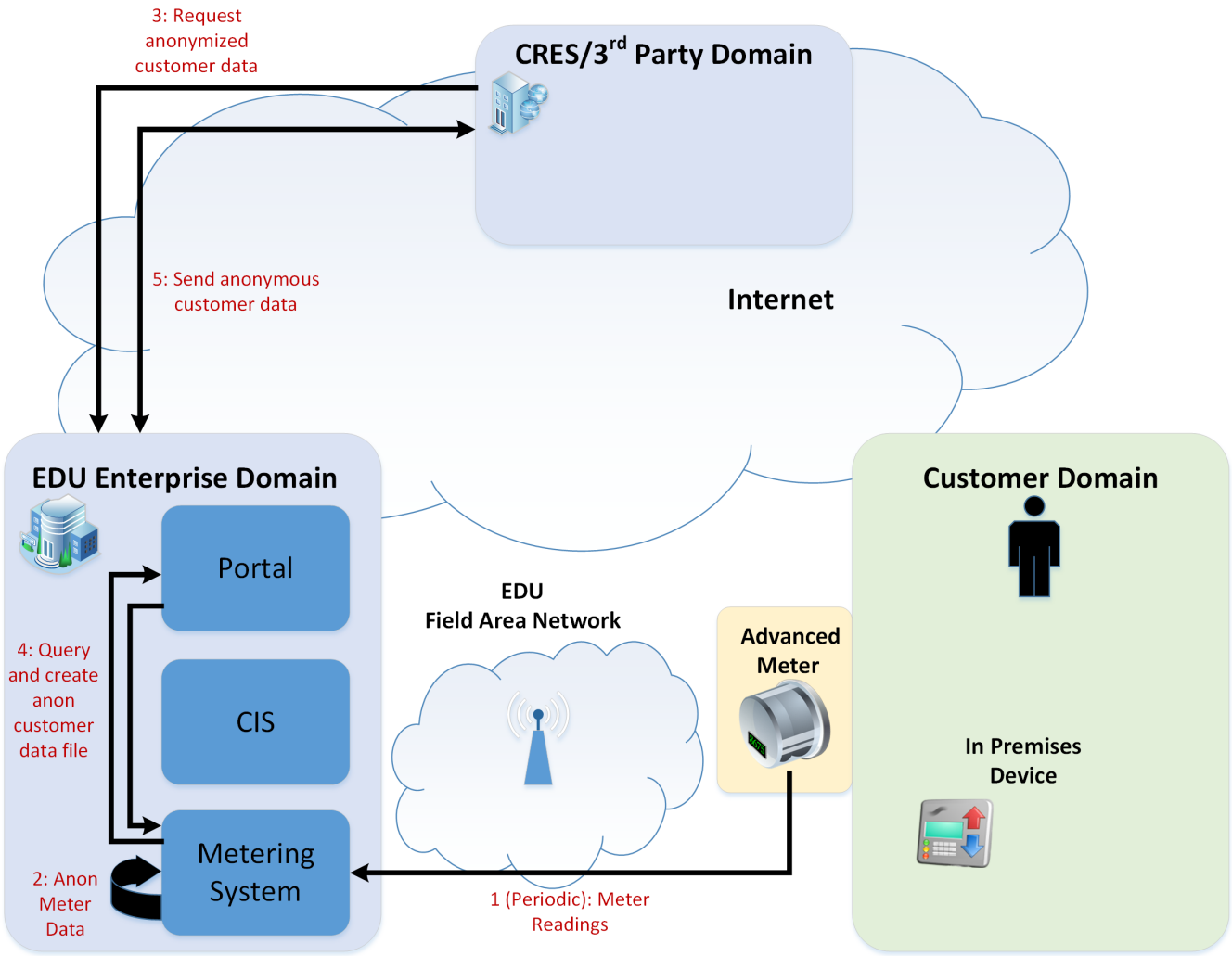

Figure 4: UC #4 – CRES Provider or Third Party Requests Anonymized Data from the EDU

4.2.4 Discussion

Anonymous usage data involves the individual usage recorded by individual meters. Anonymous usage data does not include any Customer personal identifiers and ensures the confidentiality of Customer-specific usage information by following a common industry anonymization protocol. The anonymization is generally described as X/X. The first value describes the minimum number of Customers which must be included in the dataset, and the second value is the maximum percentage of usage for any single customer in the dataset. For example, California, Colorado, and Illinois all have 15/15 data anonymization rules.[22] A dataset is a group of meters in a specific geographical area (ZIP code, city, etc.) and may be a subset of the meters filtered by a characteristic (e.g., Customer class). If the anonymization dataset does not conform to the rule, then the geographic area must be expanded until

[22] The dataset shall contain at least 15 Customers and no single Customer shall consist of more than 15% of the monthly consumption.

it meets the required limits. No consensus was determined for the appropriate X/X parameters of anonymization. One presenter advocated a 50/50 anonymization scheme[23] which provides privacy protections for smaller consumers with a tradeoff that provides less privacy for larger consumers. This position is advocated to serve the public interest of understanding energy consumption patterns. A potential compromise is two anonymization levels: One which would be generally available to the public (e.g., 15/15) and another which would be restricted to governments, academics, non-profits, or other organizations deemed to serve the public interest (e.g., 50/50). The second data would be treated as confidential.

There was a brief discussion regarding differential privacy, which is a method to obscure individual identity in large datasets using statistical methods which add mathematical noise to samples of individuals' data to prevent the identification of any specific individual. Differential privacy is used in other industries and could be valid for the anonymization of Customer meter data, although the workgroup participants were not aware of any specific implementations within the utility industry.

Aggregated data is a summation of the recorded usage for a group of meters. Aggregated data can also provide anonymization since no individual meter (or Customer) can be identified from the group of meters that are aggregated. Aggregated data is typically considered to be less useful for end users than anonymized data because the data can't be disaggregated, only averaged. An example of this averaging is the Customer class load profiles that the EDUs calculate and report.

