



Oracle Energy and Water  
Customer Edge  
Conference

# *Manage Your DER Lifecycle From Customer to Grid*

---

**Tom Eyford, Oracle**

**Paul Westwater, Oracle**

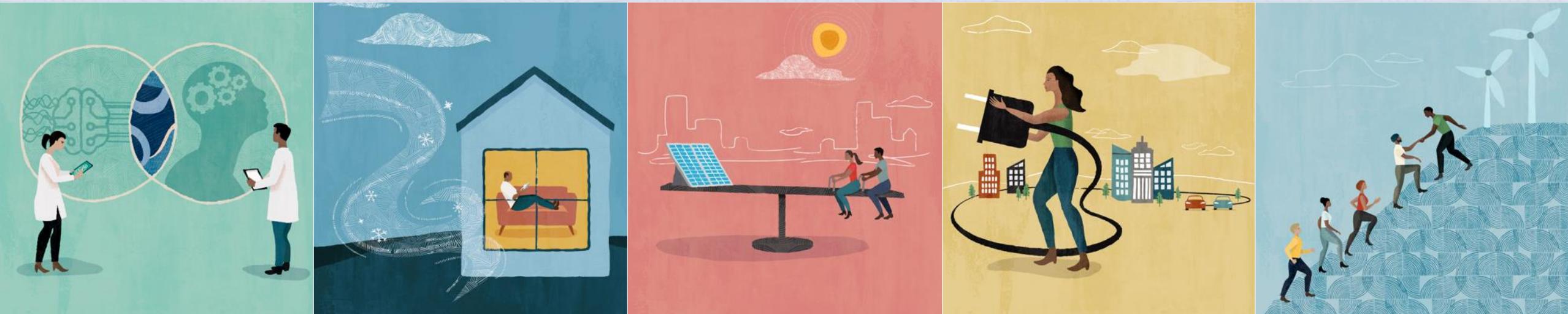
March 13, 2013

*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

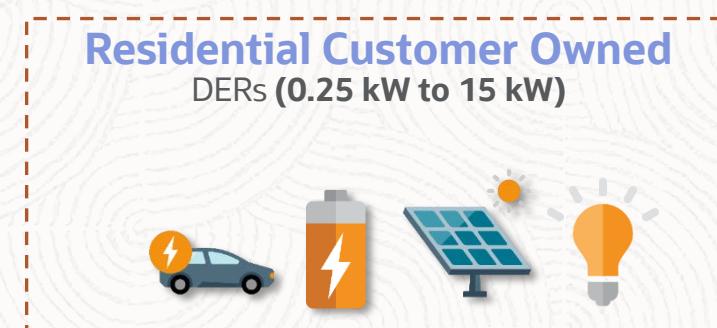
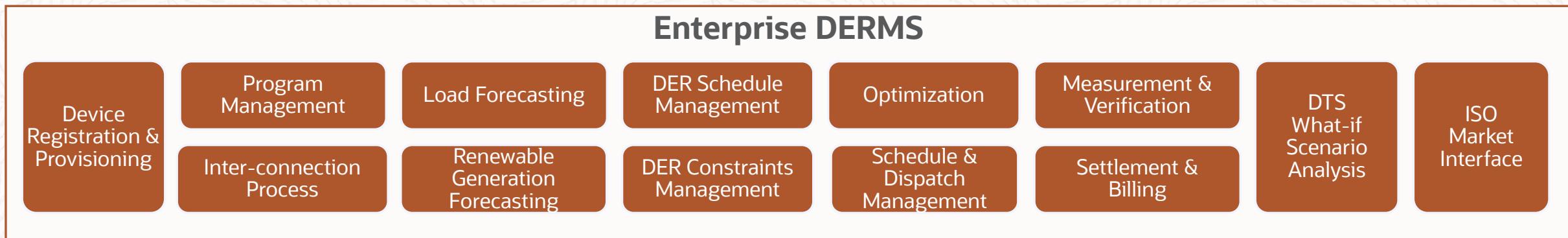
## Electrification

