Clean Coalition

Redwood Coast Airport Microgrid: Advancing a resilient and clean energy future

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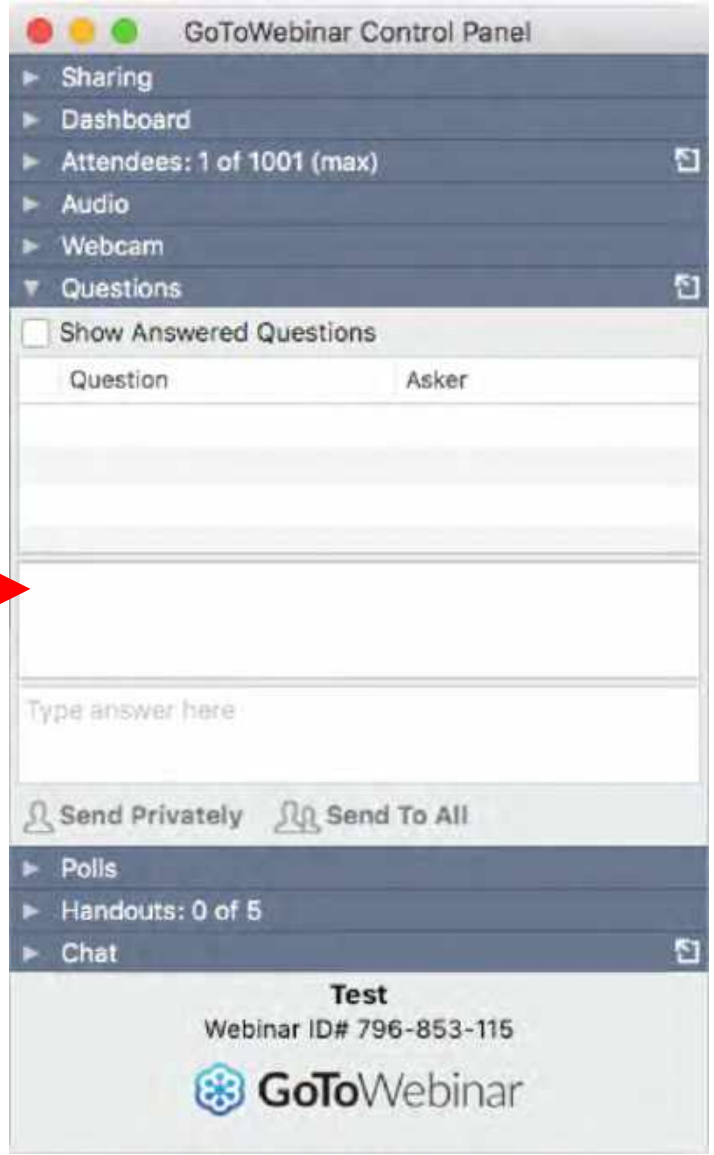


Presenters

Mathew Marshall is the Executive Director of the Redwood Coast Energy Authority, a joint powers agency of Humboldt County local governments dedicated to implementing sustainably energy initiatives in the region, including operating the local community choice aggregation program. A graduate of Humboldt State University, Matthew serves on the board of directors of several community nonprofits, including the Trinidad Coastal Land Trust, the Redwood Parks Conservancy, and the Greater Eureka Chamber of Commerce, and the Humboldt Folklife Society, and is Vice President of the California Community Choice Association (CalCCA). He plays the bagpipes and is Assistant Chief of the Westhaven Volunteer Fire Department.

Presenters

Jim Zoellick is a Principal Engineer at the Schatz Energy Research Center at Humboldt State University with 25 years of dedication. His work involves planning, analysis, project development, and implementation, with a special focus on tribal and public sector projects in rural northern California. Most recently he has worked to develop, deploy, and evaluate cutting-edge microgrid technology. He has managed or co-managed two microgrid projects at the Blue Lake Rancheria, including the 2018 DistribuTECH Project of the Year for DER Integration. Currently, he is co-managing the Redwood Coast Airport Microgrid Project; this will be the first front-of-meter, multi-customer microgrid on Pacific Gas & Electric's distribution system.

