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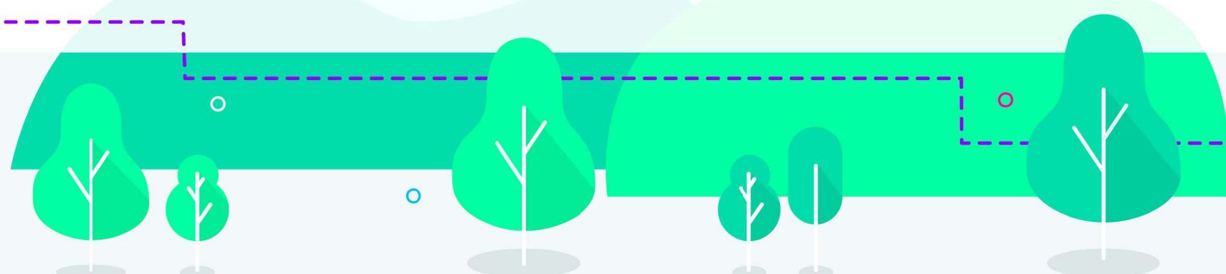

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# Preparing for and Deploying Enterprise DERMS

*From Managing new DER connections to full Market Operations*

Utility University Course #203, Monday, February 26, 2024, 8:00am- noon

## Instructors and Utility Panelists

- **Brad Williams**, VP Industry Strategy & Innovation, Oracle Energy and Water
- **Travis Rouillard**, Director R&D, Qualus
- **Sameer Kalra**, Director OT Product Management, Oracle Energy and Water
- **Michael Brown**, Integrated Energy Services Director, NV Energy
- **Rich Barone**, DERMS Solutions Architect, Oracle Energy and Water
- **Alex Rosenblatt** , Sr. Operational Technology Engineer, Advanced Grid Solutions, Duquesne Light Company

# 1) DER and Their Impacts on Utility Operation

**Brad Williams**, VP Industry Strategy & Innovation, Oracle Energy and Water

- DER market and regulatory trends
- DER resource types (DG, DS, EV, DR, and Microgrids)
- DER Integration factors (DER penetration and growth rates, operational complexity of DER mix, flexibility of existing resources mix, grid strength, market structures, utility size)
- DER impacts on distribution operations
- DER impacts on existing distribution computer applications
- FERC Order 2222
- Smart Inverter Capabilities and Standards IEEE 2030.5 and IEEE 1547

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# Global Regulatory & Policy Trends

## Sustainability

## Affordability

## Resiliency

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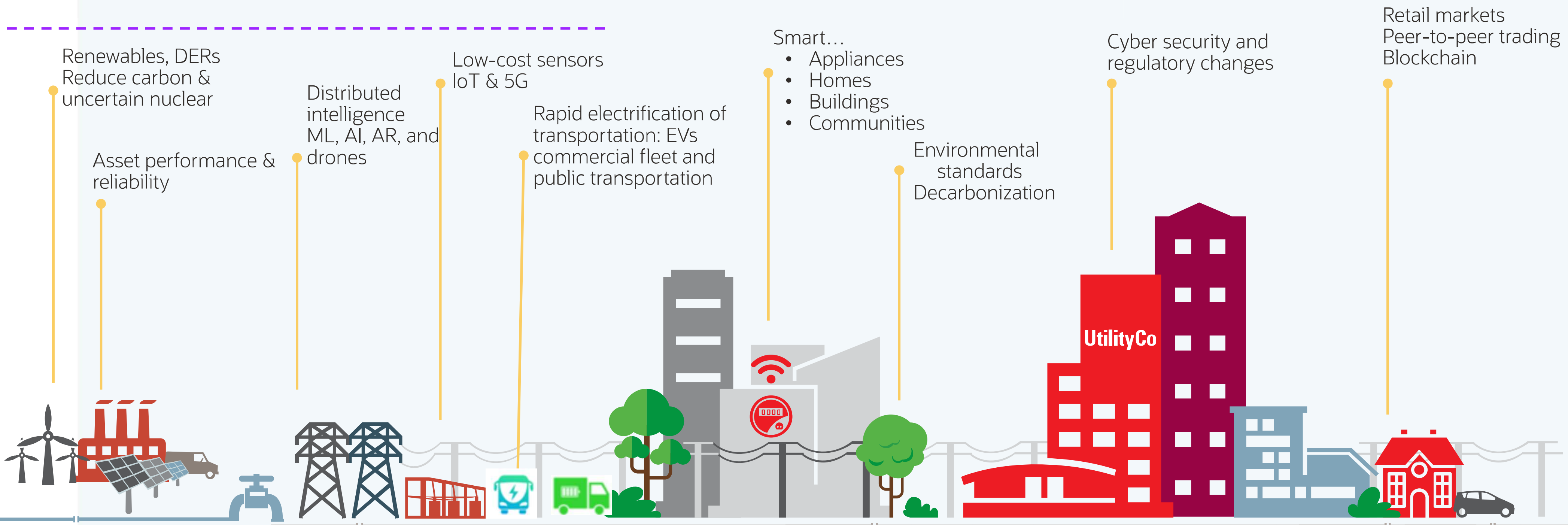
# What are Distributed Energy Resources?

Distributed energy resources (DERs) are small-scale energy resources usually situated near sites of electricity use, such as rooftop solar PV panels, small wind turbines, and battery storage, as well as controllable flexible loads such as Electric Vehicles, Smart Thermostats, and other demand response devices.

Their rapid expansion is transforming not only the way electricity is generated, but also how it is traded, delivered and consumed.

# What's changing in **Electric Utilities**? Everything!




*Historically, we have forecast **demand** for power, planned/built infrastructure, and dispatched **supply**. In the future, those roles are reversing.*

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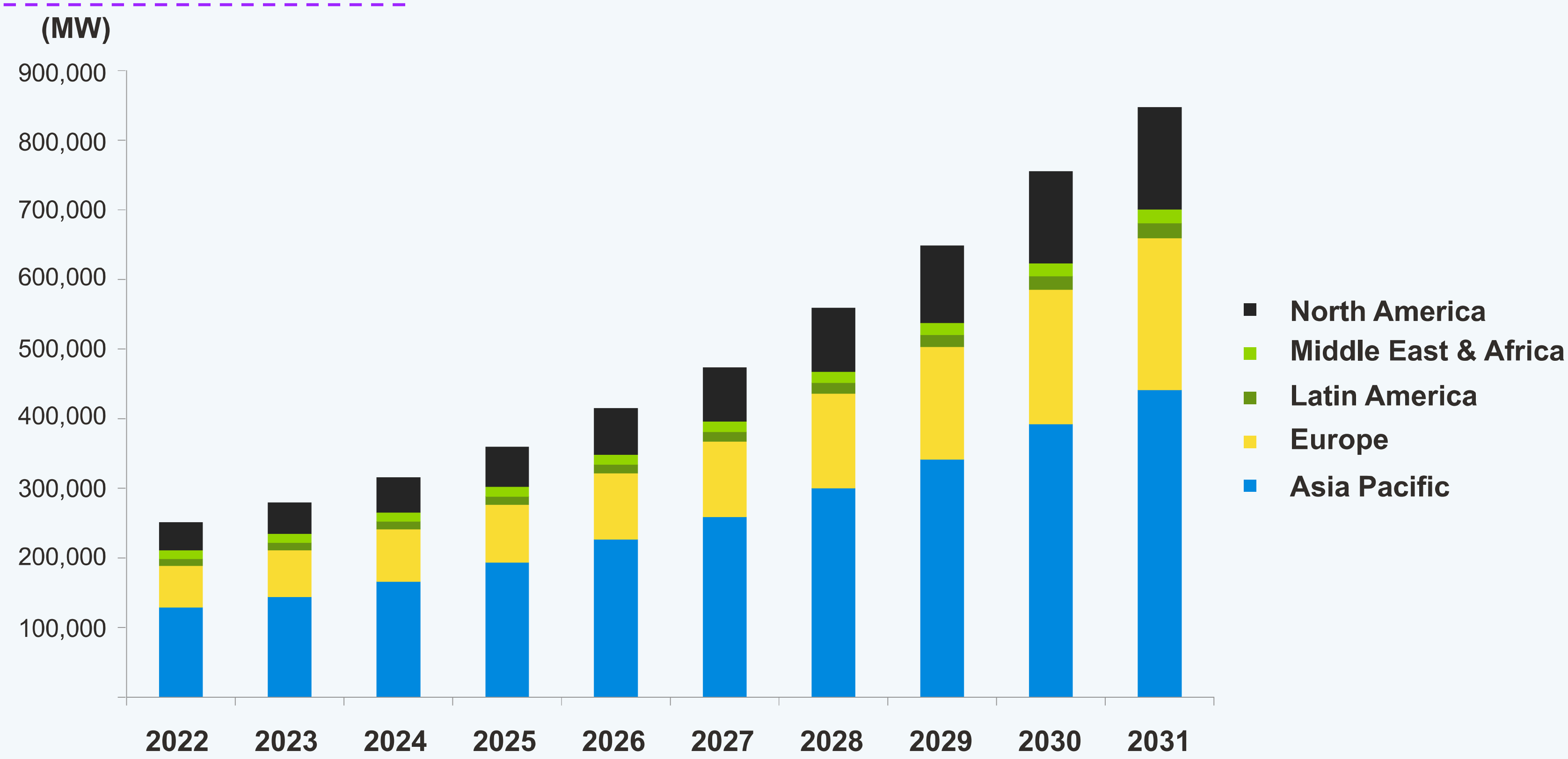
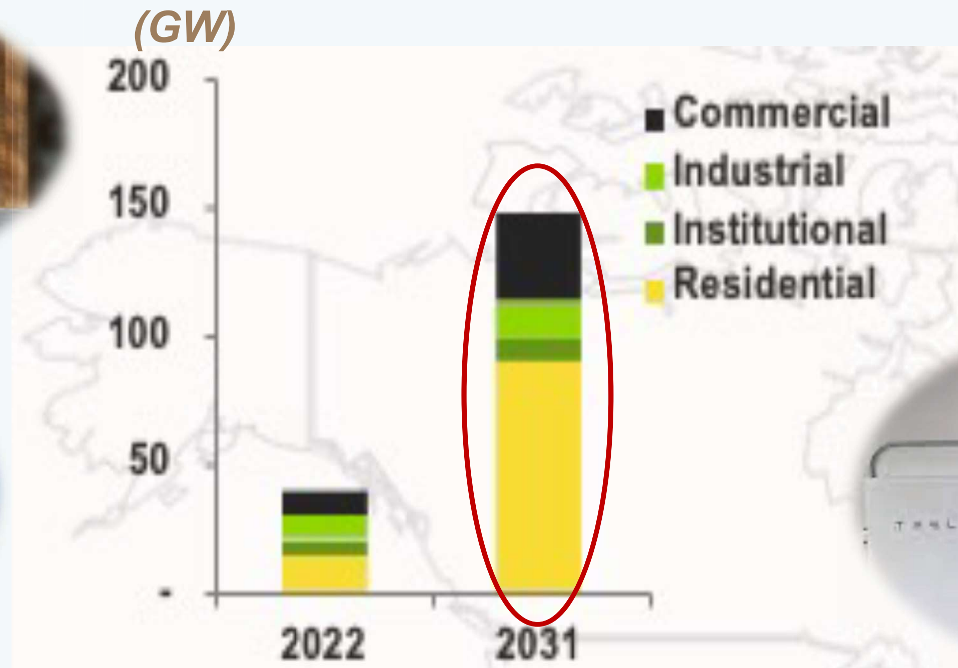
# Annual total installed DER capacity by region




Source: Guidehouse Insights, Global DER Deployment Database 1Q21

# DER capacity growth at the grid edge

*North American DER annual capacity growth installed ~40 GW of new DER capacity in 2022, forecast to increasing to 146 GW in 2031. Primarily (~80%) by residential & commercial customer-premise DER*





*What will it take to safely connect and operate 80% of DER capacity at the customer premise?*

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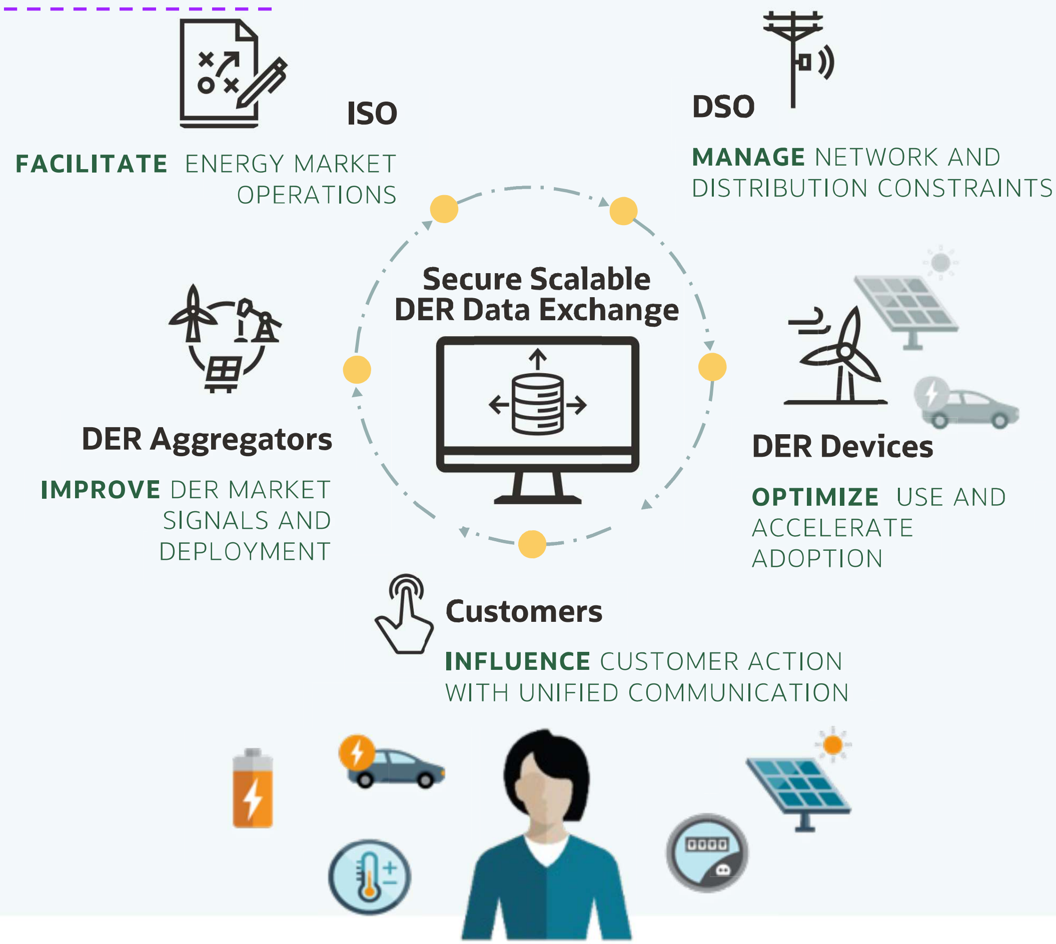
*Source: Guidehouse "Analyst Insight: DER Year in Review, Global DER Deployment Insights", 1Q 2022*

# Decarbonization requires effective secure coordination across the energy value chain

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# DER Value Chain Vision and Strategy

### Reconciliation

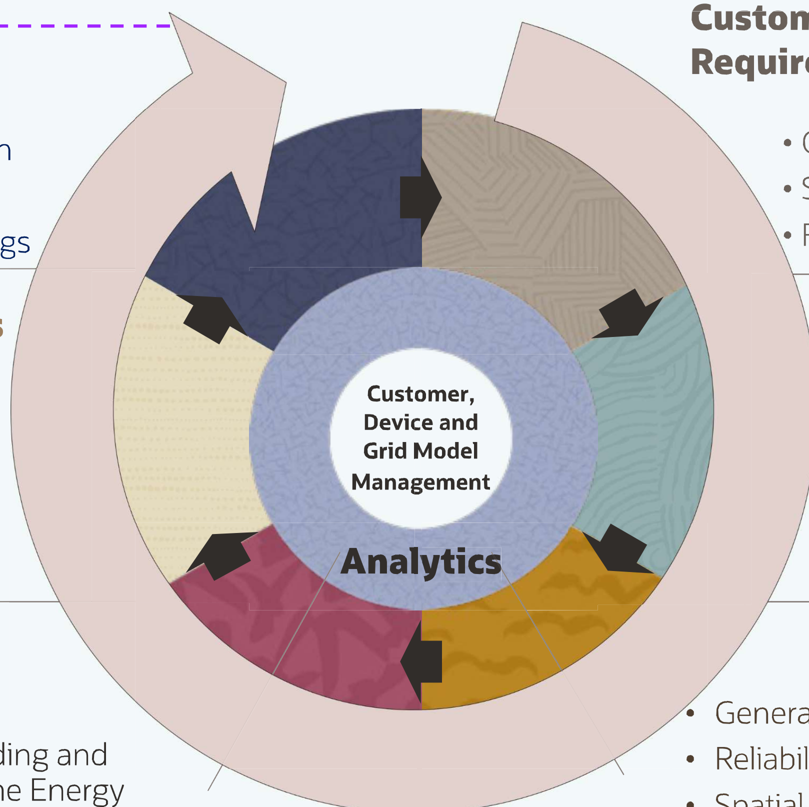
- Measurement & Verification
- Settlements
- Additional Program Offerings

### Grid and Market Operations

- Schedules
- Dispatch
- Optimization
- Planned Outage
- Congestion
- Capacity
- Contingency
- Market Portal

### Customer Programs

- EE/DR
- EV Charging/V2G
- Energy Arbitrage
- Microgrid
- Building and Home Energy Management (BEM/HEM)
- Ancillary Services




### Customer and Regulatory Requirements

- Customer Choice
- State Mandates RPS EV Adoption
- Federal Environmental Regulation

