THE CASE FOR ENERGY AS A SERVICE MUNICIPAL MICROGRIDS

CALIFORNIA'S CRITICAL FACILITY CHALLENGE

JUNE 2019
10TH ANNUAL SEEC FORUM

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WHAT IS "ENERGY AS A SERVICE" ?

An energy management portfolio combining different energy sources, reliability & sustainability goals and a guaranteed annual cost.

- An outside company guarantees a building's future energy costs:
  - Uses more energy than predicted? The service company is responsible for the difference.
  - Uses less energy? The service company profits.
  - Building owner benefits? Managed overhead electricity costs, creative energy supply and management, incentives for efficiency improvements.
- An EaaS develops a combination of saving energy, producing energy, and storing energy

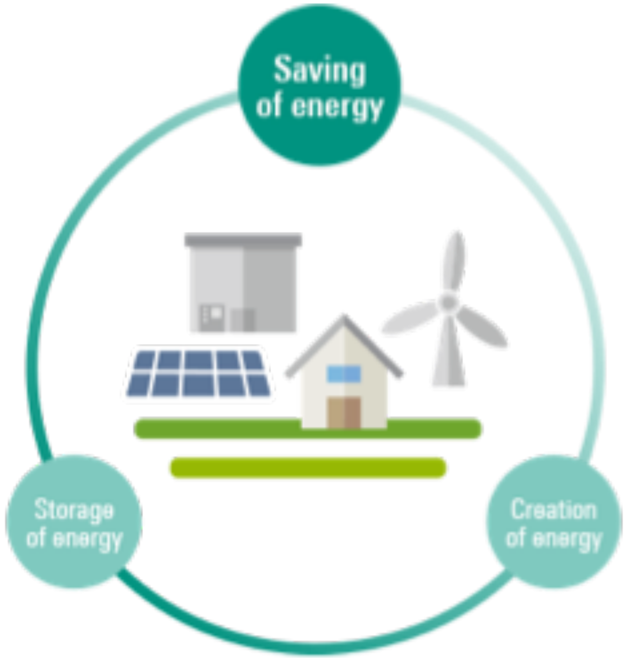

Image via Headspring - http://headspring.co.jp/en/product/energy/

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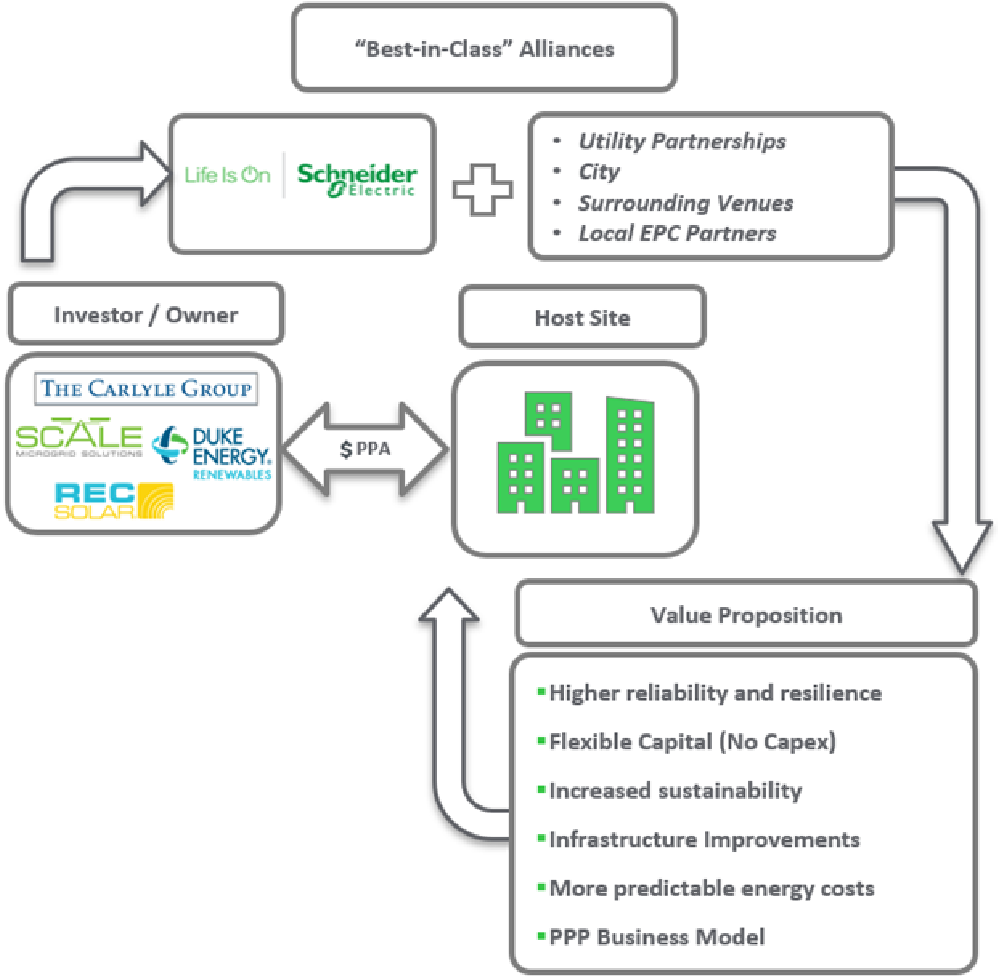
THE ENERGY AS A SERVICE MICROGRID SOLUTION