Speed up the time to value of beneficial electrification

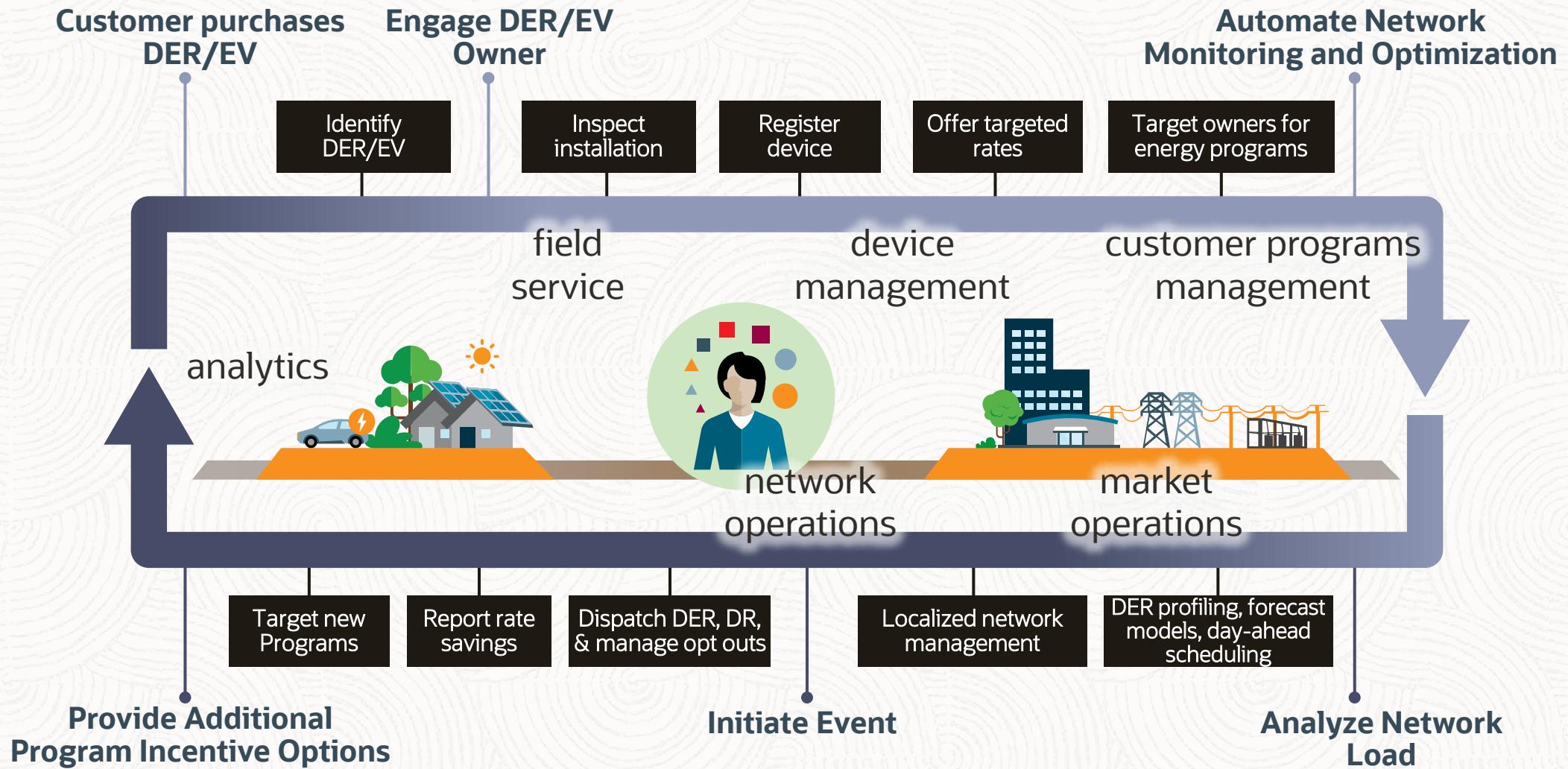
## Equity & Affordability

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

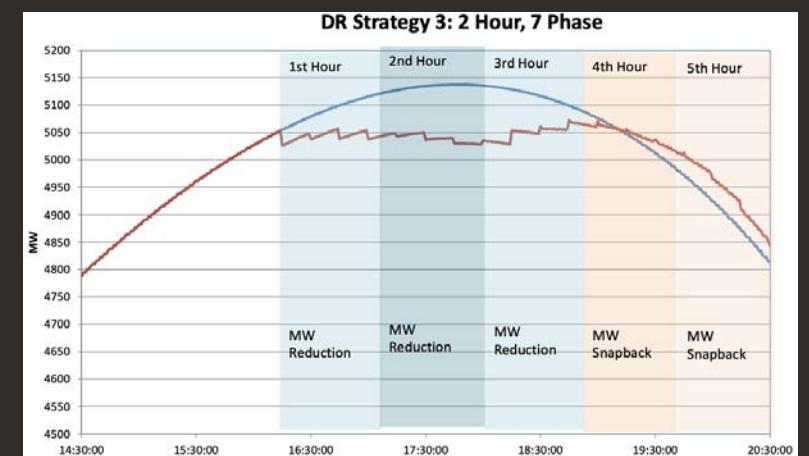
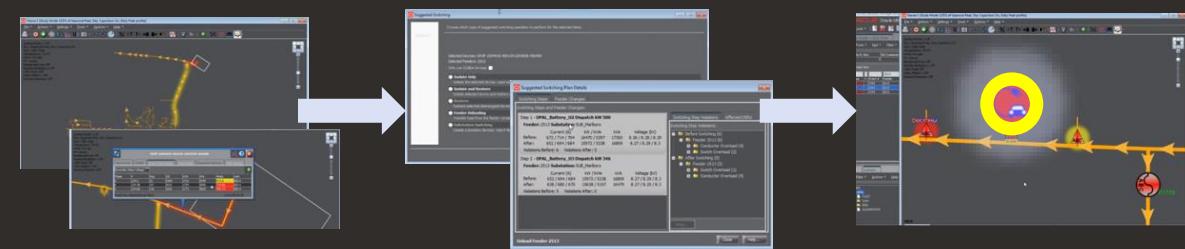
## MARKET CLEARING

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

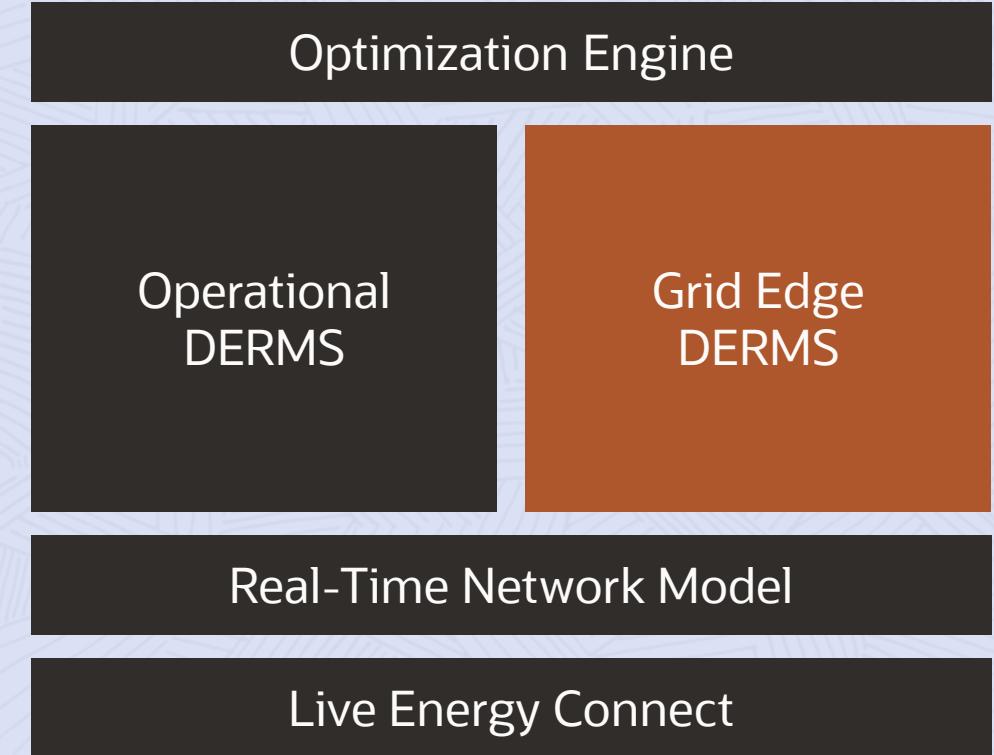
- Model individual and aggregated DER
- Forecast load and generation
- Automated control of DER
- Economic optimization of DER