Presenters

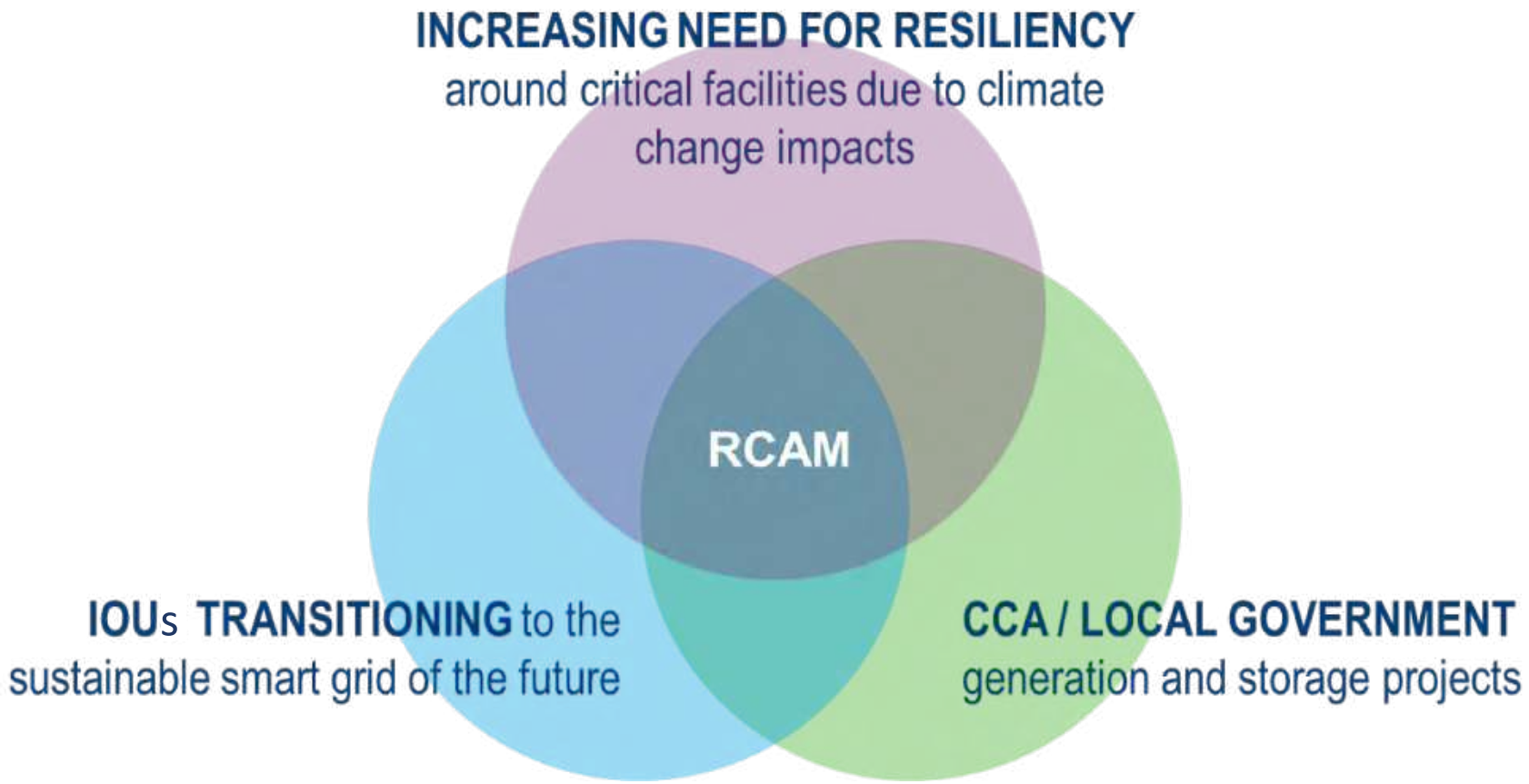
Carmen Henrikson is a Vice President in TRC's Advanced Energy practice and brings 20 years of experience in the planning and implementation of clean and distributed energy resources. She leads strategic direction for the integration of customer energy resources — including energy efficiency, demand management, storage and renewable resources — to design and develop scalable solutions in our evolving energy markets. Since 2016, Ms. Henrikson has served on the Board of Directors for the California Efficiency and Demand Management Council. Ms. Henrikson holds an MBA and MS in Natural Resource Policy from the University of Michigan's Erb Institute of Global Sustainable Enterprise and a B.A. in Earth and Environmental Science from Wesleyan University.

Redwood Coast Airport Renewable Energy Microgrid

Advancing a resilient and clean energy future

Matthew Marshall, Redwood Coast Energy Authority
Jim Zoellick, Schatz Energy Research Center
Carmen Henrikson, TRC Companies

A Microgrid for Today's Environment



Project Objectives

- Demonstrate a viable, replicable business model for a 100% renewable community scale microgrid
- Provide resilience to critical community services in the face of climate change
- Provide local benefits via renewable energy development (create jobs, keep energy $$$ local, increase energy security, reduce price volatility, increase local control & ownership)
- Reduce greenhouse gas emissions
- Develop agreements, standards and processes for replicability
- Advance technology and policy through cutting edge public research

Key Project Partners

- Schatz Energy Research Center: prime contractor & technology integrator
- Pacific Gas & Electric: distribution system operator
- Redwood Coast Energy Authority: local CCA, distributed generation owner & co-funder
- CEC and PG&E Electric Program Investment Charge (EPIC): grant funders
- County of Humboldt: airport owner/operator
- TRC Companies → business case evaluation, cybersecurity
- Key vendors: Tesla → PV/battery, Schweitzer Engr. Labs (SEL) → controls

Clean Energy, Resilient Community

Humboldt County is a rural, isolated community at the end of a transmission line.

Region is vulnerable to tsunamis, earthquakes, landslides, floods, wildfires and most recently PSPS events.

Community has ambitious plans for renewable energy utilization.

RCAM Projects Components

1 TECHNICAL DESIGN

- 2.2 MW Solar PV DC-coupled with 2.2 MW/8.8 MWh battery storage
- 300 kW NEM PV
- Microgrid controllers enable islanding capabilities

Complete

2 OPERATIONS AGREEMENT

- PG&E controls generation assets as the DSO while islanding
- CAISO wholesale market participation & revenue while grid-connected

Nearly Complete

3 BUSINESS MODEL

- Feasibility of resiliency-driven model
- Evaluating tariff agreement and other financial incentives
- Replication for front-of-the meter, multi-customer microgrid model