(Source: Schneider Electric)

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CALIFORNIA'S LOCAL GOVERNMENT CRITICAL FACILITIES - WHAT IS AT STAKE?

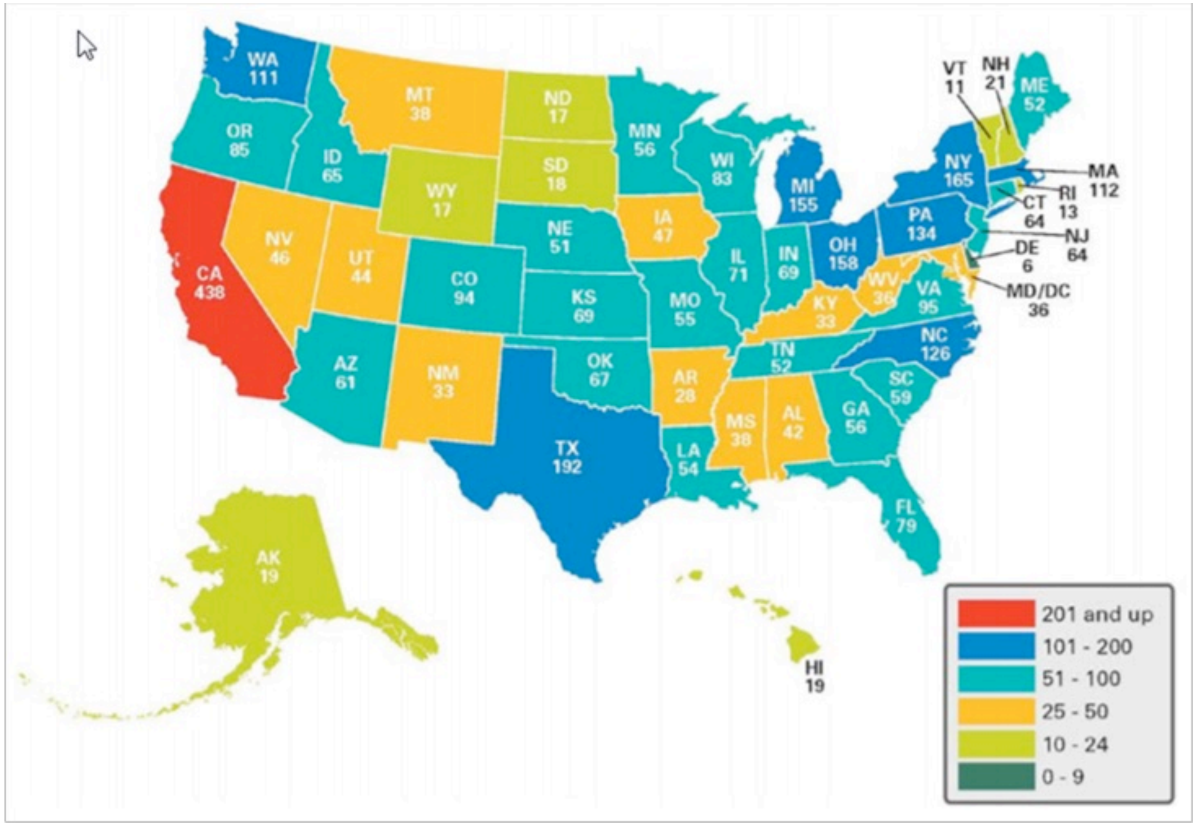
Public Safety Power Shut-Offs: A Response to Wildfires to mitigate IOU risk & liability