DERMS Dashboard										
DERMS Summary		Weather Zone Forecasts		Utility DER Forecasts						
System Summary		Weather Zone Summary								
WIND (MW/MVAR)	PV (MW/MVAR)	FUEL (MW/MVAR)	BATTERY (MW/MVAR)	DR (MW/MVAR)	SVC (MW/MVAR)	TOTAL GENERATION (MW/MVAR)	GENERATION CAPACITY (MVA)	TOTAL LOAD (MW/MVAR)		
6.3 / 0.1	7.4 / 0.0	16.3 / 2.3	121.8 / 0	0.0 / 0.0	0.0 / 0.0	36.1 / 2.4	74.5	56.2 / 22.6		
Weather Zone Summary										
WEATHER ZONE	WIND (KW/KVAR)	PV (KW/KVAR)	FUEL (KW/KVAR)	BATTERY (KW/KVAR)	DR (KW/KVAR)	SVC (KW/KVAR)	TOTAL GENERATION (KW/KVAR)	GENERATION CAPACITY (KVA)		
Alliance	75 / -36	3044 / 0	N/A	N/A	N/A	N/A	3089 / -36	13000		
Carlton	65 / -31	N/A	N/A	N/A	N/A	N/A	3610 / 1770	13200		
Chicago Innovation Center	25 / -12	198 / 0	N/A	0.0 / 0.0	N/A	N/A	239 / -12	1763		
Lake	90 / -43	4220 / 0	12560.0 / -4072.0	12056.0 / 0.0	0 / 0	0 / 0	2803 / -4115	46265		
Marshall	N/A	N/A	N/A	N/A	N/A	N/A	N/A	675		
Utility DER Summary										
RESOURCE NAME	SUBSTATION	FEEDER	POWER SOURCE	SLANGABLE	CAPACITY (KVA)	OUTPUT (KVA)	AVAILABILITY PRICE (\$/MWh)	UTILIZATION PRICE (\$MWh)	DISPATCH TIME	ICA STATUS
OPAL_DR_U4	Marlboro Sub	252	Utility Battery	N	3000	3016 / 0	10.0	10.0	05/26/22 10:47	Denied
OPAL_DR_U2	Marlboro Sub	252	Utility Battery	N	3000	3011 / 0	10.0	10.0	05/26/22 10:47	Denied
OPAL_DR_U3	Marlboro Sub	252	Utility Battery	N	3000	3000 / 0	10.0	70.0	05/26/22 10:47	Denied
OPAL_DR_U1	Marlboro Sub	252	Utility Battery	N	3000	2962 / 0	10.0	50.0	05/26/22 10:47	Denied
4115_Battery_U2	Washington S.	4115	Utility Battery	N	1000	0 / 0	75.0	210.0	05/26/22 10:47	Curtailable
4113_Battery_U1	Washington S.	4113	Utility Battery	N	1000	0 / 0	75.0	250.0	05/26/22 10:47	N/A
OPAL_Battery_U5	Marlboro Sub	253	Utility Battery	N	500	0 / 0	75.0	245.0	05/26/22 10:47	N/A
OPAL_Battery_U2	Marlboro Sub	253	Utility Battery	N	500	0 / 0	75.0	230.0	05/26/22 10:47	N/A
OPAL_Diesel_U1	Lake Sub	2422	Utility Fuel	Y	1500	0 / 0	75.0	157.5	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 Programs Management

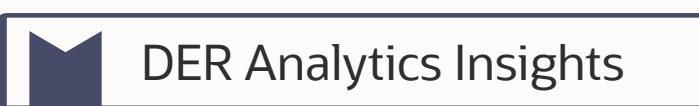
## Core DER integrated solutions



DER Network operations



DER Market Portal CS



DER Analytics Insights



Field Service Cloud

## DER Asset Register with Device Level Attributes



### 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



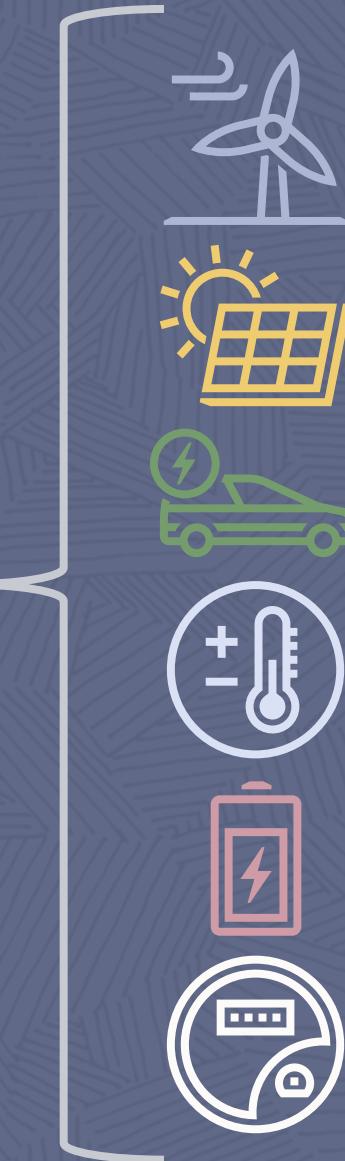
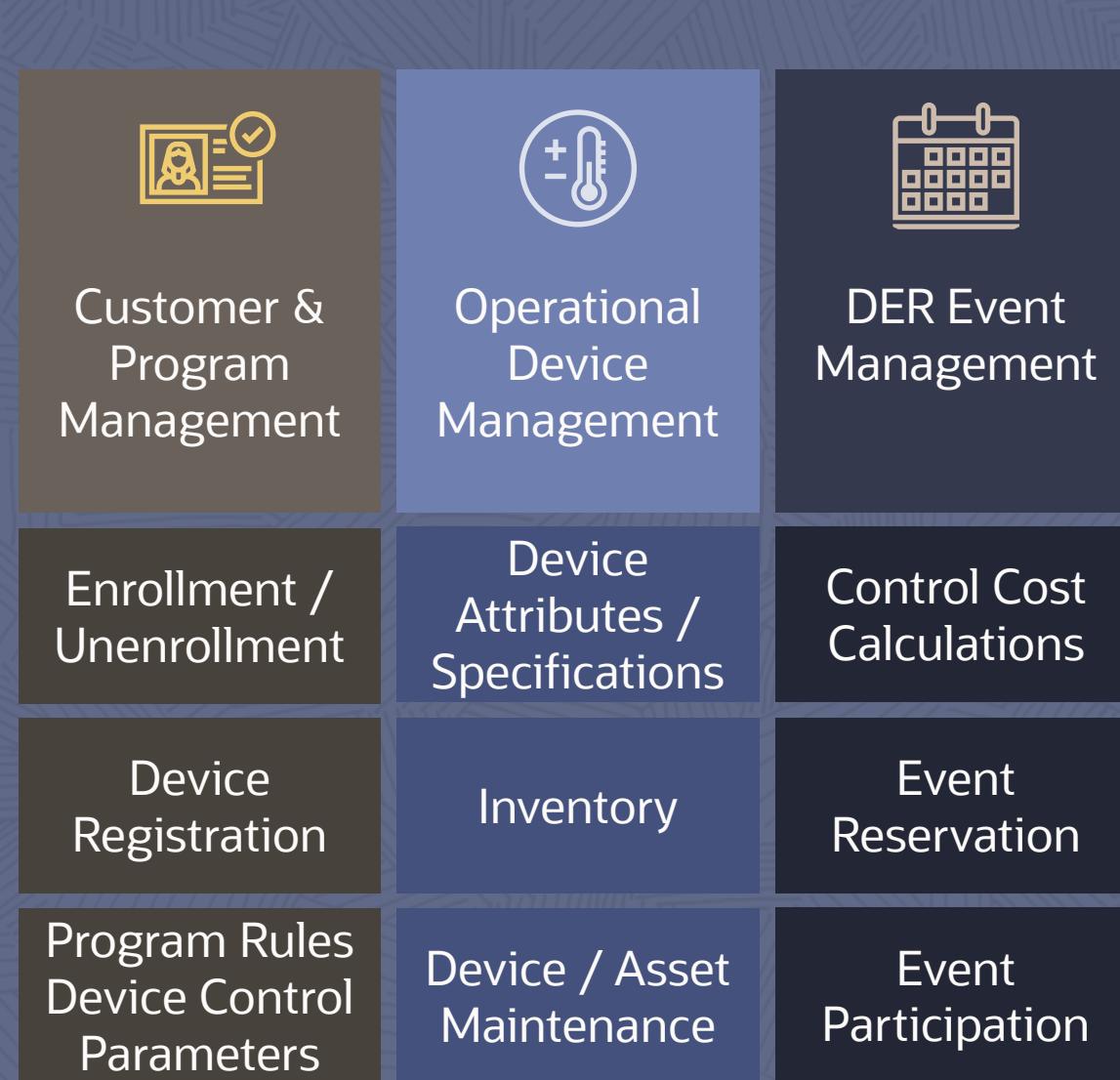
### DER cost calculations

