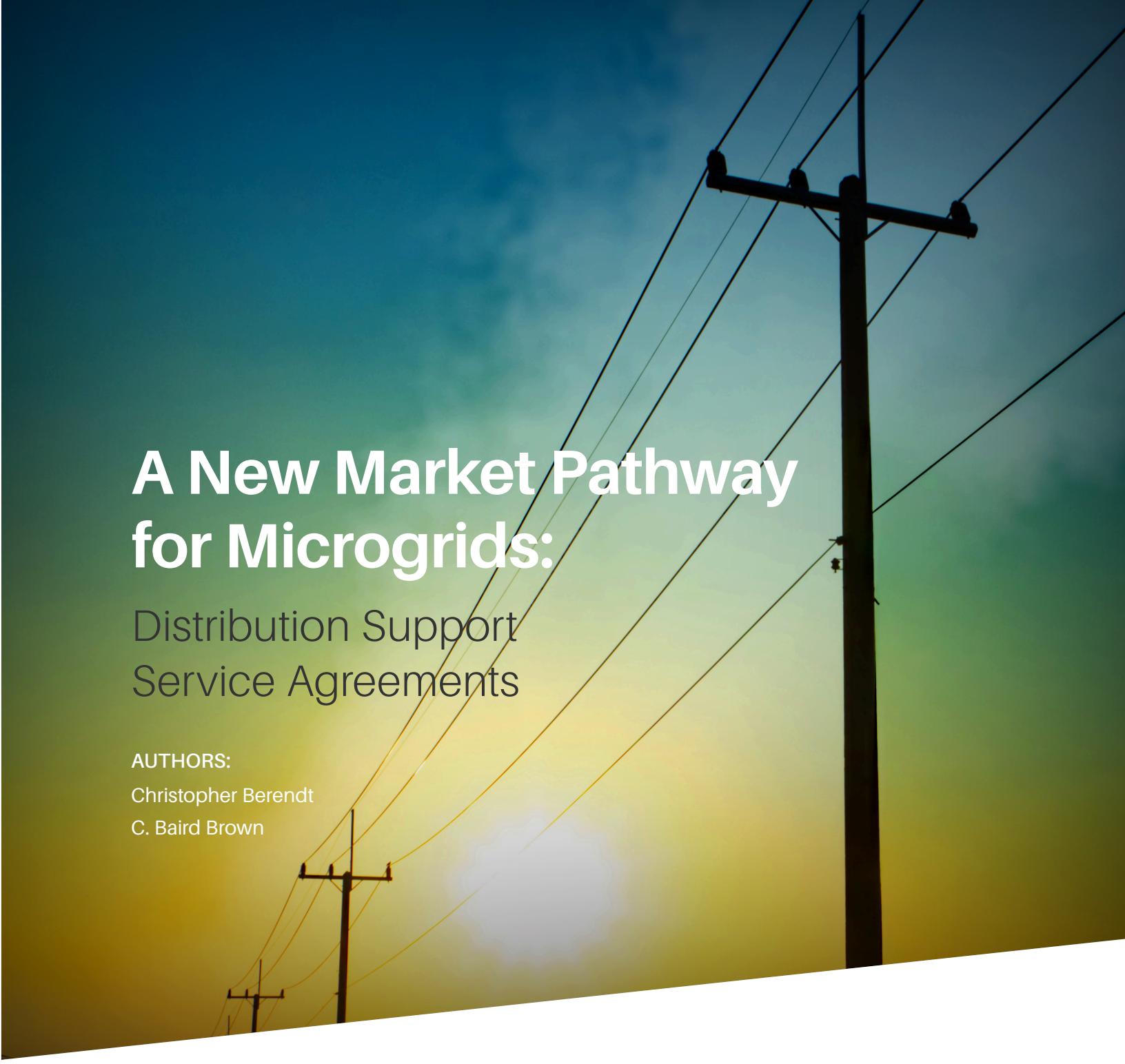

A New Market Pathway for Microgrids:

Distribution Support Service Agreements

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This white paper is the first in a planned series on advancing microgrids. Microgrids meet customer energy needs with generation, storage assets, and smart controls in an electrical system that can separate or "island" from the grid and operate on its own. When connected to the grid, microgrids can optimize customer energy use and provide a range of services to support the grid.

