



ORACLE

Oracle Energy and Water
Customer Edge
Conference

Manage Your DER Lifecycle From Customer to Grid

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Paul Westwater, Oracle
March 13, 2013

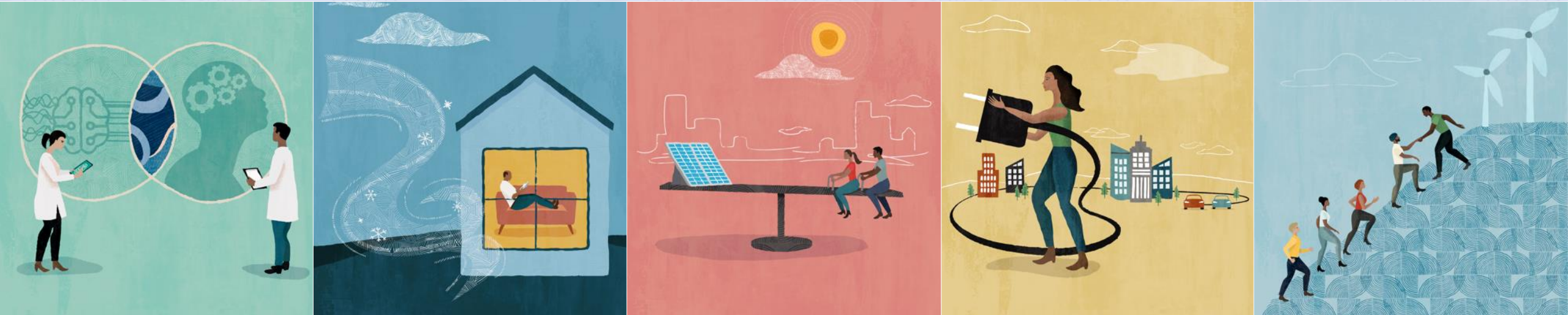


*Historically, we have forecast **demand** for power, planned/built infrastructure, and dispatched **supply**.*

In the future, those roles are reversing...



Influencing customer action toward decarbonization requires compelling engagement with effective DER programs



Engagement

Use AI and behavioral science to connect with customers digitally

Energy Efficiency

Reduce emissions faster with energy efficiency innovation

Demand Flexibility

Build system resiliency & avoid dirty peaks with demand flexibility

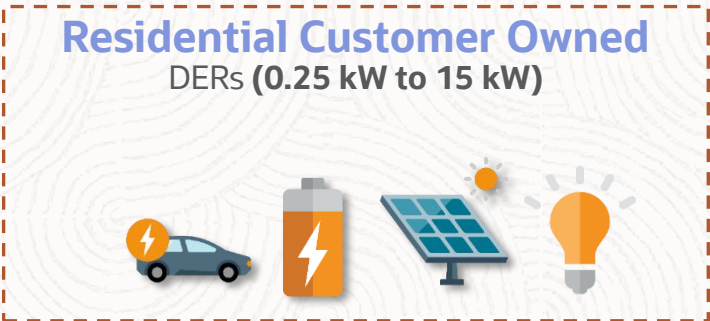
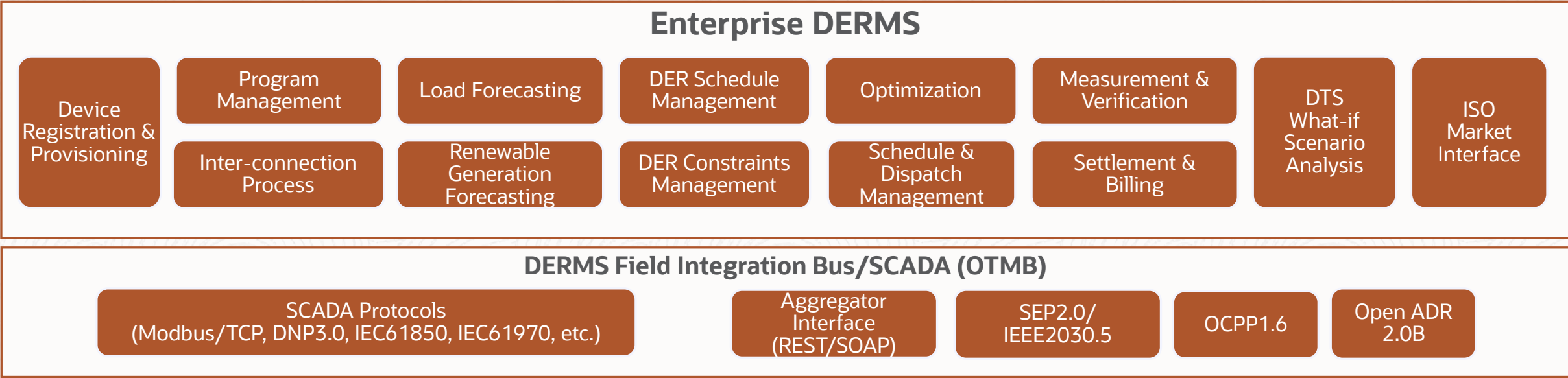
Electrification