4.2.5 Recommendations on CRES Provider or Third Party Requests Anonymized Data from the EDU

1. Each EDU shall provide bonafide requestors access to anonymized data for service points served by the EDU. The anonymized data shall:
   a) Use recorded interval data where available, otherwise the data shall use recorded monthly consumption.
   b) Provide at least kWh consumption.
   c) Be provided monthly in a dataset for a single calendar month.
   d) Indicate Customer class (e.g. residential, commercial, and industrial).
   e) Indicate the nature of the timestamps (e.g. period beginning or period end) for interval data.
   f) Anonymized data shall not include Customer name, address, or any other personally identifiable information
   Basis for Recommendation:
      - There is a need for access to this level of information for valid business purposes, e.g., market planning and assessment, as well as for community planning purposes.
2. Each EDU shall provide the anonymized data in the format and scope requested. An anonymized data request can be made for:
   a) One or more Customer classes.
   b) Specific ZIP codes or alternately, census tracts
   c) Historical datasets for at least the previous 12 months.
   Basis for Recommendation:

[23] The dataset shall contain at least 50 Customers and no single Customer shall consist of more than 50% of the monthly consumption.

- The ability to request anonymized data based on certain filter criteria facilitates examining and analyzing the data.

3. Each EDU shall anonymize the data using a 15/15 anonymization scheme or by a "differential privacy" methodology.

   Basis for Recommendation:

   - The current standards for other jurisdictions have followed similar rules for anonymization.

4. Each EDU should be able to charge a reasonable fee for the delivery of anonymized data to cover the costs of collating and delivering anonymized data files.

   Basis for Recommendation:

   - There may be incremental software programming costs for providing access to this data, it is reasonable to recover these costs via a fee.

4.3 Use Case #1 - Customer connects a device to the meter's HAN interface

4.3.1 Summary

An end user Customer who has an advanced meter that is provisioned with a ZigBee or other wireless communications link desires to establish a connection between the meter and a Customer, CRES Provider, or Third Party gateway or similar device (e.g., in home display, thermostat, load control device). The purpose of this connection is to enable data to be sent from the meter (e.g., current kW, kWh, kWh intervals) to the connected device. Connected devices may display the data or enable the data to be sent to another system to inform, track, or execute actions that may be based on this information. The connection provides one-way information access from the meter to the device.

4.3.2 Narrative

To initially establish this connection, a sequence of coordinating events must take place among the various actors and domains. These domains include the EDU, the Customer, and the CRES Provider or Third Party (if appropriate).

The Customer, or potentially an authorized CRES Provider or Third Party must inform the EDU of the desire to connect their advanced meter to the device that will be receiving data from the meter. The EDU must establish a method to ensure that the Customer's meter information is correct and secure. The EDU may require the Customer to request this connection using a unified means (e.g., Customer access portal, etc.)

Information that is provided via the meter's HAN interface will be provided directly from the meter and will not be processed by the EDU (e.g., it is NOT validated, bill quality data). This information will be presented at a prescribed periodicity (repetition rate), with a defined information content level (e.g., what registers and scale) and with a level of security consistent with the Customer's equipment.

The Customer may use this information for their own purposes, including, but not limited to capturing near-real time consumption information, executing actions internal to their premises based on this information, and/or providing the data to a CRES Provider or Third Party entity for other purposes defined between the Customer and the CRES Provider or Third Party.

