Smart Electric Power Alliance

DERMS: State of the Industry 2023

Gaps & Opportunities

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About SEPA

The Smart Electric Power Alliance (SEPA) helps all electric power stakeholders accelerate the transformation to a carbon free electricity system. SEPA concentrates our focus on the following areas to maximize impact: Transportation, Storage, Resilience, Emerging Technology, and Policy.

SEPA delivers value to our members through research, education, events, working groups, peer engagements, and member projects. We facilitate collaboration, develop innovative strategies and guidance for regulatory and business innovation, and provide actionable solutions for our members and partner organizations. For more information, visit www.sepapower.org.

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List of Acronyms and Abbreviations

Advanced Distribution Management System (ADMS)
Advanced Metering Infrastructure (AMI)
Behind-the-meter (BTM)
Demand Response (DR)
Demand Response Management Systems (DRMS)
Distributed Energy Resources (DERs)
Distributed Energy Resource Management System (DERMS)
Distribution Supervisory Control and Data Acquisition (D-SCADA)
Distribution System Operator (DSO)
Federal Energy Regulatory Commission (FERC)
Front-of-the-meter (FTM)
Net Energy Metering (NEM)
Outage Management System (OMS)
Transmission System Operator (TSO)
Virtual Power Plants (VPPs)

Executive Summary

The distributed energy resource landscape is continuously expanding and broadening its reach. Technology that started as mainly niche rooftop solar installations has now expanded to heat pump water heaters, intelligent thermostats, battery energy storage, intelligent vehicle charging, and other devices. This makes the electric grid more flexible and capable of responding to varying operating conditions. However, it also means that device management and interactions with the grid are becoming more important considerations.

Many utilities have opted to deploy software that can interact with "grid-edge" technologies. This software is often known as distributed energy resource management systems or DERMS. Unlike many legacy software systems, where the utility manages its own devices, a DERMS interacts with utility- and customer-owned devices. DERMS deployment can take on many forms, and there is no set mold. A playbook that helps establish such a mold is key to accelerating industry DERMS adoption. SEPA intends to create this playbook for utility operators, third party technology providers, and regulators in 2024.

Drivers of Utility Investments in DERMS

DERMS provide utilities with an intriguing and complex opportunity. These advanced systems promise to simplify the management of growing utility distributed energy resource (DER) portfolios, including those with electric vehicles and customer battery systems. Evaluating, selecting, and justifying DERMS remains challenging due to the broad range of available capabilities.

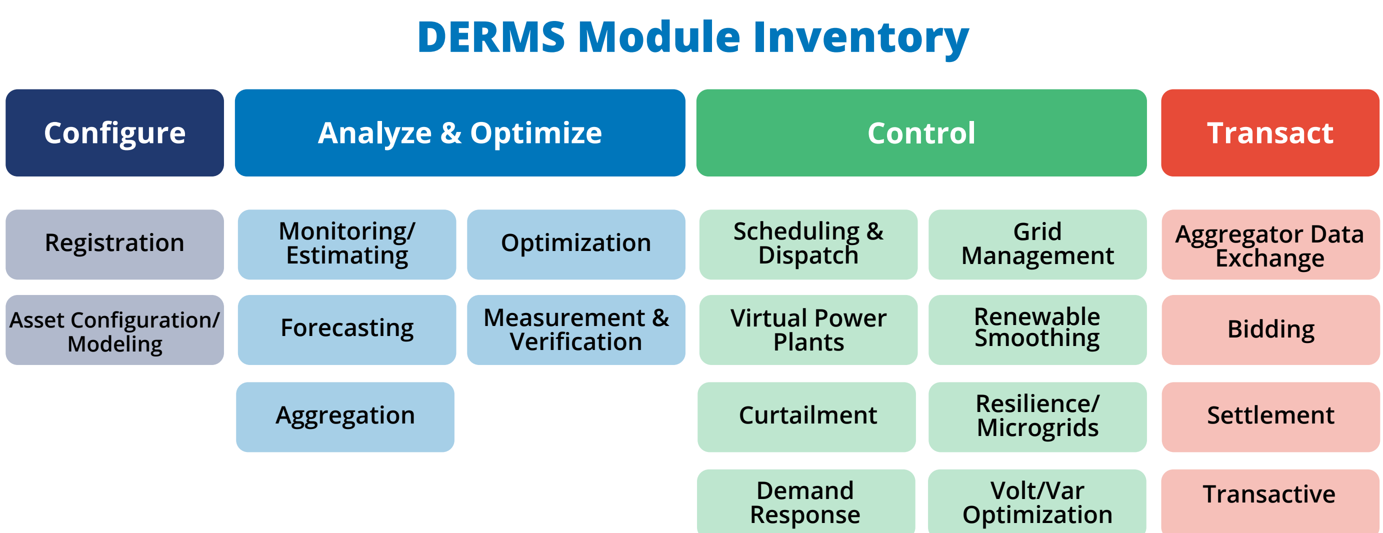
Our data shows that utilities are already investigating the implementation of Advanced Distribution Management Systems (ADMS) and DERMS solutions. SEPA's Utility Transformation Challenge (UTC) indicates that 75% of respondents either have an approved DERMS proposal, are in the process of implementing a DERMS, or have a fully operational DERMS. Eighty-nine percent of respondents have taken the same steps for ADMS solutions. Many customers are also enrolling in Demand Response (DR) programs and/or are installing solar and storage assets that utilities and technology providers can aggregate and leverage. According to the Energy Information Administration, 119 utilities have greater than 5% of their residential customers enrolled in a DR program, and forty-one utilities have greater than 5% of residential customer enrollment in solar net energy metering (NEM). As DERs proliferate on the grid, utilities will likely need to turn to ADMS and DERMS to manage these resources efficiently. The expansion of smart meters, electric vehicles, and general electrification will require greater visibility, control, and optimization of these devices for efficient utility operations and planning.