In Progress

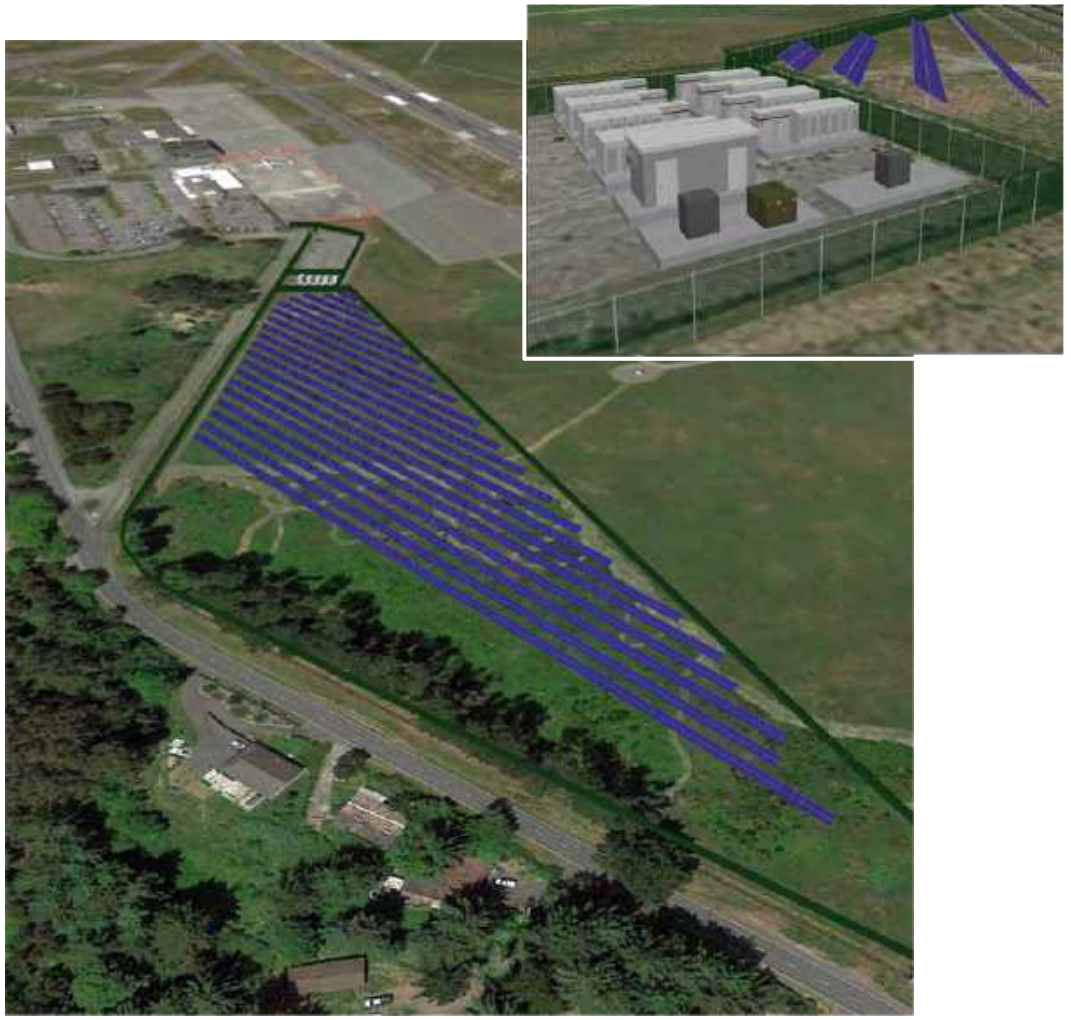
4 PROJECT BUILD

- Construction starts in Q2 2021
- Commercial operation date (COD) in Q4 2021

Future Stage

Project Description

- First front-of-meter, multi-customer microgrid on PG&E's system
- 2.2 MW PV array DC-coupled to 2.2 MW/8.8 MWh battery storage → CAISO wholesale market participation
- 300 kW_{AC} net-metered PV array → reduce airport electric bills
- Microgrid controllers → will allow the system to island and provide uninterruptible power for long periods