Speed up the time to value of beneficial electrification

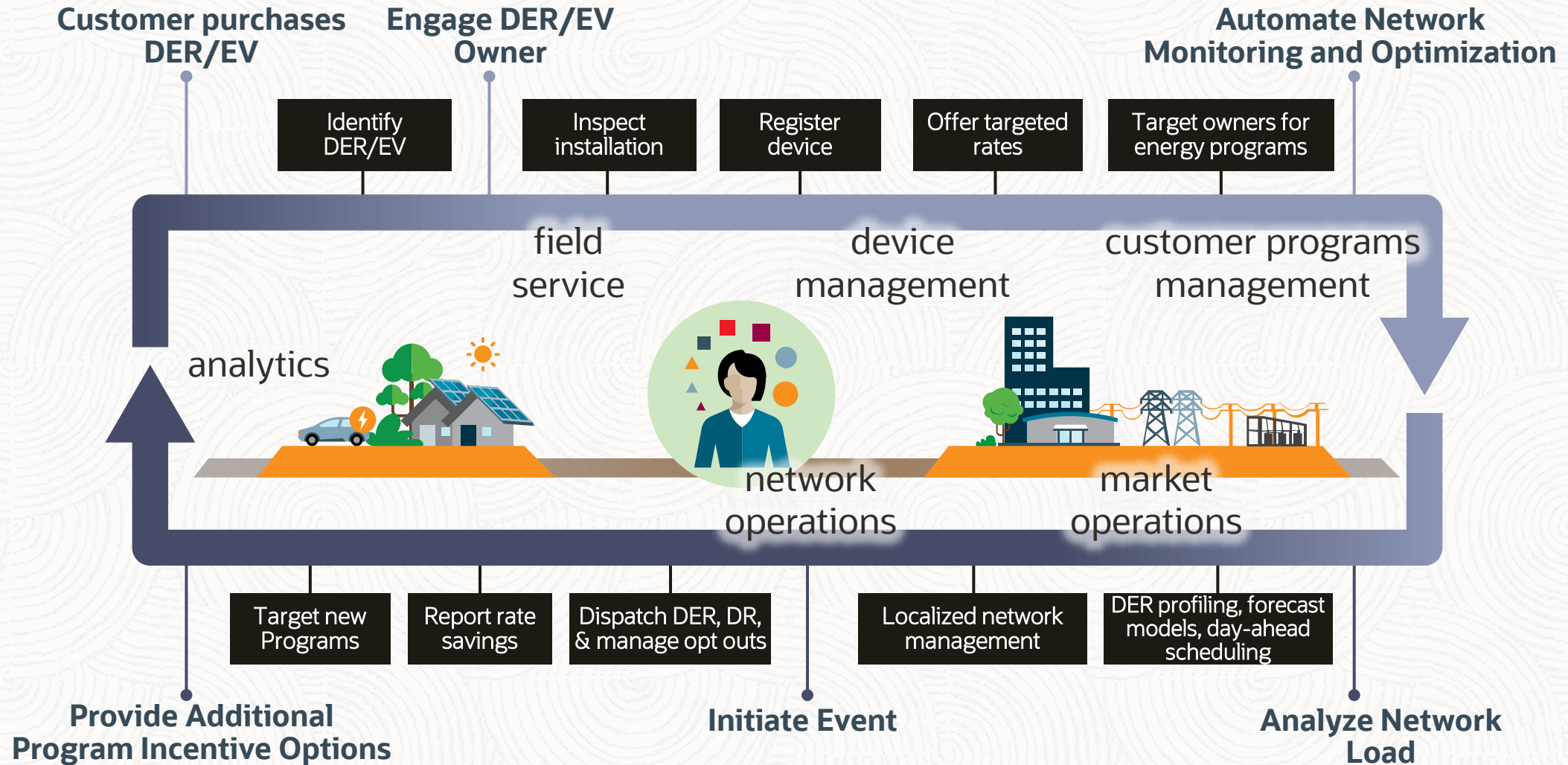
Equity & Affordability

Improve equity and energy affordability in the communities you serve

Enterprise DERMS core functions



Customer to Network



Oracle Utilities DERMS

Distributed energy resource management for the enterprise

DER MONITORING & CONTROL

SCADA, IoT and aggregator/VPP

Direct control and dynamic operating envelopes

OPTIMIZATION

Cost-based optimization based on applicability to network constraints, program rules of engagement, cost of energy, opportunity costs, etc.



FORECASTING

Weather-adjusted disaggregated load and DER/DR profiles

MARKET CLEARING

Day-ahead clearing of distribution-connected DER participating in wholesale market(s)

Real-time adjustments as conditions change

Oracle DERMS operations

- **DER digital twin model**

fully DER-aware network operations model with situational awareness and visualization

- **Identification of network constraints**

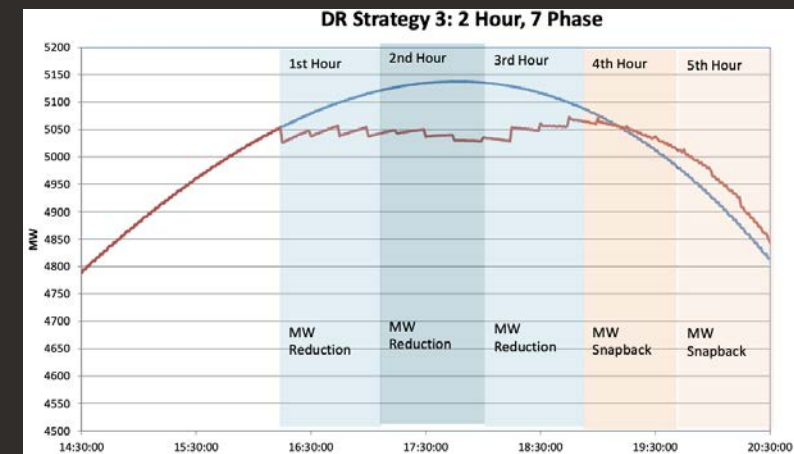
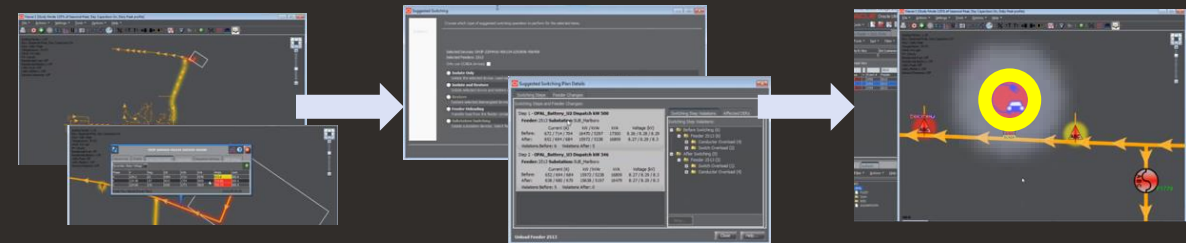
and automatically determine most optimal action(s)

- **Day-ahead DER scheduling**

Optimization Engine pre-constructs day-ahead DER load-shaping plans to optimize peak reduction while obeying dispatch constraints and snapback behavior, including VPP market bids

- **Real-time adjustments**

periodic DER re-optimization throughout the day



NMS Operational DERMS

- Model individual and aggregated DER
- Forecast load and generation
- Automated control of DER
- Economic optimization of DER

DERMS Dashboard

File

Actions

Help

System Summary

WIND (MW/MW)

PV (MW/MW)

FUEL (MW/MW)

BATTERY (MW/MW)

DR (MW/MW)

SVC (MW/MW)

TOTAL GENERATION (MW/MW)

GENERATION CAPACITY (MW)

TOTAL LOAD (MW/MW)

0.3 / 0.3

1.1 / 1.0

16.3 / 0.3

12.3 / 0.0

0.0 / 0.0

0.0 / 0.0

30.1 / 2.4

74.3

16.2 / 23.6

Weather Zone Summary

WEATHER ZONE

WIND (MW/MW)

PV (MW/MW)

FUEL (MW/MW)

BATTERY (MW/MW)

DR (MW/MW)

SVC (MW/MW)

TOTAL GENERATION (MW/MW)

GENERATION CAPACITY (MW)

Alliance

75 / -36

3054 / 0

N/A

N/A

N/A

N/A

3089 / -36

13000

Carlisle

87 / -21

N/A

N/A

N/A

N/A

N/A

2620 / 1770

11000

Chicago Innovation Center

25 / -12

204 / 0

N/A

0.0 / 0.0

N/A

N/A

229 / -12

1700

Lake

90 / -43

4200 / 0

12060.0 / -4072.0

12060.0 / 0.0

0 / 0

0 / 0

24010 / -4115

40200

Navalton

N/A

N/A

N/A

N/A

N/A

N/A

N/A

675

Utility DER Summary

RESOURCE NAME

SUBSTATION

FEEDER

POWER SOURCE

PLANNABLE

CAPACITY (KW)

OUTPUT (KW/MW)

AVAILABILITY PRICE (\$/MW)

UTILIZATION PRICE (\$/M)

SOLUTION TIME

NCA STATUS

GPAL_DR_L4

Marble Sub

2512

Utility Battery

N

3000

3000 / 0

80.0

80.0

05/26/22 10:47

Desired

GPAL_DR_L2

Marble Sub

2512

Utility Battery

N

3000

3000 / 0

80.0

80.0

05/26/22 10:47

Desired

GPAL_DR_L3

Marble Sub

2512

Utility Battery

N

3000

3000 / 0

80.0

70.0

05/26/22 10:47

Desired

GPAL_DR_L1

Marble Sub

2512

Utility Battery

N

3000

2800 / 0

80.0

90.0

05/26/22 10:47

Completed

4115_Battery_U2

Washington S.