### Grid Interconnections

- New Load Connections
- DER Solar/Wind/EV
- Energy Storage

### Planning

- Generation and Grid Capacity Planning
- Reliability/Resiliency Planning
- Spatial Load and DER Forecast and Adoption Rates
- Non-Wires Alternatives

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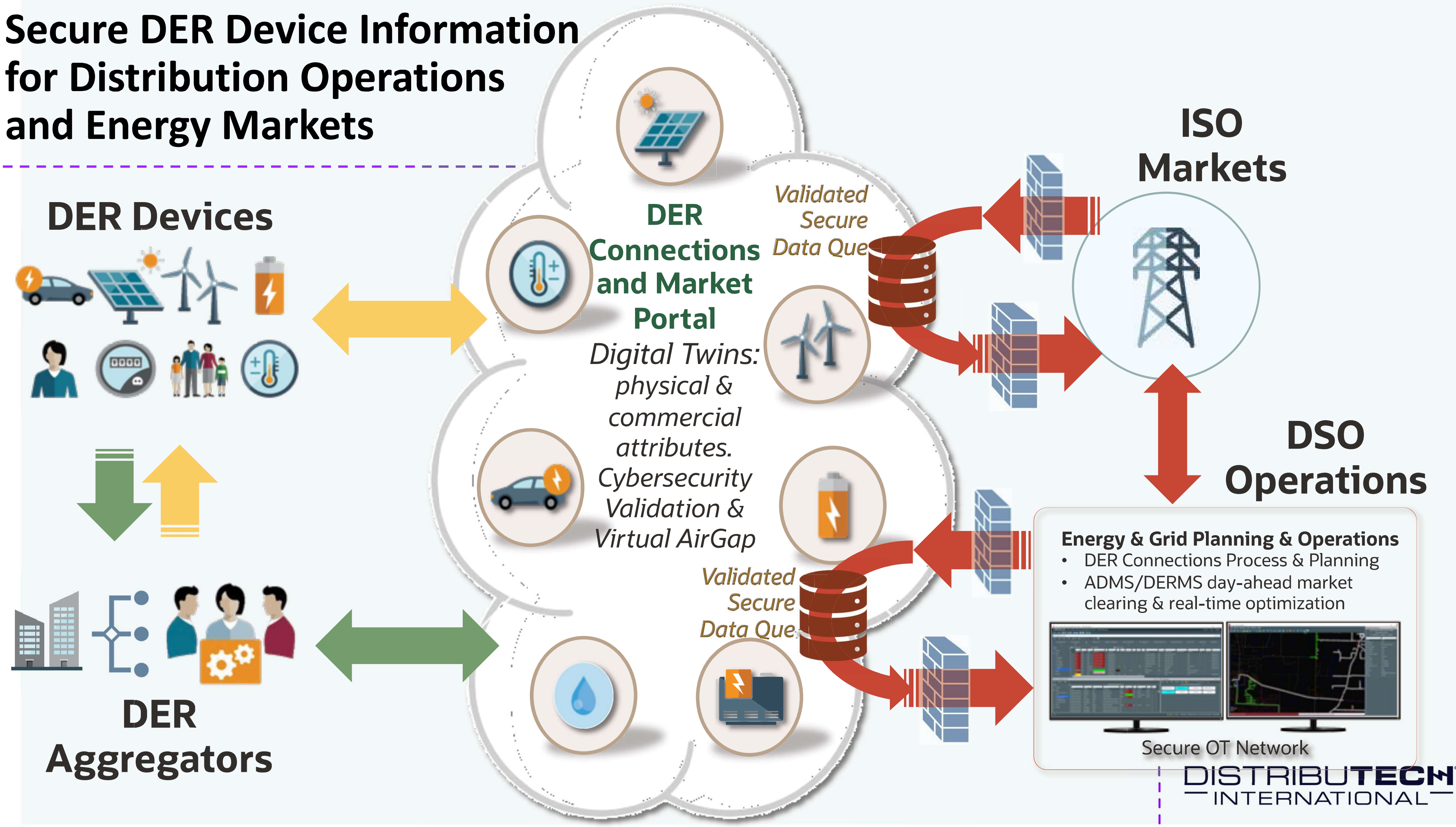
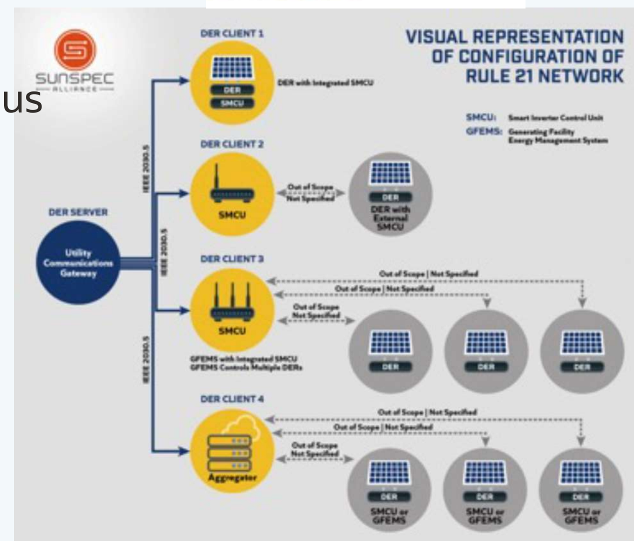
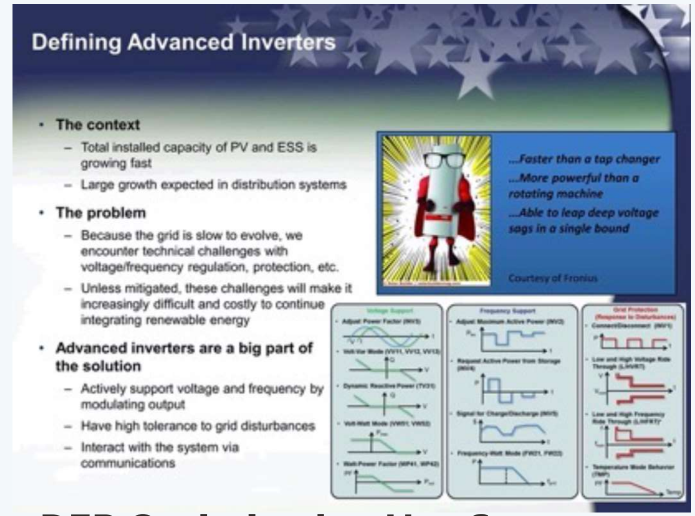
# Secure DER Device Information for Distribution Operations and Energy Markets



# Smart Inverter scheduling and controls via IEEE 2030.5 & 1547

- RESTful interface  to actively manage  DERs,  and other grid devices
- State of California mandates: SunSpec's Common Smart Inverter Profile (CSIP) – 2030.5 Inverters
- REST interface on top of Modbus for smart inverters
- Designed to communicate to devices and aggregators


## DER Optimization Use Cases

- DER dispatch, monitoring & control
- Smart EV Charging schedules
- DER volt/var control
- Grid stability: fast frequency/voltage response synthetic inertia / load balancing

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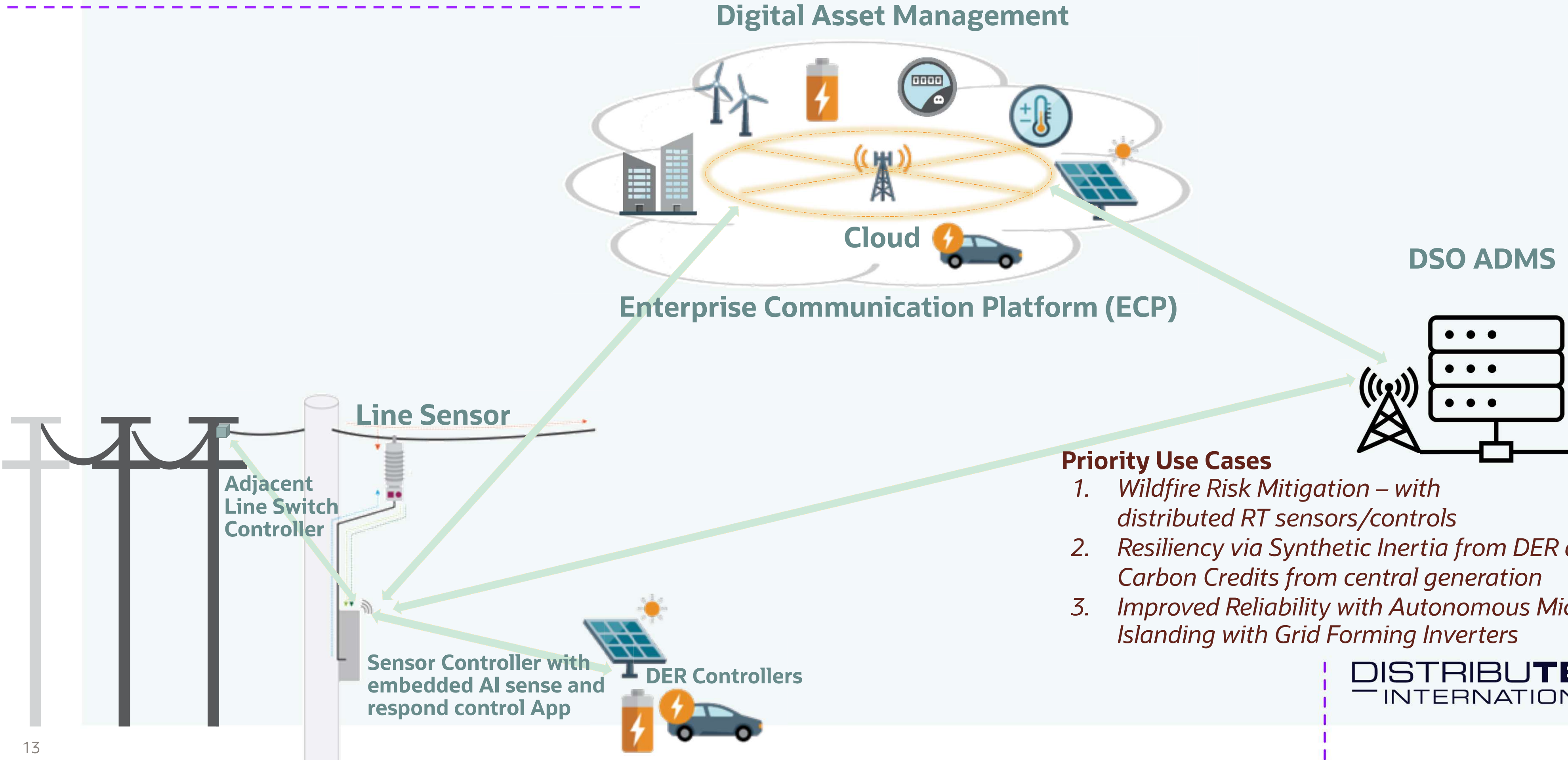
# Emerging Trends to Anticipate in the Future… Grid Edge AI

*Very Fast Risk Detection and Autonomous Grid Edge Risk Mitigation Response with Centralized Control Room Situational Awareness and Overarching Authority*




**Priority Use Cases**

1. *Wildfire Risk Mitigation – with distributed RT sensors/controls*
2. *Resiliency via Synthetic Inertia from DER devices. Carbon Credits from central generation*
3. *Improved Reliability with Autonomous Microgrid Islanding with Grid Forming Inverters*

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# Thank You!

Brad Williams, VP Industry Strategy & Innovation Engineering
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# 2) Existing and Emerging DER Management Systems

Travis Rouillard, Director R&D, Qualus

- What is a DERMS?  How did we get here?
- DERMS solution categories
- Core DERMS functionality
- DERMS maturity model & roadmap

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# Emergence of DERMS from DRMS

## DERMS: What is it?

An immature market with a (still) evolving interpretation.

A natural tendency to make ‘DERMS’ a dumping ground for gaps

- Personal experience with demand response – easy to make DRMS too big

Impact of DERs across the entire IT/OT and grid edge landscape

- Asset management, forecasting, grid management, protection equipment, etc

DERs are not some weird exception, they will be the new reality

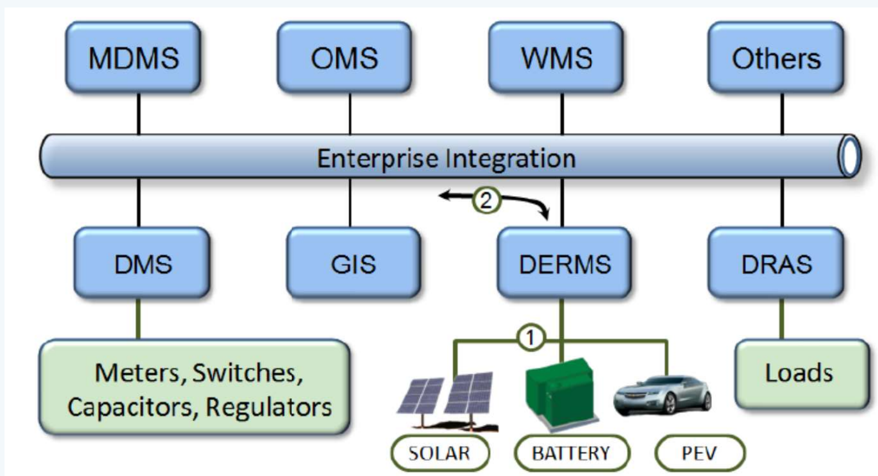
- All key operational systems will eventually need ‘DER logic’

DERs as a non-wires alternative to emerging local congestion

There is a need for new ‘DERMS’ solutions to fill operational gaps

# Biggest question: DERMS vs DRMS vs ADMS?

- Some see DERMS and DRMS (aka DRAS) as distinct, some as an evolution
- Some will tell you to just buy an ADMS with DERMS functionality
- Some will tell you they are 3 completely different systems




Source: EPRI

# The three different flavors of DERMS

An admittedly imperfect framework, but fits the current ecosystem

## 1.DRMS Evolutions

- Products that evolved out of traditional demand response load management systems to handle new DER asset types, capabilities, and local grid services

## 2.DERMS Pure-plays

- Mostly startup, standalone, hybrid products that merge DRMS and ADMS functionality into a new solution type

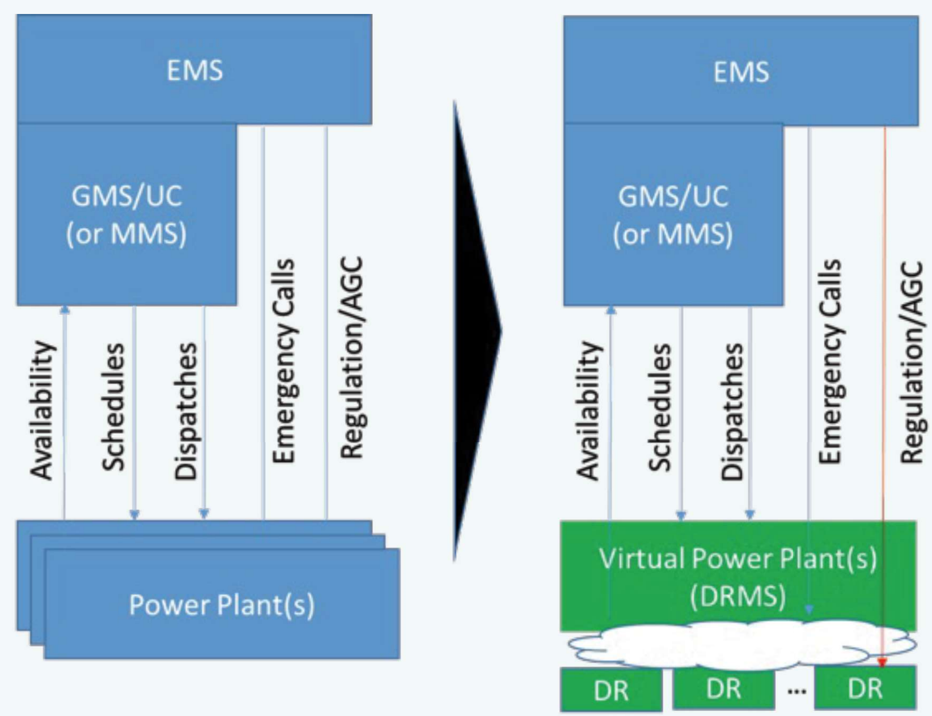
## 3.ADMS Modules / Extensions

- Products that extend ADMS platforms to handle modeling, forecasting, telemetry, and control of DER assets, directly or indirectly

# The history of ‘Virtual Power Plants’ (VPPs)

VPPs were a logical construct to more easily integrate demand side loads into the existing control room processes and systems

DRMS solutions emerged to handle complexity of VPP aggregation/ disaggregation

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# The complex lifecycle of a VPP aggregation

**Front office (IT)**

- Per-customer program enrollment, and per-asset device provisioning and comms
- Availability calculations, constraints, and tracking customer opt-out preferences

**Grid Operations (OT)**

- Aggregate VPP availability (variable ‘nameplate’) and cost (variable ‘heat rate’)
- Aggregate operational constraints and behavior (season limits, fatigue, snapback)
- Unit commitment/dispatch optimization (energy, reserves, ancillary services)
- Communications and monitoring in the absence of SCADA (disaggregate commands to individual assets, aggregate/estimate response to simulate telemetry)

**Back office (IT)**

- Per-asset metering, performance verification, and billing & settlement
- Customers and program level analytics to monitor effectiveness and costs