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

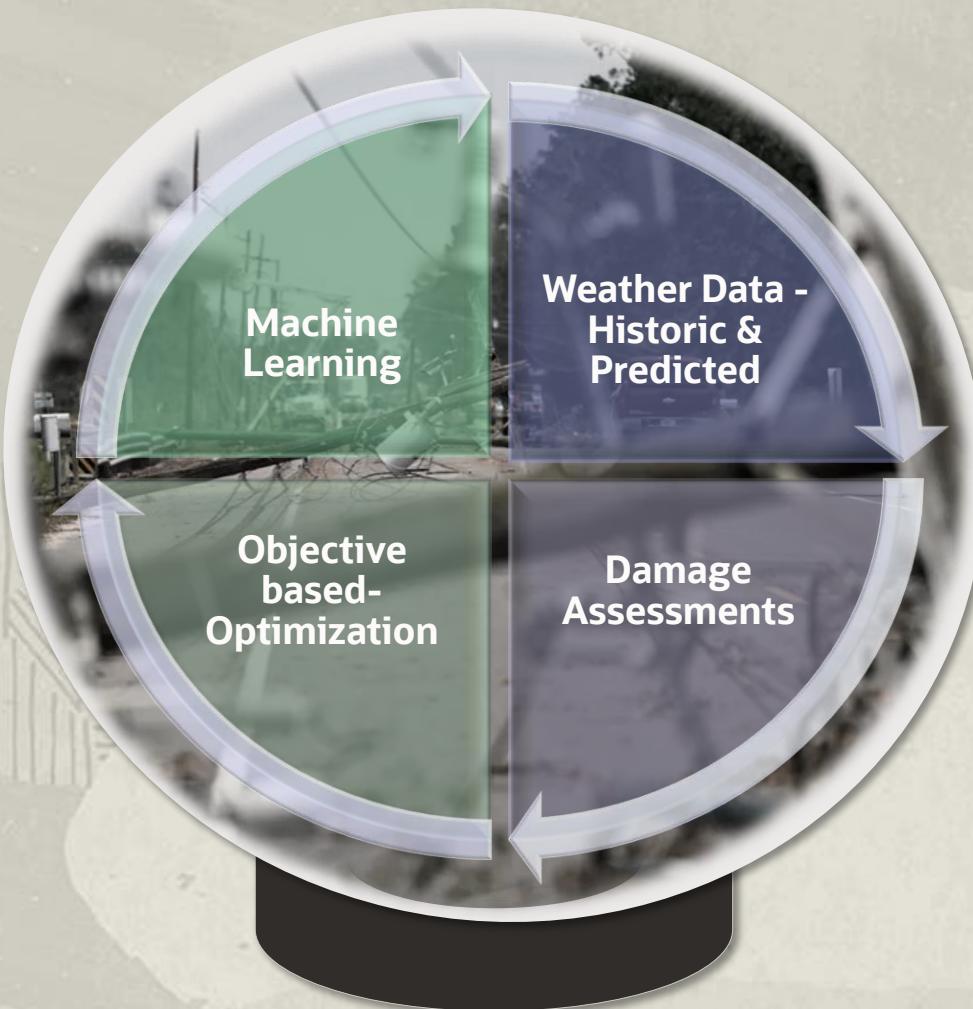


# DER Device Management

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



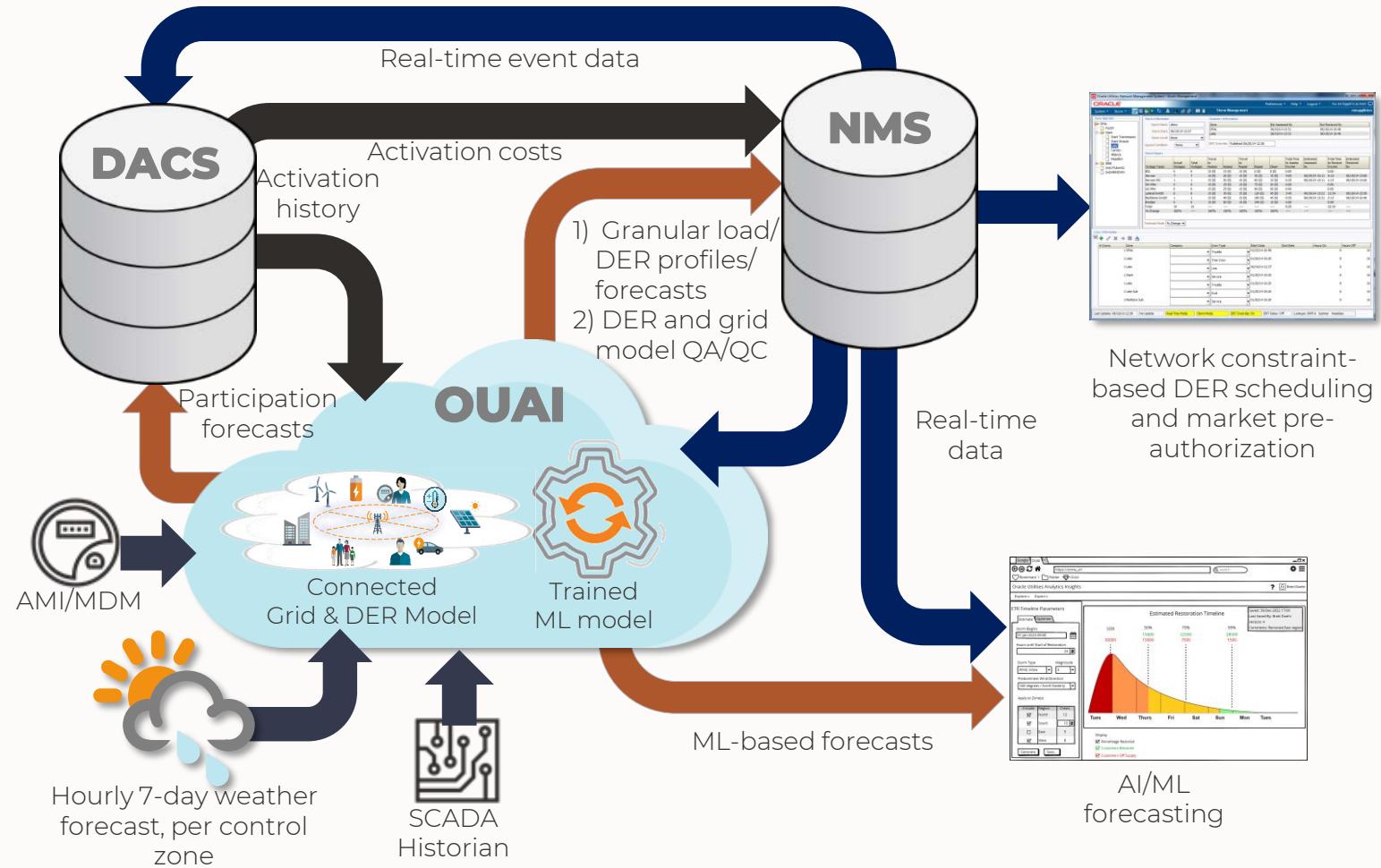
# Analytics Insights: improved DER forecasting and optimization



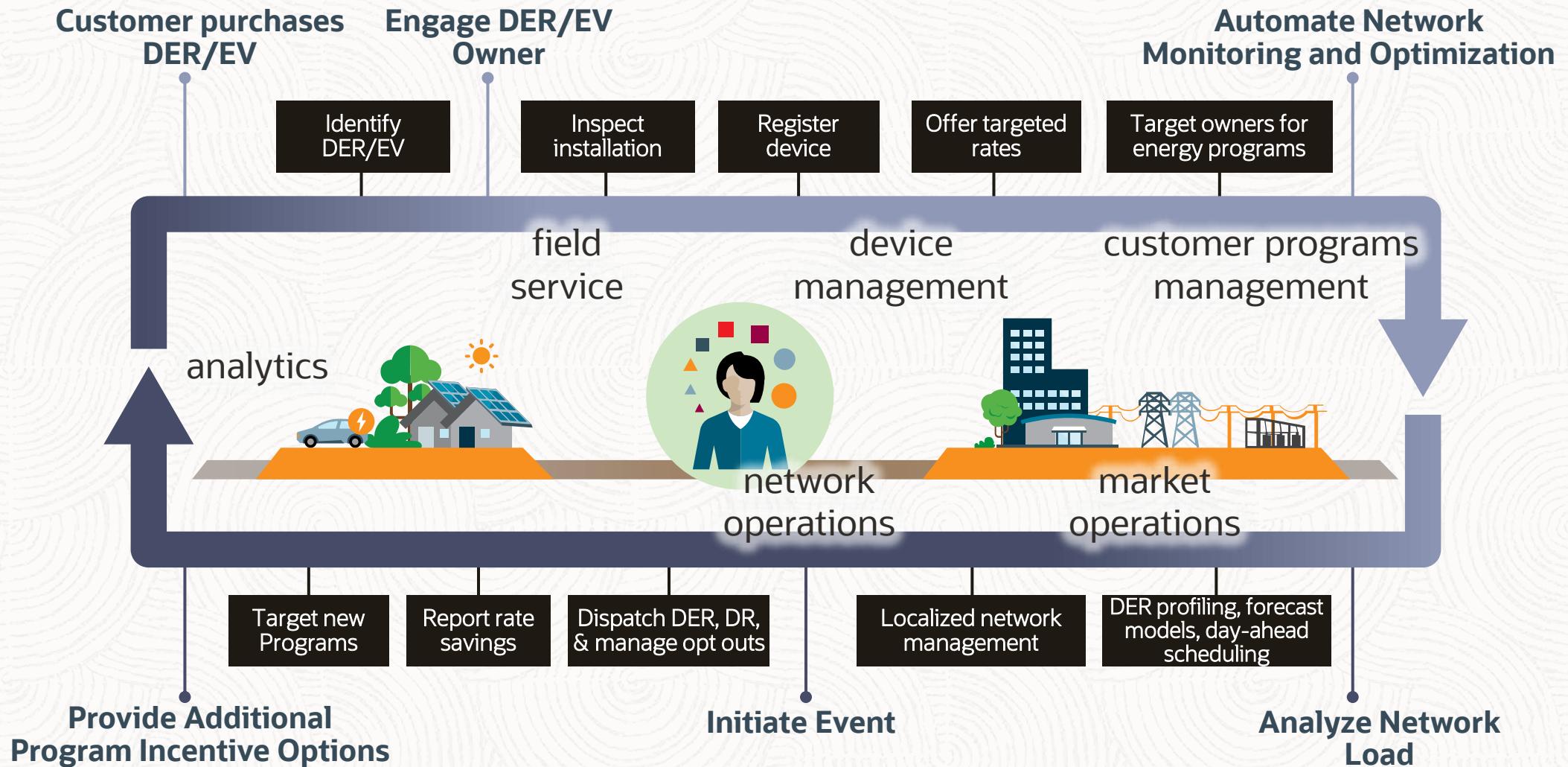
## 5 Key DERMS Analytics Insights Opportunities