The Role of the DERMS

DERMS are application platforms designed to manage DER device information, monitor and enable optimization and control of DER and demand response assets, and integrate aggregation and network information to the utility. Many DERMS capabilities are modular, often sold as application add-ons to a utility's existing ADMS and/or demand response management system (DRMS) solutions, and add incremental capabilities to the core system. Among the existing DERMS solutions, capabilities include optimization algorithms, safety or performance monitoring, demand response capabilities, customer management system integration, and/or transmission system operator/distribution system operator (TSO/DSO) coordination capabilities.

While functionalities differ among DERMS vendors, agreeing on concise, well-defined terms and language to articulate the many variations remains important. SEPA and a task force of 12 utilities used insights from 11 DERMS providers to produce a comprehensive list of DERMS capabilities categorized by four use cases: Configure, Analyze & Optimize, Control, and Transact (Figure 1). These four use cases address the most common utility business needs for integrating and deriving value from DER assets interconnected to the grid. The four use cases also vary in their grid architecture needs and whether there is a power flow model to support their functionalities. Use cases seeking to visualize and configure DERs often do not need a power flow model. More advanced use cases, such as performing transactive energy and Volt/VAR optimization, require a functioning power flow model.

Figure 1. DERMS Module Inventory by Use Case



Source. SEPA, 2023.

What makes a DERMS unique compared to other management systems?

ADMS & DRMS Systems

The industry currently lacks consensus on the relative role of a DERMS within a utility system, especially compared to technologies such as ADMS and DRMS.

A DERMS exclusively manages front-of-the-meter (FTM) and behind-the-meter (BTM) DERs, while an ADMS system is designed to run power flow analysis and execute operations on an "as-operated" network, with a primary purpose of ensuring grid safety and reliability. The lines between ADMS and DERMS begin to blur as utilities seek to manage DERs and traditional grid assets in a holistic fashion. Holistic control of the grid will rely on power flow analysis for all grid assets, requiring a network connectivity model that includes all BTM and FTM DERs. This demands tight integration between the ADMS and DERMS and introduces questions around which system owns the network model and runs power flow. Most vendors offering ADMS solutions now offer DERMS solutions either as modules of their ADMS or as discrete applications built to leverage AMDS power flow capabilities. The coupling of a DERMS to an ADMS will depend on the use case and whether the full functionality relies on a power flow model.