Technical Design

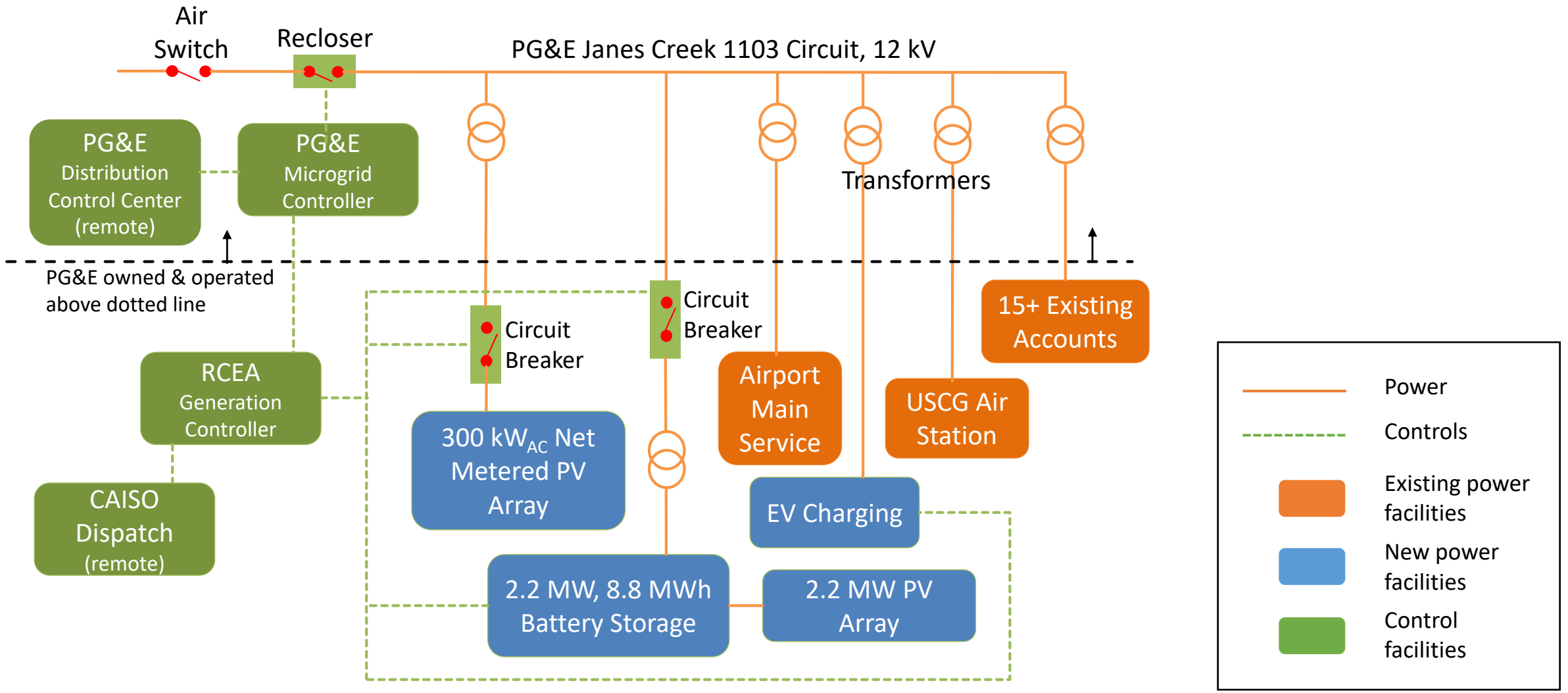
Grid-connected Mode

- RCEA (3rd party) will control generation asset, participate in wholesale market → energy arbitrage
- Wholesale interconnection constrained to 1,480 kW max import and 1,778 kW max export to mitigate otherwise required distribution system upgrades

Islanded Mode

- PG&E as distribution system operator (DSO) will control generation asset

Simplified 1-Line Diagram



Operating Agreements & Replication

- Unique partnership between an IOU and a CCA
- CCA will own and operate DERs that will form the islanded microgrid on IOU's distribution circuit, this requires special attention
- Areas of collaboration include:
  - Design → must be safe, reliable and functional and must seamlessly mesh with the existing distribution system
  - Development of contractual agreements
    - RCAM Microgrid Operating Agreement
- Focus is to develop necessary agreements for RCAM project within existing regulatory framework with eye toward future replication potential

Partnership Agreements & Replication

Design Work

- Single line diagram
- Communications block diagram
- Site plan
- Concept of Operations (CONOPs) document

- As RCEA's owner's engineer, SERC has developed docs, then iterated to agreement with PG&E.

Includes decisions on:

- Telemetry
- Communication protocols
- Controls
- Protection
- Cybersecurity

Replication Achievements: Networking Architecture & CONOPS from RCAM will be used as basis for PG&E's future projects.

Partnership Agreements & Replication

RCAM Microgrid Operating Agreement

- DER interconnection Agreements
- Special Facilities Agreement
- Operational Roles and Responsibilities
  - CONOPs
  - Protocols and procedures → define how various operational activities will be handled
- Performance requirements
- Accounting and compensation

- Transitions between operating modes
- Planned & unplanned outages
- Emergency conditions
- Access and clearances
- Maintenance and testing
- Incident reporting

Replication Achievement: Bright Clear Line linking ownership with operational roles and responsibilities.

Partnership Agreements & Replication

Tariff Work

Within the scope of the CEC project, the RCAM Tariff Working group considered several agreements including:

- Microgrid Infrastructure Cost Recovery
  - Covered by existing Rule 2 SFA
- Islanded Energy Tariff
  - Not needed, always in CAISO market
- Islanded Grid Services Tariff
  - Limited monetizable value with high transaction costs

Replication Achievement: Existing compensation mechanisms identified; upfront incentive identified as more important to overcome cost barriers, cost offsets for eligible projects to be tied to the capital equipment costs and distribution upgrades for the facility to island.

Business Model Assessment Approach

1 MODEL DEVELOPMENT + WORKING GROUP

- Define RCAM base case
  - Capture project costs and revenues
  - Quantify benefits
  - Calculate benefit-cost (B/C) ratio over lifetime
  - Determine revenue gap
- Develop replication models

2 PEER REVIEW + FEEDBACK

- Inputs on B/C, resiliency methods, and replication models
- Identify new considerations, perspectives

3 FINALIZE BIZ MODEL

- Incorporate feedback
- Complete market potential and adoption projections
- Develop replication recommendations

Analysis Inputs

Informs RCAM base case and replication use cases:

COST

Controller Hardware & Software

CapEx + OpEx

DER System and Interconnection

CapEx + OpEx

Distribution System Upgrade

CapEx + OpEx

REVENUE

Wholesale Participation

Energy and frequency regulation revenues

Other Revenues

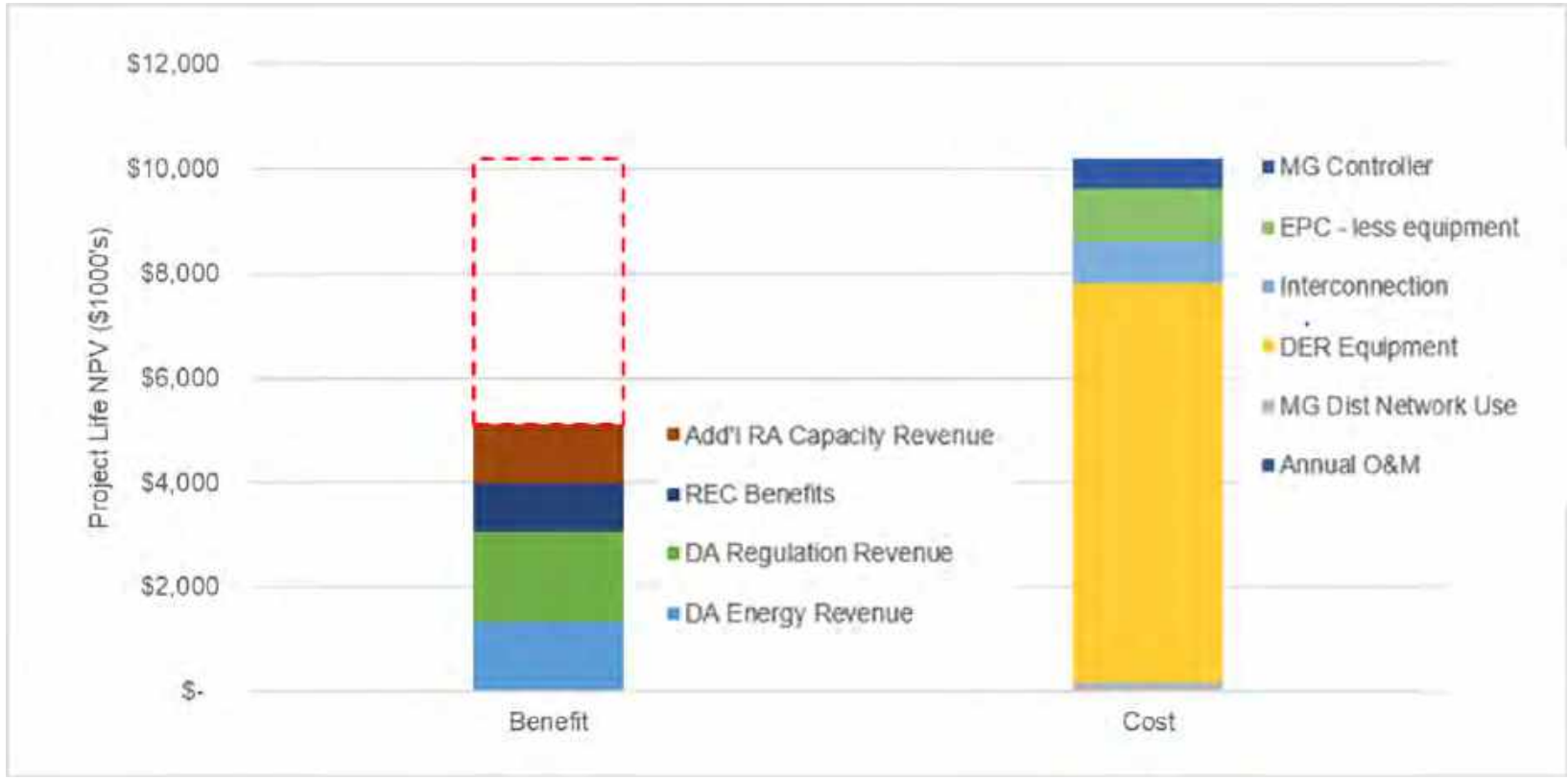
REC, RA capacity, and resiliency revenues

RCAM Base Case: Benefits & Costs

$10.2M
TOTAL COST

0.50
BENEFIT / COST (25 YEARS)

$5.1M
GAP TO ADDRESS



RCAM Resiliency Values

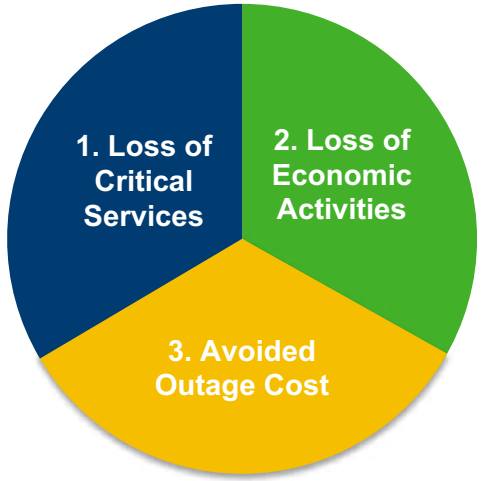
RCAM Gap = $5.1M

- $38 per capita for Humboldt County over 25-yr project lifetime, or
- $3.4 per RCEA account per year
- $1.3 per Arcata airport passenger-trip

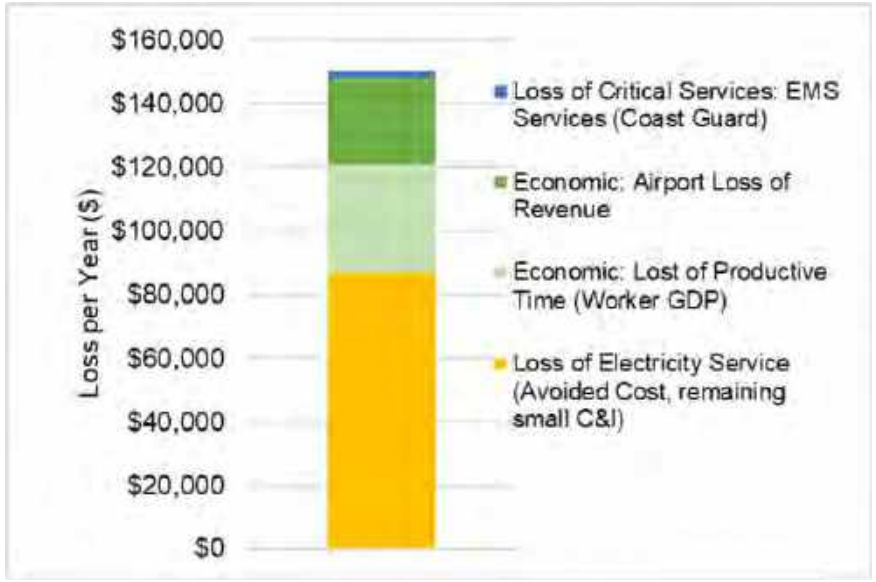
Additional values available to the community, with only a portion accounted for in resiliency value calculations.