4.3.3 Use Case #1 - Actor Interaction Diagram

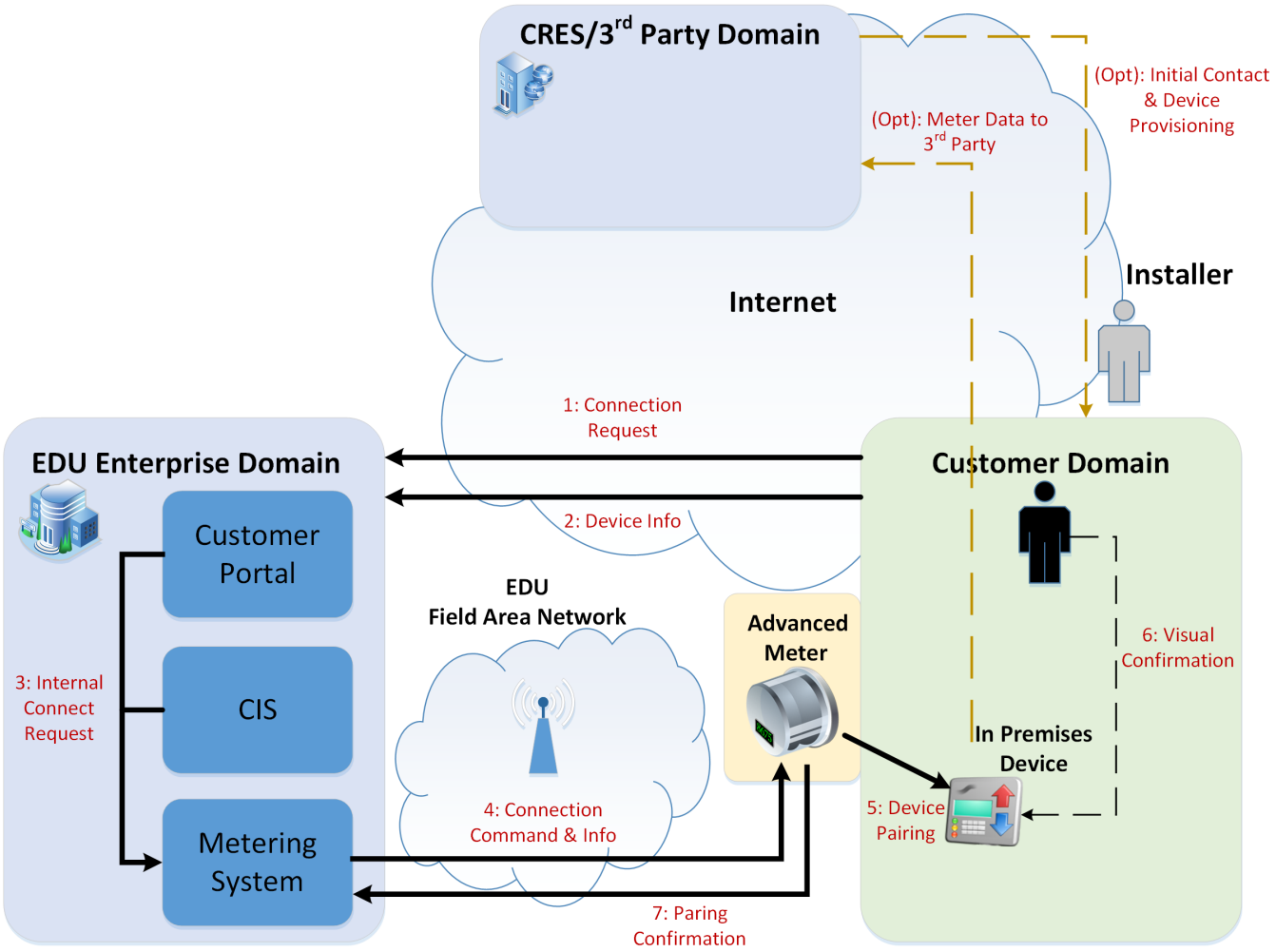

Figure 5: UC #1 - Customer Connects Device to Meter

4.3.4 Discussion

Workgroup discussions for this use case indicated that the CRES Providers and Third Parties desire a uniform method for Customers and installers providing Customer assistance to establish the connection between the meter and in-premise device. Additionally, the CRES Providers and Third Parties would prefer that a single, standardized protocol be used for all meters installed in Ohio so that a common set of devices would be compatible across all EDUs. However, commonality may be difficult to achieve because some EDUs have already installed meters using the ZigBee 1.x protocol[24] to support the HAN interface. The ZigBee 1.x protocol is currently the de facto standard used by meter vendor manufacturers, but like all standards, it may be replaced in the future. In fact, a new HAN profile IEEE 2030.5 (SEP2.0) has been released, but due to architectural changes and feature upgrades, SEP 1.x and SEP 2.0 are not compatible.

[24] This is now marketed as ZigBee Smart Energy and available as v1.2a. See https://zigbee.org/zigbee-for-developers/smart-energy/

The workgroup also noted that Customer education is important for this use case, especially since other jurisdictions that provide the functionality have seen very low participation rates. It is essential that the EDU inform the Customer wishing to install a HAN device that the information originating from the meter that they view on their device or system may not exactly match their bill because validation, editing, and estimation (VEE) processes have not occurred. Also, Customers need to be aware that establishing a data sharing agreement with a CRES Provider or Third Party using the HAN interface places the burden for data security on the Customer and the CRES Provider or Third Party, not the EDU.

4.3.5 Home Area Network (HAN) Recommendations

1. All advanced meters installed by EDUs under the jurisdiction of the PUCO shall have a Home Area Network (HAN) radio module installed that enables Customers, and their authorized agents, to receive meter data directly from the meter. The EDUs should monitor advancements in HAN technologies and protocols as these will continue to evolve over time. Decisions to upgrade or obsolete any particular technology or protocol should take into considerations cost, Customer inconvenience and potential stranding of either EDU or Customer assets.

   Basis for Recommendation:

   a) Today, advanced meters have a standard option that includes a HAN radio module; the incremental cost to include this module is negligible.
   b) Without a HAN radio module in the meter, Customers would require a separate device connected to the distribution panel to monitor their energy usage and may not get their meter data directly.
   c) At the time of installation, the choice of type of meter and its functionality is often fixed for the lifetime of that meter, particularly for AMI and HAN technologies. There is a cost to change that meter to add or remove functions tied to its manufactured configuration.
   d) Maintaining a separate inventory of advanced meters that have a different configuration (i.e. those with and those without HAN radios) would be cumbersome and potentially limit the reach of Customer-facing programs relying upon that capability.

2. The default setting for advanced meters shall have the HAN radio disabled. The EDU shall enable or disable the HAN radio service of the advanced meter based on request of the Customer. The EDU shall have the right to disable the HAN radio should such action be needed for safety and/or information integrity/security purposes. In the event that the EDU disables the HAN radio, the EDU shall notify impacted Customers.

   Basis for Recommendation:

   a) Access to the HAN radio and the meter's delivery of data using the HAN radio should be under the control of the EDU to limit the potential for abuse or accidental access.
   b) This recommendation limits the amount of radio frequency (RF) radio signals that may compete with other Customer-provided home automation systems if the HAN is not in use.
   c) This capability allows the EDU and Customer to isolate and troubleshoot any issues with the HAN and HAN connected device and ensure alignment between a specific advanced meter and HAN device.

3. The EDU and CRES Provider or Third Party shall provide a list of certified devices, systems and software applications that are compatible with the installed advanced meter. Further, the EDU should make available enough information to permit the Customer to order the device, system or service. The EDU should establish and provide a reasonable process and instructional steps to enable a Customer to connect a suitable device to the meter HAN interface. The EDU shall provide technical support for Customers who are attempting to connect a device to the meter's HAN and require assistance. This technical support shall be available during normal working hours of the EDU.[25] The EDU should maintain information about the devices that are connected to Customer meters. This list shall include, but not be limited to, device type, media access control (MAC) address, installation code, serial number and other information that uniquely identifies the device that is connected to the Customer's meter.

   Basis for Recommendation:

   a) The EDU should ensure that the devices that are connected to the advanced meter HAN have been tested and certified.
   b) Maintaining a list of certified devices provides a useful guideline for consistency and ease of Customer support.
   c) A consistent set of steps reduces the complexity of installation
   d) Ensuring a good Customer experience is essential to the success of a HAN effort.
   e) Keeping a record of connected devices is important to ensure integrity of connections.
   f) The record helps establish metrics about how many HAN devices are in operation.

4. Information[26] about the HAN device ***maintained by the EDU*** shall be considered confidential information between the Customer and the EDU. This information may be shared with a CRES Provider or Third Party if the Customer authorizes the release of this information via an appropriate means of authorization to release this information to a designated party. There is no prohibition on a Customer releasing the same information where they hold it themselves.

   Basis for Recommendation:

   a) PII conditions would apply here since the Customer's name, account and other information may be included.
   b) The Customer authorization process should also indicate that HAN device specifics, such as device type, serial number and installation code, MAC address would be maintained and protected by the EDU unless specific release is authorized by the Customer.
   c) Release of information about the HAN device may leave it more vulnerable to cyber attacks or create conditions that render anonymization difficult to achieve.

[25] The EDU and Third Party Providers help desk responsibility may be limited to helping the Customer during the installation process and to those who are having issues related to the connectivity of the HAN device. The suppliers of authorized devices that can be connected to the HAN shall be responsible for providing technical and operational support for the Customer's HAN device.

[26] Device type, media access control (MAC) address, serial number and other information that uniquely identifies the device that is connected to the Customer's meter

5. The EDU should inform Customers that the data captured by the HAN device is representative information and that said information may be different than information that is gathered for billing purposes since that data undergoes additional validation to ensure data integrity.