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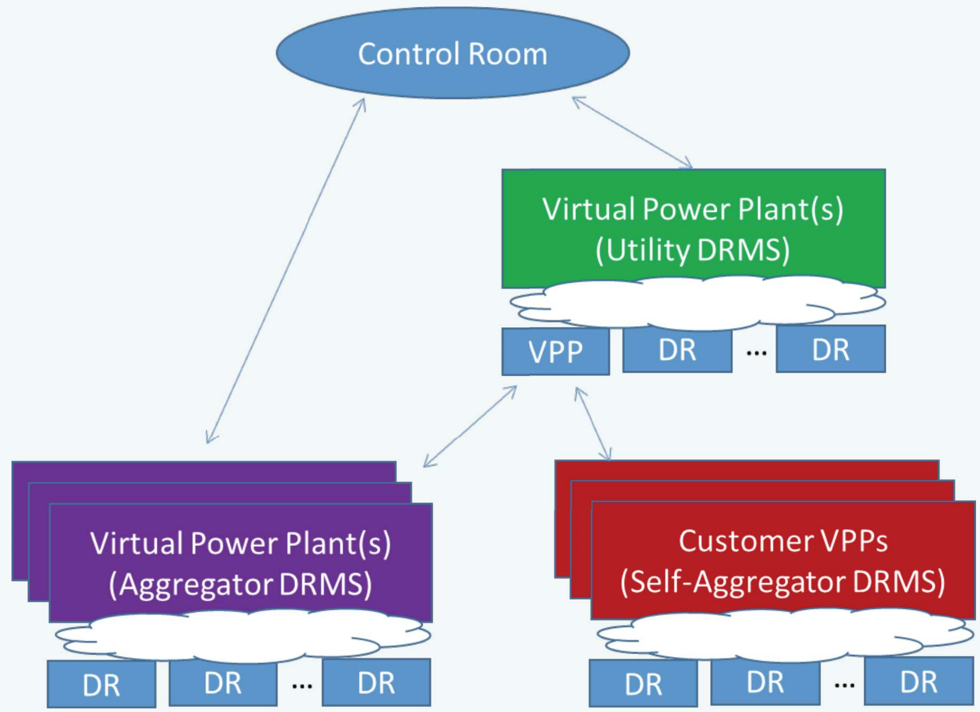
# Nested layers of VPPs and DRMS solutions

VPPs can be managed by the utility, by third-party aggregators, or in coordination with large customers who 'self-aggregate'

Each has slightly different DRMS requirements (e.g. optimizes for different economic outcomes)

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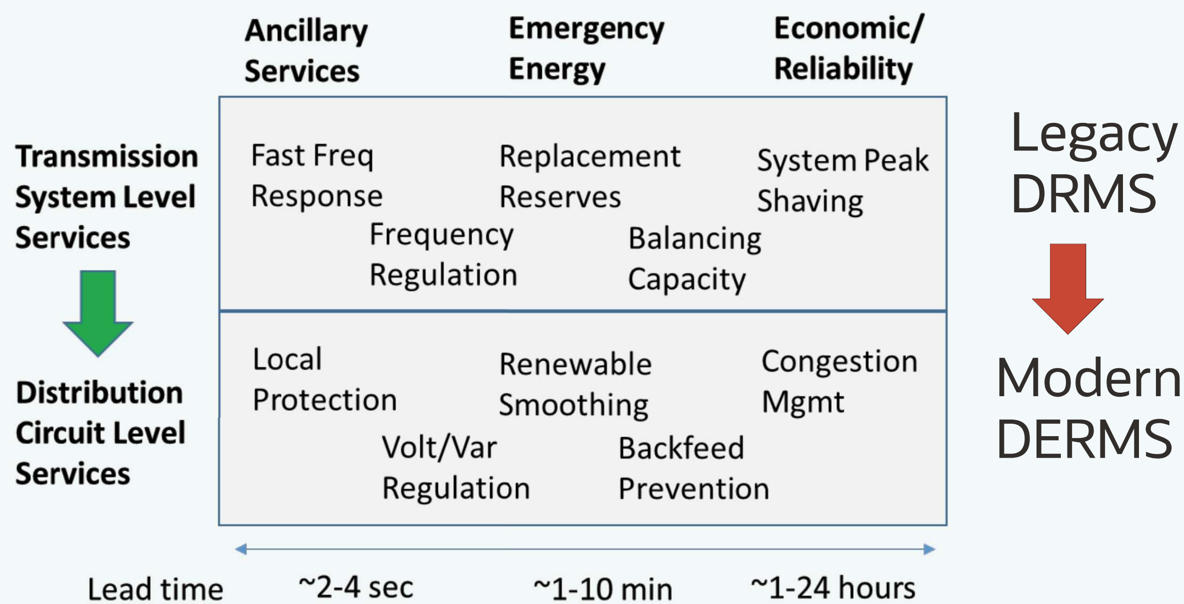
## Different types of Grid Services

Historically, VPPs provided generator-like services to the bulk-power system

Emerging need around ‘distribution circuit level’ services. Requires -

- Real and reactive control
- Surgical targeting
- New asset types
- New program types
- New dispatch constraints
- New forecasting needs

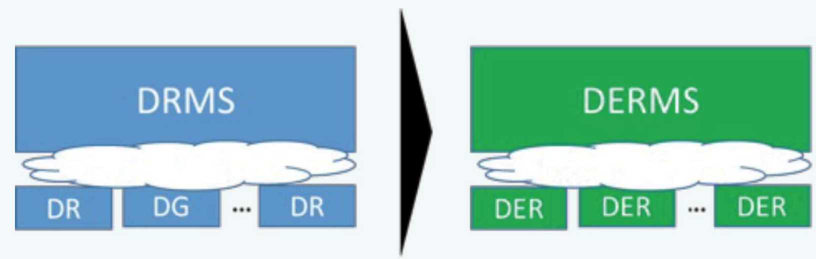


# DRMS Evolutions (Definition #1)

DR usually implies ‘load’ but has almost always included distributed generators (DG)

Thus, the ‘DR’ vs ‘DER’ distinction is somewhat arbitrary… but DER is more inclusive of new assets

Some vendors have simply relabeled their DRMS as DERMS and expanded the type of assets it can handle (e.g. inverters, batteries, microgrids)




- Load (and DG)
- Reduce real power demand
- System or zonal impact

- Load, DG, batteries, smart inverters, microgrids, etc
- Increase or decrease, real or reactive power
- Feeder or transformer impact

DER programs will have the same inherent operational complexity as traditional DR programs, but more complex use cases

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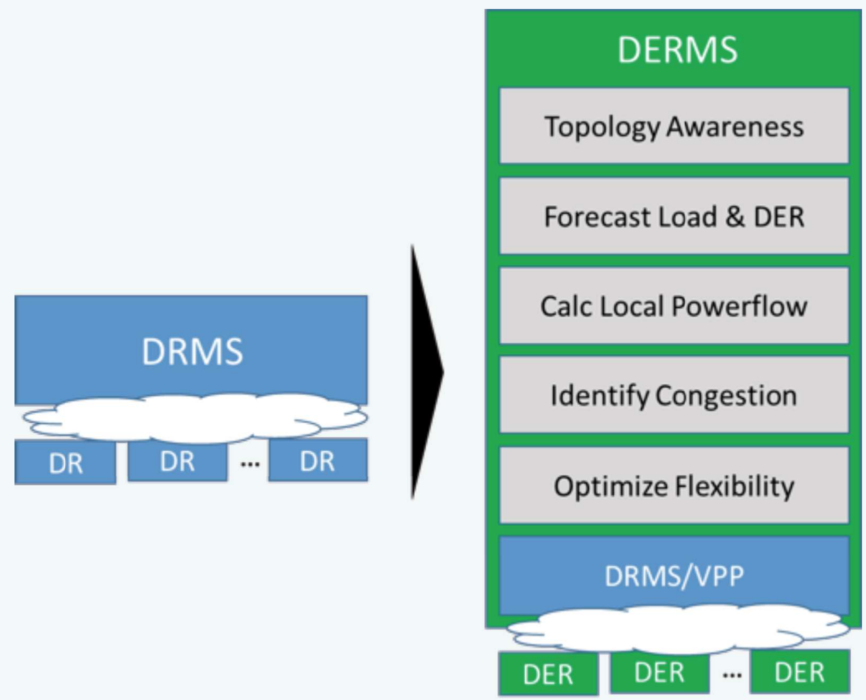
# DERMS Pure-plays (Definition #2)

- DRMS/VPP functionality plus ADMS-like network-aware 'decision support' functions
- Answer key questions -
  - Predict local flows…
  - Where/when will I have any congestion issues?
  - How best to solve it?
- Fills operational gap for utilities without an ADMS
  - DER pilot projects, and/or isolated congestion issues

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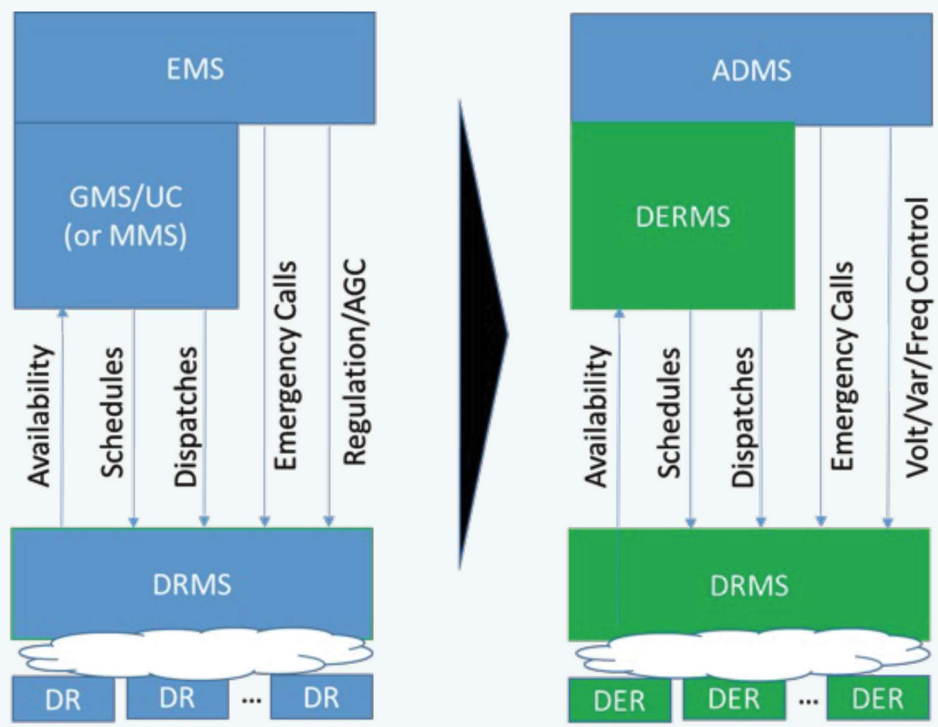
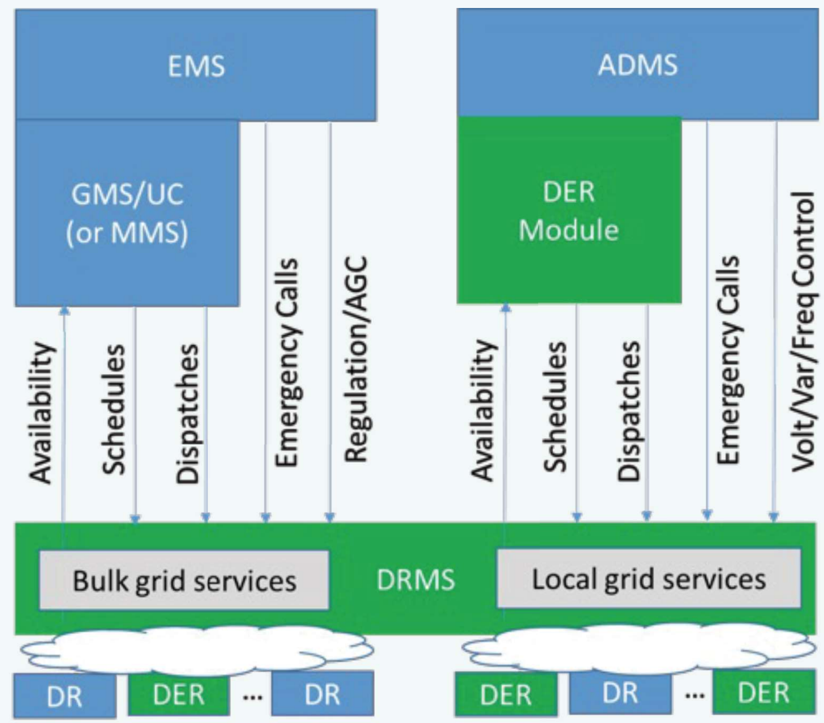
# ADMS Modules (Definition #3)

- DERMS is the ‘GMS’ analog for the distribution space
- Tightly integrated module of ADMS (uses forecasts, topology, powerflow, limits, and current state)
- Helps predict and solve local congestion, as if each circuit is an independent system
- Usually only deals with VPPs (or large DERs), so still need a DRMS (or aggregators) to handle individual assets



# Likely long-term end-state for most utilities

- ADMS 'DER Module' to determine if/when/where there is a problem
  - Select between wires and non-wires alternative solutions
- 'DRMS' to manage the VPP aggregation of small assets for both EMS and ADMS
  - Coordinate dual use of assets for bulk power and local services
- DERMS Pure-play solutions may be good interim solutions for utilities with isolated pockets of DER impactA bet

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# Vendor Examples

ADMS Providers

ABB/Hitachi
GE/Alstom
OATi
Oracle
OSI
Schneider
Seimens

DRMS Providers

- AutoGrid (now Schneider)
- Comverge (now Itron)
- Lockheed Martin (now TRC)
- EnergyHub (now Seimens)
- UISOL (now GE)
- Akuacom (now Honeywell)

DRMS category simply doesn't exist anymore

DERMS Pure-plays

- Spirae
- Enbala (now Generac)
- Smarter Grid Solutions (now Mitsubishi)
- Opus One (now GE)
- Packetized Energy (now GE)
- mPrest

Pure plays are disappearing too

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# DERMS Core Functionality

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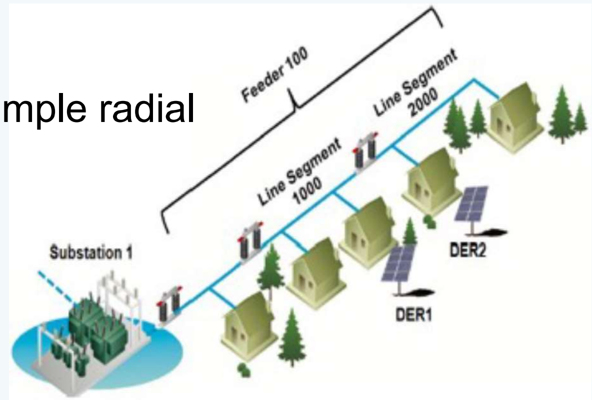
## DERMS Requirements

Proactive local congestion avoidance is the most complex use case, driving the most difficult requirements

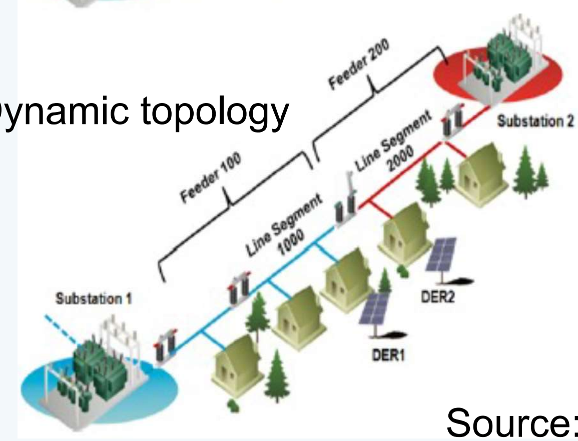
1. Network model awareness
2. Asset aggregation and disaggregation
3. Forecasting native load/gen and constrained flexibility
4. Predicting power flows, congestion, and violations
5. Optimizing schedules for network and DER assets

# Network model awareness

Simple radial

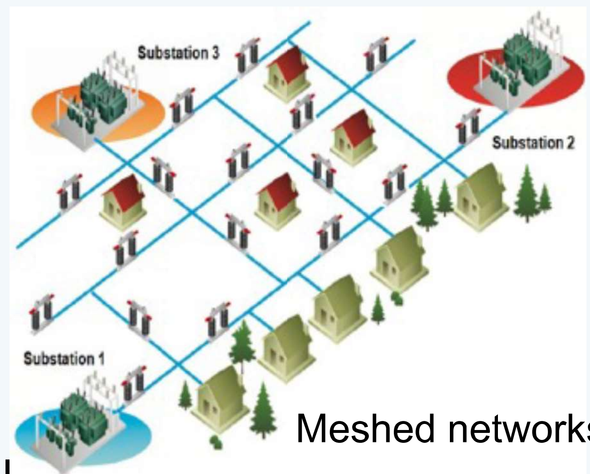



Dynamic topology




Source: EPRI

- DERMS use cases and network complexity will drive how detailed and dynamic DER modeling and aggregations are needed