RCAM Valuing Resiliency

- Focus on quantifiable community benefits
- Converted to monetary values using reputable tools and methodologies
- Baseline 20 hour/year outage at Division level – 10-year average with Major Event Days (MED)



Tools / Method	Value & Category
FEMA BCAR • Length & frequency of outage • # of facility personnel • # of cardiac arrests/100k population • Total population served	**Loss of Coast Guard Services** **Value of Lost Time**
ICE Calculator • Length & frequency of outage • Facility type • and operations	**Customer interruption cost in total $/year**
Airport Specific • Length & frequency of outage • Facility size / air traffic volume	**Loss of Revenues: Passenger, cargo, car rental, cafe**



RCAM Base Case + Resiliency

$2.2M
RESILIENCY VALUE

0.71
BENEFIT / COST (25 YEARS)

$2.9M
REMAINING GAP

Base Case to Replication

Base Case
Redwood Coast Airport Microgrid project

Natural Disaster:
E.g., PSPS-impacted customers

Critical Facilities:
Cluster of critical facilities

Islanding Premium

Infrastructure Deferral: E.g. Non-Wires Alternatives

Resiliency Driven

Additional Value Streams

Critical Facilities: Cluster Scenario

Site multiple critical facilities
within microgrid boundary

Builds on existing framework

- FTM asset, multi-customer
- Wholesale participation

Approach

- Develop and aggregate proxy resiliency benefits based on services provided and population served

Other Considerations/Limitations

- Must be on the same distribution feeder
- Space availability for hosting DER generation and MG assets
- Distribution feeder condition and current capacity

Resiliency Proxy Value Approach

Facility Type	Proxy Resiliency Value ($/year)	Facility Descriptions
Hospital		
Small	$100,000	75k population served
Medium	$600,000	200k population served
Large	$2,700,000	500k population served; full services, incident profile of 98.5% minor/1.5% mixed injury severity levels; 20 mil to next facility
Wastewater Treatment Plant		
Municipal	$400,000	16k population served (Arcata)
County	$3,300,000	164k populated served (Humboldt County)
Emergency Medical Services	$4,000	16k population (Arcata) with national average 58 cardiac arrests in 100k per year
Police Station	$90,000	16k population with national crime statistics
Fire Station	$4,000	16k population with national FEMA stats; 2.5 mil to next facility
Municipal Emergency Command Center	$78,000	$100k/day total value of service from surveys
Community Shelter	$4,000	$5k/day total value of service from surveys

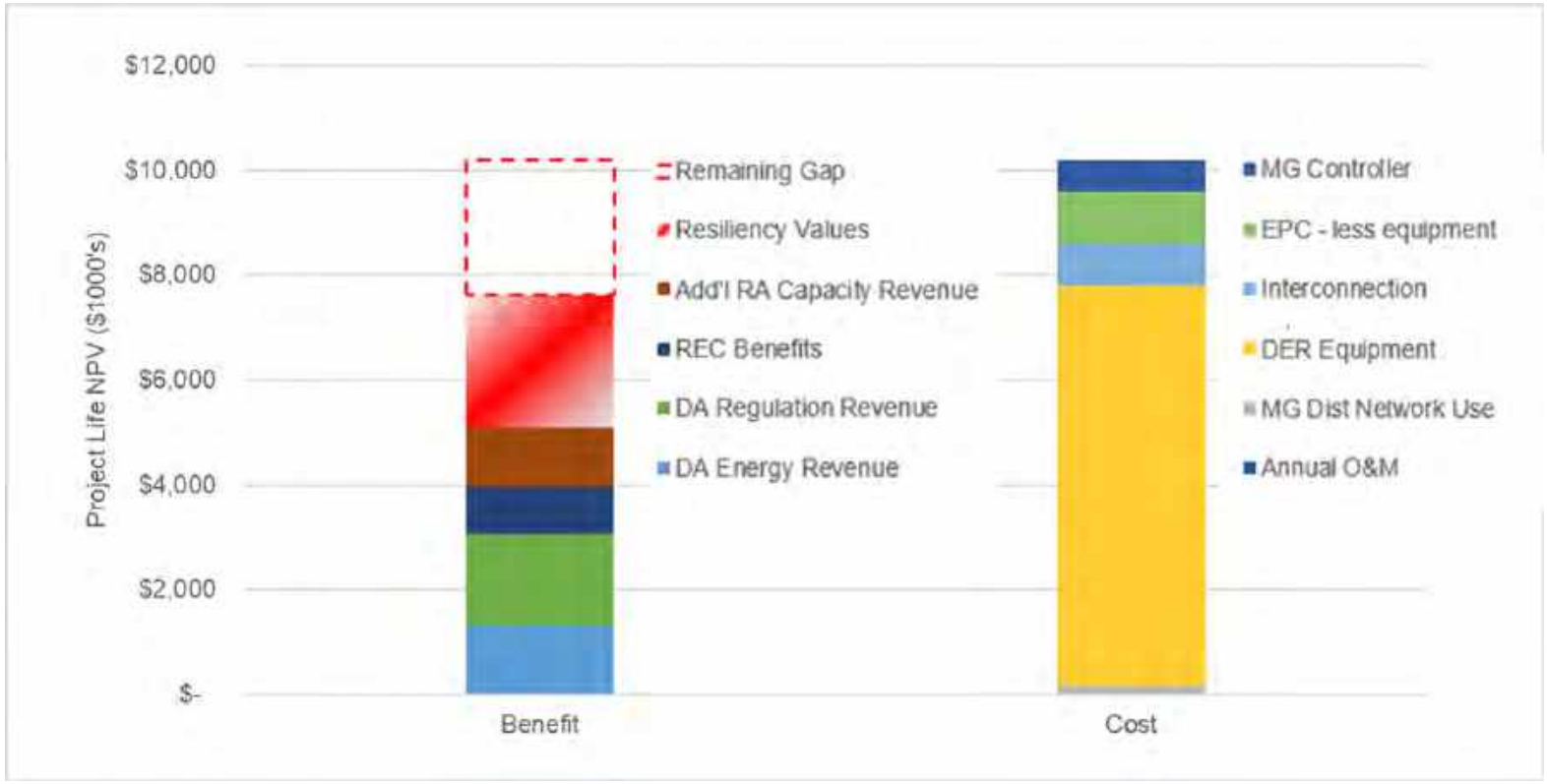
Critical Facilities: Civic Function Cluster