   Basis for Recommendation:

   a) This strategy would ensure that Customers are aware that data forwarded by the HAN radio is informational only and that billing information undergoes additional processing. Informing Customers would help reduce Customer calls when comparing their actual bill with displayed or locally computed information.

4.4 Use Case #3 – Customer, CRES Provider, or Third Party requests an on-demand reading

NOTE: This use case was discussed by the DWG and was determined to be of little value for the foreseeable future. It is included here for the sake of completeness.

4.4.1 Summary

To help the Customer and their designated CRES Provider or Third Party with access to timely consumption information, the Customer and/or CRES Provider or Third Party may request an "on demand" reading of their meter data using a web portal or similar application.

This request for information will return data presented by the advanced meter through the AMI network system within several minutes of the request. This data will be time stamped to indicate when the data was collected from the meter. To ensure the integrity of the network design and performance, EDUs will control the flow of requests that are sent from the EDUs metering Head End System to the meters. EDUs would be expected to provide periodical reports to the PUCO on numbers of on-demand requests and numbers of delayed or denied requests due to network congestion.

Information delivered will include Customer account information; however, the meter data may not be fully processed for validity by the EDU.

4.4.2 Use Case #3 - Actor Interaction Diagram

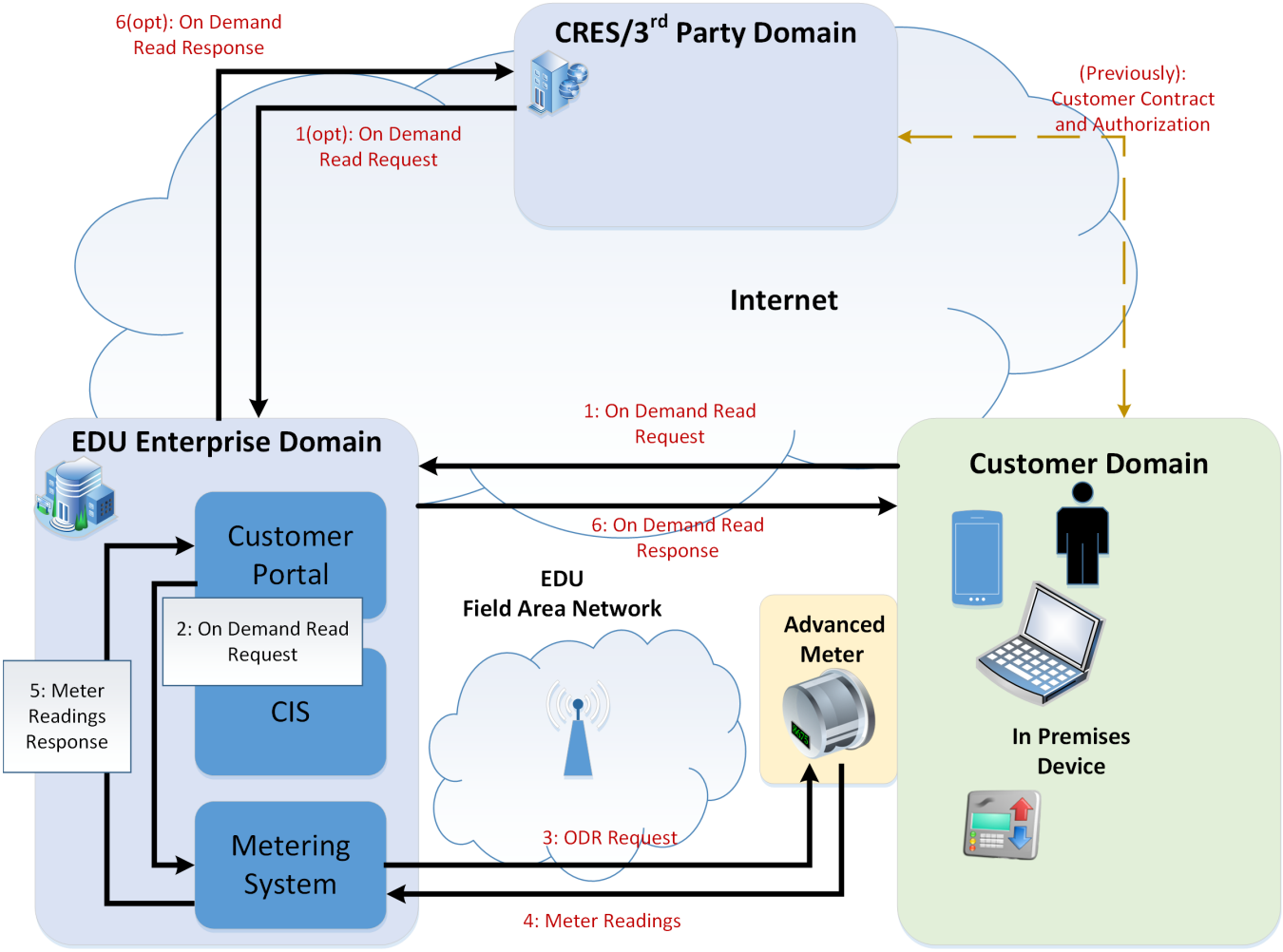

Figure 6: UC #3 – Customer, CRES Provider, or Third Party Makes an On Demand Read Request

4.4.3 Discussion

The DWG discussion determined that the Ohio EDUs' experience with advanced metering infrastructure networks and advanced meters is still in its early stages. This use case would require that additional advanced meter network capacity be available to support Customers and CRES Providers or Third Parties making on demand read requests when the same information can be accomplished through Use Case 1 and Use Case 2. As such, this use case was discussed by the DWG and was determined to be of little value for the foreseeable future.

4.4.4 Recommendations on Customer, CRES Provider, or Third Party requests an on-demand reading

There are no recommendations for this use case.

4.5 Summary of Recommendations

As a result of workgroup discussions and the judgement of EnerNex, the following chart presents a summary of recommendations for each use case. The priority for action is also identified, along with the impacted party(ies):

i. Create protocol for data privacy protection;
ii. Drive toward real-time or near real-time data becoming available to Customers;
iii. Prescribe methodology for Third Parties to obtain Customer energy usage data, including a method for CRES providers to obtain the total hourly energy obligation (THEO), peak load contribution (PLC), and network service peak load (NSPL) values.