While ADMS and DERMS systems differ primarily by the network model, DERMS and DRMS systems are becoming increasingly similar. Traditionally, DRMS systems were designed to target a utility's day-ahead and bulk system needs using BTM applications, and provided an all-or-nothing impact. As utilities have moved to more real-time control and management of DERs, DRMS systems' functionalities have become more sophisticated and similar in function to a DERMS. While both types of systems can monitor, control, and dispatch DERs, DERMS systems can better integrate and utilize real-time data and perform advanced functions related to Volt/VAR optimization, renewable smoothing, ancillary services, curtailment, and transactive energy exchanges. Many DRMS suppliers have modules and/or DERMS offerings. The distinction between the two systems has become blurred; increasingly, DERMS is seen as the next step from using a DRMS system.

Microgrid Controllers

Microgrids are a growing aspect within DER planning, requiring an understanding of how microgrid controls fit into the larger grid architecture space. According to the Department of Energy (DOE), "A microgrid is a group of interconnected loads and distributed energy resources that acts as a single controllable entity with respect to the grid. It can connect and disconnect from the grid to operate in grid-connected or island mode."[1] Rather than optimizing and controlling DER and DR assets across a utility's entire system (often considered to be an enterprise functionality), a microgrid and its controller optimizes and controls loads and DERs at an individual site or a cluster of closely connected sites (often considered a grid-edge functionality) that can then be disconnected from the grid. Microgrids and DERMS vary in their size and the primary value they provide to the grid. While microgrids have the potential to be aggregated into a DERMS, they are typically localized and their key value is the resilience provided at a local level. DERMS are often centralized and are typically aimed more at optimizing DERs according to a given set of objectives and controlling DERs across a service territory.

Virtual Power Plants/Fleet Management

Similar to a DERMS, Virtual Power Plants (VPPs) and fleet management software services help manage and coordinate DERs to provide grid services. The key difference between them is that VPPs provide system-wide benefits, while DERMS are capable of providing grid services along specific feeders, along sections of the grid, and across the entire grid system. The ability to manipulate power flows on specific feeders or system-wide determines the benefits and use cases of these

1 Department of Energy. (2012). The U.S. Department of Energy's Microgrid Initiative.

different solutions. VPPs generally provide benefits to larger areas and are typically used for demand response, frequency regulation, energy arbitrage, and peak demand management. DERMS, on the other hand, have the potential to provide voltage management, optimal power flow, and locational capacity relief at specific feeders and locations in addition to the broader system-wide benefits of VPPs.

Choosing a Resource Management System

Ultimately, the economics of each solution, a utility's specific use case, and the utility's DER environment, all dictate which resource management system is most appropriate. For many utilities, the cost of a centralized utility DERMS is too high for the granular control it offers. For other utilities, their use case may not necessitate a centralized DERMS but rather require solutions that offer less control and/or granularity such as an ADMS, DRMS, or VPP, resiliency solutions such as microgrid controllers, or optimization software such as those used for fleet management. Lastly, many utilities do not have the visibility needed to maximize the potential of a DERMS. Prioritizing investments in smart technologies, such as sensors and advanced metering infrastructure (AMI), can optimize a DERMS investment.

Gaps in DERMS Capabilities

As with any emerging technology, the DERMS marketplace is still undergoing many changes, including the simultaneous convergence and differentiation of key DERMS vendors, piloting and scaling of DERMS solutions, analyzing the most effective grid architectures, and understanding how utilities can plan for the deployment, determine cost recovery, and justify the use of a DERMS. SEPA has identified has identified these topic areas as high priority for utilities.

Vendor Convergence & Differentiation

Due to the relative nascency of DERMS offerings, many vendors are still establishing their niches in the marketplace. In the last couple of years, there has been a growing trend of consolidation of DERMS vendors and/or partnerships between companies offering different types of utility enterprise systems. As of Q1 2023, EnergyHub and GE Vernova announced their partnership to combine the grid optimization capabilities of GE's GridOS DERMS with EnergyHub's resource formation capabilities,[2] Hitachi & ABB merged into Hitachi ABB Power Grids,[3] Schneider Electric and AutoGrid partnered to develop a DER flexibility management system,[4] and Yokogawa acquired PXiSE.[5] These acquisitions and partnerships will continue to expand DERMS capabilities, including functionalities for marketplace and transactive energy interactions.