- California is home to over 400 cities and towns, more than 50 Counties, and 4000 local government special districts, such as:
  - Water districts: 338
  - Community service districts: 313
  - Fire protection districts: 275
  - Parks and recreation districts: 100
  - Sanitation districts: 91
  - Hospital districts: 79
  - Public utility districts: 63
  - Harbor districts: 11
  - Airport districts: 9

These facilities are part of the fabric of local communities. They are vital to functioning communities and responding to Emergencies: wild fires, extreme storms, public health emergencies, earthquakes and terrorist attacks.

CALIFORNIA'S POWER GRID HAS BEEN UNRELIABLE FOR A DECADE

California has led the nation in power outages for 9 years in a row. In 2017, the last year that data is available, the state experienced over 400 power outages.



(Source: Eaton)

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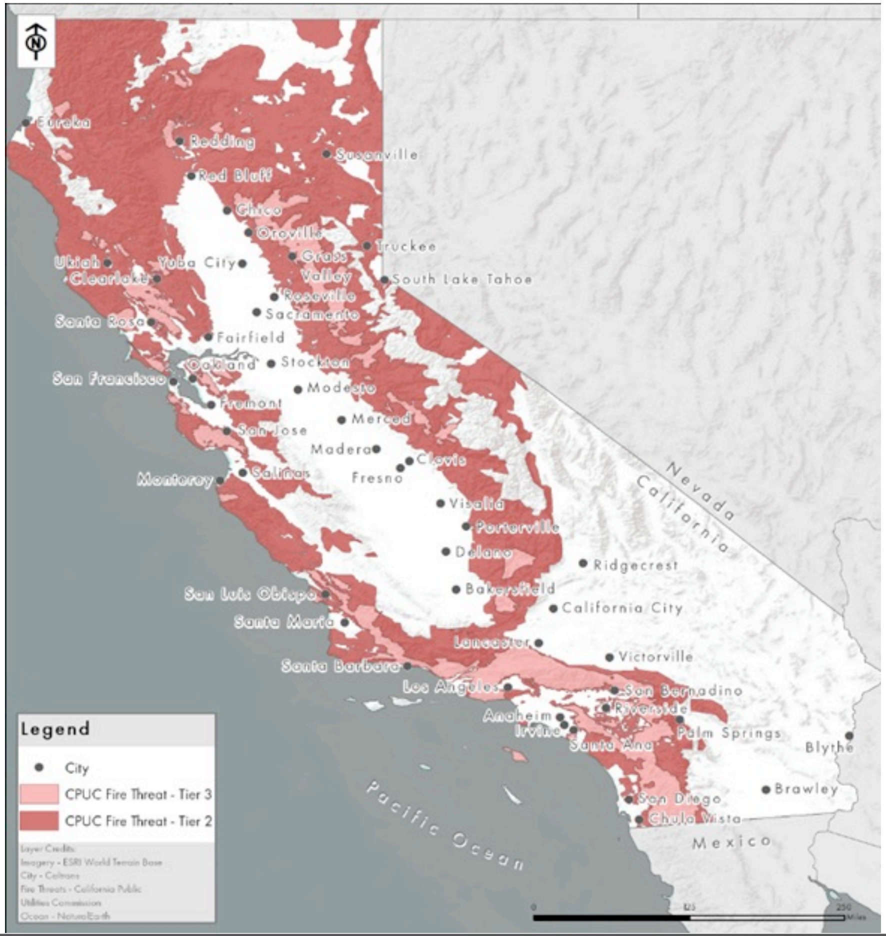
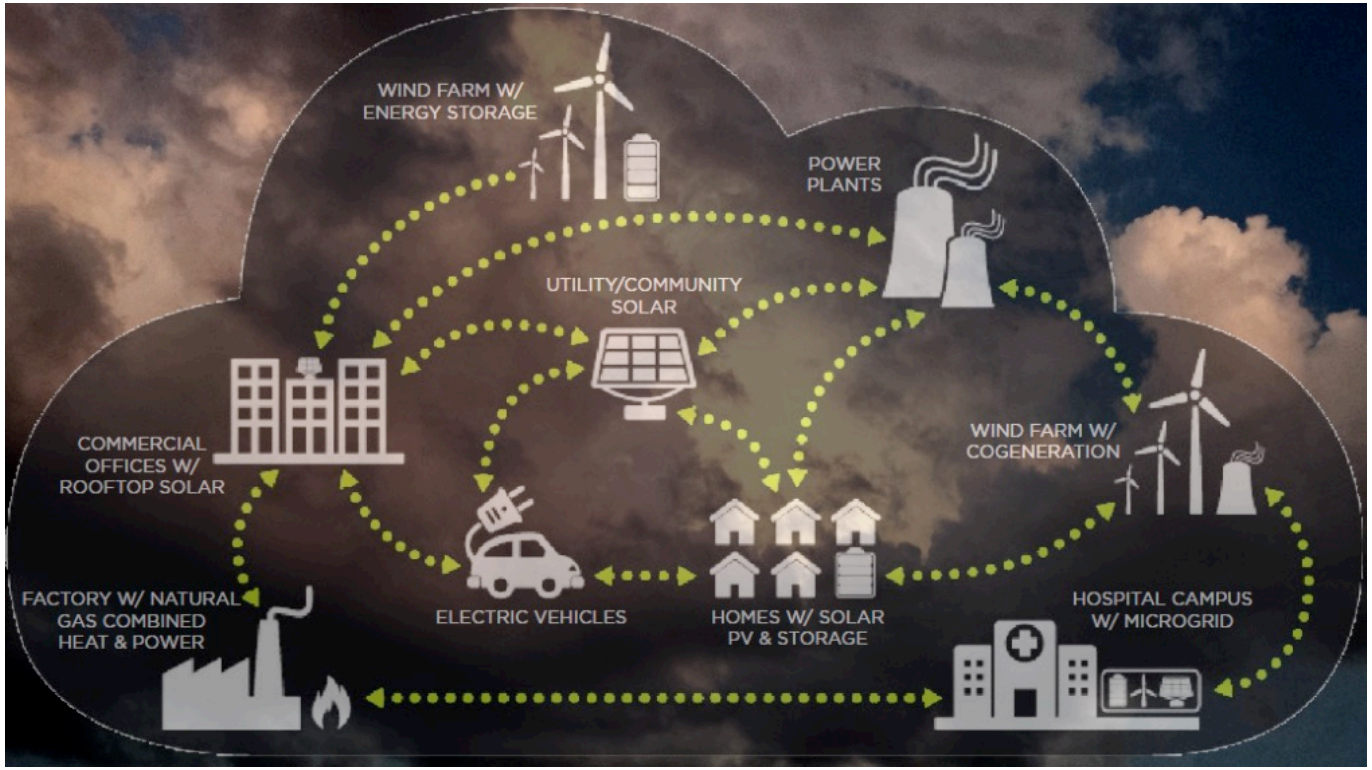
CALIFORNIA'S HIGH FIRE RISK REGIONS

Tier 2 and Tier 3 High Fire Risk Regions



(Source: California Public Utilities Commission)

MOVING BEYOND THE CURRENT STATUS QUO CENTRALIZED GRID



Utilities are proposing ratepayer investments in the legacy centralized grid.