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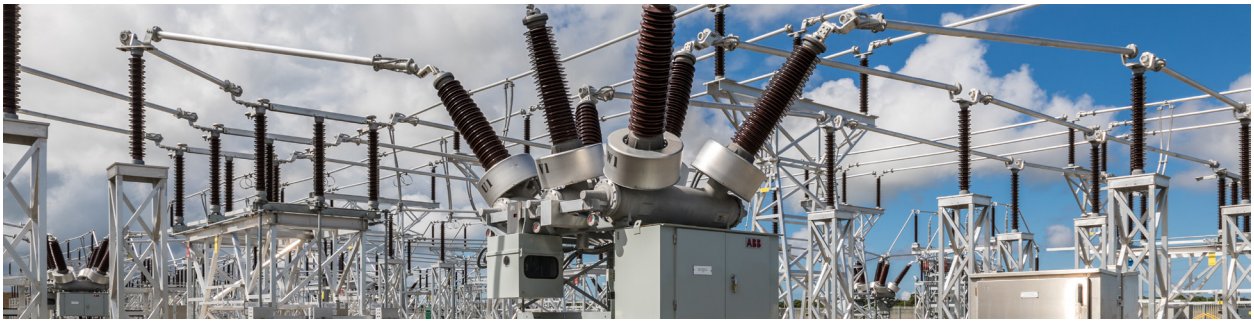

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I. Executive Summary

Distribution Support Service Agreements ("DSSAs") are long-term agreements that allow a utility to call for services from customer and community resources as needed to support smart distribution grid operations. These agreements would build dynamic relationships between utilities and customers with dispatchable distributed energy resources ("DERs") such as microgrids. DSSAs would enable microgrids to provide flexible, tailored services to meet local grid needs, while allowing them to extend their economic, environmental, and resilience benefits to the surrounding community.

DSSAs support optimization of distribution grid operations and more resilient communities, both during normal ("blue sky") grid operation and emergency ("black sky") response. They offer a new market pathway for the next generation of grid resources that will support the development and finance of microgrid and other dispatchable DER projects. This white paper explores how DSSAs can serve as a new contractual vehicle to create sustaining relationships between microgrids and the distribution grid for the benefit of all stakeholders.

II. Introduction to Distribution Support Service Agreements

A DAY IN THE FUTURE: MICROGRIDS AND SMART GRIDS

Imagine it is September 3rd, 2031: Unexpected extreme heat during the day has led to several severe storm fronts tearing through the region bringing down many trees and lines. However, unlike today, this is not a major grid restoration event for the utility — most of its territory never lost power, and where it did, essential community services were maintained. Further, the utility avoided the need to have peaking power plants run during the middle of the day reducing both wholesale power market prices and greenhouse gas emissions. Utilities are getting smarter, but how did this one become so agile?

Advanced Control Technology

The first part of the answer is that the utility invested in advanced control technology. Its digital control center runs systems with semi-autonomous distributed controls enabling dynamic grid monitoring, response, and switching as well as distributed energy resource management capabilities. During the storm, those combined systems were able to quickly isolate damaged circuits, reroute power flows, and dispatch several local microgrids to assist the grid operator in maintaining service to the surrounding communities and to aid in restoration. In the damaged circuits, load providing essential emergency services to the community stayed powered within islanded microgrids. That same system called services from various microgrids before the storms at the peak of the day to avoid the utility bearing a spike in wholesale power prices.

Dynamic Customer Relationships

The second part of the answer is that the utility invested in dynamic relationships with its customers — especially those large customers and groups of customers with advanced distributed energy resources, such as dispatchable microgrids. Those relationships, formalized through established contracts and reliable operating protocols, enabled the local microgrids — regardless of who hosts and owns them — to provide benefits to everyone in their communities.