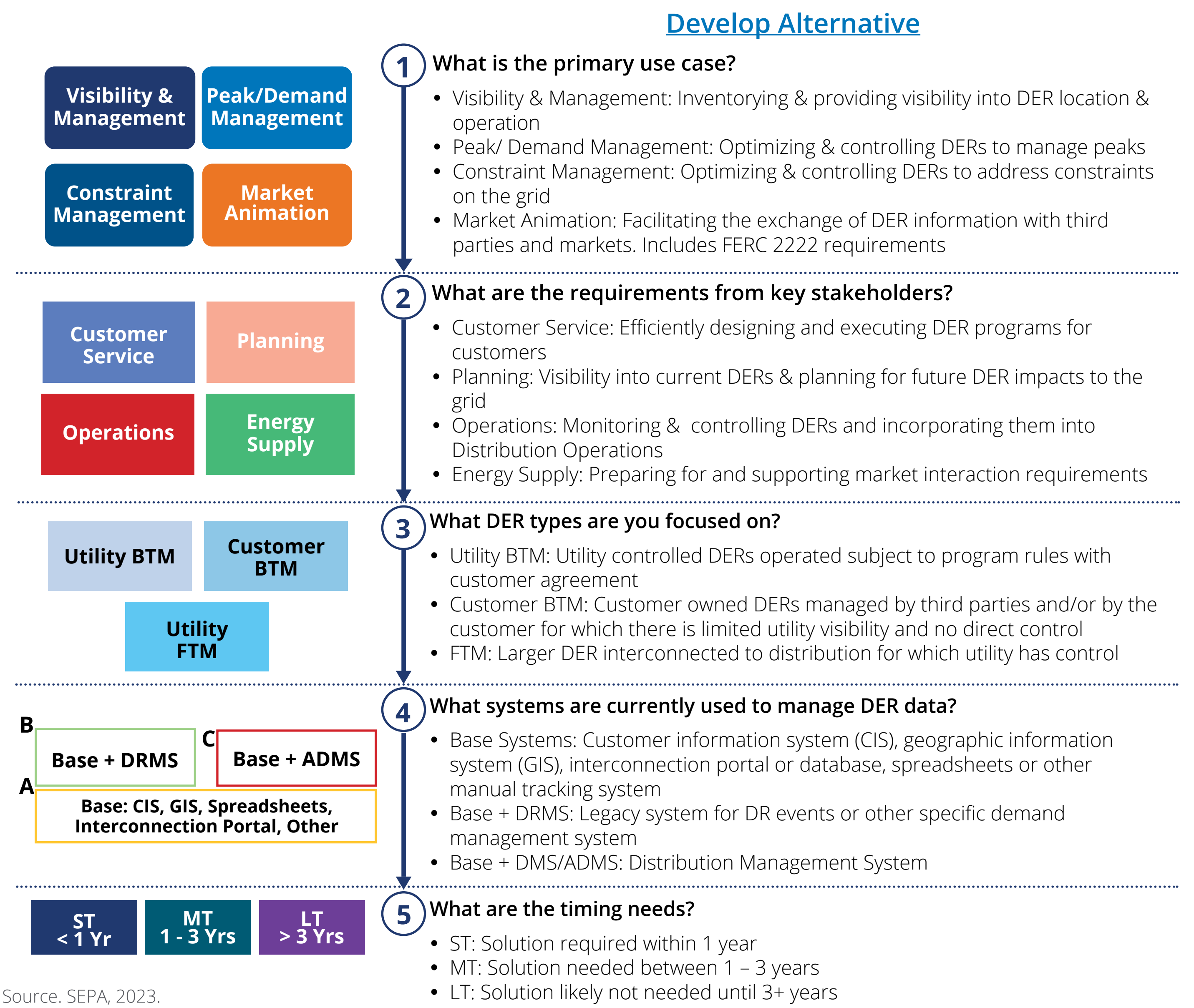
Grid Architecture & Planning

As utilities plan for more DERs on the grid, they will need to determine if, and when, implementing a DERMS makes sense for their utility. DERMS implementations often require smart meters and other monitoring devices, which can be challenging for smaller utilities that have yet to justify the cost of deploying these monitoring devices. As of 2021, 74% of all electricity meters were smart meters.[6] While that number is projected to increase steadily over the next decade, some utilities will have to undergo extensive grid planning to implement a fully-fledged DERMS. These utilities may instead consider using vendors who offer smaller solutions geared towards one-off solutions such as those used for microgrids and grid-interactive buildings. SEPA has worked with small municipal and cooperative utilities who have raised concerns that many of the existing DERMS solutions are designed for much larger utility systems and have pricing points that do not make sense for utilities with small customer bases. In the short-term, these utilities can utilize DERMS alternatives to achieve similar functionalities. However, in the long-term, these utilities will need to consider whether acquiring a fully-fledged DERMS would be a more effective solution.

