

Distributed Energy Resource Management System (DERMS)

EPIC Pilot Project Overview

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Distributed Energy Resources (DERs) present both challenges and opportunities for PG&E



Distributed Renewable Generation



Energy Storage



Energy Efficiency



Demand Response



Electric Vehicles

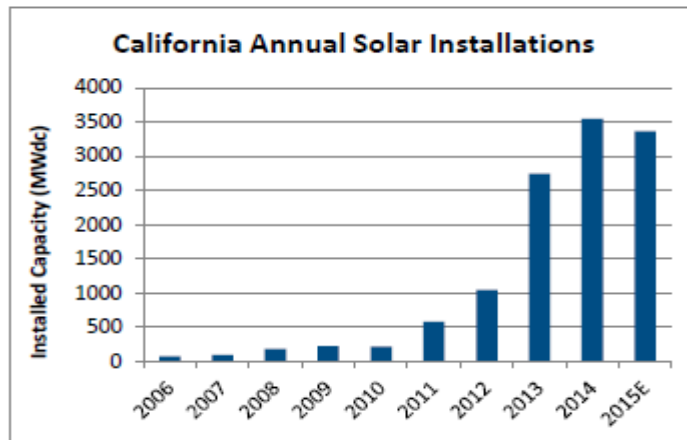
Market Drivers

Expected high DER penetration by 2025

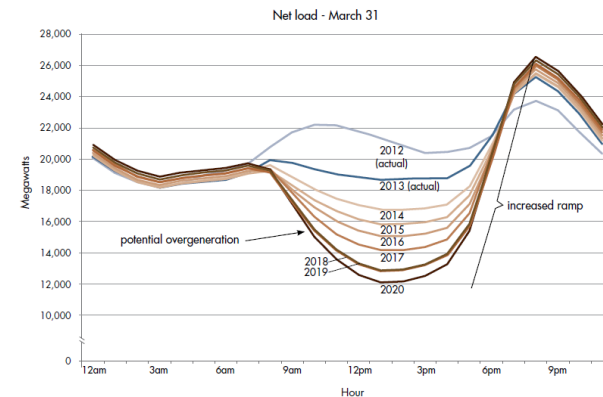
- 200 – 400% growth in solar customers (400-800k)
- 500k additional EVs in PG&E's territory
- 290 MW of distribution connected and behind-the-meter storage

Regulatory Drivers

California has indicated a need for sophisticated DER management, through CPUC rulings/guidance including the Distributed Resource Plan (DRP), energy storage mandates and CAISO's Energy Storage and Aggregated DER (ESDER) Initiative



THE DUCK CURVE
(Net load chart)



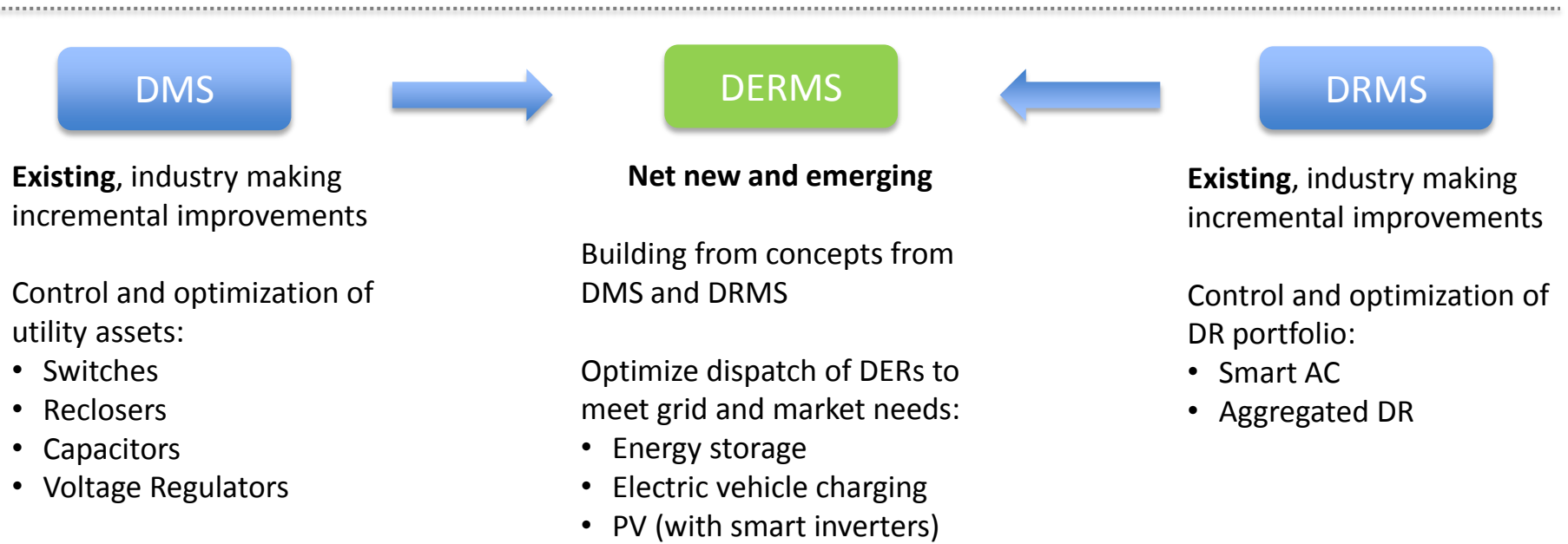
Why Distributed Energy Resource Management System?