4115

Utility Battery

N

1000

0 / 0

75.0

200.0

05/26/22 10:47

N/A

4115_Battery_U1

Washington S.

4115

Utility Battery

N

1000

0 / 0

75.0

250.0

05/26/22 10:47

N/A

GPAL_Battery_US

Marble Sub

2521

Utility Battery

N

500

0 / 0

75.0

240.0

05/26/22 10:47

N/A

GPAL_Battery_U2

Marble Sub

2513

Utility Battery

N

500

0 / 0

75.0

230.0

05/26/22 10:47

N/A

GPAL_Battery_U1

Lake Sub

3452

Utility Fuel

10000

1000

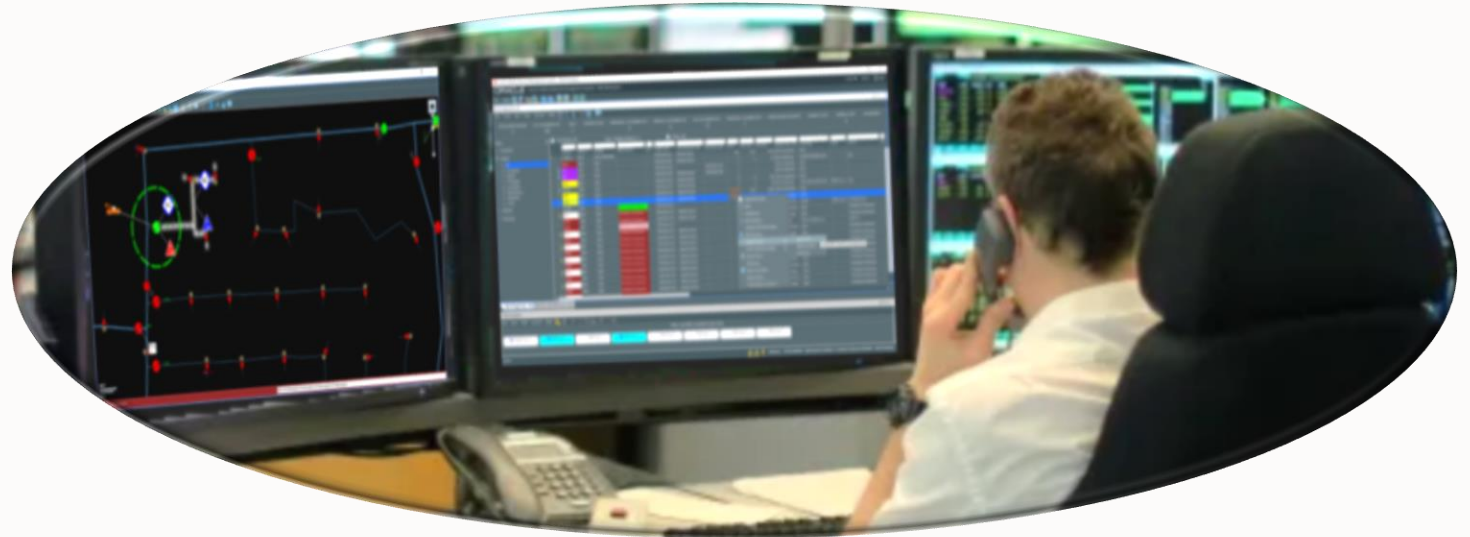
0 / 0

75.0

115.0

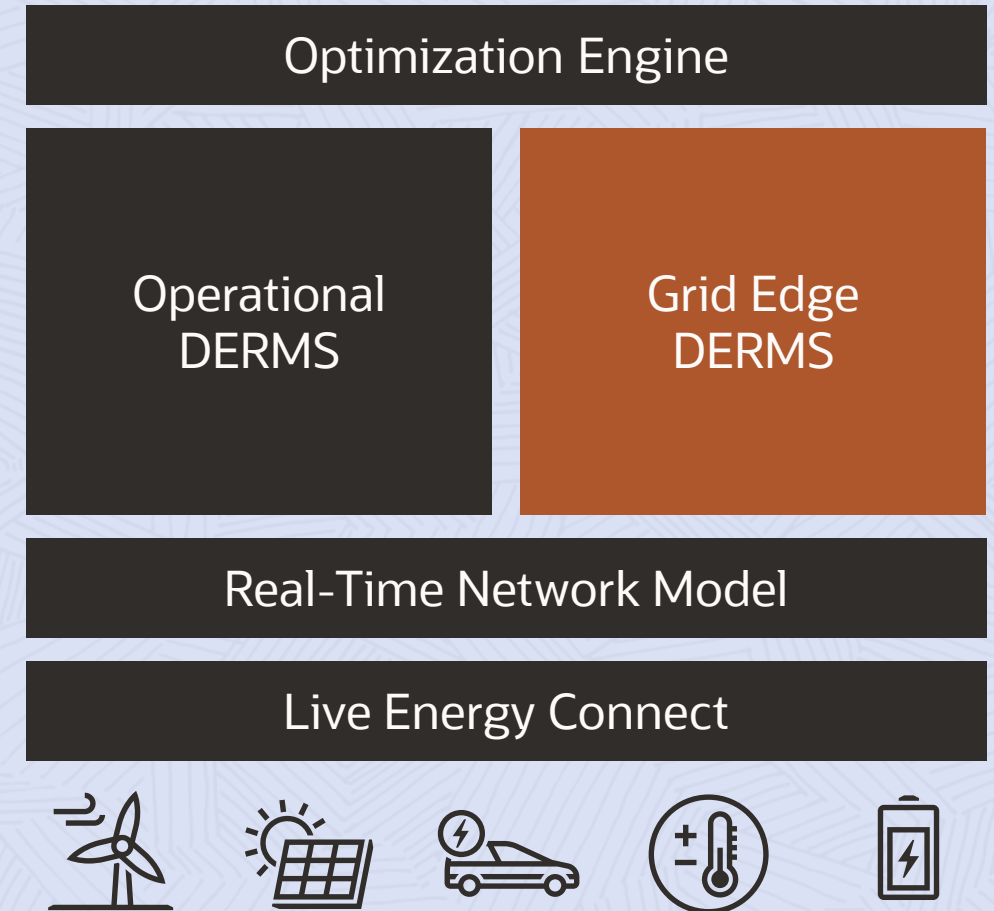
05/26/22 10:47

N/A



NMS Grid Edge DERMS

- **Manages individual connected devices**
- **State models using device data from DACS**
- **Operating envelopes calculated by NMS**
- **New: capacity events (demand response)**
 - Create and schedule day-ahead demand response events
 - Optimized based on DACS control scores
 - Emergency events
 - Real-time event management
- **Up Next: DER market services and VPP**
 - Real power, reactive power, frequency response, flexibility, spinning reserve, etc.
 - Fully cost-optimized



DERMS optimization engine

High-performance mixed-integer linear programming (MILP) solver



Optimal power flow constraint-based cost optimization

- Improved reliability
- More efficient use of capital/O&M
- Improved environmental performance
- Higher customer satisfaction
- Flexible time horizon (hour-ahead, day-ahead, week-ahead, etc. for forecast weather-based and load and DER output)
- Planned outage / maintenance -aware