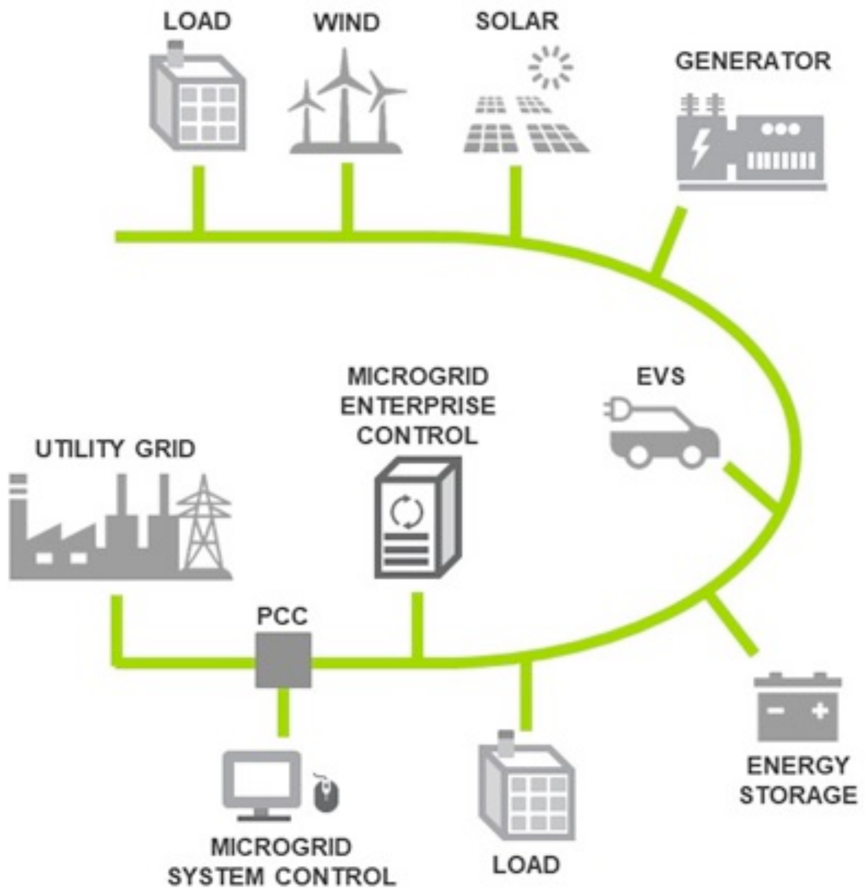
But the world is changing.

Moving toward a new distributed Energy Cloud system could be lower cost, more sustainable and more resilient.

(Source: Navigant)

CRITICAL FACILITY MICROGRIDS ARE PART OF THE ENERGY CLOUD TRANSITION

- **What is a "Critical Facility"?**
  - "Buildings or structures where loss of electric service would result in the disruption of a critical public safety life sustaining function."
  - Critical facilities include: fire stations, water and waste water districts, emergency shelters, hospitals, data centers, etc.
- **What is a microgrid?**
  - A microgrid is a distribution network incorporating a variety of distributed energy resources (DER) optimized and aggregated into single system balancing loads and generation with or without energy storage and capable of islanding whether connected or not connected to a traditional utility power grid.



(Source: Navigant Research)

LESSONS LEARNED FROM RECENT WILD FIRES

- **From the Tubbs fire –**
  - The Stone Edge Farm microgrid in Sonoma, California was able to island from the utility distribution grid for 10 days – enabling basic enterprise functions to continue.

- **San Diego 2007 fire -**
  - The University of California, San Diego microgrid quickly switched from importing power from the grid to exporting power. A swing of a total of 7 MW was credited with keeping the larger San Diego Gas & Electric grid from collapsing.

PG&E reported 414 ignition events between 2015 and 2017.
Nearly 94% of these ignition events occurred on PG&E's distribution infrastructure.
Distribution level microgrids may reduce risks of ignition or disruption from fires.