Meshed networks

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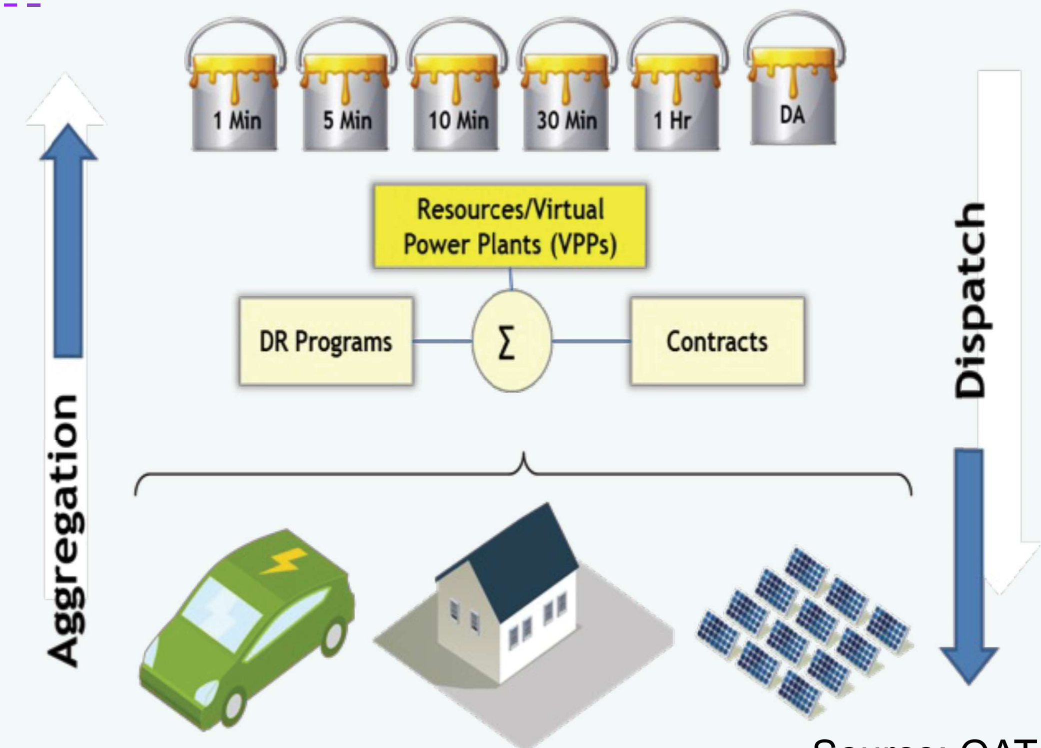
# Demand Side (DR or DER) Aggregation

- Key Dimensions
  - Program (Asset type)
  - Contract (Aggregator AND Retailer!)
  - Lead time & Duration (Constraints)
  - Location (Zone, Substation, Feeder, etc)

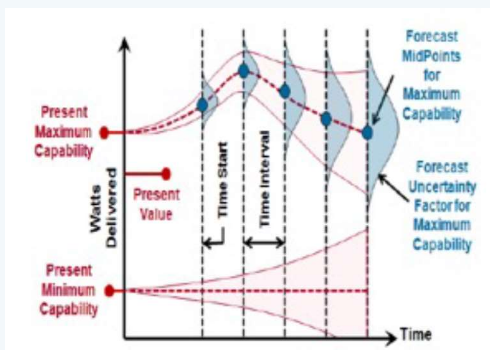



Source: OATI

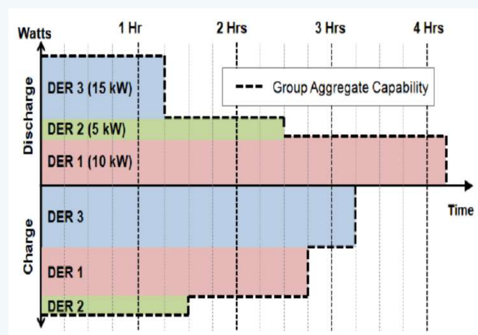
# Forecasting

- DER forecasting is itself a huge challenge and multi-faceted
  - Highly granular and distinct forecasting of default load, gen, and storage
  - Composition of forecasts, according to the network model, at various levels
  - Calculation of DER *flexibility* is a complex function of capability and constraints

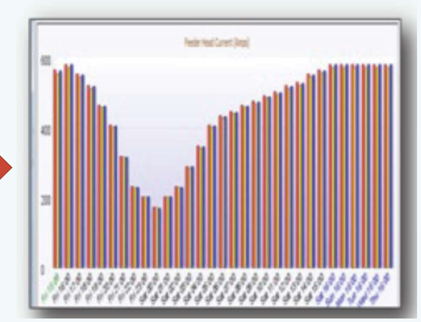
Stochastic resources, capability, and constraints




Scheduled resources, capability, and constraints




Decomposed and net schedules, uncertainty, and flexibility



Source: EPRI

## Predicting Power Flows

Rolling multi-day look-ahead, using latest topology, SCADA, and forecasts

- Current, voltage, real and reactive power, and predicted violations along feeder
- Less complex if only looking at net load at substation or feeder head

Recalculated on network change, asset loss, or other system disturbance

Study mode for switch planning, recovery, or setting seasonal limits

Forecasts and uncertainty — Power flow analysis — Warnings and violations

# Optimization

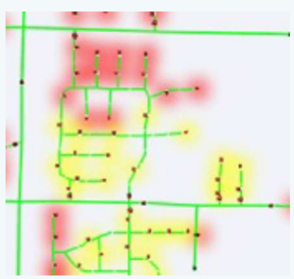
Co-optimization of reliability and economic efficiency

- How to use DERs as a cost efficient non-wires alternative?
- How to value 'local reliability' and unbundle distribution grid service costs?

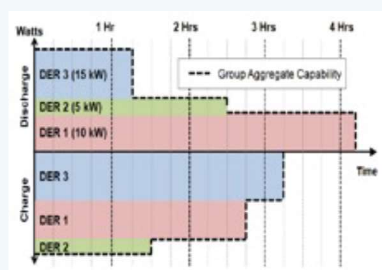
Will likely see an evolution of sophistication over time

- From simple dispatch of flexibility when network violations cant be solved
- To a complete plan of network configs, DER schedules, and contingency/reserves

Objectives & weights



Capability, costs & constraints




→ Network optimization

→ DER asset optimization

→ Contingency plans & asset reserves

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# DERMS Maturity Model

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# Smart Grid Maturity Model Levels

| | | |
|---|---|---|
| 5 | PIONEERING | Organization is breaking new ground and advancing the state of the practice within a domain |
| 4 | OPTIMIZING | Organization's smart grid implementation within a given domain is being tuned and used to further increase organizational performance |
| 3 | INTEGRATING | Organization's smart grid deployment within a given domain is being integrated across the organization |
| 2 | ENABLING | Organization is implementing features within a domain that will enable it to achieve and sustain grid modernization |
| 1 | INITIATING | Organization is taking the first implementation steps within a domain |
| 0 | DEFAULT | Default level for the model |

Source: SEI/CMU

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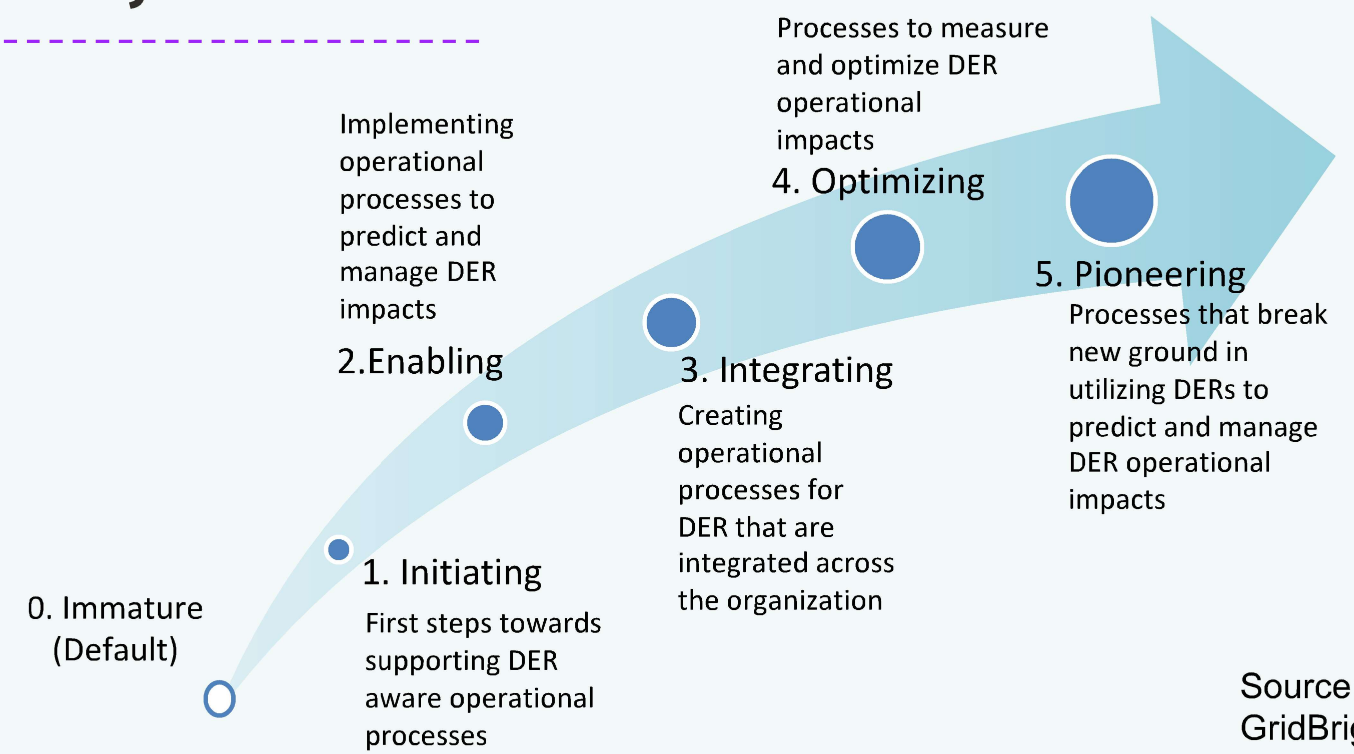
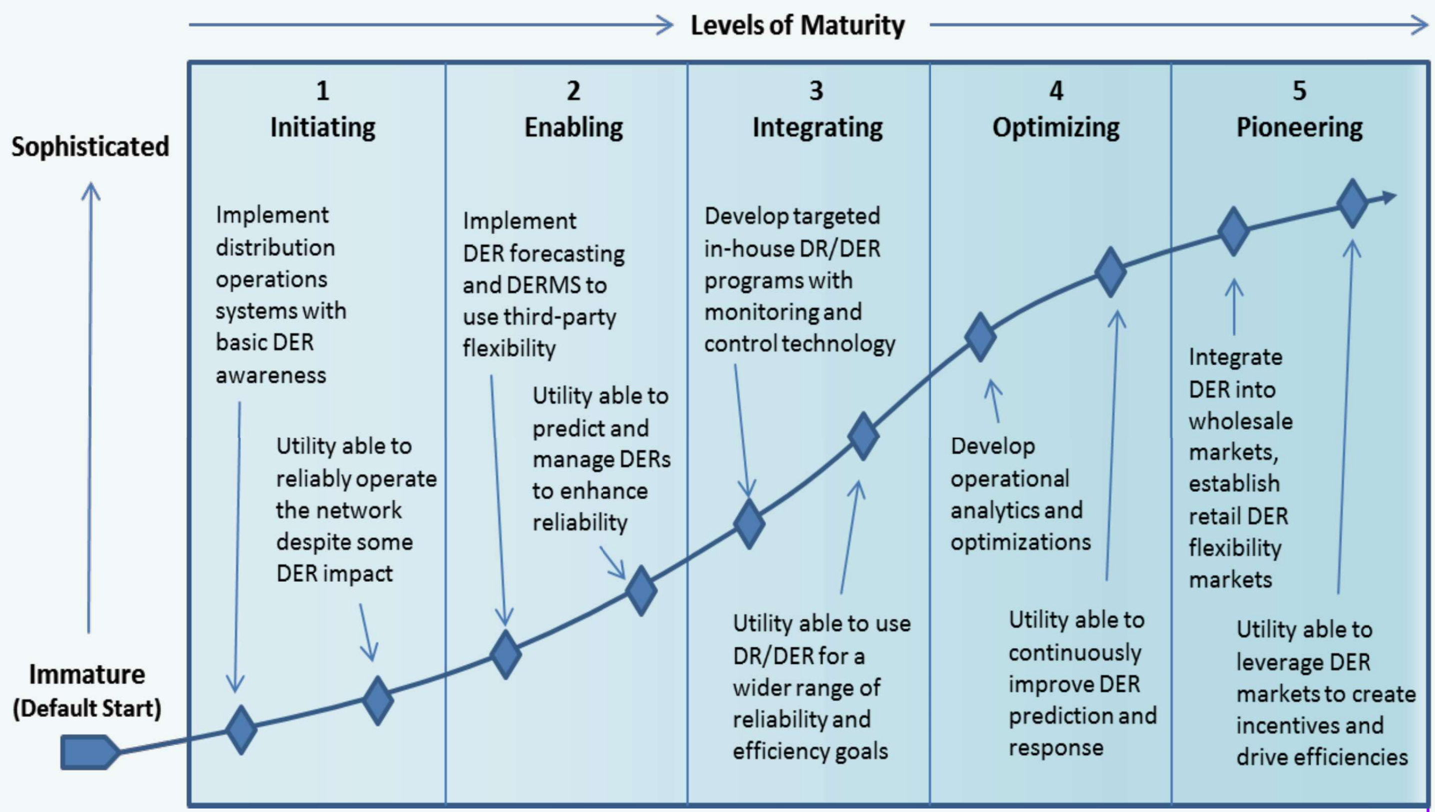
## DER Maturity Model Levels




Source: GridBright Research

# DER Maturity Roadmap (example)



## Current and Future State Assessment

Conduct a self-assessment of current capabilities and target future maturity for key operational process –

1. Look-ahead analysis
2. Forward scheduling
3. Operations monitoring
4. Real-time dispatching
5. Distributed control
6. Event recovery
7. Customer relations
8. Metering & analytics
9. Billing & settlement

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# Assess your DER Asset Mix and Growth

Many small DERs vs a few larger DERs

- millions of small behind-the-meter units require some logical aggregation
- easier and more cost effective to keep track of a small number of large DERs

Ownership and controllability of those DER assets

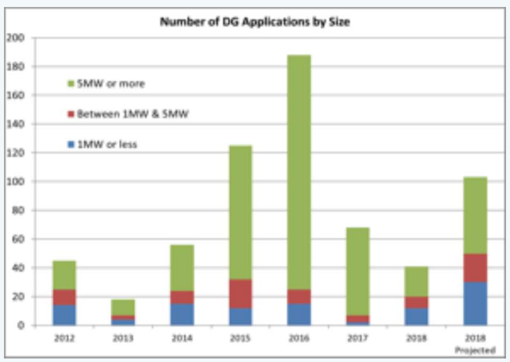
- utility owned assets are generally controllable within technical limits
- customer or retailer owned assets may have technical or contractual constraints on using the assets for managing power balance or quality
- community aggregates can have complex contractual and incentive schemes

Many different DER asset types require more sophisticated solutions

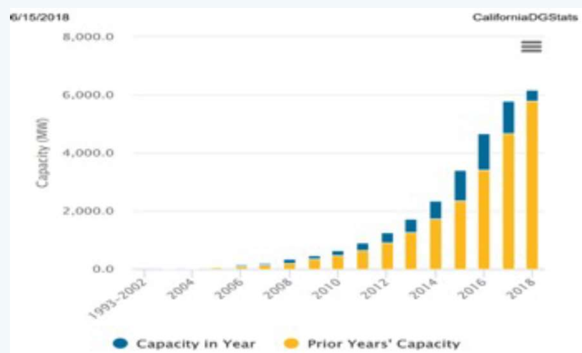
- easier to manage a simple AC load control program, vs a complex portfolio of DG, DS, DR, EV, and Microgrids, each with its own operating considerations

# Future Business Scenarios (example)

1. Large DER grows faster

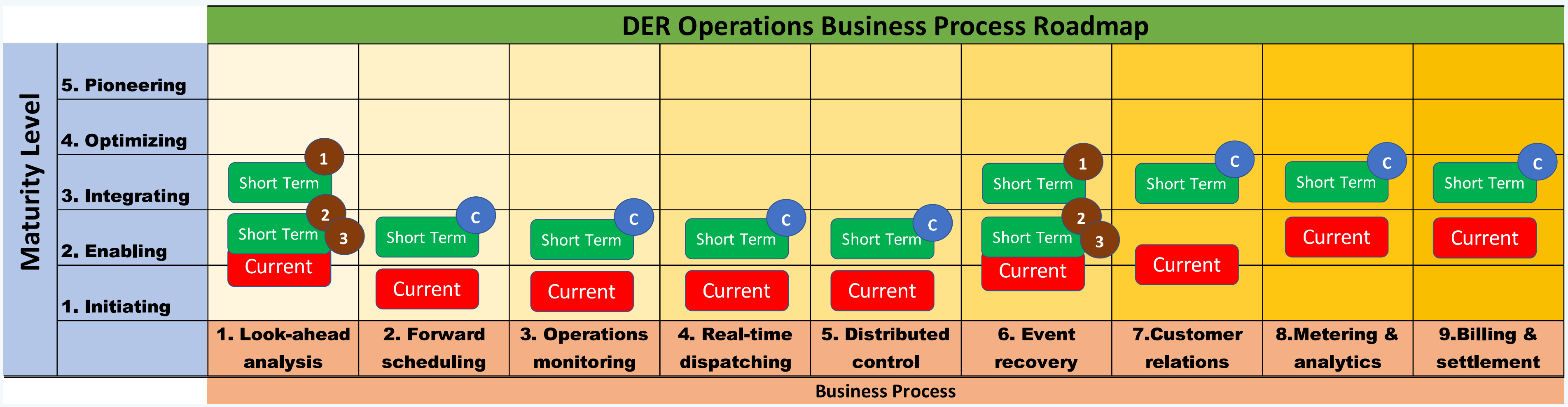



2. Small DER grows faster




3. Community aggregates grow faster

# Common & Different Process Maturity Levels Between Scenarios




Scenario 1 – Large DERs
Scenario 2 – Small DERs
Scenario 3 – Aggregate DERS
Scenario C – Common – no regrets

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# Technology Roadmap (example)