Optimization objective – relieve grid/supply constraints

- Optimization Engine generates lowest cost plans to relieve violations
- Multiple DER locations on feeder
- Network conditions cause loading constraints
- Options can include:
 - Switching to reconfigure network
 - Schedule / Dispatch DER
 - VVO actions
- Executes commands to field to dispatch DER or switching

Automated and/or manual optimization:

- VVO
- FLISR
- Feeder Load Management (FLM)
- Load shedding
- Multi-tiered transfers
- DER Scheduling & Dispatch
- Active Network Management
- Optimization Triggered by network topology change or configured intervals

DER Device Management

Full DER operations and forecasting model with situational awareness state estimation

DER Asset Register with Device Level Attributes

DER Programs Management

Core DER integrated solutions

DER Network operations

DER Market Portal CS

DER Analytics Insights

Field Service Cloud



Physical attributes

E.g., make and model, location, size, orientation, chemistry, communications capability and protocol



Electrical attributes

E.g., I/V/P/Q, stored energy level, efficiency, ramp rate, time to live, inverter capabilities, normal and emergency limits



Contractual/behavioral attributes

Enrolled program(s), activation cost, standby cost, event lead time, rules of engagement (duration, frequency, number of opt outs allowed), expected participation probability based on past performance



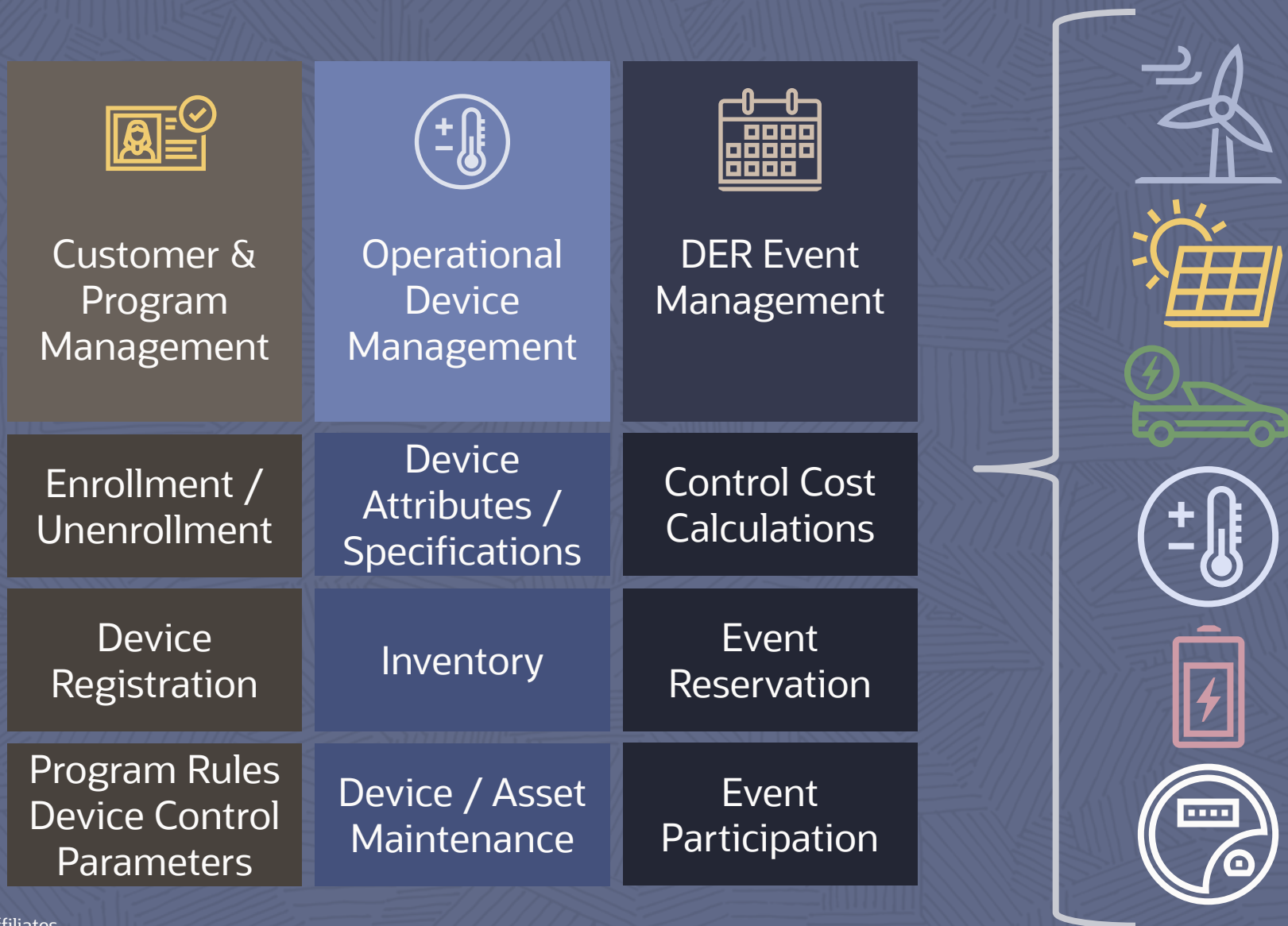
DER cost calculations

Calculate Opportunity Costs for DER Scheduling Optimizer based on Market Locational Marginal Cost, Program Rules, Past Performance and Probability of Future Participation