Use Case #2 Statements: CRES Provider or Third Party requests access from the EDU to a Customer's meter data

Priority	Statements	Impacted Party
High	1. 1. Each EDU shall provide access to CEUD for CRES Providers and Customer authorized Third Parties. The CEUD shall, at a minimum include the time stamped interval of measurements and summary data that is collected by the EDU from the Customer's meter. For each Customer, the information provided shall include meter id and/or account number or other unique identifier associated with the Customer's account, which is considered PII. The measurements shall include power (kW), energy (kWh), and any other measurements used to calculate a customer's bill. The recommended interval period for energy intervals is 15 minutes but should be, at minimum, aligned with PJM's current energy market settlement. The mechanism for adoption should be the Green Button Connect My Data (CMD) methodology.	EDU
High	1a. Customers shall be able to authorize CRES Provider or Third Party access to their own CEUD as defined above at any time.	
High	1b. Customers shall have a secured method to authorize access to their CEUD as defined above.	EDU
High	1c. CRES Providers and Third Parties shall have a standardized method to access authorized CEUD as defined above.	EDU
High	1d. The PUCO should establish a technical interface working group for EDUs, CRES Providers and Third Parties to discuss the technical details required for standardization of access to CEUD.	PUCO
High	1e. EDUs may limit the amount of data provided to a CRES Provider or Third Party at a single time (e.g., 30, 60, 90 days per dataset) and up to a maximum amount of historical data (e.g., two most recent years).	EDU
High	1f. The mechanism for adoption should be the Green Button CMD mechanism.	EDU
Medium	1g. There should be a centralized list of non-CRES Third Party "bad actors" to check, with a process to be removed if conditions warrant.	EDU PUCO
High	2. Each EDU shall provide access to CEUD for Customers served by the EDU. The CEUD shall, at a minimum include the time stamped interval of measurements and summary data that is collected by the EDU from the Customer's meter. The measurements shall include power (kW),	EDU

Priority	Statements	Impacted Party
	energy (kWh), and any other measurements used to calculate a customer's bill. The recommended interval period for energy intervals is 15 minutes but should be, at minimum, hourly intervals to match PJM's current energy market settlement. Additionally, for each Customer the information provided shall include, at a minimum, meter id and/or account number. The mechanism for adoption should be the Green Button Download My Data (DMD) methodology.	
High	2a. Customers shall be able to download their own CEUD as defined above at any time.	
High	2b. Customers shall have a secured method to download their own CEUD as defined above.	EDU
High	2c. Customers shall have a standards-based method to download their own CEUD as defined above.	EDU
High	2d. EDUs may limit the amount of data downloaded at a single time (e.g., 30, 60, 90 days per dataset) and up to a maximum amount of historical data (e.g., two most recent years).	EDU
High	2e. The mechanism for adoption should be the Green Button DMD methodology.	EDU

Use Case #4 Statements: CRES Provider or Third Party Requests Anonymized Data from the EDU

Priority	Statement	Impacted Party
High	1. Each EDU shall provide bonafide requestors access to anonymized data for service points served by the EDU. The anonymized data shall: a. Use recorded interval data where available, otherwise the data shall use recorded monthly consumption. b. Provide at least kWh consumption. c. Be provided monthly in a dataset for a single calendar month. d. Indicate Customer class (e.g. residential, commercial, and industrial). e. Indicate the nature of the timestamps (e.g. period beginning or period end) for interval data. f. Anonymized data shall not include Customer name, address, or any other personally identifiable information.	EDU
High	2. Each EDU shall provide the anonymized data in the format and scope requested. An anonymized data request can be made for: a. One or more Customer classes. b. Specific ZIP codes or alternately, census tracts c. Historical datasets for at least the previous 12 months.	EDU
High	3. Each EDU shall anonymize the data using a 15/15 anonymization scheme or by a "differential privacy" methodology.	EDU
High	4. Each EDU should be able to charge a reasonable fee for the delivery of anonymized data to cover the costs of collating and delivering anonymized data files.	EDU

Use Case #1 Statements: Customer connects a device to the meter's HAN interface

Priority	Statement	Impacted Party
Medium	1. All advanced meters installed by EDUs under the jurisdiction of the PUCO shall have a Home Area Network (HAN) radio module installed that enables Customers, and their authorized agents, to receive meter data directly from the meter. The EDUs should monitor advancements in HAN technologies and protocols as these will continue to evolve over time. Decisions to upgrade or obsolete any particular technology or protocol should take into considerations cost, Customer inconvenience and potential stranding of either EDU or Customer assets.	EDU
Medium	2. The default setting for advanced meters shall have the HAN radio disabled. The EDU shall enable or disable the HAN radio service of the advanced meter based on request of the Customer. The EDU shall have the right to disable the HAN radio should such action be needed for safety and/or information integrity/security purposes. In the event that the EDU disables the HAN radio, the EDU shall notify impacted Customers.	EDU
Low	3. The EDU and CRES Provider or Third Party shall provide a list of certified devices, systems and software applications that are compatible with the installed advanced meter. Further, the EDU should make available enough information to permit the Customer to order the device, system or service. The EDU should establish and provide a reasonable process and instructional steps to enable a Customer to connect a suitable device to the meter HAN interface. The EDU shall provide technical support for Customers who are attempting to connect a device to the meter's HAN and require assistance. This technical support shall be available during normal working hours of the EDU. The EDU should maintain information about the devices that are connected to Customer meters. This list shall include, but not be limited to, device type, media access control (MAC) address, installation code, serial number and other information that uniquely identifies the device that is connected to the Customer's meter.	EDU
Low	4. The information about the HAN device maintained by the EDU shall be considered confidential information between the Customer and the EDU. This information may be shared with a CRES Provider or Third Party if the Customer authorizes the release of this information via an appropriate means of authorization to release this information to a designated party. There is no prohibition on a Customer releasing the same information where they hold it themselves.	EDU
Low	5. The EDU should inform Customers that the data captured by the HAN device is representative information and that said information may be different than information that is gathered for billing purposes since that data undergoes additional validation to ensure data integrity.	EDU CRES PUCO

Use Case #3 Recommendations

This use case was eliminated from consideration by consensus of stakeholders.

Section 5 **Conclusions**

The DWG effort undertaken and the participation by stakeholders, including the PUCO staff, has been effective and collaborative. This forum provided a facilitated means to provide education, reference material and meaningful dialogue and interchange among all parties.

The entire focus of the DWG regarding data access is topical, pertinent and a very appropriate aspect of grid modernization not only for Ohio, but for the entire electric industry in general. Ohio once again has demonstrated their leadership role in this regard.