**0 Default**

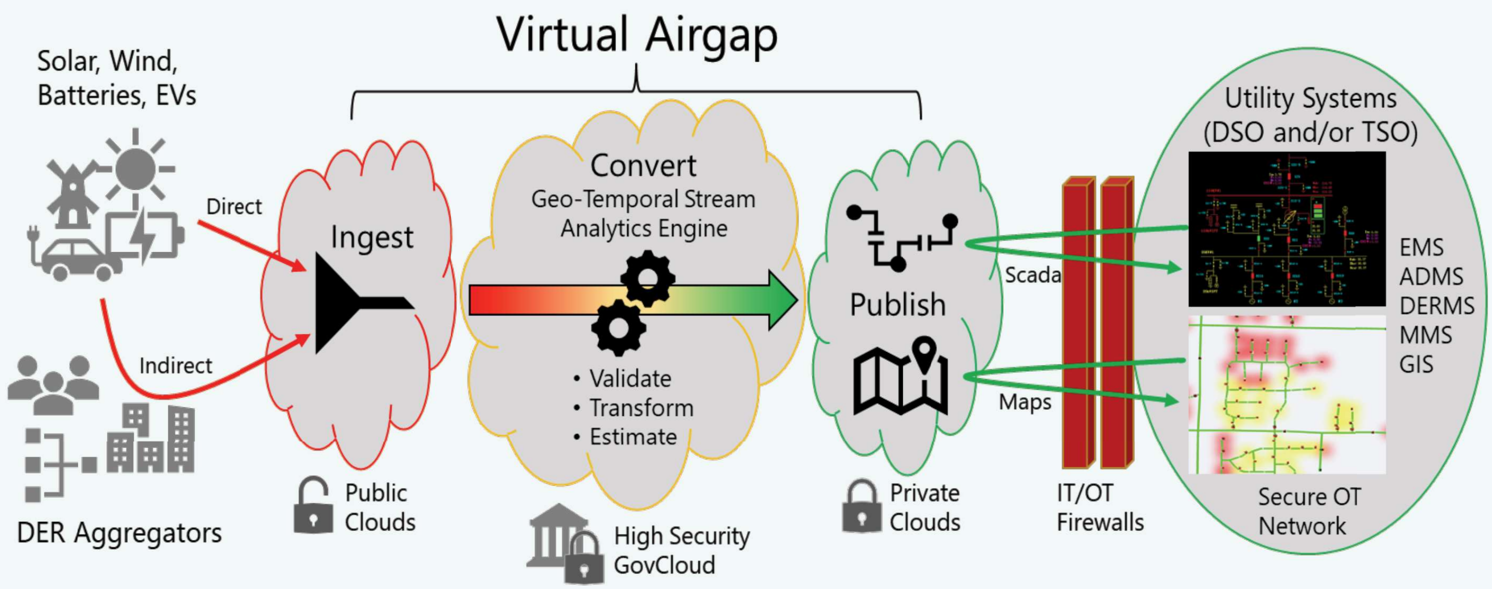
- DMS/OMS
- GIS
- SCADA
- Basic Load Forecasting

Levels of Maturity →

| 1 Initiating | 2 Enabling | 3 Integrating | 4 Optimizing | 5 Pioneering |
|---|---|---|---|---|
| • GIS model extensions for DER<br>• SCADA integration to large DER<br>• Net load forecasting with DER | • ADMS with DER support<br>• DERMS pilot<br>• DER asset control<br>• Forecasting DER native behaviors | • DERMS<br>• IoT gateway integration<br>• Distributed automation<br>• DER flexibility forecasting | • DER response analytics<br>• Look-ahead contingency analysis<br>• Distributed optimization<br>• Forecasting DER dispatch response | • Central market integration<br>• Local market operations<br>• Price responsive DER<br>• Distributed intelligence |

# DOE/SETO ***PV Integration using a 'Virtual Airgap'*** (PIVA)

GridBright, SDG&E, NVE, Oracle, NREL, others




SETO Award Press Release

https://www.energy.gov/eere/solar/solar-energy-technologies-office-fiscal-year-2021-systems-integration-and-hardware

Project Press Release

https://www.newswire.com/news/u-s-department-of-energy-solar-energy-technologies-office-selects-21702595

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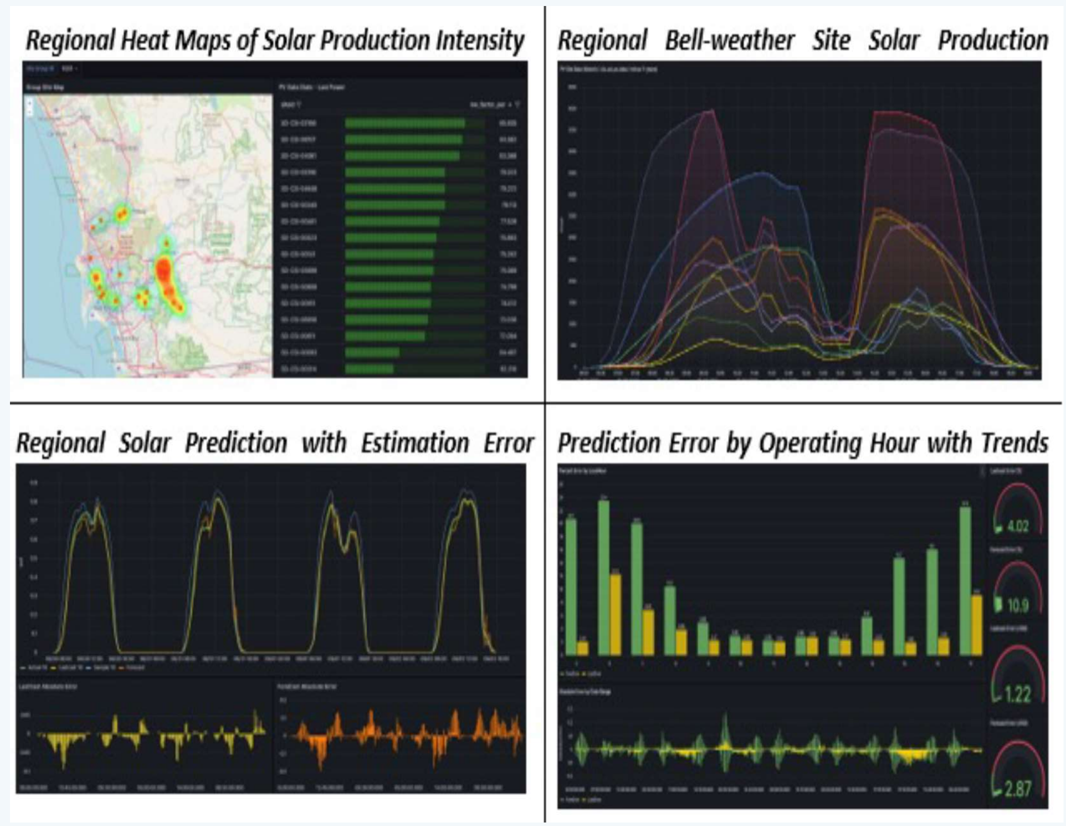
## PIVA Nowcast & Forecast

- Collects PV data from a variety of real-time but potentially unreliable and untrusted behind-the-meter ‘bell-weathers’ sites
- ML/AI model trained to estimate solar kW factor for regional micro-climate from recent historical telemetry
- Engine calculates both a real-time ‘nowcast’ and rolling 15-min forecast for each region
- ADMS can use to calculate shadow gen and load for section, feeder, substation, or area
- DERMS can use to trigger events

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# Thank You!

Travis Rouillard
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# 3) DER Functional Requirements & Use Cases

**Sameer Kalra**, Director OT Product Management, Oracle Energy and Water

- Business & Functional capabilities
- Types of DERMS
- High level architecture
- Step-by-step journey
- Use Cases
- Business value

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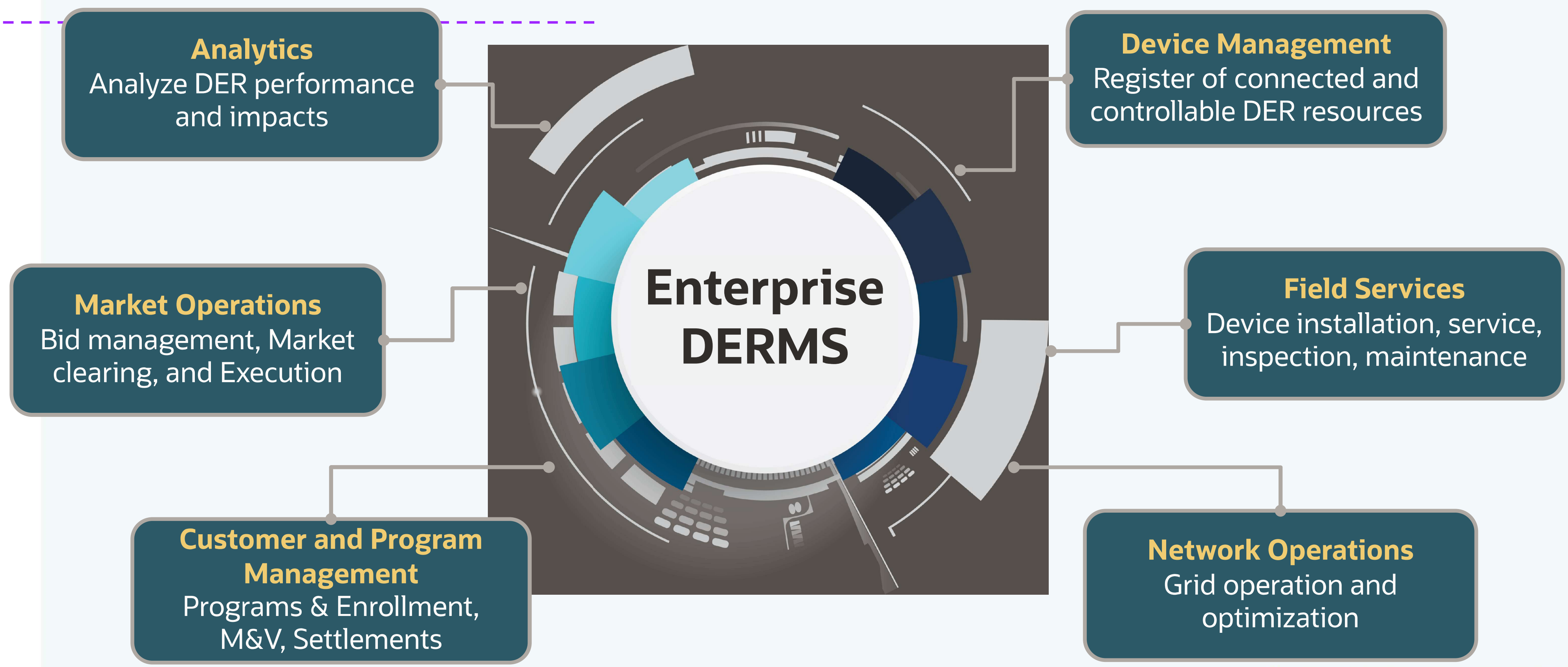
# What is a utility enterprise DERMS solution?

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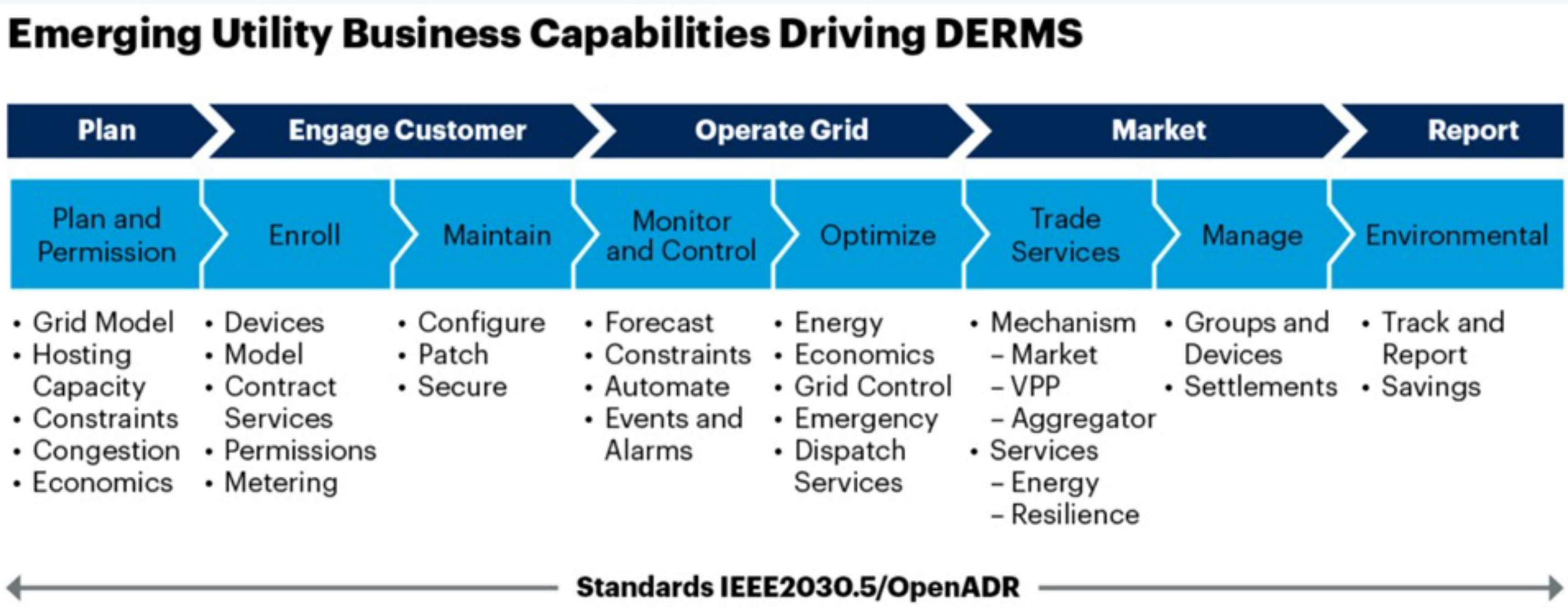
# Gartner: Business Capabilities



# SEPA: DERMS standardization

system

- SEPA initiative : ‘Encyclopaedia of DERMS’.
- Use case focus details functionality and DERMS ‘modules’:

| DER Device Mgmt | DER Visibility & Analysis | DER Control | Grid Services | | Market Interaction |
|---|---|---|---|---|---|
| Registration | Monitoring / Estimating | Scheduling & Dispatch | Energy Mgmt | Power Quality Mgmt | Bidding |
| Asset Config / Modelling | Forecasting | Optimization | Capacity Mgmt | Renewables Smoothing | Settlement |
| Aggregator Data Exchange | Aggregation | VPP | Constraint Mgmt | Resilience / Microgrids | Transactive Energy |
| | Measurement & Verification | Curtailment | | VVO | |
| | | Demand Response | | | |

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# DERMS Classification

| Digital Asset Management | Operations | Grid Edge | Communication & Control | Analytics & Data Science |
|---|---|---|---|---|
| • Device registration and enrolment<br>• Device Management<br>• Customer & Program Management<br>• Event Management<br>• Settlement | • Digital twin model of DER/DR<br>• Full Situation awareness<br>• Forecasting<br>• Optimization<br>• Monitor, Control and Dispatch | • Create and Schedule events<br>• Control score-based optimization<br>• Aggregator/VPP integration | • Data integration engine<br>• Front End Processor<br>• Multi-protocol integration | • PV/EV detection<br>• ML/AI based Forecasting<br>• DER/DR insights<br>• Business intelligence, reporting |

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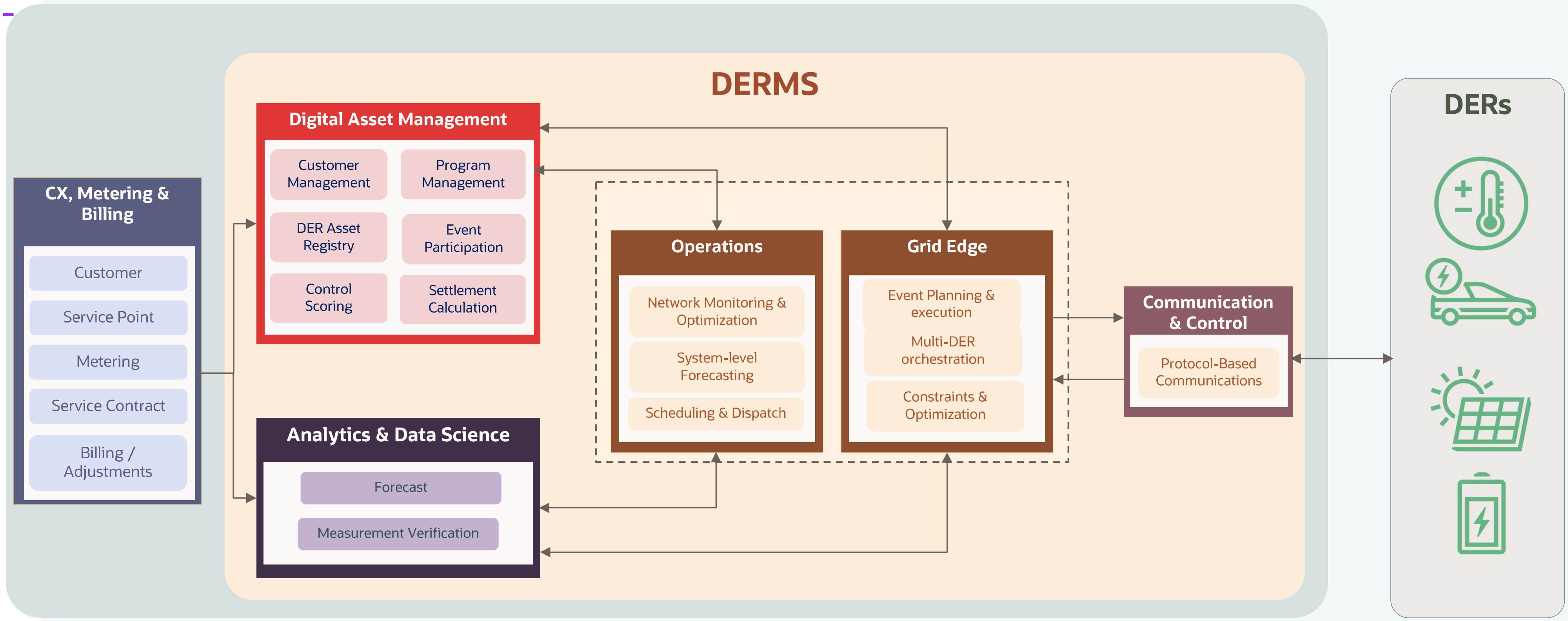
# Enterprise DERMS High Level Architecture