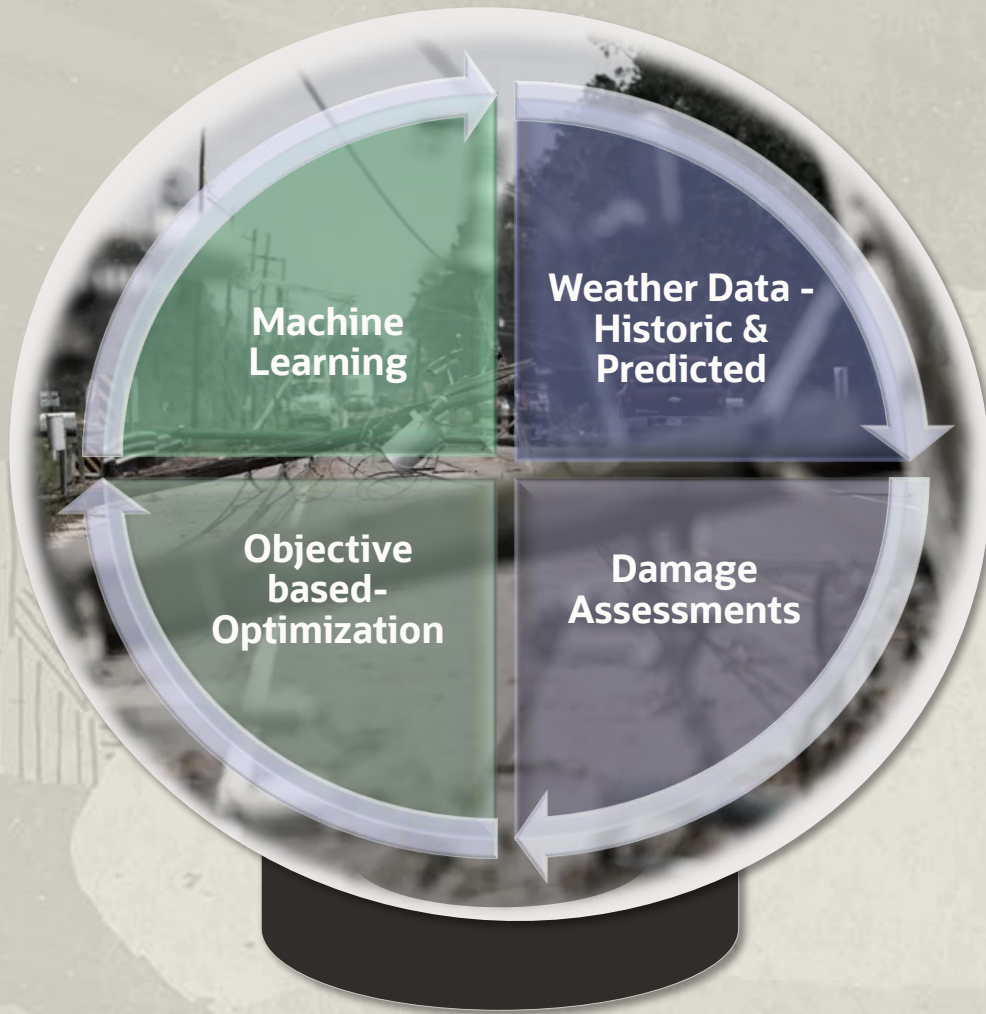


DER Device Management

Device attributes required for DERMS programs, operations, scheduling, and VPP



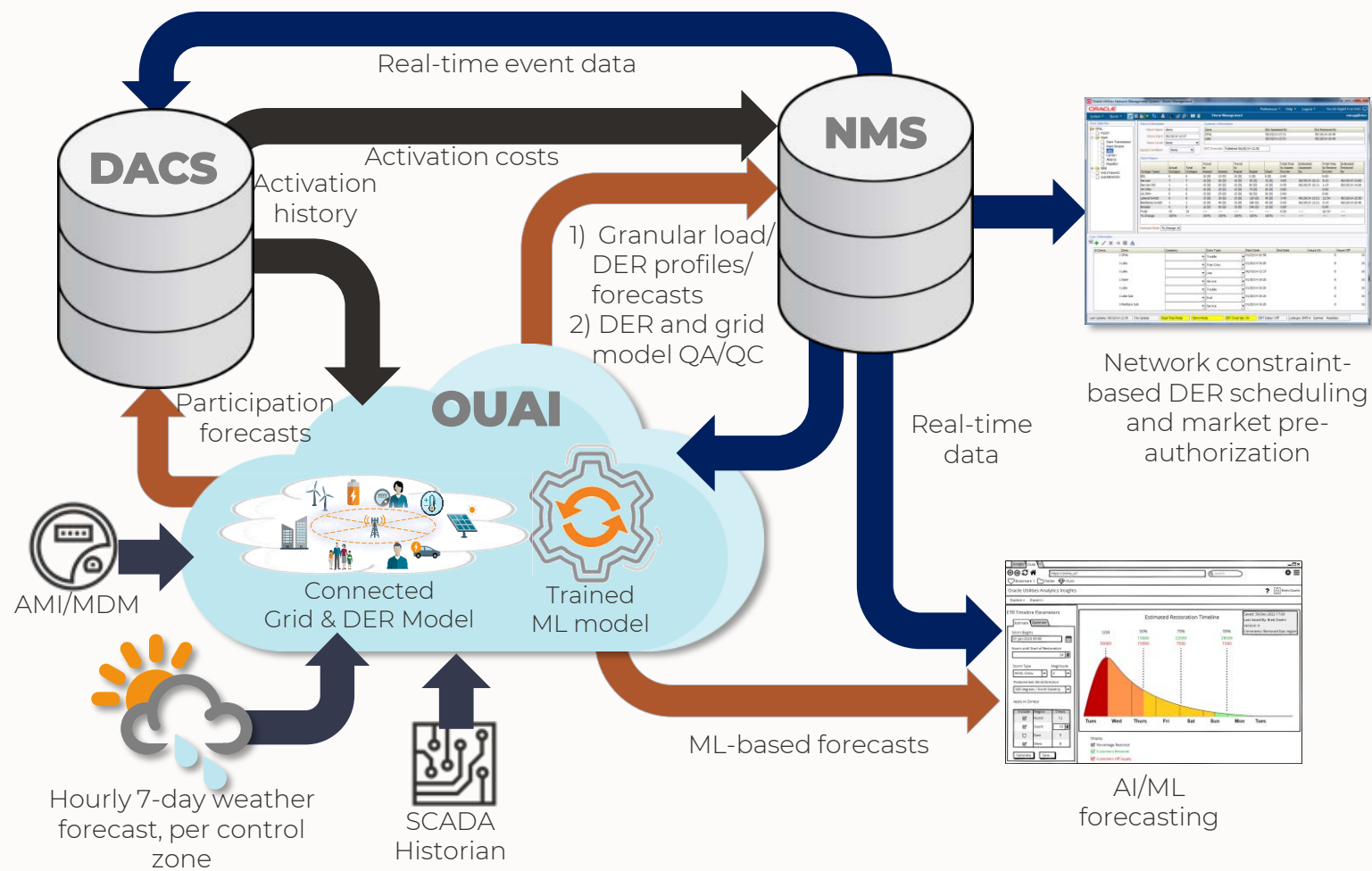
Analytics Insights: improved DER forecasting and optimization



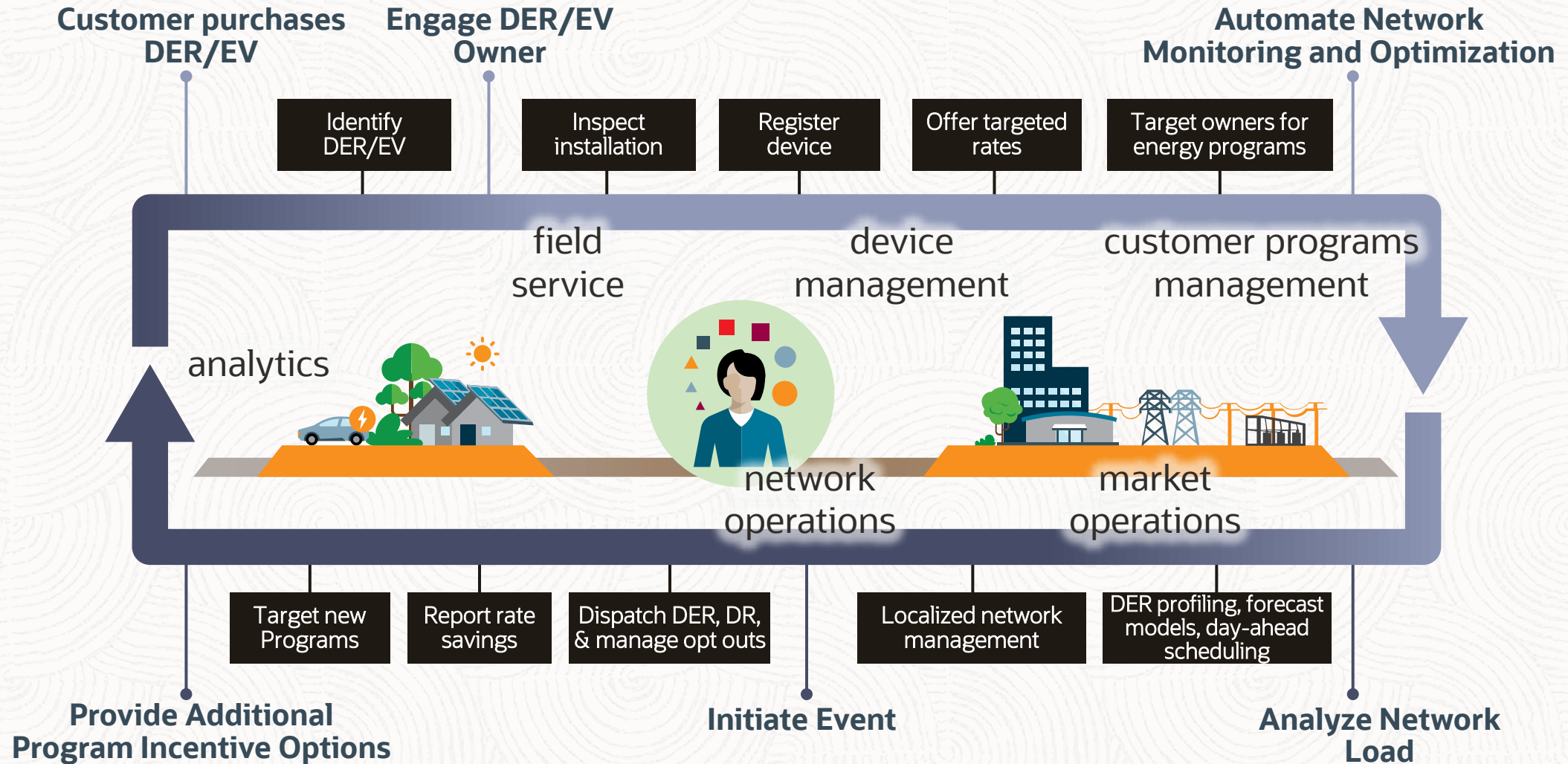
5 Key DERMS Analytics Insights Opportunities