A NEW CONTRACT VEHICLE: DISTRIBUTION SUPPORT SERVICE AGREEMENTS

Distribution Support Service Agreements are long-term contracts between a microgrid and its local distribution utility that allow the utility to call for services from the microgrid to support smart distribution grid operations. Microgrids, combining adjustable load, generation and storage resources, are among the most flexible and dispatchable DERs in operation today and can provide a range of custom, localized services to utilities. Procurement of DSSAs from customer microgrids allow the utility to select valued microgrid capabilities and

establish procedures that allow the utility to rely in advance on those capabilities. DSSAs represent a contractual mechanism through which microgrids can provide the service benefits that flow from those capabilities to all of a utility's customers and communities (not simply the microgrid's host and owner) by giving the utility tools to deliver on the promise of a smarter grid.

The Evolving Utility Business Model & DSSAs

Utilities are increasingly working to develop and manage cleaner, smarter, more resilient grid systems, marked by the presence of large amounts of DERs, including generation and storage. They are looking not only at creating a dynamic platform for services and information, but to conducting the DER concert of advanced, dispatchable DERs, such as microgrids. From this smart management platform, utilities could monitor real-time conditions and dispatch local microgrids to optimize grid operations under both blue and black sky conditions. The technology to build a dynamic platform is available — DER and Advanced Distribution Management Systems ("DERMS & ADMS") product offerings are propagating.

DSSAs provide the regulatory mechanism to permit utility investment in the dynamic customer relationships that will create the DER concert, and in the underlying platform technology required to orchestrate. They are a contractual representation of this new relationship — one in which utilities enable customer development of advanced DERs, such as microgrids, and utilize their services to the benefit of all ratepayers.

There is general agreement that the grid system in the future will look less like a hub and spoke system and more like a mesh. That mesh will be marked by significantly higher levels of DER installed capacity, including microgrids and other advanced DERs. This transformation and growth in microgrid installed capacity should be driven in part by new market pathways such as DSSAs.

DSSAs are a contractual representation of this new relationship — one in which utilities enable customer development of advanced DERs, such as microgrids, and utilize their services to the benefit of all ratepayers.

MICROGRID SERVICES AND DSSAs: A NEW MARKET PATHWAY

As unified aggregations of diverse onsite resources, microgrids are by nature flexible, with the ability to be dispatched for the provision of standardized or customized products and services. In addition to service to their included (or "native") load, microgrids can combine onsite load, generation, and storage resources to rapidly increase exports of various services back to the grid. This can reduce or increase imports from the grid, or island completely, keeping all or a portion of their included load powered, and aid in grid restoration.

Microgrids often include competitive, high-performance resources and are allowed to provide standardized products and services to organized wholesale markets run by Regional Transmission Operators and Independent System Operators ("RTOs and ISOs"), at a minimum, as wholesale demand response resources. Some distribution utilities may procure standardized services from distribution-level resources such as microgrids through fixed tariffs for interruptible load, curtailment, and retail demand response programs. The provision of standardized products represents a present market pathway for microgrids, and one that is important to expand at both wholesale and retail levels. However, it is their ability to provide locally tailored, customized products and services that is most remarkable, and deserving of a new market pathway.

Microgrids can typically assume a seamless range of operating postures. In effect, microgrids can show the distribution grid a wide range of supply and demand

"profiles" that can be pre-selected and customized to its requirements. Utilities can be given the ability to dispatch microgrids into these profiles through DSSAs, for instance to support a stressed substation, radial feeder, or a larger grid area isolated by smart controls. DSSAs create a new market pathway for customized grid services that takes advantage of microgrids' intrinsic flexibility and locational service value.

The new market pathway offered by DSSAs can extend beyond microgrids to other flexible and dispatchable DERs, demand resources, and emerging local resource aggregations such as electric vehicle fleets. The DSSA market pathway for customized grid services would allow the locational dynamics and service values of dispatchable distribution-level resources to be captured and optimized by utilities on behalf of local communities and all customers. DSSAs demonstrate the beneficial relationship and partnership possible between grid-edge DERs, their communities, and utilities.

III. The Range of Distribution Support Service Agreement Stakeholder Benefits

DSSAs offer a range of benefits across stakeholders. Primarily, they extend the service capabilities of a microgrid, beyond the microgrid's host and owner, to the surrounding grid and communities through provision of services to the local utility. Second, DSSAs provide an incentive supporting microgrid development and finance by providing a microgrid bankable offtake from a creditworthy utility counterpart.