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# Step-by-step journey to DERMS – parallel path

**Operations**

## DER Modeling and Awareness
- DER modeling
- DER awareness

## Monitoring and Impact Analysis
- DER monitoring
- DER impact analysis
- DER forecasting

## Optimization and Control
- DER performance analysis
- DER control
- DER optimization

**Customer & Market**

## Device & Programs Management
- DER device registry
- Program design
- Program enrollment

## Measurement & Analytics
- Device detection
- Program effectiveness

## Market Management
- Bid management
- Bid clearing
- Settlements

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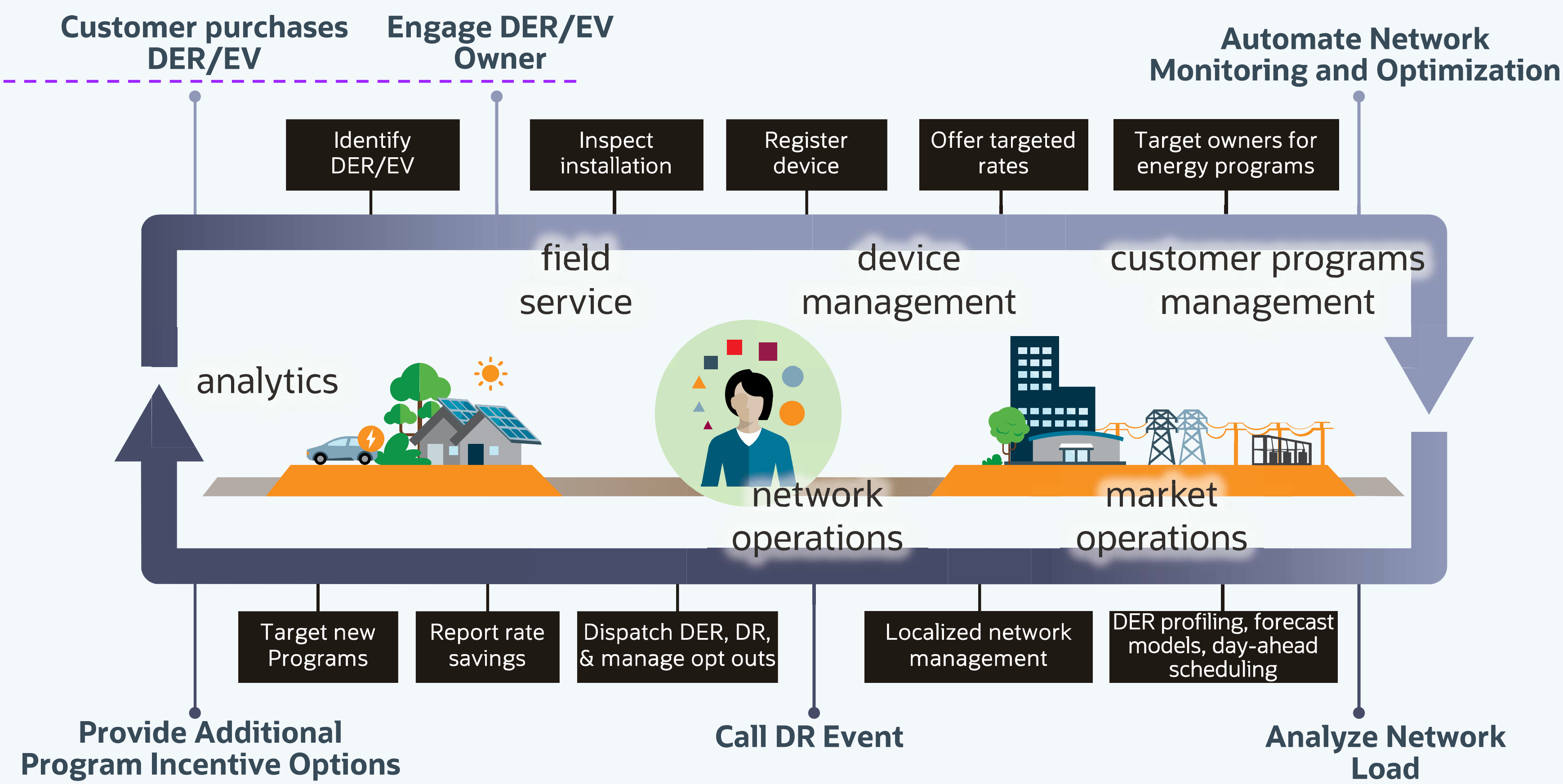
# Typical end-to-end DER interconnection process

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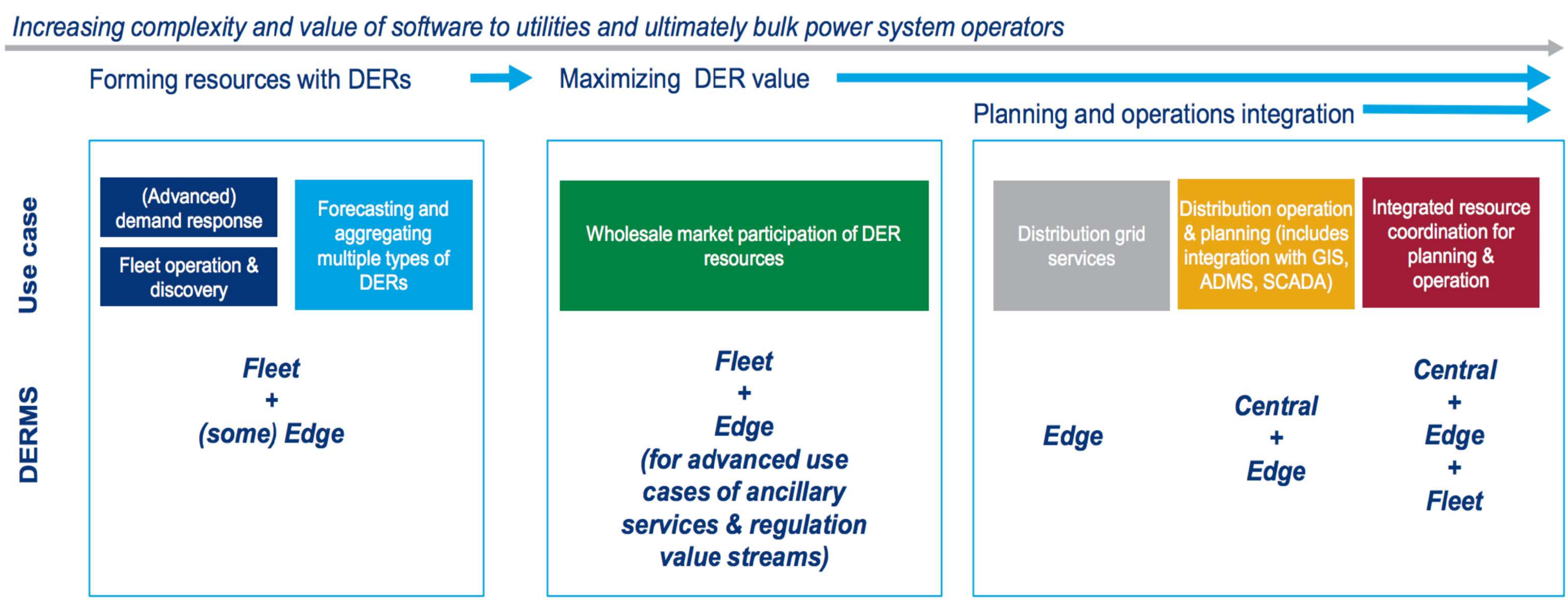
# DERMS Use Cases and Value



# Summary of DERMS Use Cases

| Beyond the Meter | | T&D | System |
|---|---|---|---|
| Customer Engagement | Site Optimization | Grid Services | Market Applications |
| • Program enrollment<br>• consumption and DER performance reporting<br>• Savings tips | • Time-of-use shifting<br>• Demand charges reduction<br>• Solar self-consumption<br>• Microgrids including resiliency | • Situational awareness (DER monitoring, forecasting)<br>• Peak load management<br>• Targeted congestion relief (e.g., non-wire alternatives, upgrade deferrals)<br>• Interconnection management (e.g., Rule 21)<br>• Renewables integration<br>• Load shaping<br>• Power quality optimization (e.g., VVO)<br>• Integrated grid management (e.g., Outage management and FLISR support) | • Virtual power plant (VPP) management<br>• Capacity contracts and trading<br>• Energy trading<br>• Ancillary services: reserves, frequency regulation, voltage support |

*(Source: Navigant Research)*

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# EPRI DERMS Use Cases

- Constraint of DERs Participating in Wholesale Markets for Distribution Grid Reliability
- DER Flexible Interconnection
- Distribution Grid Upgrade Deferral
- Distribution Grid Voltage Support
- Economic Optimization
- Fault Restoration Support
- Load reduction to extend maintenance window
- Load Shifting & Duck Curve Management
- Peak Load Reduction
- Scheduled Dispatch+

- Wholesale Energy Price Response
- Backup Power
- Microgrid Control
- Self-Consumption of Renewable DER
- Contingency Frequency Response (Primary Control)
- Contingency Voltage Response (Primary Control)
- ISO Market Products – Day Ahead or Real-Time Energy
- Regulation Reserve
- Spinning Contingency Reserve
- Transmission System Voltage Support

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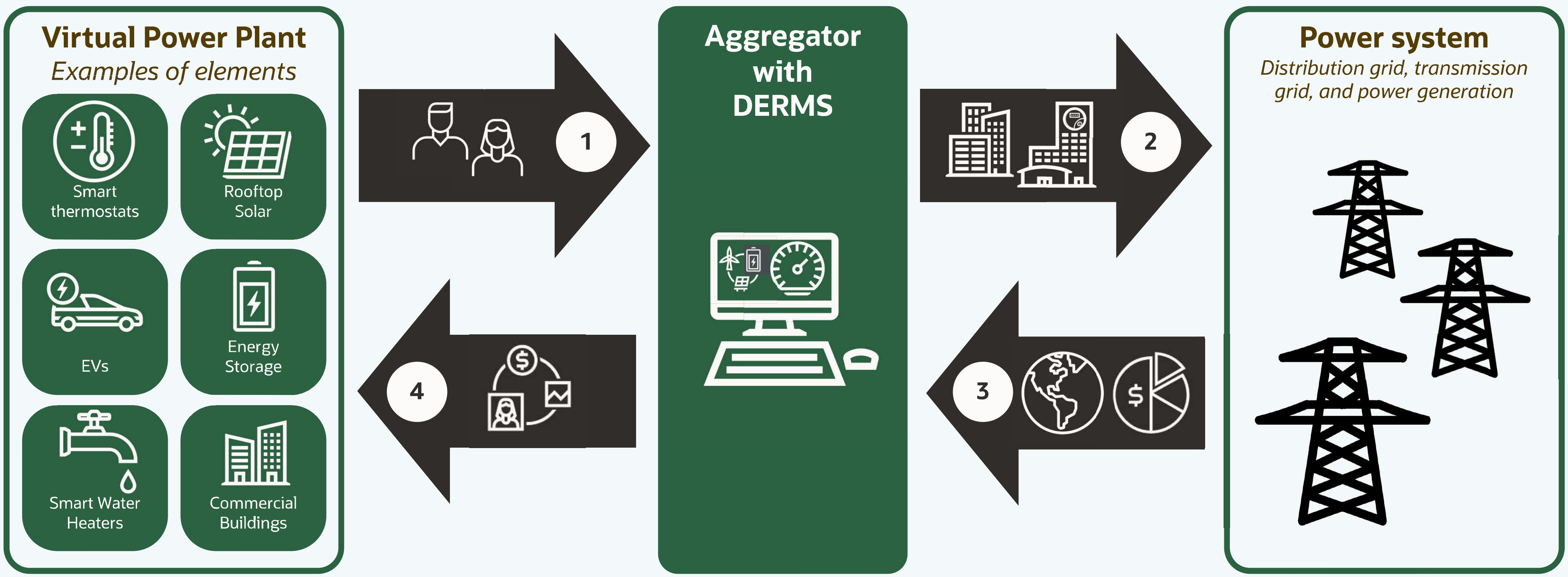
# Virtual Power Plants

*A portfolio of DERs that are orchestrated to benefit generation, grid, consumers, and environment*




*Source: Real Reliability The Value of Virtual Power, The Brattle Group, May 2023*

## Business Case Value Proposition
### *Safe, Reliable, and Cost-Effective DER/EV Optimization*

| Benefit / Business Outcome | Value |
|---|---|
| • Increase visibility of DER and improve planning capabilities<br>• Increase ability to study and realize benefits of non-wires alternatives<br>• Use DER and demand response to address network issues, potentially deferring capital investment and reducing Opex | • Cost-effective carbon-free Demand Response as peak power resources/spinning reserves as part of IRP<br>• Safe connections of DER with full visibly and predictive operational mitigation of forecasted constraints enables utilities to comply with regional Renewable Portfolio Standards (RPS) safely ahead of schedule. Improves regulatory and political standing by embracing DER adoption and accelerating regional energy policies.<br>• Enable customer's DER and smart appliances to participate in non-wires alternatives (NWA) programs by leveraging customers existing investments instead of building tradition delivery infrastructure capacity when shown to be more-cost effective. This is particularly important for EV adoption to create programs to leverage available off-peak capacity instead of overloading neighborhood infrastructure. This will optimize existing utility infrastructure to enable increase EV charging revenue without raising rates for non-participants. Can promote EV smart charging rates to drive new revenues that also reduces overall $CO_2$ emissions. |

# Looking forward

***Every utility will have their own DERMS journey varying by DER, use cases, value drivers, existing systems.***

*DERMS requirements will be utility specific and are continuing to evolve…*

**1**

- Changing regulations
- New use cases
- Interacting use cases

**2**

There is still a way to go…….

- DER at very large scale still to happen
- DERMS scale-up at early stage
- Integration across ISO/DSO/DERMS functions still at early/conceptual stage
- Teams / knowledge growing

**3**

Utilities require flexibility as many detailed requirements are still to emerge:

- Focus on core capability and architectural flexibility
- Benefits from a different type of collaborative vendor relationship(s)
- Staged delivery through pilots, extended pilots, expansions and roll-outs have proven more successful than 'trying to get it right first time'

# Thank You!

Sameer Kalra, Director OT Product Management
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# 4) DERMS Implementation Best Practices

**Michael Brown**, Integrated Energy Services Director, NV Energy
**Rich Barone**, DERMS Solutions Architect, Oracle Energy and Water

- **Solution Approach**
  - Strategy
  - Roadmap
  - Architecture
  - Making the Business Case
  - Sourcing (RFI, RFP, Resourcing)
  - Contracting (Structuring and Negotiation)
- **Implementation**
  - Requirements Deep Dive
  - Interactive Design
  - Build & Test
  - Steady State Operations, Maintenance, and Support
  - Utility Business and Operational Process Optimization
  - Product Evolution

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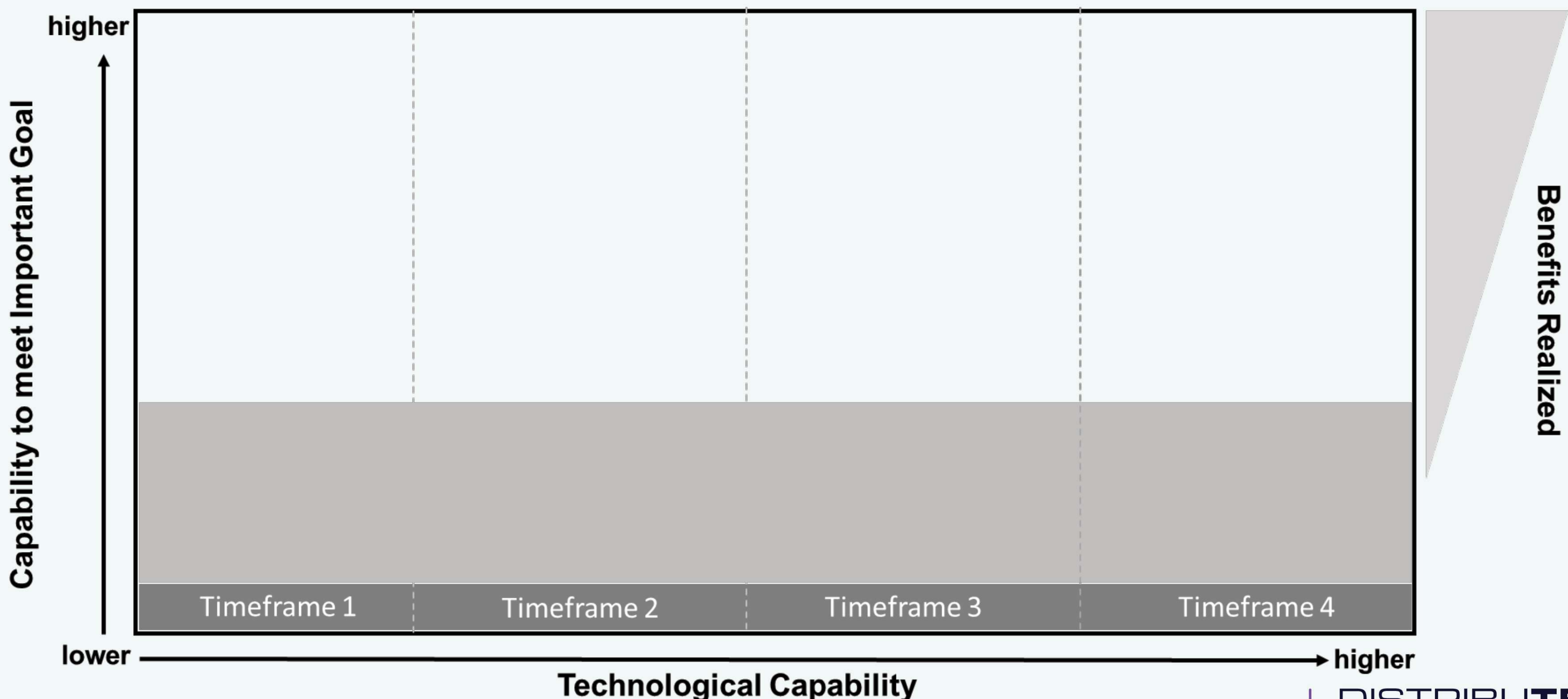
# Implementation Best Practices: Strategy & Roadmap