1. Phase connections (service transformers, tap lines, main lines) validation QA/QC and continuous improvement
2. Customer-to-transformer connections validation QA/QC and continuous improvement
3. Load, DER, and controllable/flexible resource disaggregation
4. Disaggregated load and DER weather adjusted forecasts to update NMS for day-ahead (*or longer periods*) powerflow analysis that will adjust in real-time with current weather and real-time SCADA feeds.
5. Estimated Repair Time
6. Network Equipment Failure and Impact Analytics for Resiliency Investment Priority

Bringing it all together: end-to-end DER optimization



Customer to Network



Network to Customer

DER Device Management

Customer Owned

How do we know where the DER is located?



Analytics

- Detect where DER is located
 - PV
 - EV
 - Battery

Where can we detect from?

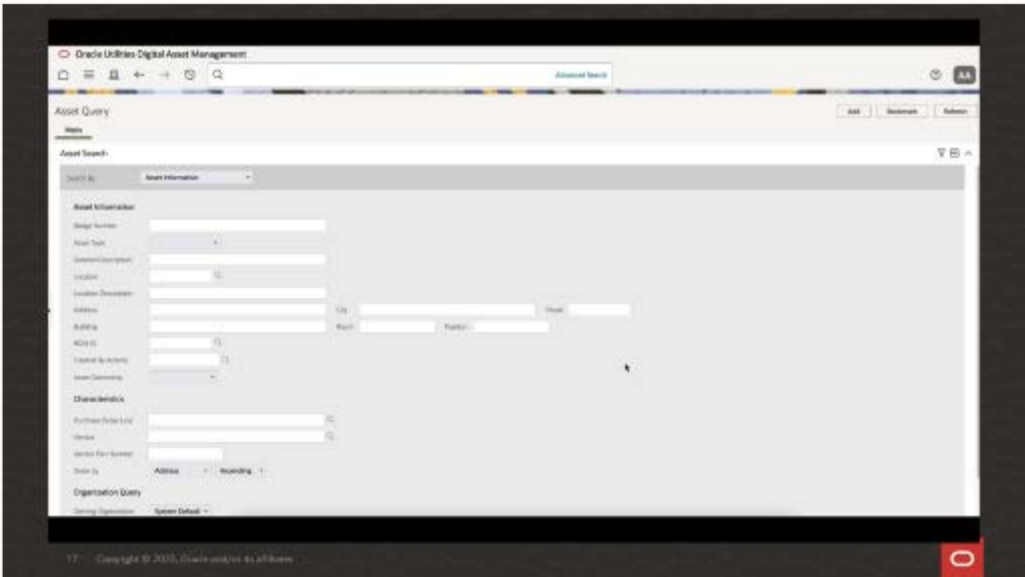
- Feeder Head
- Transformer



Utility Owned

How do we manage the installation?

- Customer sign-Up
- Utility installed



Asset Query

Add

Bookmark

Refresh

Main

Asset Search



Search By Asset Information

Asset Information

Badge Number	<input type="text"/>		
Asset Type	▼		
Detailed Description	<input type="text"/>		
Location	<input type="text"/>		
Location Description	<input type="text"/>		
Address	<input type="text"/>	City	<input type="text"/>
Building	<input type="text"/>	Room	<input type="text"/>
BOM ID	<input type="text"/>	Position	<input type="text"/>
Created By Activity	<input type="text"/>		
Asset Ownership	▼		

Characteristics

Purchase Order Line	<input type="text"/>	
Vendor	<input type="text"/>	
Vendor Part Number	<input type="text"/>	
Order by	Address ▼	Ascending ▼

Organization Query

Owning Organization	System Default ▼
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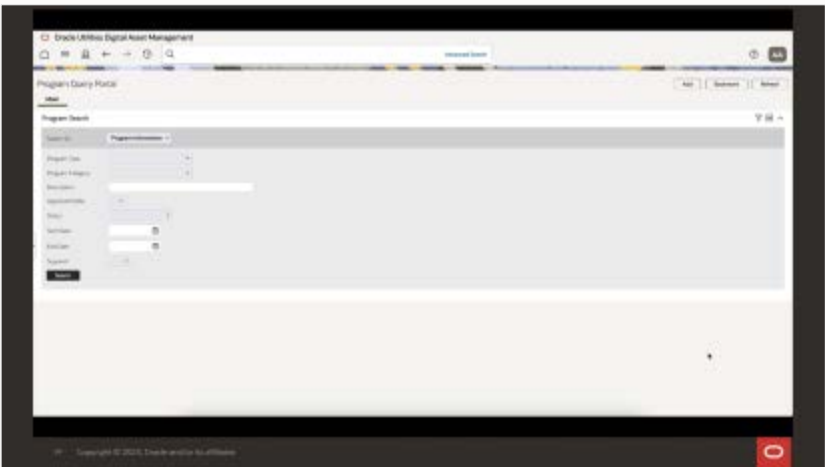
Device registration and cost calculation in DACS

Program Management and Participation

How do I define and manage my programs?