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



# 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?

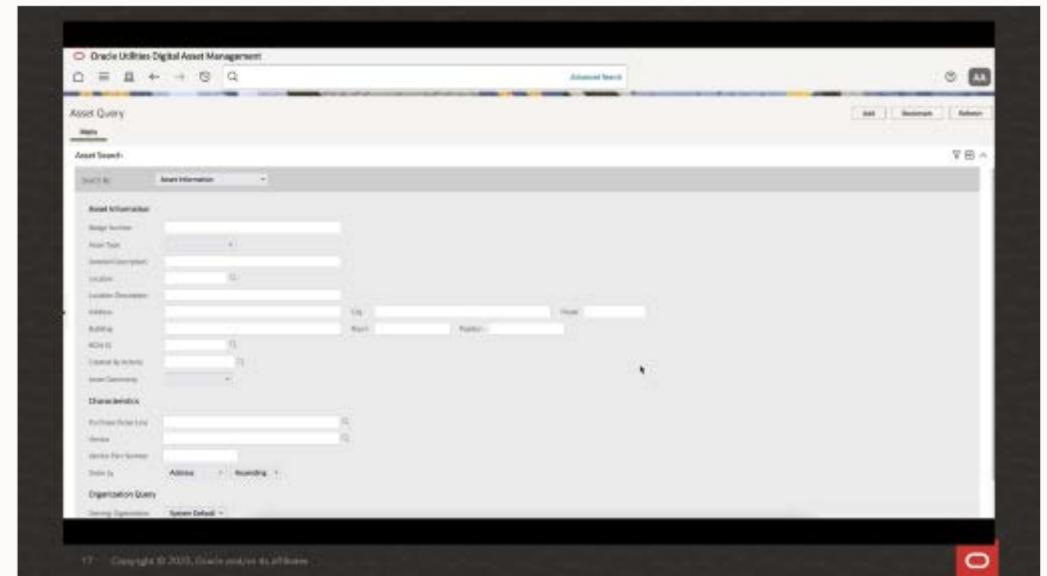
- Feeder Head
- Transformer



## Utility Owned

*How do we manage the installation?*

- Customer sign-up
- Utility installed



## Asset Query

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

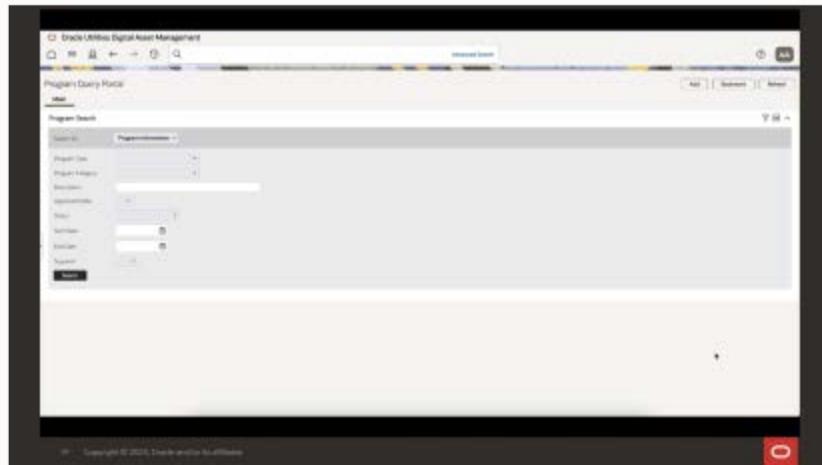
# Device registration and cost calculation in DACS

## Program Management and Participation

*How do I define and manage my programs?*



Define programs for different categories, eligibility rules and qualification questions

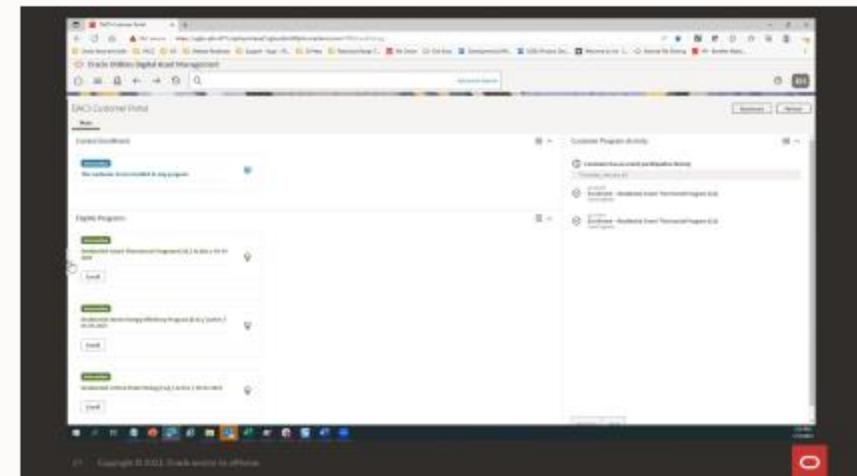


## Enrolment

*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](#)

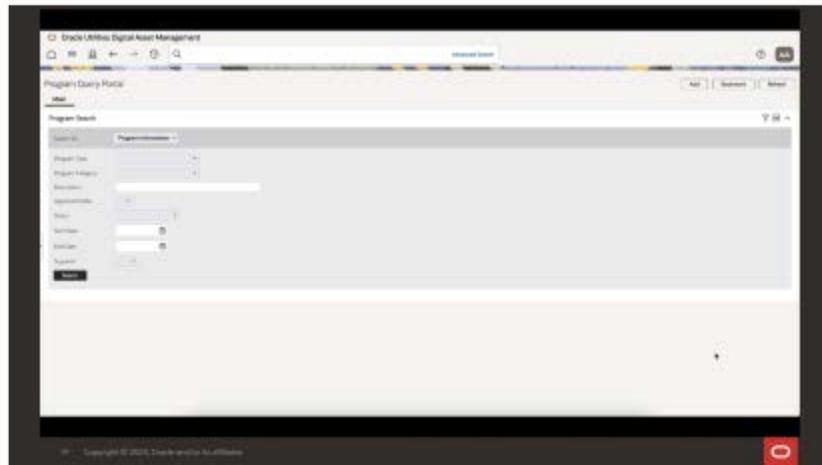
# Device registration and cost calculation in DACS

## Program Management and Participation

*How do I define and manage my programs?*



Define programs for different categories, eligibility rules and qualification questions