- Strategy Development
  - Process that requires input from stakeholders
- Strategy Documentation
  - Prioritized Goals & Risks
  - Business Objectives
  - Maturity Level
  - Type of DERMS
- Roadmap
  - Sets context for key milestones and benefits realization

**Sample Contents**

- Strategy Overview
- Goals & Metrics
- Programs (Current & Proposed)
- Regulatory Strategy
- Prioritized Initiatives
- Organizational Design
- Operational Systems
  - Premise Technologies & Devices
  - Back-Office Infrastructure
- Valuation Strategy
- Contracting Approaches
- Risks & Risk Mitigation Plan
- Federal Grants related to DR, DER, Load Flex
- Known Challenges

# Implementation Best Practices: Roadmap Sample Framework

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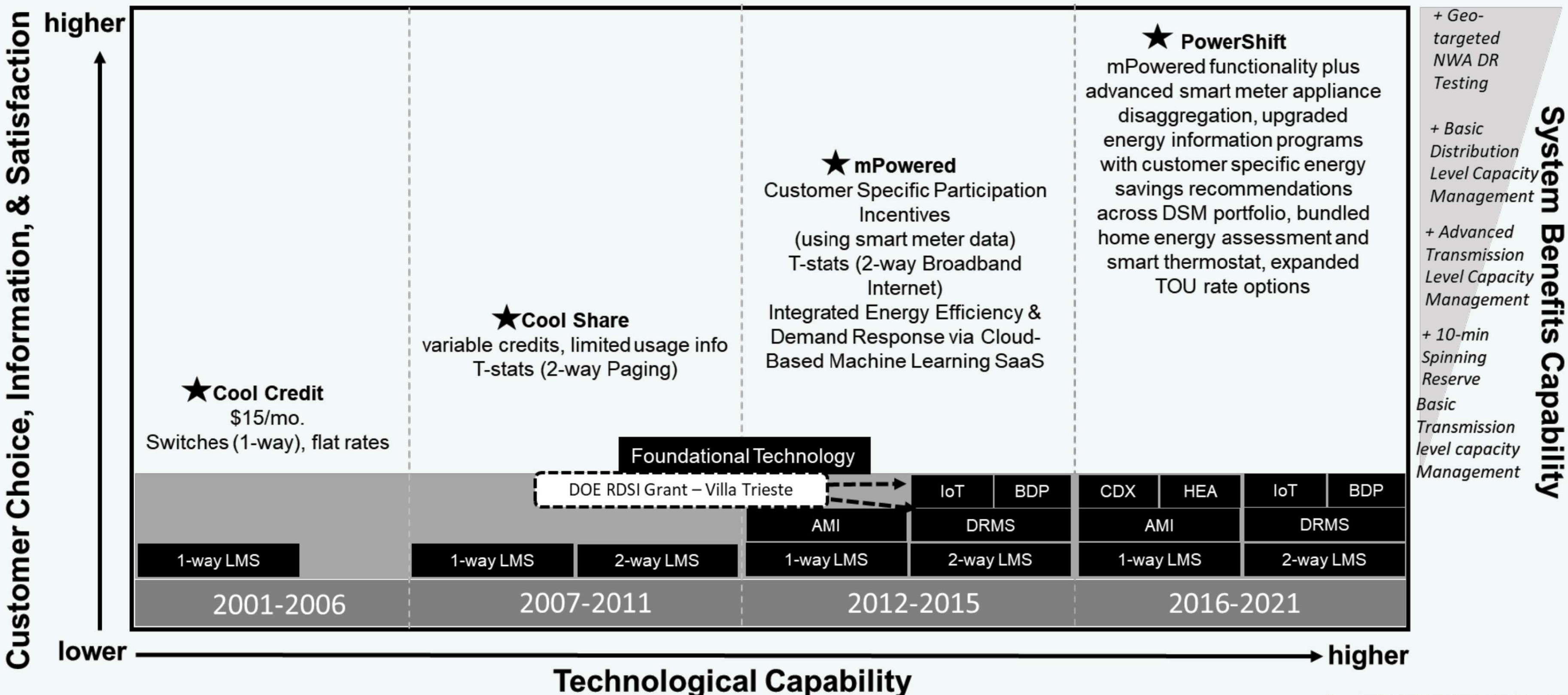
# Implementation Best Practices: Roadmap Sample 1




LMS = Load Management System
DRMS = Demand Response Management System
AMI = Advanced Meter Infrastructure
IoT = Internet of Things (e.g. EE/DR smart thermostats)
HEA = Advanced Online Home Energy Assessment
CDX = Customer Digital Experience
BDP = Big Data Platform

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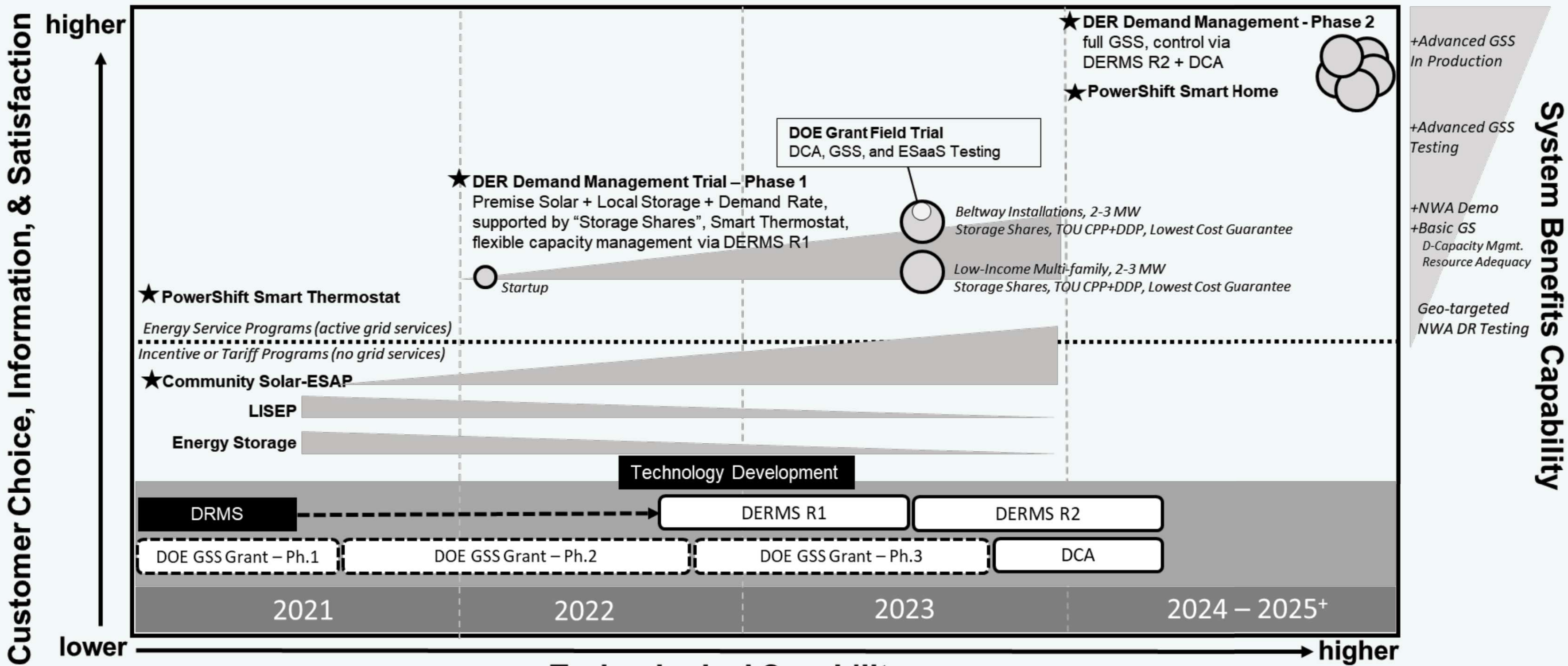
# Implementation Best Practices: Roadmap Sample 2




DRMS = Demand Response Management System
DERMS = Distributed Energy Resource Management System

DCA = Distributed Communications & Control Architecture
*(developed via DOE GSS Grant)*

GSS = Grid Service Set from aggregated DERs
(voltage, frequency, capacity mgmt., energy arbitrage, phase balancing)

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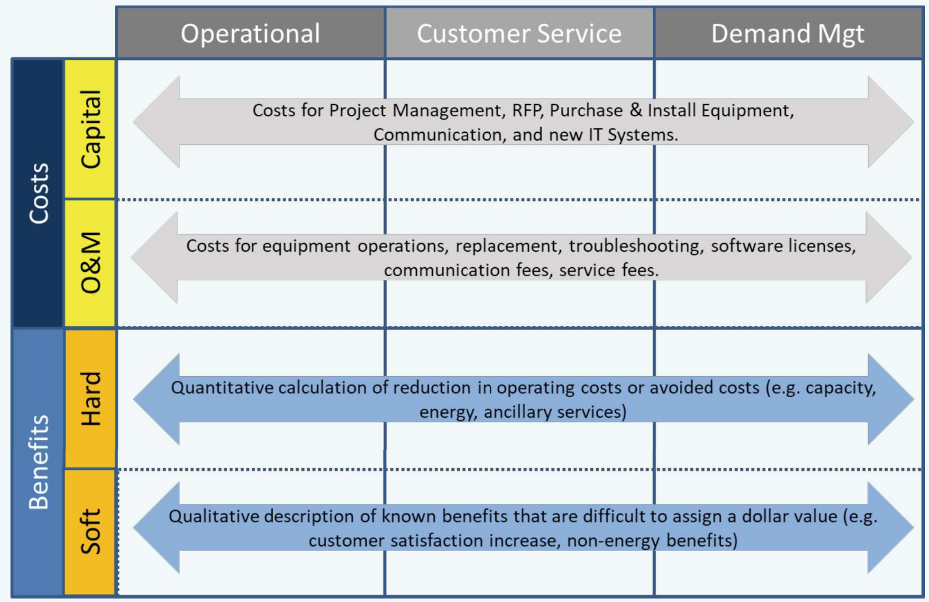
# Implementation Best Practices: Making the Business Case

## Estimation Methods

| Costs | Benefits |
|---|---|
| • RFP - vendor provided costs | • Benchmark - estimated savings from other utility AMI deployments adjusted for utility specific conditions. |
| • Benchmark - estimated costs from other utility AMI deployments | • Actual – discovered during a pilot or other implementation |
| • In-House – estimated from similar internal costs and historical accounting data | • Substitution – estimate from summing historical accounting costs that will be superseded by AMI |
| • Indirect Benchmark – estimated from indirect costs (e.g. damage claims) using adjusted external benchmarks | • Qualitative – described based upon other utility AMI deployments |
| • Actual – discovered during a pilot or other implementation | • Qualitative – described based upon internal utility specific knowledge |

## General Cost-Benefit Framework




The bottom line =
***Expected B/C Ratio***
(from robust scenario analysis)

$$\text{Benefit-To-Cost} = \frac{\text{PVRR of (Capital Savings + O\&M Savings + Demand Response) LESS PVRR of (Post Deployment Capital + O\&M)}}{\text{PVRR of Deployment Costs}}$$

Source: Southern California Edison Smart Connect Financial Assessment and Cost-Benefit Analysis

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# Implementation Best Practices: Architecture

- Generate series of architectural diagrams to further define solution
  - Component architecture
  - Systems architecture
  - Security architecture
  - Communications architecture
- Understand compatibility with existing systems and business processes
- PNNL Grid Architecture Resources:

  *https://gridarchitecture.pnnl.gov*

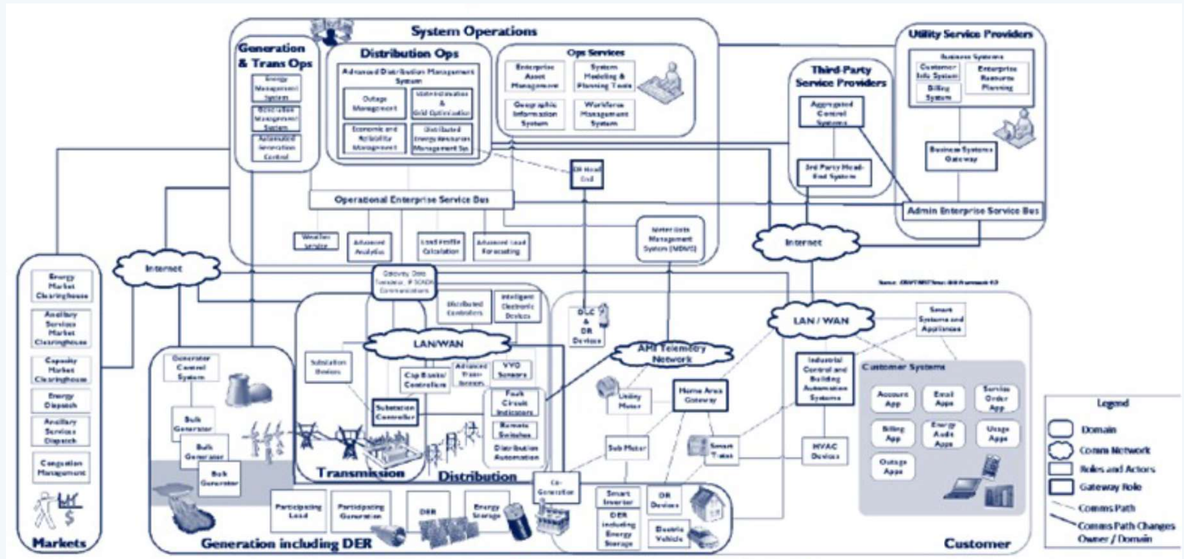


Figure 6 – High-DER communication pathways scenario

Source: NIST, *NIST Framework and Roadmap for Smart Grid Interoperability, Release 4.0* (Washington D.C.: U.S. Department of Commerce, July 2020 )

https://www.nist.gov/document/draft-smart-grid-framework

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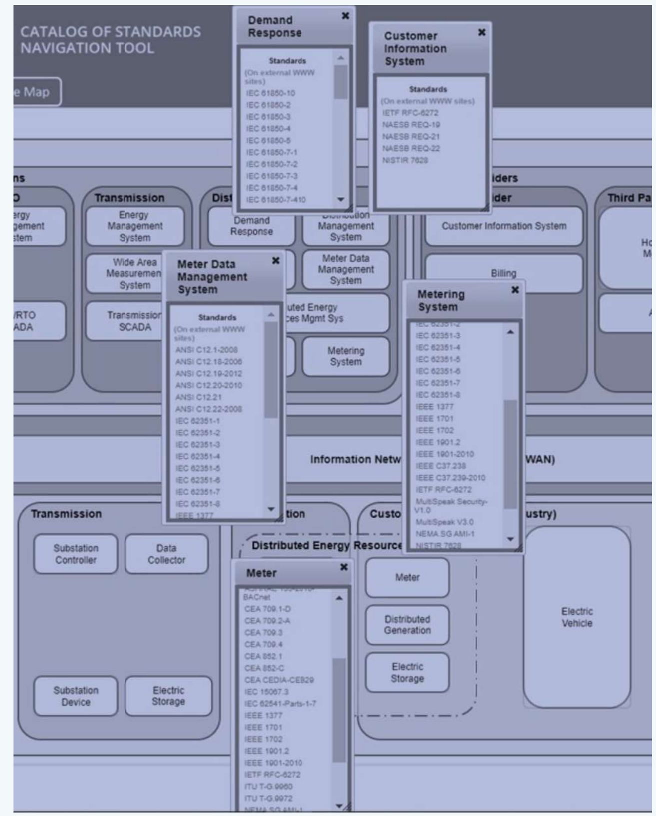
# Implementation Best Practices: Sourcing

- Preparation
  - Benchmarking and Industry Research
  - Leverage industry standards and reports (e.g. SEPA requirements)
  - Peer Reviews & RFIs
- Sourcing Methods
  - Internal
  - Sole Source
  - Extend/Integrate
  - RFP
- Resource/Provider Types
  - Compatible DERMS vendors
  - System integrator
  - SME Consultants / staff augmentation
  - Security (architecture review, penetration testing)
- Selection Process



# Implementation Best Practices: Contracting

- Scope
- Functional Requirements
- Technical Requirements
- Integration Requirements
- Schedule
- Pricing Models
  - Fixed
  - T&M
  - Variable (utilization, performance based,)
- Performance Management
  - Requirement traceability matrix
  - Acceptance criteria related to payment milestones
  - Schedule delay consequences
  - Service level agreements
  - Clear evaluation methods for performance based components

- Well-defined Terminology
- Risk Management
  - Clear deliverable expectations
  - Transition Services
  - Escrow
- Change Order Process
- Software Upgrades, Updates, Maintenance
- Clear roles and responsibility domains
- Well-defined Terminology
- Provisions to support regulatory filings and desired recovery methods
- Data Privacy
- Cybersecurity

