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Comments from Utilidata, Inc. to the Workshop to Begin Evaluating Alternative Distribution System Operator Models for California

Utilidata thanks the California Public Utilities Commission and Gridworks for the opportunity to comment on the workshop, which will begin evaluating the Distribution System Operator (DSO) Models for California, under Track 2 of the High DER Future OIR, R.21-06-017. We will not appear on May 3, but are eager to participate and will be following the discussion closely.

Introducing Utilidata:

Utilidata, an industry-leading grid-edge software company, is teaming up with NVIDIA, the world leader in accelerated computing and artificial intelligence, to develop an advanced computing chip for smart meters and other grid-edge devices. Powered by an edge graphical processing unit (GPU) and distributed software, the smart grid chip will provide utilities an easily deployed all-in-one processor plus software that prepares the grid for rapid decarbonization, electrification, and more extreme weather events.

Previous generations of smart grid devices, including meters, lack the computing power and software necessary to support real-time, autonomous operations, which will be necessary to manage the complexity of a modern grid. By combining Utilidata's expertise in real-time grid operations with NVIDIA's low-wattage GPUs designed for the edge, the smart grid chip will transform meters into the foundation of a clean, autonomous grid. This technology will ensure that meters deliver greater value to utilities and their customers, while also unlocking new opportunities for clean energy companies and third-party market participants. Utilidata has a track record of success in distribution grid solutions, with patented real-time machine learning software deployed at scale by National Grid and American Electric Power.

The smart grid chip is designed to future-proof a meter investment by driving outcomes that matter:

- Deliver greater value to customers by streamlining DER interconnections and integrating DERs into grid operations in real-time;
- Create an open data platform that makes energy insights available to third parties;
- Reduce outages during extreme weather events by leveraging AI to preemptively identify anomalies and allow for autonomous, distributed operations and surgical load shedding to mitigate the need for large-scale rolling blackouts;
- Prioritize infrastructure investments by using real-time data and machine learning to better forecast and manage load growth, which ultimately increases the likelihood of securing regulatory approval for investment expenditures.

We offer the following comments:

1. *Lessons learned from DSO initiatives beyond California:*

The White Paper leaves a number of questions unanswered.

- None of the models have had a linked impact in expanding adoption of DERs, with the exception of rooftop solar in Australia and limited construction of community solar in New York. What can we learn from the limitations of these models? How have states in the U.S. like Hawaii and California been more successful in adopting DERs without a DSO-similar entity? Are there features in DSO models and tariffs that might impede adoption of DERs and reduction of GHG emissions? Why did New York fail to attract competing operators for their Distribution System Service Platforms, and how should that inform our choices here?
- California law sets limits on the scale and scope of retail and distribution markets, and all of the models offered operate in deregulated markets. The language and the implicit intent of a DSO is to use market tools like the UNIDE. What is the effect of further fragmenting existing regulated activities by creating a new set of market operations? Which models have had an impact on distribution infrastructure planning and procurement and how?
- It is not clear from the paper and the three models as to how and by whom decisions regarding infrastructure upgrades within the distribution systems should be made. This question has been raised by participants in the Smart Inverter Operationalization Working Group, where at least one participant surmised that it would be addressed in the Distributions Systems Operation Working Group.

This last point is critical to accommodating and integrating a large number of DERs that serve multiple use cases and operate in diverse ways. The U.S. Department of Energy's Grid Modernization Laboratory Consortium recently published *Emerging Trends and Systemic Issues Influencing Today's US Electric Grid - Context for Grid Architecture Development*.[1] Among the many issues they raise are:

> **Faster system dynamics:[2]**
> Power system dynamics are increasing in speed and decreasing in latency requirements by orders of magnitude. The implementation of new grid capabilities has brought great increases in the speed with which grid events occur. This is especially true on distribution grids, although the trend exists for transmission as well. In the last century, aside from protection, distribution grid control processes operated on time scales stretching from about five minutes to much longer - and human-in-the-loop was (and still is) common. With the increasing presence of technologies such as solar PV and power electronics for inverters and power flow controllers, active time scales are moving down to sub-seconds and even to milliseconds. Consequently, automatic control is necessary, and this brings with it the need to obtain data on the same times scales that the control must operate. Thus, there is a sort of double hit: many more new devices to control, and much faster dynamics for each device, leading to vast new data streams and increasing dependence on ICT for data acquisition and transport, analysis, and automated

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[1] GMLC-1.2.1, February 2022.

[2] Page 2.15, under Section 2.6, "Control"

decision and control.

Evolving control system structure[3]
Utility control systems have traditionally been centralized, with hub and spoke communication to remote subsystems and equipment as needed. As the various trends cited here have emerged, the need for changes in control system structure has become apparent. Specifically, control systems must change from being centralized to a hybrid of central and distributed control.

While the industry generally recognizes the need for a transition to more distributed forms of control, this cannot happen without vendor-developed products. The vendors see thin markets and are unwilling to commit to new product development investment until they are reasonably assured of a market; the utilities are unwilling to commit to buying until they can see how new controls would work for them and what support they would see from regulators for new expenditures on controls and communications.