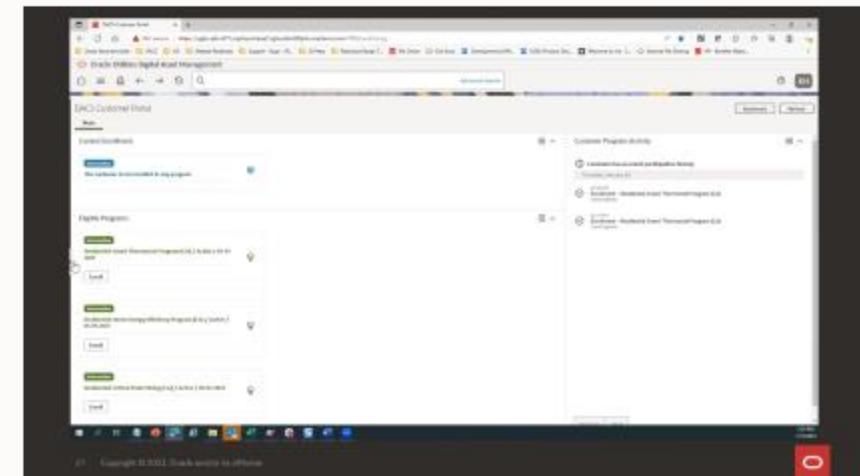


## Enrolment

*How do customers sign up for programs?*



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



DACS Customer Portal x +

Not secure | <https://ugbu-phx-671.snpbxprshared1.gbuclsint02phx.oraclevcn.com:7805/ouaf/cis.jsp>

Oracle favorites folder DACS GIS Release Readiness Support - Bugs - SR... St Petes Redwood Design T... My Oracle Ora-Docs Development || WA... UGBU Product Dev... Welcome to Jira - C... External File Sharing HR - Benefits Websi...