POLICE, FIRE DEPT, COMMAND CENTER

$2.5M
RESILIENCY VALUE

0.75
BENEFIT / COST (25 YEARS)

$2.6M
GAP TO ADDRESS



Critical Facilities: Hospital Scenario

MEDIUM (200K SERVED) HOSPITAL

$6.3M
RESILIENCY VALUE

1.12
BENEFIT / COST (25 YEARS)

none
GAP TO ADDRESS

Natural Disaster Case: Sustained outage

Design and site microgrid to ride through long-duration, sustained outages from natural disasters

Approach

- Introduce one 2-week, or 336-hr long continuous outage at year 8 (of 25 year)
  - In contrast to the baseline level 20 hr/year for each year over project lifetime
- Estimate additional resiliency benefits

Other Considerations

- Low frequency, high impact events

2 Weeks Ready

2 Weeks Ready
2017 Total Solar Eclipse
Business Preparedness
Cascadia Island Mapping
Cascadia Subduction Zone
Community Preparedness
Hazard Mitigation
Hazards in Oregon

2 WEEKS READY
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Date	Number of Customers Affected *	Longest Customer Interruption (Hours)
02/17/2017 – 02/22/2017	732,590	235
1/18/2017 – 1/23/2017	653,502	170
1/8/2017 – 1/11/2017	580,246	450
4/6/2017 – 4/7/2017	249,024	328
10/8/2017 – 10/9/2017	211,812	587