Define programs for different categories, eligibility rules and qualification questions

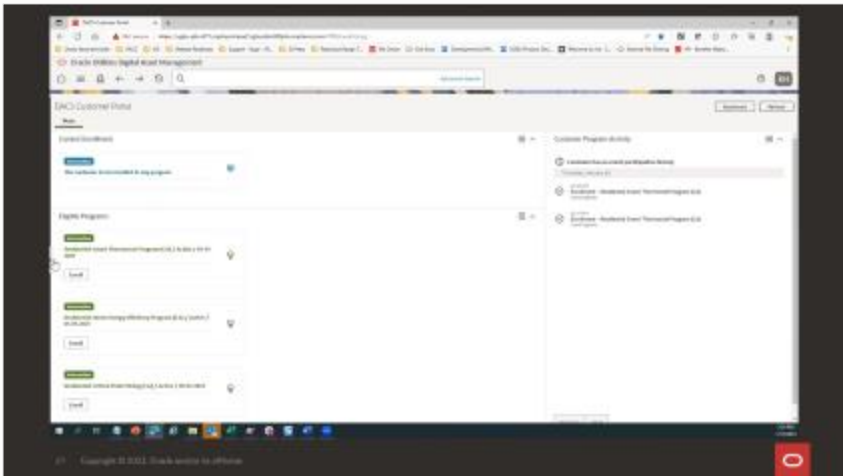


Enrolment

How do customers sign up for programs?



Simple workflow with the programs available to the user, device information capture and eligibility checking



Program Query Portal

Add

Bookmark

Refresh

Main

Program Search



Search By Program Information

Program Type

Program Category

Description

Approval Profile

Status

Start Date

End Date

Suspend

Search

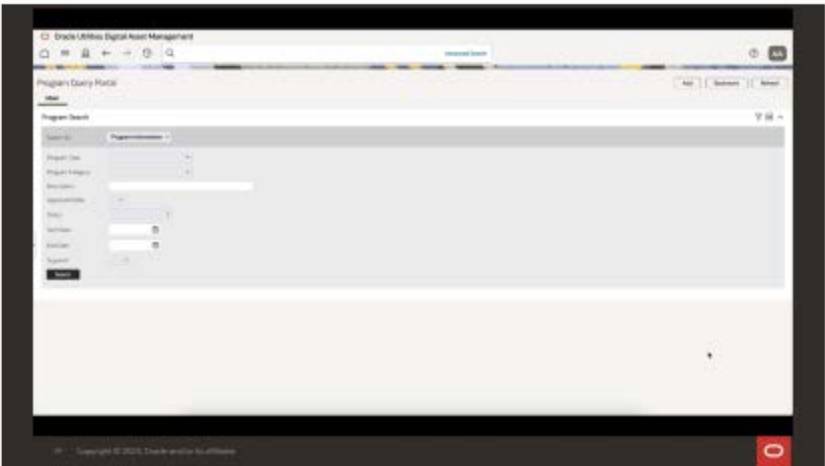
Device registration and cost calculation in DACS

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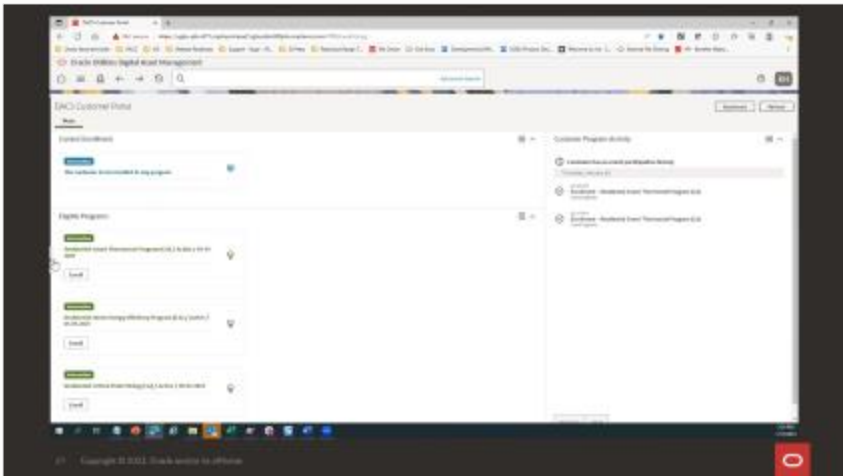


Enrolment

How do customers sign up for programs?



Simple workflow with the programs available to the user, device information capture and eligibility checking



Oracle Utilities Digital Asset Management

DACS Customer Portal

Main

Current Enrollment

Information

The customer is not enrolled in any program

Eligible Programs

Information

Residential Smart Thermostat Program (CA) / Active / 01-01-2021

Enroll

Information

Residential Home Energy Efficiency Program (CA) / Active / 01-01-2021

Enroll

Information

Residential Critical Peak Pricing (CA) / Active / 01-01-2021

Enroll

Customer Program Activity

Customer has no event participation history

Thursday, January 26

02:18 PM
Enrollment - Residential Smart Thermostat Program (CA)
Check Eligibility

02:17 PM
Enrollment - Residential Smart Thermostat Program (CA)
Check Eligibility

Previous Next

3:24 PM
1/31/2023



Forecasting for Demand Reduction

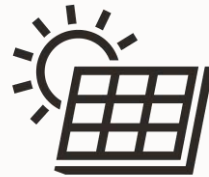
It's going to be a hot day, how much load can I drop?

Providing an algorithmic approach to identifying how much load I can save per device



- Use historical data

- Use inputs such as weather and propensity to participate



- Daily look-ahead values providing the amount of load that can be expected to be dropped



Event dispatching in NMS

So I need to call an event, how do manage it?

Strategies and Events

- Define strategies that will cover different type of scenarios such as economic or emergency situations
- Strategies can define:
 - Types of customer such as commercial or residential
 - The area of the network that will be affected
 - Different stages for the strategy
- Events will define
 - An instance of a strategy on a particular day
 - Visualise the expected load after reduction applied
- Events will go through a workflow to be approved before being activated
- When approved, requests are sent to the aggregators to implement the reduction at the defined time

[illegible]

DERMS Strategies and Events

File Actions + ✎ 🗑️ ↺

Active Showing: 17 of 55

<div><div></div></div> ID ↑	Class	Name	Type	State	Description	Zone	# Times Executed	Date Last Executed
<div><div></div></div> 1001	Strategy	MT- EM	Emergency	New	MT Emergency Strategy	Stark		
<div><div></div></div> 1006	Strategy	RT ECON	Economic	New	RT Strategy	Stark		
<div><div></div></div> 1010	Strategy	MT ECO ST 27	Economic	New	MT Eco Stage 27	Stark		
<div><div></div></div> 1012	Strategy	RT-ECON-27	Economic	New		Stark		
<div><div></div></div> 1015	Strategy	RT-STRATEGY-28	Economic	New		Stark		
<div><div></div></div> 1017	Strategy	RT-TEST01	Economic	New		Stark		
<div><div></div></div> 1021	Strategy	RT Test Ack	Economic	New		Stark		
<div><div></div></div> 1040	Strategy	RT-S1	Economic	New		Stark		
<div><div></div></div> 1060	Strategy	d	Emergency	New		Stark		
<div><div></div></div> 1121	Event	DEMO-22	Economic	Scheduled	DEMO DATA	Stark		
<div><div></div></div> 1140	Strategy	JC Strategy 1	Economic	New	Testing Adapter	Stark		
<div><div></div></div> 1160	Event	JC Strategy 1	Economic	Scheduled	Testing Adapter	Stark		
<div><div></div></div> 1180	Strategy	RT	Economic	New	RT Remote	Stark		
<div><div></div></div> 1181	Event	RT	Economic	Scheduled	RT Remote	Stark		
<div><div></div></div> 1220	Strategy	Lake Residential Strategy	Economic	New	Lake and Marlboro Subs Reduction Strategy (12-4pm)	Lake	1	21/02/23, 10:48
<div><div></div></div> 1260	Strategy	RT-STRATEGY-23	Economic	New		Stark		
<div><div></div></div> 1263	Strategy	IDW_TestEventOutcomeLake...	Economic	New	Lake 2412	2412		