2 PowerGrid International (2023, February 2). Siemens and EnergHub join forces for next generation DER management.
3 GE. (Sept. 2023). GE Vernova and EnergyHub announce partnership to enhance DER management and grid optimization.
4 Schneider Electric. (2021). Schneider Electric EcoStruxure DERMS and AutoGrid Flex.
5 PXiSE. (2021, December 1). Yokogawa acquires PXiSE.
6 Smart Metering in North America (2022, December). Smart Metering in North America - 5th Edition.

Increasingly, utilities that are in the process of acquiring their DERMS solutions have indicated that creating a roadmap is an essential component of this process. They have noted that DERMS systems should be implemented in a step-wise, phased manner so that the utility can study how the DERMS interacts with the system, accommodate any customer related issues and concerns, and integrate the DERMS into other utility systems. Such systems include ADMS, DRMS, Outage Management Systems (OMS), Distribution Supervisory Control and Data Acquisition (D-SCADA) systems, AMI control systems, and others. The step-wise, phased approach can also help utilities address their short-term use cases, such as needing greater visibility into the DERs on their system, while they develop their business models for other, more complex use cases, such as DER optimization, demand response, market transactions, and transactive energy programs. As utilities begin to develop their DERMS plans, they can use decision trees to analyze business cases for DERMS and impacts on short- and long-term planning (Figure 2). SEPA's 2022 DERMS task force developed this decision tree with the premise that most utility systems were starting with a DRMS, ADMS, or no management system at all. This type of decision tree could be used on a variety of business use cases including: DER visibility, DER device configuration, program management, optimizing DERs for peak management and grid services, and market participation.

Figure 2. DERMS Alternatives Decision Tree



Source. SEPA, 2023.

Regulatory Parameters

All utilities will need to consider their specific regulatory requirements and mandates when developing their DERMS planning process. Some jurisdictions limit a utility's ability to directly communicate with and/or control customer DERs, sometimes requiring a DER size minimum of 1-2 megawatts before allowing a utility to communicate and control the DER. These regulatory limitations can hamper the use of a DERMS for customer DERs and will impact the utility's usage of a DERMS. In contrast, other regulatory changes have helped promote the adoption of DERMS. FERC Order 2222 has opened the door for the creation of market frameworks for the further expansion of two-way distribution generation assets, such as vehicle-to-grid electric vehicles, grid-interactive water heaters, and residential battery systems, all of which can be controlled by VPPs and DERMS. These frameworks will allow the full value proposition of VPPs and DERMS to be realized and may promote utility implementation of VPPs and DERMS.

Industry Partnerships

As more utilities navigate the DERMS space, they can accelerate their adoption of DERMS by learning from other utilities and engaging in thoughtful discussions with a variety of DERMS vendors. A key takeaway from SEPA's 2022 task force was the sharing of insights and learnings among the participating utilities. In the future, utilities will be tasked with continuing to engage with each other to accelerate DERMS adoption. Many utilities will benefit from learning about the pain points, successes, and grid considerations that other utilities have already identified in their own pilot programs. Open forums and discussions among different utilities will help facilitate this learning exchange. Additionally, discussions between utilities and vendors can help vendors identify future DERMS functionalities, plan for the limitations and needs of new communication protocols, and help vendors identify where they can improve their offerings.

Conclusion

DERMS deployments are at the forefront of utility planners' minds, yet there is confusion over the capabilities and overlap of various "intelligent" systems (i.e. ADMS, Volt/VAR, etc.). Continuing off of the work that SEPA conducted in 2022 to develop a DERMS encyclopedia and a DERMS Implementation Considerations and Alternatives guide, SEPA is developing a DERMS Playbook. The Playbook will identify phased approaches to DERMS implementation that determine how the DERMS interacts with the system and will give utilities an idea of where they sit on the DERMS continuum and how they might deploy a DERMS. The Playbook will also give technology providers an opportunity to contribute to a fully comprehensive DERMS deployment schedule and an opportunity to better understand the variables that utilities use to deploy a DERMS.

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