Source: *Utility Reliability Report* on largest unplanned outages in 2017

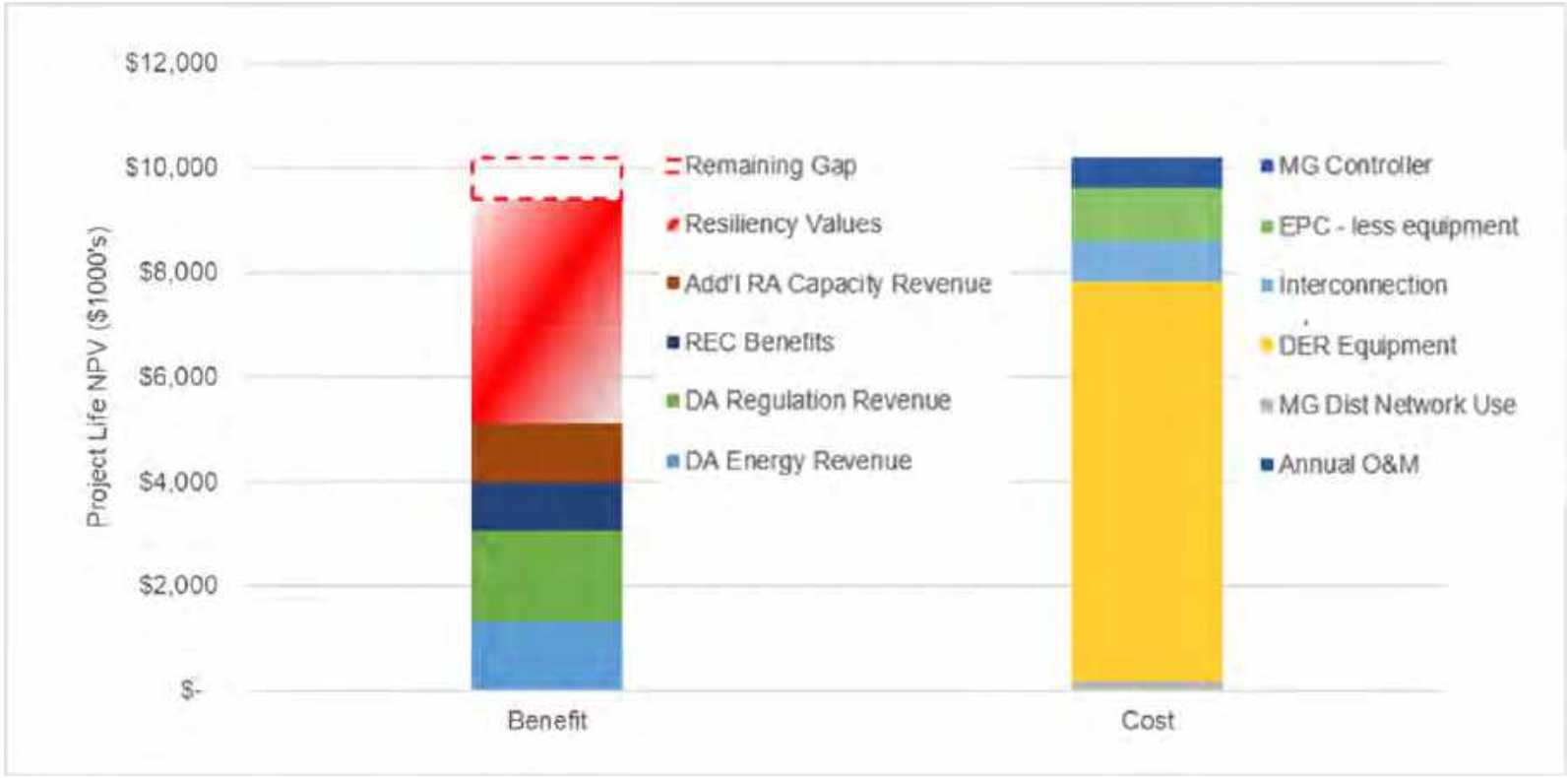
Natural Disaster Case: Single Event

ONE 2-WEEK EVENT, YEAR 8

$4.3M
RESILIENCY VALUE

0.92
BENEFIT / COST (25 YEARS)

$0.8M
GAP TO ADDRESS



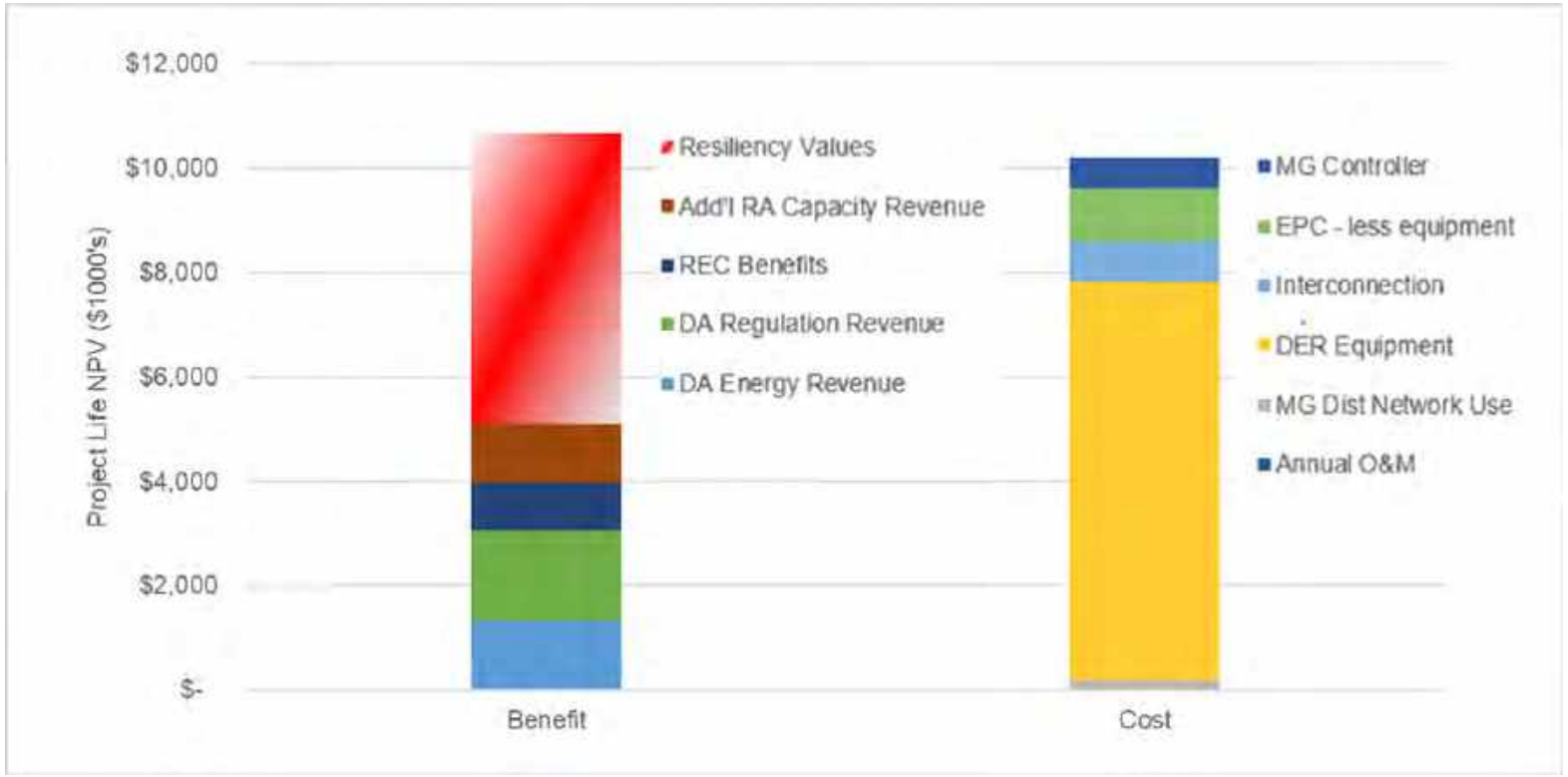
Natural Disaster Case: Consecutive Events

TWO 2-WEEK EVENTS, YEARS 12 & 13

$5.7M
RESILIENCY VALUE

1.05
BENEFIT / COST (25 YEARS)

$0
GAP TO ADDRESS



Additional Value Considerations

Prioritize non-wires alternatives (NWA) locations

NWA Case Studies from Leading US Projects 2018

Offsetting Islanding "Premium"

Lessons Learned….

…and still investigating about the RCAM's benefit to the local community and beyond

1 TECHNICAL DESIGN	2 OPERATIONS AGREEMENT	3 BUSINESS MODEL	4 PROJECT BUILD
• 2.2 MW Solar PV DC-coupled with 2.2 MW/8.8 MWh battery storage • 320 kW NEM PV • Microgrid controllers enable islanding capabilities	• PG&E controls generation assets as the DSO while islanding • CAISO wholesale market participation & revenue while grid-connected	• Feasibility of resiliency-driven model • Evaluating tariff agreement and other financial incentives • Replication for front-of-the meter, multi-customer microgrid model	• Construction starts in Q2 2021 • Commercial operation date (COD) in Q4 2021
Complete	Nearly Complete	In Progress	Future Stage

Questions?

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