Measurement and verification in analytics

Providing an algorithmic approach to identifying how much load was saved per device

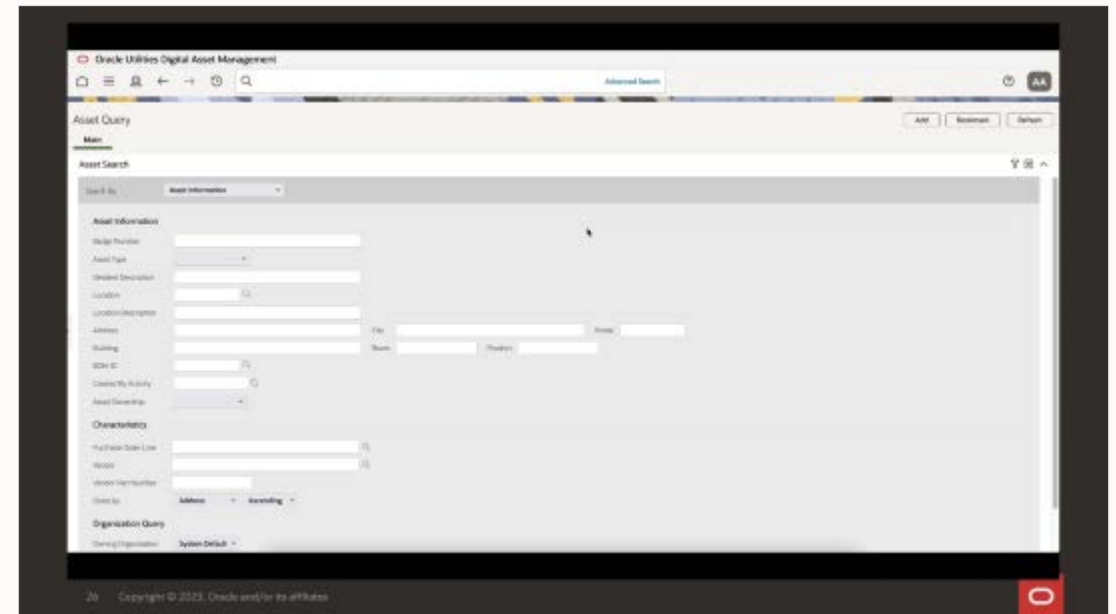


- Compare forecasted vs actual load values

- Define the calculations to apply the cost per customer



- Apply the credit back to the customer account



Asset Query

Add

Bookmark

Refresh

Main

Asset Search

Search By

Asset Information

Asset Information

Badge Number

Asset Type

Detailed Description

Location

Location Description

Address

City

Postal

Building

Room

Position

BOM ID

Created By Activity

Asset Ownership

Characteristics

Purchase Order Line

Vendor

Vendor Part Number

Order by

Address

Ascending

Organization Query

Owning Organization

System Default

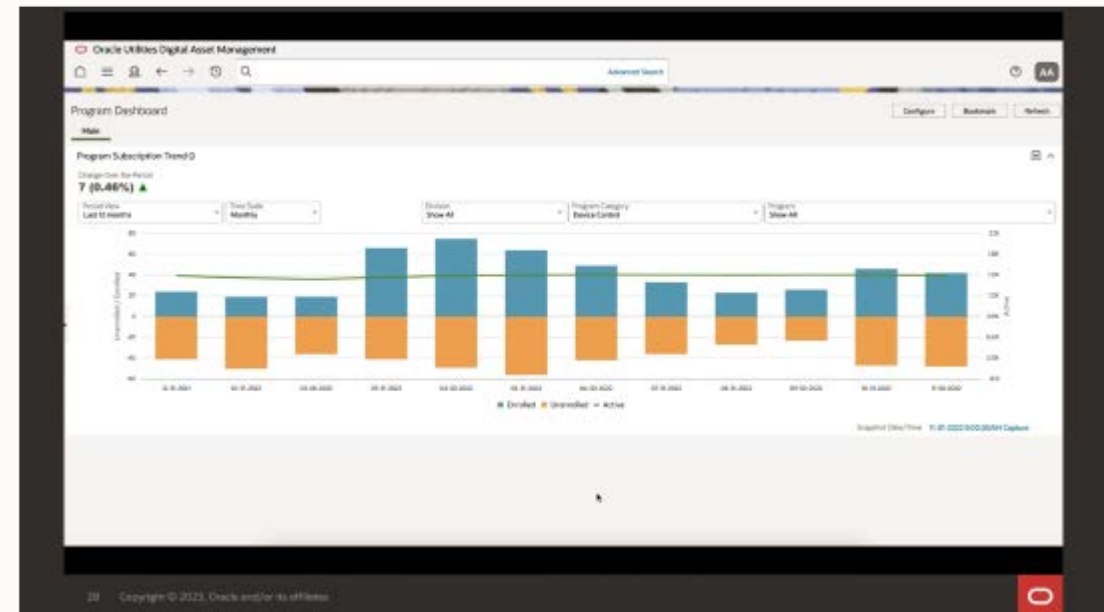
Program history in DACS

Program Overview

How well is my program doing?

Provide an overview of the program with

- Numbers entering and leaving the program over a selected period
- Number of active members in the program
- Drill down into details through filtering



Program Dashboard

Configure

Bookmark

Refresh

Main

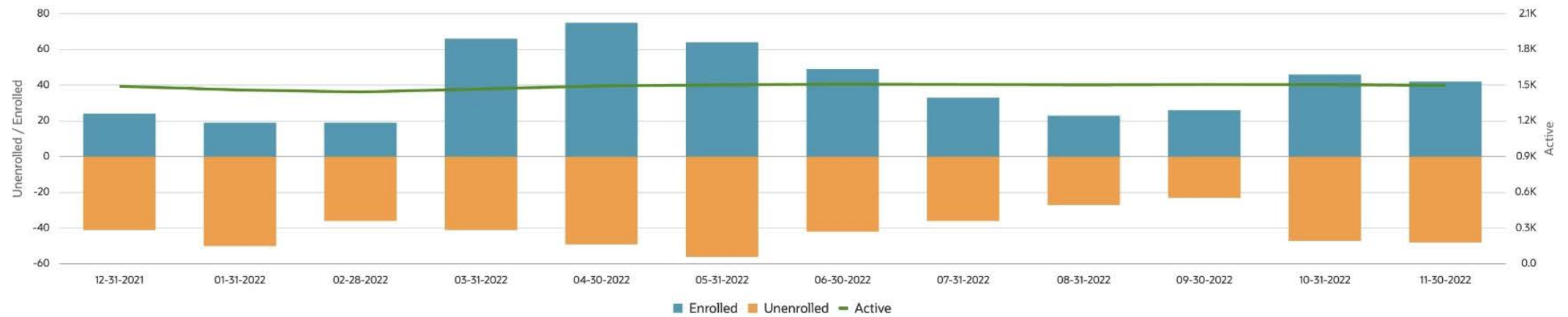
Program Subscription Trend



Change Over the Period

7 (0.46%) ▲

Period View: Last 12 months |
 Time Scale: Monthly |
 Division: Show All |
 Program Category: Device Control |
 Program: Show All



Snapshot Date/Time: 11-01-2022 8:00:00AM Capture

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