One of the core tenets behind the Smart Grid Investment Grant (SGIG) under the American Recovery and Reinvestment Act of 2009 (ARRA) was to implement the necessary technologies that would enable Customers to have access to energy information which in turn enables them to take actions to improve their awareness and potential control of energy interactions. With nearly ten years of experience with smart meters, the expectations for mass market engagement with meter data has not yet been realized.

While real-time or near real-time meter data may not make the threshold for front of mind interest for the average consumer, the value of meter data and access to it in a meaningful and timely manner continues to be of great interest to many stakeholders in Ohio (as evidenced in the DWG sessions) and nationwide. Data access is a dominant modernization theme identified in the North Carolina Clean Energy Technology Center, "The 50 States of Grid Modernization Report.[27] In the third quarter summary for 2019, the report highlights that there were approximately 30 actions regarding data access issues being undertaken nationally, making this topic second only to Energy Storage Deployments.

Meter data access is an essential element needed to stimulate, invigorate and execute a fully competitive retail market, where Ohio is second only to Texas in the statewide average percentage of competitive energy supplier participants nearing 60%[28]. The competitive market in Ohio further re-enforces both the applicability and relevance of the DWG and subsequent actions that should be considered by the Commission.

As a result of the meetings, correspondence, and most importantly open and candid dialogue that took place over the course of this effort, we assert that the objectives of the DWG have been achieved. The set of recommendations presented have taken into due consideration all of the collaboratively agreed upon issues and individual inputs from stakeholders.

EnerNex has applied our independence, process rigor and oversight diligence in the preparation and review of the recommendations, and we believe it is reflective of the best interest of the PUCO to consider each one in its own merit.

We also recognize that the Commission holds the responsibility of acting upon these recommendations for the advancement of the needs of the state to promote the precept that "the data generated needs to be used to better enable Customer choice to inform Customers of their energy consumption and

[27] North Carolina Clean Energy Technology Center, The 50 States of Grid Modernization: Q3 2019 Quarterly Report, October 2019.

[28] https://www.puco.ohio.gov/industry-information/statistical-reports/ohio-customer-choice-activity/

costs so they can manage their energy usage, adopt technologies that provide benefits and drive systemic benefits for the grid[29]."

EnerNex wishes to thank all parties who participated actively, became involved, contributed to this effort or who passively observed.

[29] PowerForward Roadmap https://www.puco.ohio.gov/industry-information/industry-topics/powerforward/powerforward-a-roadmap-to-ohios-electricity-future/

Appendix A: Current State

Billing-Quality, Interval Data	
• A meter data management system (MDMS) sends raw interval meter data through a validation, editing, and estimation (VEE) process, e.g., resolves issues with missing data or data exceptions, and produces data that can accurately be used for billing purposes. Ultimately, this data is used to collect revenues through retail rates for end-use customers. • The PJM values (THEO, PLC, and NSPL) described later are used for wholesale market settlements, including the purchase of energy, capacity, and transmission needed to provide retail electric service to end-use customers.	
	Method(s) of CRES Access
AEP Ohio	• Bill-quality, hourly interval data, i.e. data that has gone through the validation, editing, and estimation (VEE) process, is available via Electronic Data Interchange (EDI) on an individual customer basis for large C&I customers, both existing and prospective. • Bill-quality, hourly interval data, is available via the business partner portal for all AMI customers, subject to the submission of a LOA for residential customers.
Dayton Power & Light	• Bill-quality, hourly interval data is available via EDI on an individual customer basis for large C&I customers, both existing and prospective. DPL does not have any AMI meters deployed.
Duke Energy Ohio	• Bill-quality, hourly interval data will be available via EDI on an individual customer basis for all AMI customers (all classes), both existing and prospective, pursuant to Case Nos. 17-0032-EL-AIR, et al.
FirstEnergy Ohio	• Bill-quality, hourly interval data is available via EDI on an individual customer basis for large C&I customers, both existing and prospective. • Bill-quality, hourly interval data, will be available via an Application Programming Interface (API) on an individual customer basis for AMI customers (≈700,000), both existing and prospective, pursuant to Case Nos. 17-2436-EL-UNC, et al.

Total Hourly Energy Obligation (THEO)		
Retail load schedules with reconciliation data (in kWh) provided by the applicable EDC are reconciled on an hourly basis on a two-month billing lag.		
• For all EDUs, Settlement A ("next day") information is available to CRES via PJM's InSchedule on an aggregate customer basis within 48 hours. ○ Settlement A: For most customers, load profiles are used to calculate the THEO values for the "next day" settlement. • For all EDUs, Settlement B ("60-day") information is available to CRES via PJM's Market Settlements Reporting System (MSRS) on an aggregate customer basis at the end of the billing period.		
	Method(s) of CRES Access	**Values**
AEP Ohio*	• Settlement B ("60-day") actual aggregate information is available via PJM's Market Settlements Reporting System. • True up factors for unaccounted for energy ("UFE factors") are posted to the EDC's website.	Settlement B: • For shopping customers with demands greater than 200 kW, actual hourly usage is used to determine the THEO. • For SSO customers with demands greater than 1,000 kW, actual hourly usage is used to determine the THEO. • For customers participating on a CRES time-of-use rate, actual hourly usage is used to determine the THEO. • For all other customers, a load profile is used to determine the THEO.
Dayton Power & Light	• Settlement B ("60-day") actual aggregate information is available via PJM's Market Settlements Reporting System. • True up factors for unaccounted for energy ("UFE factors") are posted to the EDC's website.	Settlement B: • For shopping customers with demands greater than 200 kW, actual hourly usage is used to determine the THEO. • For most SSO customers with demands greater than 1,000 kW, actual hourly usage is used to determine the THEO. • For all other customers, a load profile is used to distribute load into hourly values spanning the billing period.
Duke Energy Ohio	• Settlement B ("60-day") actual aggregate information is available via PJM's Market Settlements Reporting System.	Settlement B: • For customers with demands greater than 200 kW, actual hourly usage is used to determine the THEO.