Existing grid and customer program operations platforms not sufficient to enable safe, reliable, affordable operation of the high DER grid of 2025

Safety: System or process must ensure DER dispatch driven by CAISO market does not violate distribution system thermal and voltage limits – DERMS may be this system

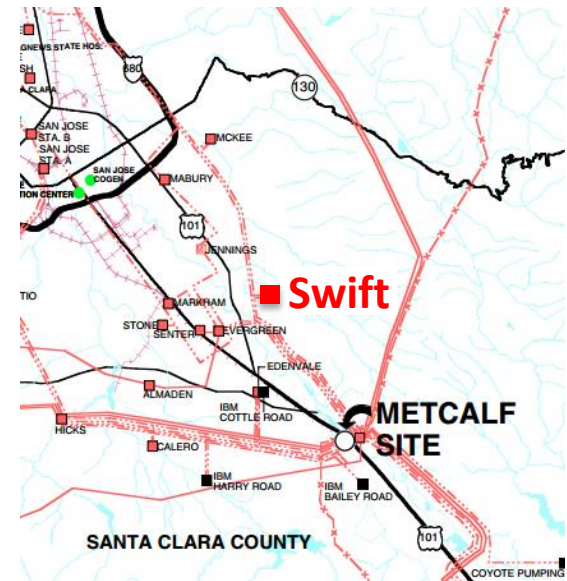
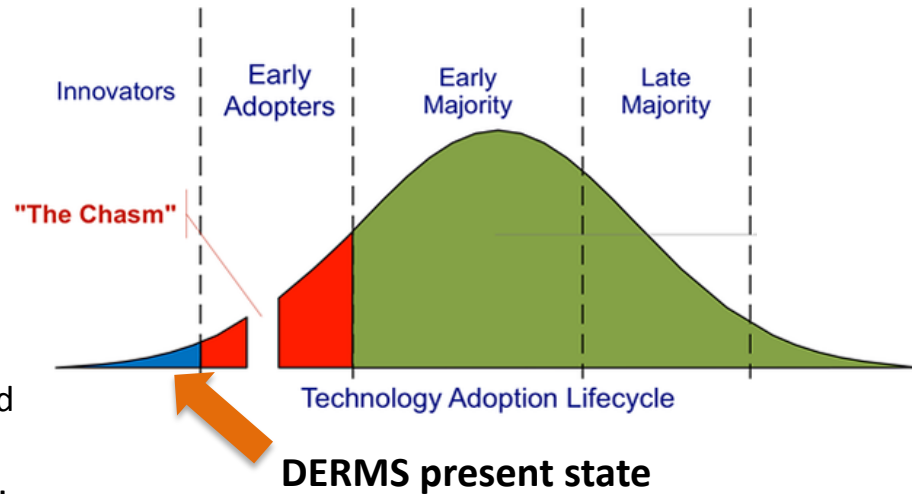
Affordability: UK utilities and US Utility Pilots have shown that DERMS technology may be able to increase hosting capacity to accommodate DG more cost effectively than traditional wires upgrades

Reliability: SDG&E and ERDF (France) demonstrating DER coordination to enable microgrid islanding