COMMUNITY DSSA BENEFITS

The service benefits of microgrid DSSAs extend to the surrounding community. These benefits range from increased community resilience and lower power prices to enabling higher levels of DER deployment and better community environmental performance. Services under DSSAs can address challenges presented to communities under both blue and black sky conditions.

THOUGHTS ON RESILIENCE:

Resilience is a hot topic in the energy policy debate with a variety of stakeholders seeking to define it. As a practical matter, it is clear that resilience must manifest at the distribution level to make a difference in protecting our communities. Given that most grid failures are experienced at distribution to midrange voltage levels, it is efficient to drive resilience at the grid-edge. Further, our focus must be on the critical infrastructure that provides our communities with essential services in an emergency. To do otherwise would see the power sector making hollow offerings of security to our communities.

A "resilient" grid system that allows critical infrastructure to face days without service, forced to rely on less-than-dependable backup generation, does not deserve the characterization. It may be generally "reliable," be meeting its reserve margins, have acquired plenty of enhanced capacity, and be critically important, but such a grid system should not be called "resilient" as no amount of distant, undeliverable reserves can make local communities resilient. Islandable microgrids, with robust onsite generation and storage, can make such a grid system resilient by buttressing the grid-edge; DSSAs are one of several potential policy mechanisms to help capture and foster this value.

Black Sky Benefits

Emergency or "black sky" conditions are often characterized by the loss of circuits and community outages. Communities rely on their distributional utilities to keep outages from occurring and to restore them rapidly when they do. Further, DSSAs offer utilities the service tools to improve job performance. Under DSSAs, a local utility can call local microgrids into various export profiles to support and sustain circuits. Additionally, DSSAs can direct islanded microgrids to synchronize and reconnect to a restoring grid without putting load on their local substations, thereby reducing the power needed for circuit restoration.

DSSAs enable utilities to use microgrid services to make the distribution grid and local communities more resilient during emergency conditions.

Microgrids with DSSAs can be encouraged to directly offer community members shelter from the storm by including and powering critical infrastructure that provides essential community emergency services (e.g. first responders, hospitals, community centers, nursing homes, community schools, grocery stores, gas stations, and water and sewer systems) as load within their islands. When utilities procure DSSAs, those offered by microgrids that also sustain emergency services could receive preferential treatment (and may be complemented by new public benefit fund community resilience assistance programs). Coordinating policies to incentivize microgrid development and service provision in low-income communities is especially important. In communities where customers (such as renters) may have difficulty affording or being allowed to run backup generators, let alone install solar+storage systems, local microgrids may be the only available refuge for community members during a prolonged outage.

Blue Sky Benefits

Under normal or "blue sky" operating conditions, microgrid services provided under DSSAs can offer smart and agile utilities a new layer of control to optimize distribution grid operations. Such optimization may be in furtherance of lower-cost procurement, locationally customized services, increased deployment and utilization of renewable energy resources, or reductions in greenhouse gas emissions, among other aims. States are increasingly pursuing aggressive renewable energy and decarbonization goals, but widespread deployment of unbuffered renewables can lead to the generation mismatch issues represented by the "duck curve" requirement for ramping capacity in California. By including flexible generation and storage along with renewables, microgrids can responsibly expand renewable generation and also act as "shock absorbers," helping to stabilize their surrounding circuits and enabling higher levels of simple, non-dispatchable DER deployment around them. With the wide range of microgrid operational capabilities, from rapidly increasing imports to exporting power to the grid, these shock absorbers have a good bit of travel. Many past DER concerns about system disruption, lack of resource flexibility and visibility simply do not apply when it comes microgrids, especially those providing services under DSSAs with an active link to the distributional utility. No matter the conditions, microgrids can provide a host of benefits to utilities and communities under DSSAs.

DSSAs Work under a Variety of Microgrid Ownership Structures

DSSAs can operate and provide benefits to utilities and communities regardless of ownership structure. Microgrids may be hosted, developed, owned and operated by a variety of entities. Such entities may be customers, third parties, utilities, or hybrid combinations of the three. For example, a customer might own and operate a microgrid, including both its distribution and generation. A customer, or group of customers, might be served by third-party-owned generation, but otherwise host, own and operate the rest of its microgrid. That same scenario could have the utility owning and operating the microgrid's distribution system.