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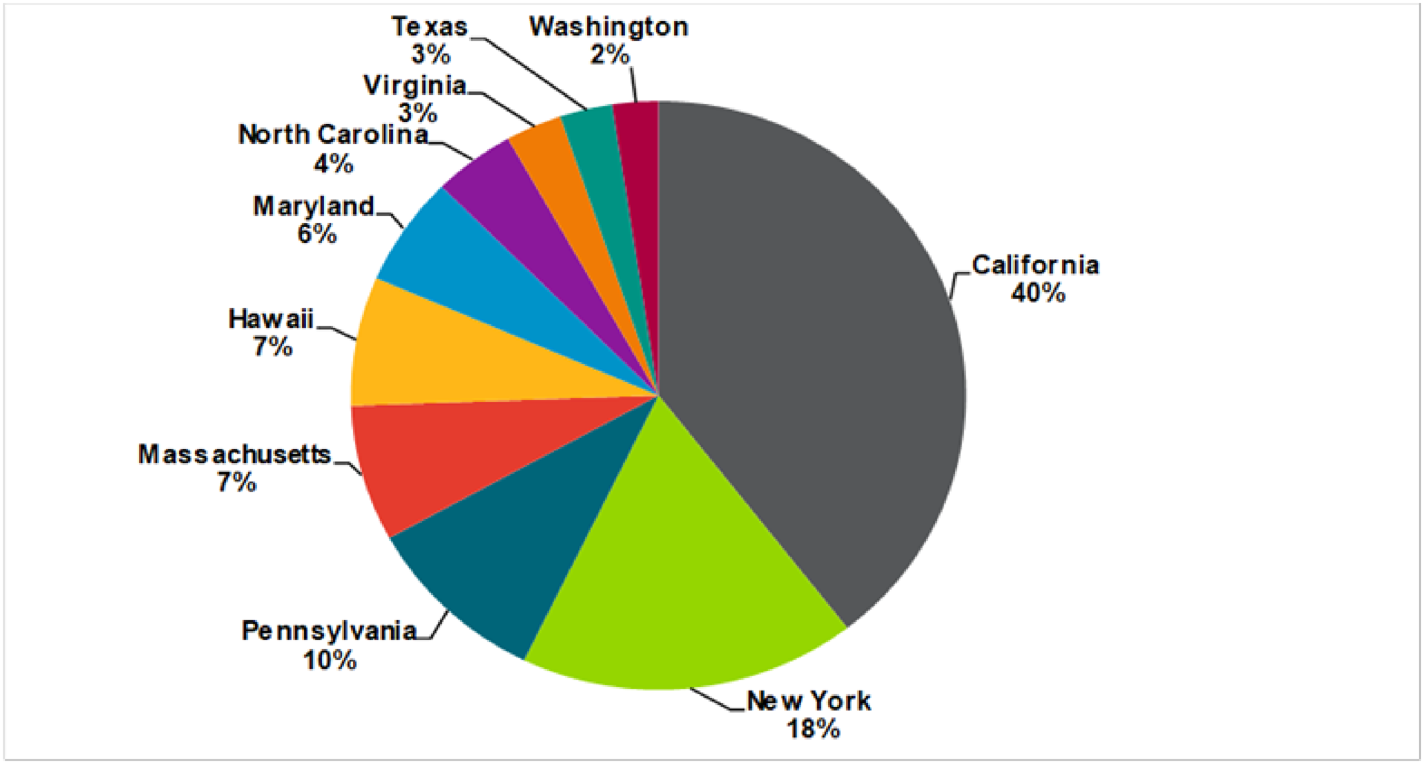
CALIFORNIA IS ALREADY A LEADER IN MUNICIPAL MICROGRIDS

Municipal microgrids are defined as serving local government critical facilities and local communities. They may or may not involve local utilities.

Total Municipal Microgrid Capacity, US: 2018



(Source: Navigant Research)

PUBLIC-PRIVATE PARTNERSHIPS ARE KEY FOR MUNICIPAL MICROGRIDS

A Montgomery County, Maryland microgrid offers a compelling model for California local governments.

(Source: Schneider Electric)

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TWO MICROGRIDS IN ONE OFFERS MULTIPLE COMMUNITY BENEFITS

(Source: Schneider Electric)

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MONTGOMERY MICROGRIDS SERVES AS A MODEL FOR CALIFORNIA

- The microgrids combine solar energy, combined heat and power, and legacy back-up generators, along with energy efficiency and grid infrastructure upgrades

- Schneider Electric provided the automation and controls; REC Solar, a subsidiary of the Duke Energy utility, was the investor

- **The microgrid has gained recognition for its design by Green Business Certification Inc. (GBCI) under its Performance in Excellence in Electricity Renewal (PEER) program.**
  - The PEER criteria rewards implementation of industry best practices and encourages the adoption of new, innovative strategies.