	• True up factors for unaccounted for energy ("UFE factors") are posted to the EDC's website.	• For all other customers, a load profile is used to distribute load into hourly values spanning the billing period.
FirstEnergy Ohio**	• Settlement B ("60-day") actual aggregate information is available via PJM's Market Settlements Reporting System. • True up factors for unaccounted for energy ("UFE factors") are posted to the EDC's website.	Settlement B: • Actual hourly usage is utilized under provisions of the Companies' tariffs and contractual requirements for interval meter customers. • Going forward, actual hourly usage will be used to determine the THEO for customers with AMI meters, pursuant to Case Nos. 17-2436-EL-UNC, et al. • For all other customers, a load profile is used to distribute load into hourly values spanning the billing period.

**AEP Ohio: Ohio Choice Market Settlement Policies & Procedures (5/2018)*
***PJM Open Access Transmission Tariff: Attachment M-1 (FirstEnergy Zones) FirstEnergy Procedure for Determining a Load Serving Entity's Hourly Energy Obligations*

Peak Load Contributions (PLC)		
The annual allocation of generation capacity costs for each electric distribution company (EDC) within PJM is based on the proportionate share of the PLC, as determined by the 5 coincident peaks (CP) methodology. The 5 CPs are the 5 highest daily unrestricted RTO peak loads for each summer (June 1 through September 30).		
	Method(s) of CRES Access	**Values**
AEP Ohio*	• Business Partner Portal • Pre-Enrollment List • Electronic Data Interchange (EDI) • The 5 CPs and Weather Normalized Zonal Peaks are posted to PJM's website and the EDC's website.	• For shopping customers with demands greater than 200 kW, actual hourly usage at those five hours is averaged to determine the PLC. • For SSO customers with demands greater than 1,000 kW, actual hourly usage at those five hours is averaged to determine the PLC. • For customers participating on a CRES time-of-use rate, actual hourly usage at those five hours is averaged to determine the PLC. • For all other customers, a load profile is used to determine the PLC.
Dayton Power & Light	• Business Partner Portal • Pre-Enrollment List • Electronic Data Interchange (EDI) • The 5 CPs and Weather Normalized Zonal Peaks are posted to PJM's website and the EDC's website.	• For shopping customers with demands greater than 200 kW, actual hourly usage at those five hours is averaged to determine the PLC. • For SSO customers with demands greater than 1,000 kW, actual hourly usage at those five hours is averaged to determine the PLC. • For all other customers, a load profile is used to determine the PLC.
Duke Energy Ohio	• Business Partner Portal • Pre-Enrollment List • Electronic Data Interchange (EDI) • The 5 CPs and Weather Normalized Zonal Peaks are posted to PJM's website and the EDC's website.	• For shopping customers with customers with demands greater than 200 kW, actual hourly usage at those five hours is averaged to determine the PLC. • For SSO customers with demands greater than 1,000 kW, actual hourly

		usage at those five hours is averaged to determine the PLC. • Going forward, actual hourly usage will be used to determine the PLC for customers with AMI meters, pursuant to Case Nos. 17-0032-EL-AIR, et al.
FirstEnergy Ohio**	• Business Partner Portal • Pre-Enrollment List • Electronic Data Interchange (EDI) • Application Programming Interface (API), pursuant to Case Nos. 17-2436-EL-UNC, et al. • The 5 CPs and Weather Normalized Zonal Peaks are posted to PJM's website and the EDC's website.	• Actual hourly usage is utilized under provisions of the Companies' tariffs and contractual requirements for interval meter customers. • Going forward, actual hourly usage will be used to determine the PLC for customers with AMI meters, pursuant to Case Nos. 17-2436-EL-UNC, et al. • For all other customers, a load profile is used to determine the PLC.
**AEP Ohio: Ohio Choice Market Settlement Policies & Procedures (5/2018)* ***PJM Open Access Transmission Tariff: Attachment M-2 (FirstEnergy Zones) FirstEnergy Procedure for Determining a Load Serving Entity's Peak Load Contribution (PLC) and Network Service Peak Load (NSPL)*		

Network Service Peak Load (NSPL)		
The PJM NSPL loads for each year are based on the metered demand coincident with zonal peak load hour for each annual period (November 1 through October 31).		
	Method(s) of CRES Access	**Values**
AEP Ohio*	• Business Partner Portal • Pre-Enrollment List • Electronic Data Interchange (EDI)	• For shopping customers with demands greater than 200 kW, actual hourly usage at that hour is used to determine the NSPL. • For SSO customers with demands greater than 1,000 kW, actual hourly usage at that hour is used to determine the NSPL. • For customers participating on a CRES time-of-use rate, actual hourly usage at that hour is used to determine the NSPL. • For all other customers, a load profile is used to determine the NSPL.
Dayton Power & Light	• Business Partner Portal • Pre-Enrollment List • Electronic Data Interchange (EDI)	• For shopping customers with demands greater than 200 kW, actual hourly usage at that hour is used to determine the NSPL. • For SSO customers with demands greater than 1,000 kW, actual hourly usage at the hour is used to determine the NSPL. • For all other customers, a load profile is used to determine the NSPL.
Duke Energy Ohio	• Business Partner Portal • Pre-Enrollment List • Electronic Data Interchange (EDI)	• For shopping customers with demands greater than 200 kW, actual hourly usage at that hour is used to determine the NSPL. • For SSO customers with demands greater than 1,000 kW, actual hourly usage at that hour is used to determine the NSPL. • Going forward, actual hourly usage will be used

		to determine the NSPL for customers with AMI meters, pursuant to Case Nos. 17-0032-EL-AIR, et al.
FirstEnergy Ohio**	• Business Partner Portal • Pre-Enrollment List • Electronic Data Interchange (EDI) • Application Programming Interface (API), pursuant to Case Nos. 17-2436-EL-UNC, et al.	• Actual hourly usage is utilized under provisions of the Companies' tariffs and contractual requirements for interval meter customers. • Going forward, actual hourly usage will be used to determine the NSPL for customers with AMI meters, pursuant to Case Nos. 17-2436-EL-UNC, et al. • For all other customers, a load profile is used to determine the NSPL.
**AEP Ohio: Ohio Choice Market Settlement Policies & Procedures (5/2018)* ***PJM Open Access Transmission Tariff: Attachment M-2 (FirstEnergy Zones) FirstEnergy Procedure for Determining a Load Serving Entity's Peak Load Contribution (PLC) and Network Service Peak Load (NSPL)*		

Appendix B – Green Button

In September 2011, U.S. Chief Technology Officer, Aneesh Chopra, challenged utilities across the country to develop "Green Button"—a means of providing detailed Customer energy-usage information available for download in a simple, common format. This effort was to mimic "Blue Button," a similar government-led effort for personal health information where consumers, or patients, can get easy, secure access to their own health information in a format they can use. Through utility industry support for Green Button, consumers would be able to make better-informed decisions about their energy consumption due to the easier access to their own consumption data. Standardizing on the data format was intended to result in innovative applications that might transform the way people use energy.