Paying for Services, Not Microgrids

For the common structure where the value of the microgrid providing services to included load along with private ownership and capital drive microgrid

DSSAs offer utilities a contractual vehicle to benefit from local microgrid services without their customers bearing rate increases for microgrid construction.

development & finance, DSSAs offer a unique advantage to utilities and the communities they serve: ratepayers pay for microgrid services, but not the cost of building microgrids. It will be difficult to deploy microgrids at scale by asking utilities and their ratepayers to bear the capital expenditure of their construction, especially as communities are asking utilities to invest in other capital-intensive areas such as advanced distribution system control technologies, EV charging networks, and utility-scale renewable generation and storage. DSSAs offer utilities a contractual vehicle to benefit from local microgrid services without their customers bearing rate increases for microgrid construction.

A similar dynamic can operate at the wholesale market level. Microgrids can often offer competitively priced wholesale products due to host value propositions largely supporting their development and operations. While wholesale revenues are an important part of their value stack, microgrids tend not to be dependent on merchant revenues.

UTILITY DSSA BENEFITS

Utilities and communities benefit from DSSAs by giving utilities finer and more granular controls to optimize the distribution grid. Contracting for smart grid services at the distribution level is efficient. The grid system delivers its core value at the grid-edge. It is where supply and demand balances. Microgrids are flexible and dispatch grid-edge, distribution level resources. Again, this flexibility is not fully utilized when microgrids provide standardized products through existing market pathways. DSSAs offer a new market pathway for customized, locational-specific services for utilities to capture that value on behalf of their communities. They offer a new layer of control and service optimization to utilities.

DSSAs demonstrate a clear use case for advanced utility control systems and support investment in distribution system upgrades. They will give utilities finer control over the advanced DERs that are populating distribution systems. As such, DSSAs should have a role in the emerging utility business models of the future.

New Utility Business Models and DSSAs

Utilities are increasingly facing pressure from customers, communities and regulators to achieve multifaceted economic, technology and environmental goals. From accommodating more DERs and electrification of buildings and transportation systems, to providing a broader range of service options to and from customers, utilities are looking to transition from the traditional, one-way, pipeline business model to multidirectional, "platform" business models. Unlike the traditional sales volume driven model, under platform business models, utilities invest in, and are compensated by, success in providing customers services that enable them to have a more dynamic relationship with their utility and to achieve a range of economic, environmental, and resilience goals. Such a relationship includes, but is certainly not limited to, the utility providing enhanced information about the status and needs of its system and loads as well as embracing and enabling the deployment of customer DER. The mission of a platform utility is excellence in customer service and experience, resilience and reliability, not selling the most power possible. The transition to these performance-based, platform utility business models is underway, and just as with wholesale market deregulation, regulators need to help ease the impact on utilities. Providing revenue safety nets to utilities as they transition to platform functionality is important. Utilities will continue to need to raise capital and invest in advanced controls, among other technologies, to create a smarter grid. It does not make sense to require utilities to make significant investments and to run up their cost of capital at the same time. As utilities look to

establish new platform models, the opportunity arises to provide enhanced services to ratepayers by conducting the emerging DER concert at the distribution level through the creation of portfolios of DSSAs with their local microgrids and other advanced DERs.

Utilities are increasingly able to monitor real-time distribution system conditions down to specific loads and customers. DSSAs offer those utilities the complementary ability to exert control over localized, distribution-level resources and dispatch local microgrids in concert to optimize grid operations. The glimpse into the future at the start of this white paper features a utility with such abilities. Those abilities can be made possible in part by DSSAs and the opening of new relationships and partnerships between customers with grid-edge resources and their utilities.

Preparing for the DER Concert: Building Utility DSSA Portfolios

As discussed above, microgrids are unique in being able to assume a variety of customized operational profiles or postures. The advanced DER concert will be made up of different microgrids collectively assuming different profiles in furtherance of their utility optimizing distribution system operations. Utilities will need to build portfolios of DSSAs that allow for the collective dispatch of multiple microgrids or "microgrid clusters." Such portfolios can offer utilities a wide range of collective dispatch and operational options from local microgrids. How a utility succeeds in building and operating its DSSA portfolio represents a key performance metric for smart grid operations and should be considered as a component of performance-based utility regulation.