Vastly increasing number of endpoints attached to the grid that must be managed, sensed, and controlled[4]
Increasing sophistication and addition of new functions to the grid results in increasing numbers of devices with embedded processing and communication capabilities. These devices must be managed in the FCAPS sense. FCAPS is a terminology borrowed from the networking domain, meaning Fault (management), Configuration, Administration, Performance (monitoring), and Security. Those that have sensing and measurement capabilities must be read; those that have control capabilities must be commanded or otherwise directed to action.

Control systems now handle sensing and control endpoints numbered in the thousands, and network management systems now handle up to about 5 million devices. Widespread DER/DR penetration implies that a grid control system may have to handle 30 million to 100 million endpoints (aligned with a popular term in the first two decades of the twenty-first century: internet-of-things or IOT), which existing grid control currently cannot accommodate [48].

Increasing data volumes from the grid, increasing variety of data due to diversity of device types, and increasing observability[5]
While much of the discussion around increasing volumes of data from the grid focused on meter data, particularly large volumes are also coming from - and will continue to grow from - newer instrumentation on both transmission and distribution grids. Eventually the more than 5,000 PMUs that will be installed on the U.S. transmission grid will produce vast volumes of data at about 1.5 Petabyte per year. The vast amounts of data from PMUs are because these are streaming devices, much like video in that they produce streams of

[3] Page 2.16, under Section 2.6, “Control”
[4] Page 2.17, under section 2.6, “Control”
[5] Page 2.18, under Section 2.7, “Data and Communications”

data (as often as 60 values per second) that are used at multiple destinations. Similar technology is about to start penetrating the distribution grids, which will have orders of magnitude more streaming sensing devices than will be found on the transmission grid.

In addition, as interest in asset monitoring continues to increase, vast new volumes of asset health and operational data will be generated, with some to be used in real time and some to be stored and analyzed later. Finally, newer protection and control systems needed for advanced grid functionality will generate enormous volumes of sensor data that must be transported, processed, and consumed in real time and be stored for offline analysis. All told, the utility industry will experience an expansion of data collection, transport, storage, and analysis needs of several orders of magnitude by 2030.

Latency hierarchy[6]

Grid data is consumed by a variety of applications and these applications define latency requirements that collectively form a hierarchy. This hierarchy has significant impact on architecture of the data management, analytics, and control systems. Some data has multiple uses and so has multiple latency requirements. Some latency requirements are so short that the data must be processed close to the source and use points. This in itself implies a distributed (or at least decentralized) architecture for grid information processing and control.

Large-scale data collection driving machine learning (and Artificial Intelligence (AI)) and automation[7]

The growth of data analysis methods such as deep learning have led to a tremendous increase and interest in automation. Using larger amounts of data acquired from the grid, and learning from patterns, has created the possibility of new model-free and topology agnostic control algorithms, rapid automatic control without a human-in-the-loop step, and significantly faster grid response to known states in the grid [50].

Although there is significant work remaining in creating fully automated operations in certain areas of the grid, new grid designs are being developed with the full awareness that the available computational power presents great potential to optimize and provide robustness to the grid.

This report also references the potential for DSOs, speaking to market design and varieties of customer choice. However, the authors offer no advice as to the optimal business model that can build out the infrastructure the report identifies as necessary for the development of a more nimble, distributed grid.

We have already seen elsewhere that existing foundational components of the distribution system, like breaker or meter boxes, are incapable of supporting the influx of novel DERs that seek circuits behind the meter in residential and commercial applications. There are workarounds, such as meter collars, which should use open-access communications so as not to create undue market power.

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[6] Page 2.19, under Section 2.7, “Data and Communications”

[7] Page 2.17, under Section 2.7, “Data and Communications”

2. *On meeting the Commission's expectations:*

The notice to the Service List asks: "How do alternative Distribution System Operator models compare in their ability to plan and operate a high DER grid, unlock economic opportunities for DERs to provide grid services, limit market power, reduce ratepayer costs, increase equity, support grid resiliency, and meet State policy objectives?"

Not all the conditions needed to achieve these goals are apparent to us from the information provided so far. We suggest making more transparent criteria that the optimal choice of a DSO should support:

a. The market should be ***transparent,*** in that results of bidding must be known at some point to set market expectations.
b. The market must be ***open and accessible*** to all qualified participants.
c. The market must support the buildout of ***distribution infrastructure that is flexible, nimble and future-proofed***, so that future use cases can be identified and acted on with the least amount of friction.
d. The market must be able to hold participants ***accountable***, so that grid operators and consumers can be confident about pricing, resource adequacy, and reliability needs.
e. The market must further California's ***clean*** energy goals.
f. The concept of ***equity*** is usually not easily or fully addressed by markets. Can this market structure discussion overcome this inherent market deficiency?

3. *On the choice of Gridworks' Proposed Track 2 process:*

Utilidata supports the use of Proposal 3, with the clarifying addition that one of the four workshops must address how infrastructure upgrades and adoptions are made. It is inconceivable that a DSO can achieve the high expectations set forward without additional grid improvements. Any selection of a DSO model must include this important criteria.

Thank you for this opportunity to share our thoughts.

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