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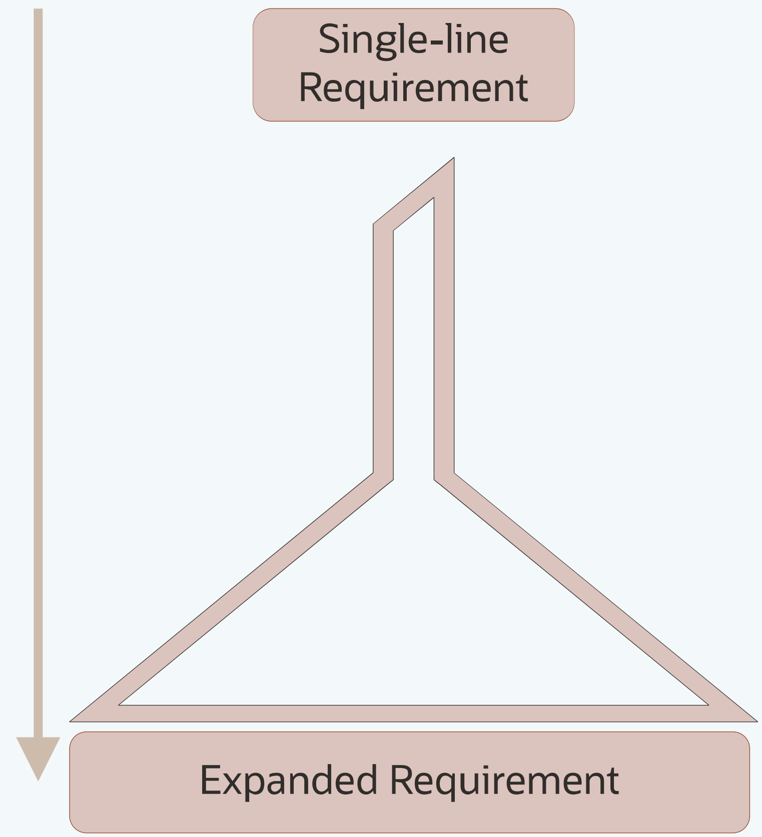
# Implementation Best Practices: Requirements Deep Dive

- Deep Dive
  - Iteratively expand upon existing single-line requirements
  - Inverted funnel
- Requirements Traceability Matrix (RTM)
  - Traces contracted requirements to expanded requirements
  - Serves as the basis for Acceptance Criteria and Test Case Development
- Enterprise wide SME Engagement & Functional Workshops



# Implementation Best Practices: Iterative Design

- **Preliminary Designs**
  - High-level
  - Big Picture
  - Major functional building blocks
  - Identify potential RICE elements.
  - Considering phasing
    - Evaluate alignment w/DER strategy
    - Assess resource needs and workforce plan


- **Detailed Design**
  - Can be agile or step-function.
  - Full functional, RICE and Conversion specifications
  - Cross-reference Requirements are addressed
  - Define Configurations

- **Documentation**
  - Well-defined terminology
  - Leverage industry standard approaches

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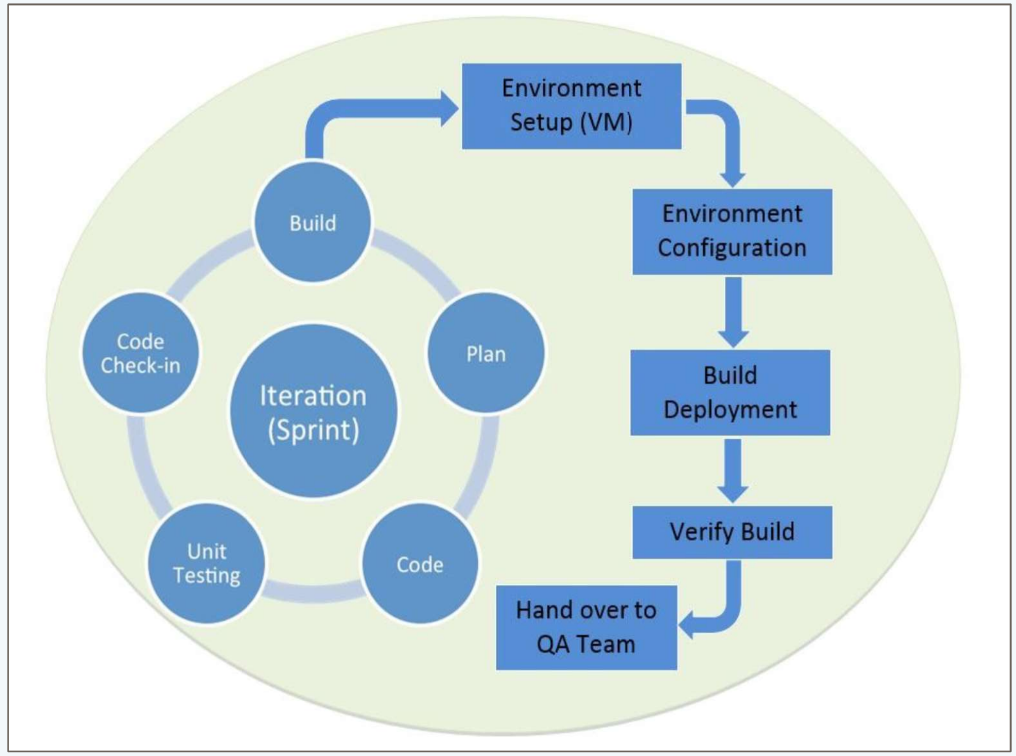
# Implementation Best Practices: Build & Test

- Integrative Detailed Design-Build can be beneficial
  - Define environments.
  - Define DR strategy
  - Develop & execute test plans
  - Cutover & Go-Live

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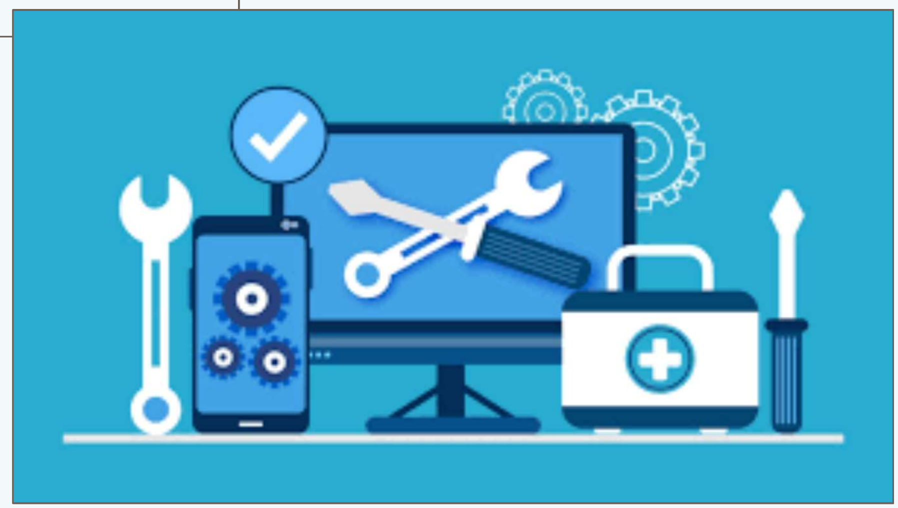
# Implementation Best Practices: Steady State Operations, Maintenance, and Support

- Promote broad internal engagement with new product
- Facilitate feedback mechanisms to enhance product
- Ongoing product support will naturally enhance value



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# Implementation Best Practices: Utility Business and Operational Process Optimization

- Extend potential reach of product through broader, integrative, multi-disciplinary engagement (planning, operations, market desk etc.)

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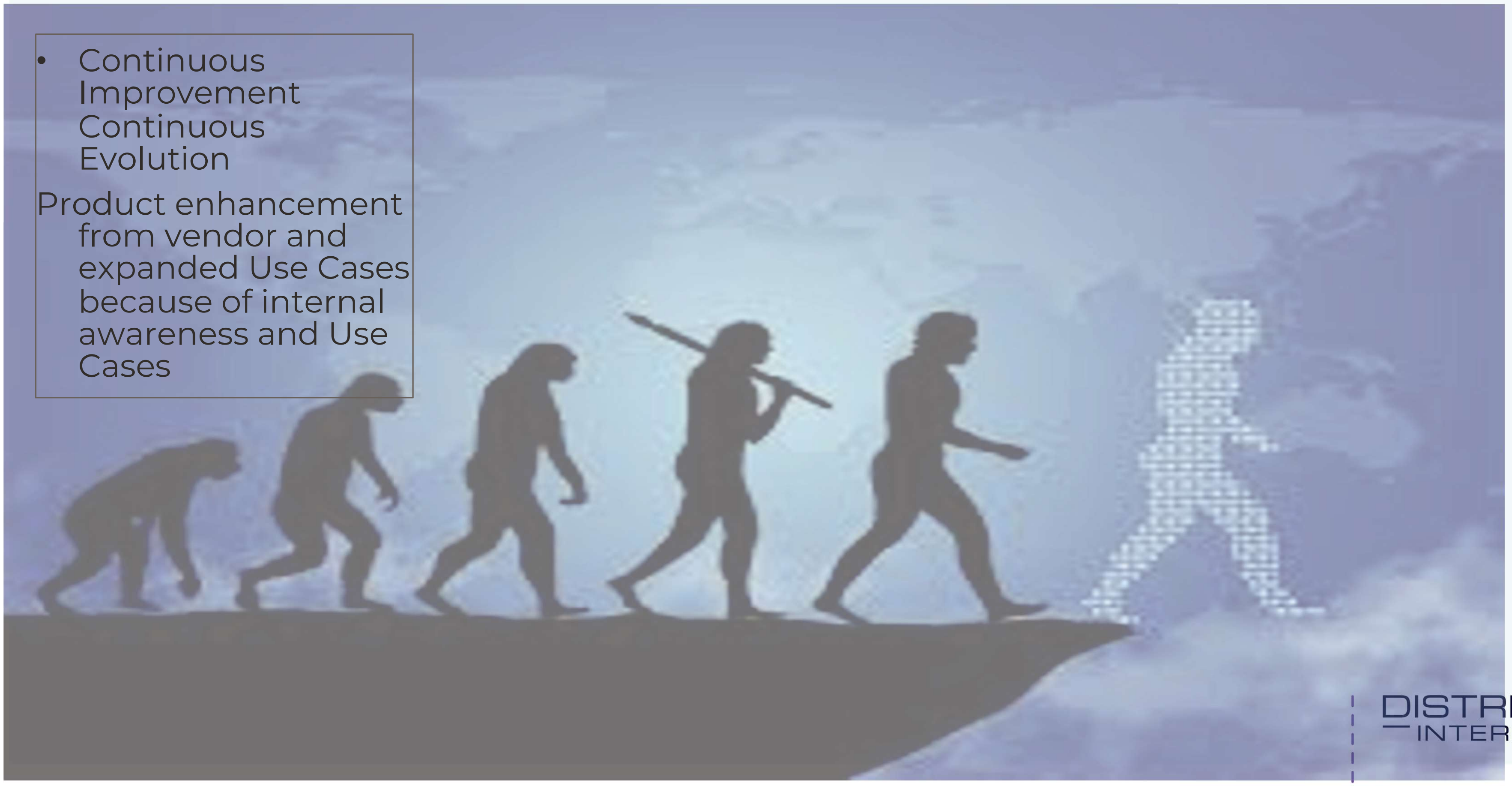
# Implementation Best Practices: Product Evolution



- Continuous Improvement Continuous Evolution

Product enhancement from vendor and expanded Use Cases because of internal awareness and Use Cases

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# Thank You!

Michael Brown, NV Energy, Michael.Brown@nvenergy.com
Rich Barone, Oracle Energy and Water, Rich.Barone@oracle.com

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Preparing for and Deploying Enterprise DERMS

*From Managing new DER connections to full Market Operations*

# Utility DER Panel of Experts

- Michael Brown, Manager, DER/DSM Services, NV Energy
- Rich Barone, formerly Hawaiian Electric Company, DERMS Solutions Architect, currently Oracle Energy and Water
- Alex Rosenblatt , Sr. OT Engineer, Advanced Grid Solutions, Duquesne Light Company

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## 1) Utility Overview and your DER Challenges and Opportunities

a) Brief overview of your utility. Also tell us how much customer-owned and utility-scale DER does your utility support now in terms of number of connections or participating customers (e.g. demand response programs) and total MW capacity?

b) How much of that has distribution operations and planning visibility
(e.g. modeled in your ADMS and planning systems)?

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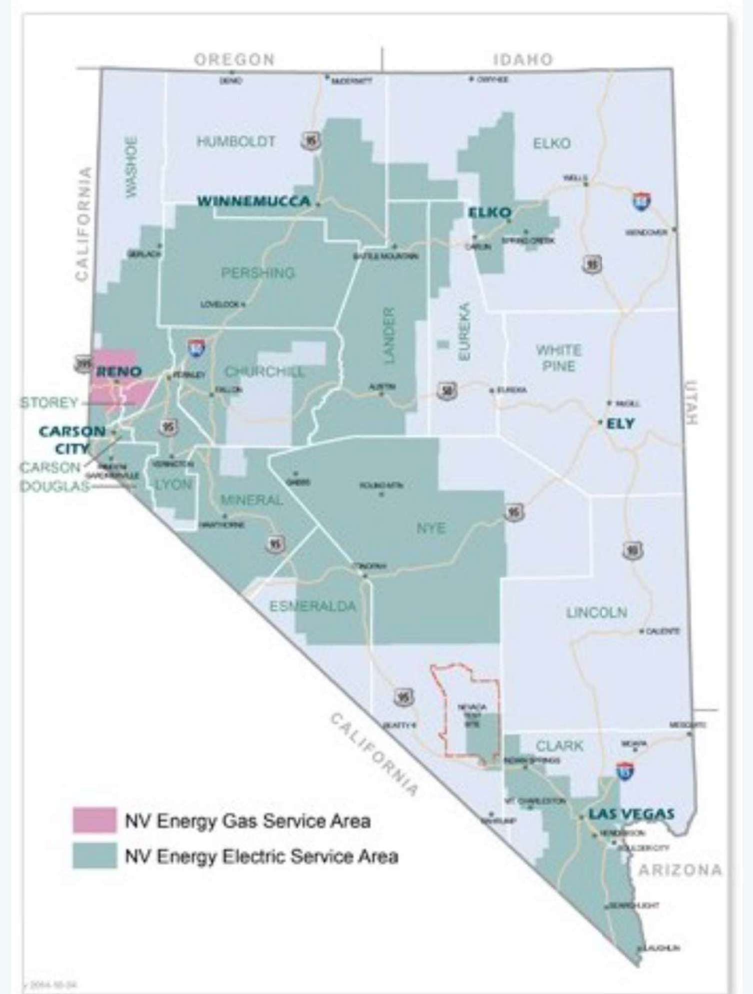
## NV Energy

NV Energy serves a 45,703-square-mile service territory that stretches north to south from Elko to Laughlin

NV Energy provides a wide range of energy services to more than 1.5 million customers throughout Nevada and a typical annual tourist population of 54 million.

NV Energy is well on its way to achieving our state's renewable portfolio standard of 50 percent by 2030.

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# About DLC: Facts and Figures

**>600,000**
Customers

**1,700+**
Employees

**$1.9 Billion**
Invested in infrastructure improvements 2023-2027

**5 Service Centers**
Edison, McKeesport, Penn Hills, Preble, Raccoon

**90% Residential**
Customer Base

**345 Substations**
Including company- and customer-owned

**>7,700 Miles**
Transmission, distribution and sub transmission lines maintained

**812 Square Miles**
Service territory in Allegheny and Beaver counties

**150+**
Vehicle charging station ports

# 1) Utility Overview and your DER Challenges and Opportunities *(continued)*

c) Does your state or utility connection requirements require smart inverters or controllable resources?

Are you doing anything to model and control them from a utility operations perspective?

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# 1) Utility Overview and your DER Challenges and Opportunities *(continued)*

d) Are you doing (or investigating) anything to improve your DER and grid data model management business process and quality improvement processes?

*(e.g. automated model updates from connection processes, AMI meter disaggregation/detection analytics, outage and AMI correlation analytics for transformer phase connections and customer-transformer QA/QC)*

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## 2) DER Growth in your area

a) What does your state/region/utility expect as far as Renewable Portfolio Standards (RPS)?

e.g. 100% by 2035

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## 2) DER Growth *(continued)*

b) What does your state/region/utility around EV adoption?

Do you have any plans for customer EV smart charging or V2G programs?

Is your utility involved with any with Municipal, School Bus, or commercial fleet EV Programs?

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## 2) DER Growth *(continued)*

c) How will utility-owned or customer-owned Energy Storage (Batteries, Thermal Energy, EV V2G, etc.) align into expected DER growth?

## 3) Microgrids

a) What is your experience, plans, or ideas for Microgrids? What needs to happen to make this a reality?

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## 4) Does your DER vision and strategy support Non-Wires Alternatives (NWA) and DER Market Operations?

e.g. DER controls and distribution optimization to support…

a) Day-ahead DER forecasting, scheduling and controls to support DER Market Requirements like FERC Order 2222.

Also, Mitigate DER-caused distribution constraints

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## 5) Integrated business processes across the utility

a) Are you finding DER management driving more interaction and convergence between traditionally siloed utility functions (e.g. Customer Service, Metering, Distribution Planning, Distribution Operations, Transmission, Power Supply, and Energy Market Management)?

   If so, in what ways? Are you doing anything to align these…

   Are you doing or planning anything to better integrate any of these cross-business functions to support the concept of an Enterprise DERMS? If so, what?

# Audience Questions

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# Thank you for you for joining us today!

"Preparing for and Deploying Enterprise DERMS"

*From Managing new DER connections to full Market Operations*

Utility University Course #203, Monday, February 26, 2024, 8:00am- noon

## Instructors and Utility Panelists

- **Brad Williams**, VP Industry Strategy & Innovation, Oracle Energy and Water
- **Travis Rouillard, Director R&D, Qualus**
- **Sameer Kalra**, Director OT Product Management, Oracle Energy and Water
- **Michael Brown**, Integrated Energy Services Director, NV Energy
- **Rich Barone**, DERMS Solutions Architect, Oracle Energy and Water
- **Alex Rosenblatt** , Sr. Operational Technology Engineer, Advanced Grid Solutions, Duquesne Light Company

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**EXHIBITION: FEBRUARY 27-29, 2024**
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