Utilities Should Earn a Rate-of-Return on DSSAs

DSSAs support the development of advanced utility distribution grid control infrastructure such as DERMS and ADMS in furtherance of optimizing distribution grid operations and achieving multifaceted policy goals. DSSAs will function as utility smart grid infrastructure (i.e. virtual generating and storage, paper facilities), regulators should consider treating DSSAs as partial capital assets or otherwise include them in incentive rates to promote their widespread use. Under such treatment, DSSAs would be part of a utility's ratebase and the utility would be entitled to earn a rate-of-return for establishing portfolios of DSSAs comparable to fully or partially building infrastructure that would serve a similar purpose.

DSSAs Should Serve as Non-Wires Alternatives

DSSAs can clearly serve as Non-Wires Alternatives ("NWAs") by offering a lower-cost solution close to the imbalance or constraint in the grid system that is causing problems. Such microgrid service solutions are likely to be more dynamic than simply creating more capacity on a line or at a substation. Microgrid services procured through DSSAs can offer a range of services to the utility and can support community resilience thereby offering more value than traditional wires solutions. As utilities look to implement more NWAs, they must increase transparency into distribution system constraints and imbalances and collaborate with communities and state emergency response agencies to identify critical community facilities. Efforts to create "heat maps" of distribution grid constraints are a good start. In addition, utilities should seek to provide grid information concerning imbalances and opportunities for power flow optimization and to collect information about critical community facilities to make the most of the range of services that portfolios of DSSAs could offer. Procurement processes can be designed with timeframes and information that enable customers to consider how they might be part of a NWA via a DSSA. Further, since a customer might decide for their own reasons on their own schedule that a microgrid or other advanced DER is needed, utilities should remain open to unsolicited proposals or have an always open procurement track for DSSAs to serve as NWAs.

DSSAs WILL ENCOURAGE MICROGRID DEVELOPMENT AND FINANCE

As discussed above, DSSAs help utilities and their ratepayers benefit from microgrid services without having to pay for the direct cost of constructing microgrids. Instead, the customers that host microgrids and/or third-party developers and

investors would pay to build them. DSSAs can help support such privately financed microgrids and put private capital to work creating assets that provide services to the public in addition to the host customer. Specifically, DSSAs allow microgrid developers to contract with creditworthy utilities that can be relied upon to utilize and pay for microgrid services. Thus, DSSAs should be "bankable" so that microgrid investors feel comfortable relying on the future revenue streams from selling services to utilities under DSSAs. This supports microgrid developers obtaining financing for microgrid construction. DSSA revenue would complement those that would flow from any wholesale market product sales and the core revenue streams under service contracts with customers included within the microgrid (e.g. microgrid service agreements, energy service agreements, microgrid concession agreements, power purchase agreements, etc.).

DSSAs can be designed with service schedules that cover a wide range of microgrid service profiles and thus encourage developers to explore building microgrids with greater ranges of capabilities. More capable microgrids can provide better economic, environmental, and resilience services to their host customers, utilities, and ultimately their communities. Overall, DSSAs enable everyone to benefit from the development of increasingly capable microgrids in their communities.

IV. Structuring & Regulating Distribution Support Service Agreements

DSSAs are a contractual vehicle for utilities to partner with customers that deploy microgrids in furtherance of economic, environmental, and resilience goals. They work across microgrid ownership structures, including hybrid and multi-customer structures. When structuring DSSAs themselves, the core question is: What is the utility structuring for? What services do they want from microgrids for smart grid operations? DSSA service structures and the manner in which they are procured will ultimately be dependent on solutions that utilities and their customers and local communities are seeking. It could be a Non-Wires Alternative that is sought, the ability to sustain isolated circuits, to rapidly respond to an export signal, or any combination of these and other services. From a service definition perspective, this could mean DSSAs could cover the ability to call a microgrid, among other actions, to:

- Partially or fully curtail or increase its grid imports;
- Export energy or ancillary services to the grid;
- Island itself from the grid; and;
- Reconnect to the grid fully supporting its own load, and thus not adding load for the local substation to bootstrap.