PG&E Emerging Grid Technologies Piloting Minimum Viable Product DERMS

- DERMS market nascent, California and Western Europe will be early adopters
- EPIC Pilot allows managing early stage technology risk
- Pilot objective is to demonstrate new technology enabling monitoring and controlling DERs to manage system constraints and maximize the value of DERs to the Grid
- A pilot allows learning about the people, process, and technology needed to operate the high DER penetration grid of 2025. Specifically the pilot will:
 - **Demonstrate up to 8 use cases, coordinating energy storage and PV-connected Smart Inverters**
 - Create, test, and iterate on DERMS requirements (e.g., communication requirements for PG&E and 3rd party owned DERs)
 - Define boundaries and integrations with other PG&E systems (DRMS, DMS, market systems)
 - Enable choosing a long-term strategic vendor in 2017+
- Cross LOB team selected Swift Bank 1 for DERMS and other DER-related pilots
 - Co-locate DER-related EPIC pilots to slowly build *Grid of Things Demonstration Feeder*



DERMS Pilot Aims to Demonstrate up to 8 Use Cases

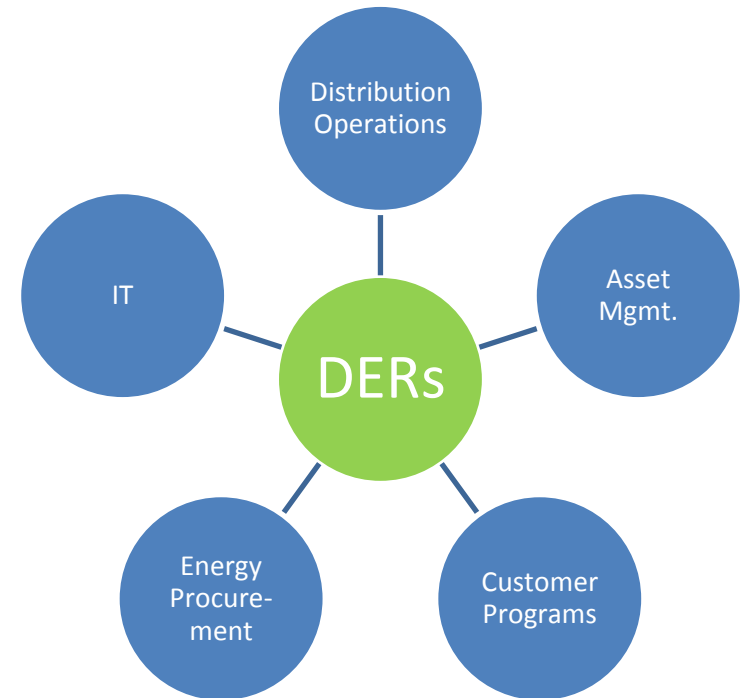
For each use case, DERs will be grouped at different levels of aggregation (e.g., substation, bank, feeder, line segment, aggregation node¹)

UC	Description
1	Load Masking / Phantom Load - Visualize actual and forecasted DER related grid conditions in real time: native gen, native load, net gen/load and flexibility
2	Manage Equipment Capacity Constraints - Control DERs to dynamically mitigate overload issues through operational control (e.g., increase load by charging energy storage, increase load on load control devices or reduce generation by curtailing DG production or storage output)
3	Mitigate Voltage Issues with Real Power Output - Leverage DER flexibility to resolve an existing voltage issue by altering real power output (e.g., kW curtailment of smart inverter output and/or selective charging/discharging of dispatchable assets).
4	Mitigate Voltage Issues with Reactive Power - Leverage smart inverter settings and functionality to generate reactive power to support voltage stability (e.g., mode control of smart inverters to set power factor)
5	Economic Dispatch of DG and Energy Storage - Dispatch of DG/energy storage based on economic factors such as cost or external pricing signals
6	Operational Flexibility - Demonstrate that DERMS can be used to develop forecasts and optimizations during abnormal switching configurations
7	Mitigate Solar Resource Intermittency - Use autonomous smart inverter settings and functionality to stabilize voltage during periods of solar resource intermittency
8	Performance Verification – Use DERMS system data, along with Aggregator performance data at the asset level, to analyze event performance at specified levels of aggregation

DERs are Driving Convergence of Traditionally Separate Utility Lines of Business Divisions

Aligning changes to people, process and technology is complicated and takes time

- Convergence of Energy Procurement, Electric Strategy & Asset Management, and Electric T&D Operations, Customer Energy Solutions (CES), and IT for DER technology procurement and operations
- Increasing customer program offerings and behind-the-meter aggregators offering services to the grid
- Third-parties offering aggregated behind-the-meter resources to CAISO, and potentially to future DSO
- Convergence across LOBs in need for new IT capabilities that share significant commonalities
 - Communications pathways, IT architectures, monitoring and control capabilities
- Operational realities of DERs require a high degree of **cross-organizational integration** to efficiently procure, integrate, and operate



Questions?

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