Oracle Utilities Digital Asset Management

Advanced Search

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

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

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

Customer Program Activity

**i** 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

Advanced Search

Bookmark Refresh

KH

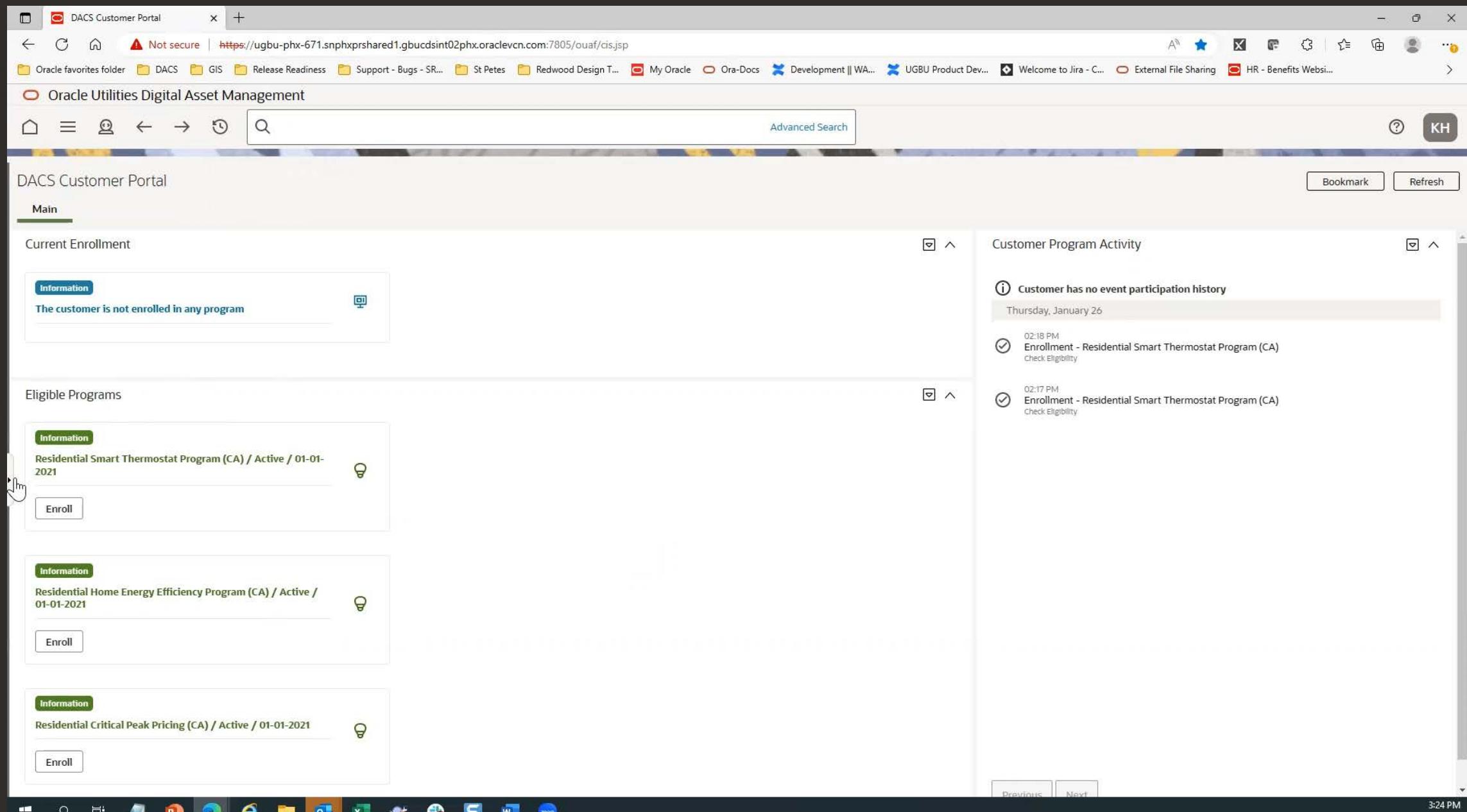
Enroll

Enroll

Enroll

Previous Next

3:24 PM 1/31/2023



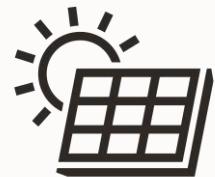
## Forecasting for Demand Reduction

*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

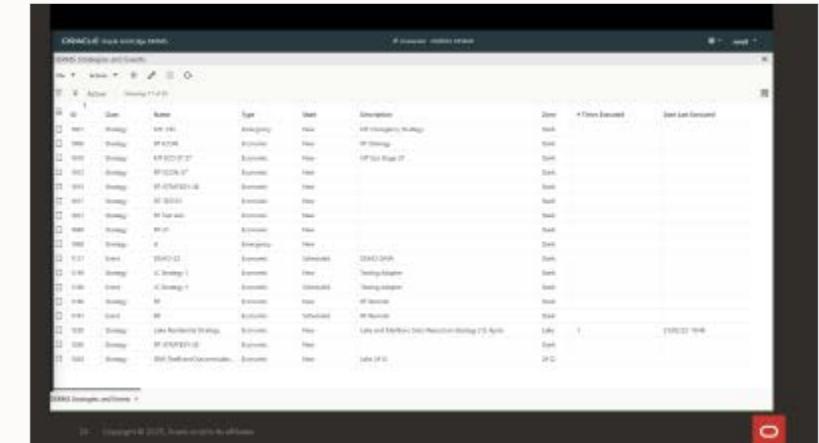


# Event dispatching in NMS

*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



## DERMS Strategies and Events

File ▾ Actions ▾ + 🖊 🗑️ 🔎

Active Showing: 17 of 55