In response to requests from the U.S. DOE, the National Institute of Standards and Technology (NIST) and the White House to help accelerate application development and industry adoption, a new initiative launched in the form of the Green Button Alliance. The Alliance utilized existing standards from the North American Energy Standards Board (NAESB) and work groups of the UCA International Users Group (UCAIug) to focus its attention on developing a rich, industry ecosystem consisting of electric utilities, independent system operators (ISOs) and regional transmission operators (RTOs), suppliers/vendors and users of automation and control systems, technology integrators, policy makers, regulatory agencies, and others. [30]

The NAESB's Energy Services Provider Interface (ESPI) standard, retail energy quadrant REQ.21[31] serves as the basis for Green Button technology by providing a model for business practices, use cases, and an eXtensible Markup Language (XML) schema for the standard.

Undertaken in 2011, the first effort known as Green Button Download My Data, permits individual Customers to download their own "Customer energy usage data" (energy, demand, cost, billing rates and other values) recorded by their service provider from their own metered service. Like Download My Data, the data is modeled and provided in a standardized format/schema fashion. That data may also include personally identifiable information (PII) and comes with a collection of assurance methods around authentication, privacy, and security, depending upon the implementation by each individual utility providing the data. This is analogous to getting banking data from your bank – those factors depend on the implementation the bank puts in place and your own practices when accessing your data. Once you have downloaded it, it is no more secure than any practice you put into place to secure it.

Undertaken in late 2012, the second effort known as Green Button Connect My Data, permits Customers to authorize Third Parties to obtain their "Customer energy usage data" (energy, demand, cost, billing rates and other values) directly from their provider in a business-to-business fashion using secure web technologies.[32] The data is modeled and provided in a standardized format/schema fashion. The data may also include personally identifiable information (PII) and comes with a collection of assurance methods around authentication, privacy, and security with defined mechanisms (strong public

[30] https://www.greenbuttonalliance.org/about#history
[31] https://www.naesb.org/ESPI_Standards.asp
[32] A full certification program for providers was established in 2018.

key HTTPS[33] certificate, TLS1.2 and TLS 1.3,[34] and FIPS 140-2, L1 [35]) to secure information in transit as well. The data requests require proof of authorization using unique, OAuth 2.0[36] "access tokens," and a corresponding requirement to authenticate both the Customer and the requested data elements prior to creating that token. This effort requires business process and software investments by the utility and CRES Providers or Third Parties to support the processes and methods for the Connect My Data functionality.

Most contemporary meter data management system (MDMS) applications (and other applications providing access to Customer energy usage data) offer Green Button Download My Data functionality and can be part of a Green Button Connect My Data offering.

[33] While HTTP/S is an application layer protocol, the addition of a secure socket layer (SSL) certification can render HTTP into HTTPS. See https://www.globalsign.com/en/ssl-information-center/what-is-an-ssl-certificate/

[34] TLS is "transport layer security". See https://www.globalsign.com/en/blog/ssl-vs-tls-difference/

[35] Federal Information Processing Standards Publication 140-2, "Security Requirements for Cryptographic Modules," where L1 refers to Security Level 1. See https://nvlpubs.nist.gov/nistpubs/FIPS/NIST.FIPS.140-2.pdf

[36] Open Authorization, an open standard for token-based authentication and authorization. See https://oauth.net/2/

Appendix C - Acronyms and Definitions

AMI	Advanced Metering Infrastructure – The use case used the term “smart meter;” however, Ohio calls this an “advanced meter” in OAC 4901:1-10-05 Metering.
Anonymize	Removing identifying information so that the original source cannot be known. Anonymized CEUD shall not contain any uniquely identifiable attributes about the customer.
CEUD	Customer Energy Usage Data – Includes all data specific to an individual customer‘s energy use, including at a minimum, individual energy use by time interval.
Consensus	The term “consensus” as used in this document represents a judgement arrived at by most of those concerned and does not imply the unanimity of all stakeholders.
CRES	Competitive Retail Electric Service
DER	Distributed Energy Resource
Differential Privacy	A method to obscure individual identity in large datasets using statistical methods which add mathematical noise to samples of individuals’ data to prevent the identification of any specific individual.
DMS	Distribution Management System
DOE	Department of Energy
DRMS	Demand Response Management System
DWG	Data and Modern Grid Workgroup
EDI	Electronic Data Interchange
EDU	Electric Distribution Utility
ESPI	Energy Services Provider Interface
FIPS	Federal Information Procession Standard
HAN	Home Area Network
HES	Head End System
HTTPS	Hyper Text Transfer Protocol Secure
HVAC	Heating, Ventilation, and Air Conditioning
IEEE	Institute of Electrical and Electronic Engineers
ISO	Independent System Operator
kW	kilowatt
kWh	kilowatt hour
LMP	Locational Marginal Price
M2C	Meter to Customer
M2M	Machine to Machine
MAC	Media Access Control
May	This word, or the adjective "OPTIONAL", means that an item is truly optional. From https://www.ietf.org/rfc/rfc2119.txt
MDMS	Meter Data Management System
MORPC	Mid-Ohio Regional Planning Commission

NAESB	North American Energy Standards Board
NIST	National Institute of Standards and Technology
OMS	Outage Management System
PII	Personally Identifiable Information - Typically consists of an individual‘s name and address, social security number, banking and medical information, mailing address if different from a service address, telephone numbers, and payment history.
PUCO	Public Utilities Commission of Ohio
PWG	Distribution System Planning Workgroup
REQ	Retail Energy Quadrant
RF	Radio Frequency
RTO	Regional Transmission Operator
Shall	This word means that the definition is an absolute requirement of the specification from https://www.ietf.org/rfc/rfc2119.txt
Should	This word, or the adjective "RECOMMENDED", mean that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course. From https://www.ietf.org/rfc/rfc2119.txt
TLS	Transport Layer Security
UCAIug	UCA International Users Group
VEE	Validation, Estimation, and Editing
XML	eXtensible Markup Language

Summary: Report Data and Modern Grid Workgroup (DWG) Final Report electronically filed by Mr. Ronald J Chebra on behalf of EnerNex, LLC