As commercial agreements, DSSAs would have common terms for service performance, including performance assurances and liquidated damages a microgrid would bear for its non-performance when called by the utility. Among several potential payment models, it is envisioned that a microgrid would be compensated for its services under a DSSA via an annual fixed fee and a variable fee for specific services when called. Regulators would need to approve DSSAs for service structure, fees and rate recovery dynamics, but could allow for disputes concerning the commercial dynamics of a DSSA to be settled via commercial litigation.

Regulators and their utilities have many options as to the regulatory mechanisms to use for DSSAs. From existing planning and procurement programs to new program structures, there are plenty of policy tools for regulators. In some jurisdictions, existing authorities could be combined to achieve a more sophisticated regulatory framework that can drive DSSA adoption. In others, legislative action may be needed, often in the form of tuning existing frameworks for removal of barriers to microgrid development thereby unlocking DSSA-related opportunities. For jurisdictions moving forward with grid modernization, the unbundling and decoupling of utilities, and the transition to platform utility business models, DSSAs are easily incorporated into performance-based revenue metrics.

From a jurisdictional perspective, DSSAs should have state regulation complemented by light handed, deferential, federal regulation. State commissions would need to authorize any utility DSSA procurement and ratebasing. The development of utility tariffs for Microgrid Customer Classes by state commissions are important to clarify the microgrid development and operational environment. These state jurisdictional tariffs should also expressly enable the DSSA market pathway. DSSA regulation will need to integrate with the state's overall regulatory status (i.g. unbundled, decoupled, participation in power markets organized by RTOs and ISOs, retail choice, vertically integrated regulation, etc.). Customized microgrid services provided to local utilities complement the standard products microgrids are able to provide to RTO- and ISO-organized wholesale markets. Where aligned with the overall regulatory status, allowing microgrids to arbitrage among services to the host customers, the local utility, and the regional organized wholesale market enables those microgrids to operate to their fullest capabilities.

In addition to having aspects that trigger state commission jurisdiction, some services under a DSSA will represent a wholesale "sale-for-resale" and thereby give rise to Federal Energy Regulatory Commission ("FERC") jurisdiction. FERC may require microgrids to be granted market-based rate ("MBR") authority to enter into such DSSA transactions. As many microgrids would also be certifiable as Qualified Facilities under PURPA, their regulatory burdens would be lessened (e.g. self-certification, exemptions for certain reporting and for prior approval of microgrid asset sales, and depending on size, not requiring MBR authority to make market sales via DSSAs), and in any event, if needed, they would likely also qualify for exempt wholesale generator status and could obtain MBR authority. However, as with net metering, which is technically a "sale-for-resale," FERC may choose to not assert jurisdiction over DSSAs, especially if the parameters for DSSA establishment and structure are creatures of state jurisdictional tariffs. DSSAs are a way for utilities to directly acquire customized, local services from customer-based assets, an area generally left to state regulation under the Federal Power Act.

EXPLORING THE FUTURE

Grid modernization proceedings should explore how DSSAs might be structured and operated to enable the expansion of microgrid benefits. Utilities should develop enhanced distribution system mapping to identify strategic microgrid locations for customized service provision. Utilities and their regulators should start to consider the various forms of DSSAs, such as ranges of service categories and fee structures. Pilot projects can be a valuable tool for charting DSSA functionality, especially in areas such as DSSA portfolio and microgrid cluster dispatch sequencing, grid optimization modeling, and testing the interface of master microgrid controllers with DERMS and ADMS.

CONCLUSION

DSSAs can serve as an important mechanism for utilities, their customers and communities to achieve economic, environmental, and resilience goals. They represent the emerging relationship between utilities and customers with dispatchable distributed energy resources. DSSAs enable utilities to utilize local microgrids and extend their economic, environmental, and resilience benefits to the surrounding community. As grid modernization proceeds, stakeholders interested in microgrids should consider DSSAs as an essential element for building a smarter grid.

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