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

## DERMS Strategies and Events

# Measurement and verification in analytics

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



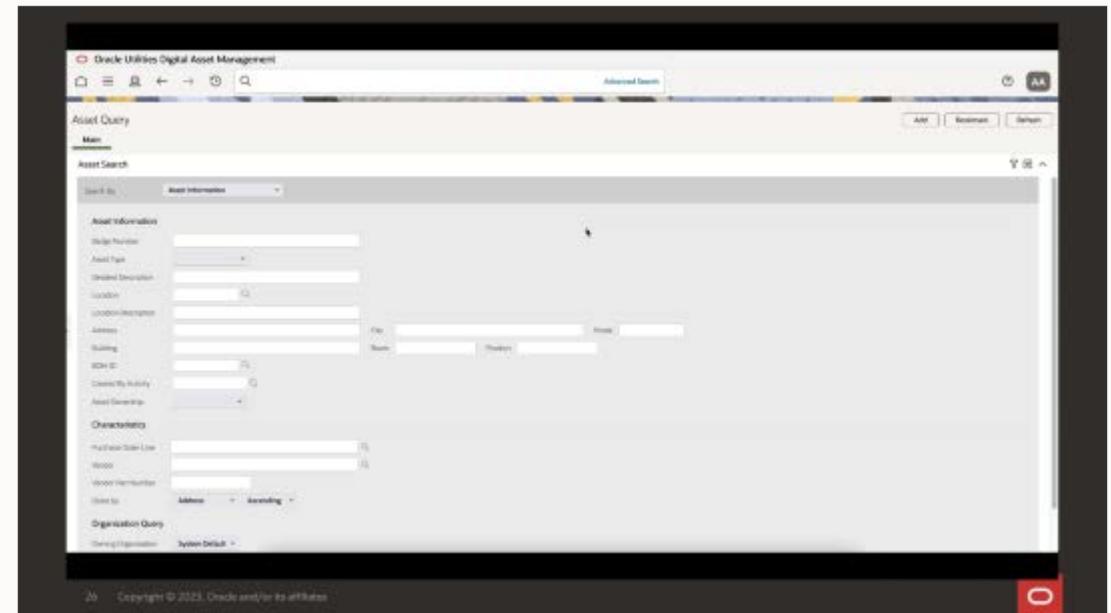
- Compare forecasted vs actual load values



- 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

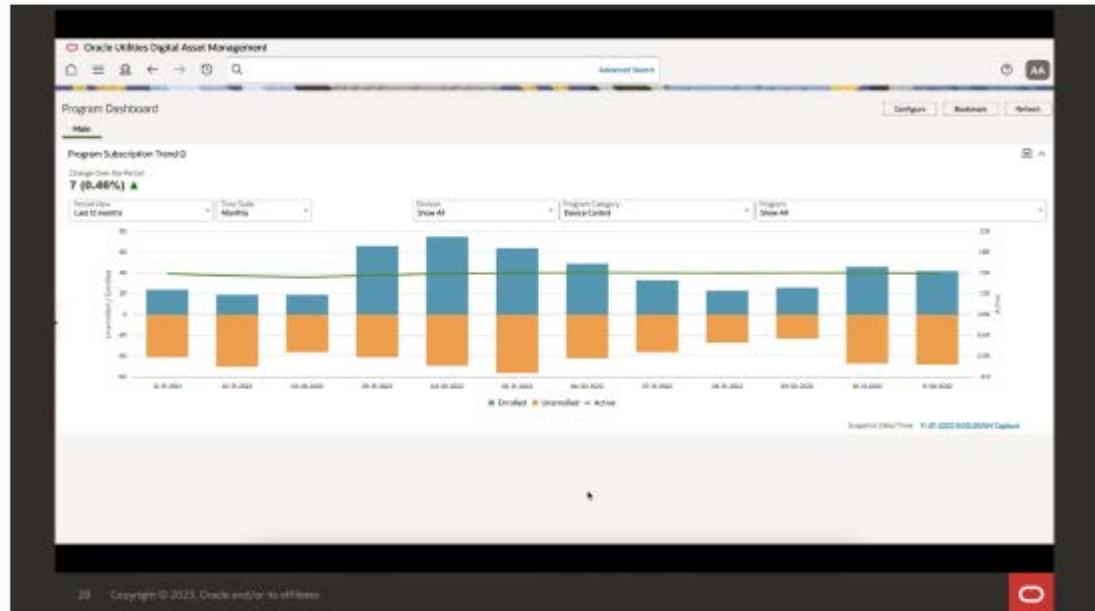
# Program history in DACS

## Program Overview

*How well is my program doing?*

Provide an overview of the program with

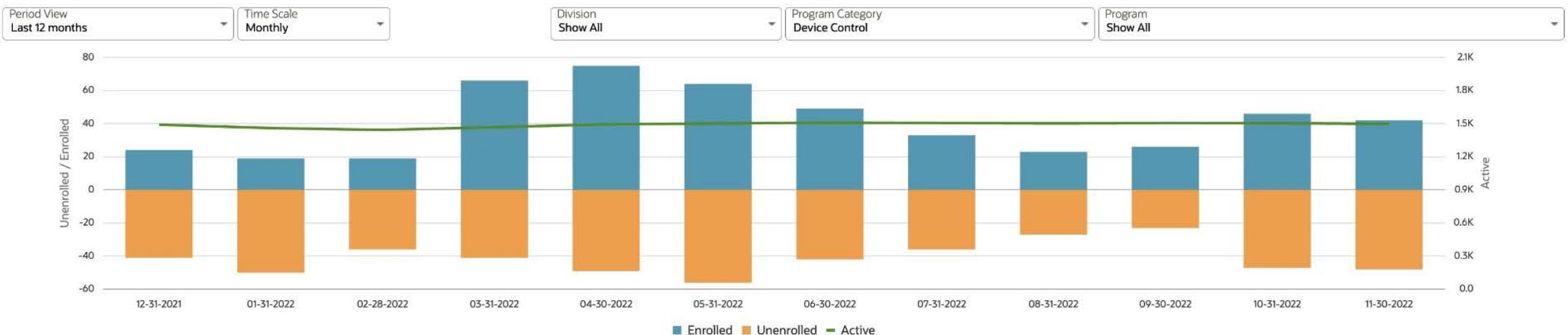
- Numbers entering and leaving the program over a selected period
- Number of active members in the program
- Drill down into details through filtering



## Program Dashboard

[Configure](#) [Bookmark](#) [Refresh](#)MainProgram Subscription Trend  [ⓘ](#)

Change Over the Period

**7 (0.46%) ▲**

ORACLE