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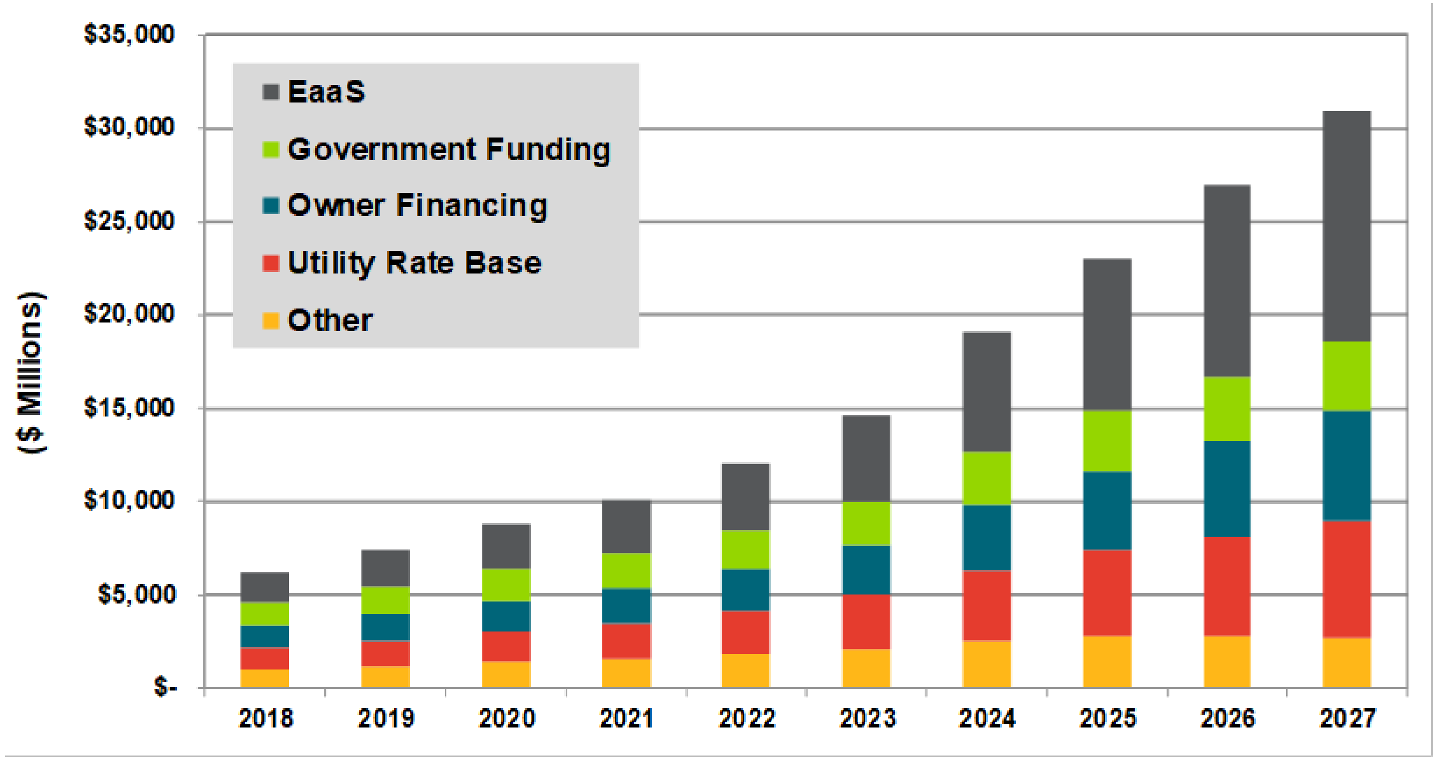
ENERGY AS A SERVICE MICROGRIDS IS PREFERRED BUSINESS MODEL

According to Navigant Research, over 80% of all microgrids in the world are deployed with some form of an EaaS business model. On a capacity basis, it is also forecasted to be preferred business model.

Microgrid Business Models, World Markets: 2018-2027



(Source: Navigant Research)

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THINKING GLOBALLY, ACTING LOCALLY

California local governments are increasing their role in providing power to communities.

- California is now a national leader on using the powers of local governments for the concept of community choice aggregation (CCA), whereby cities and counties act as buying agents of electricity for their own facilities as well as their constituents under an automatic opt-in framework.
- Yet without greater resilience in the form of microgrids, critical facilities may still suffer – and climate goals will be jeopardized -- by greater reliance on polluting back-up generators at critical facilities.

As California goes, so goes the nation – at least on energy and environmental policy.

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CONCLUSIONS

One solution for critical facilities includes microgrids financed under the EaaS model.

- The EaaS microgrid addresses these public safety concerns, and offers a financing solution for local governments lacking capital to invest in new infrastructure

- There is an emerging ecosystem of expertise and technology providers, including:
  – Schneider Electric, Carlyle Group, REC Solar and Scale Microgrid Solutions

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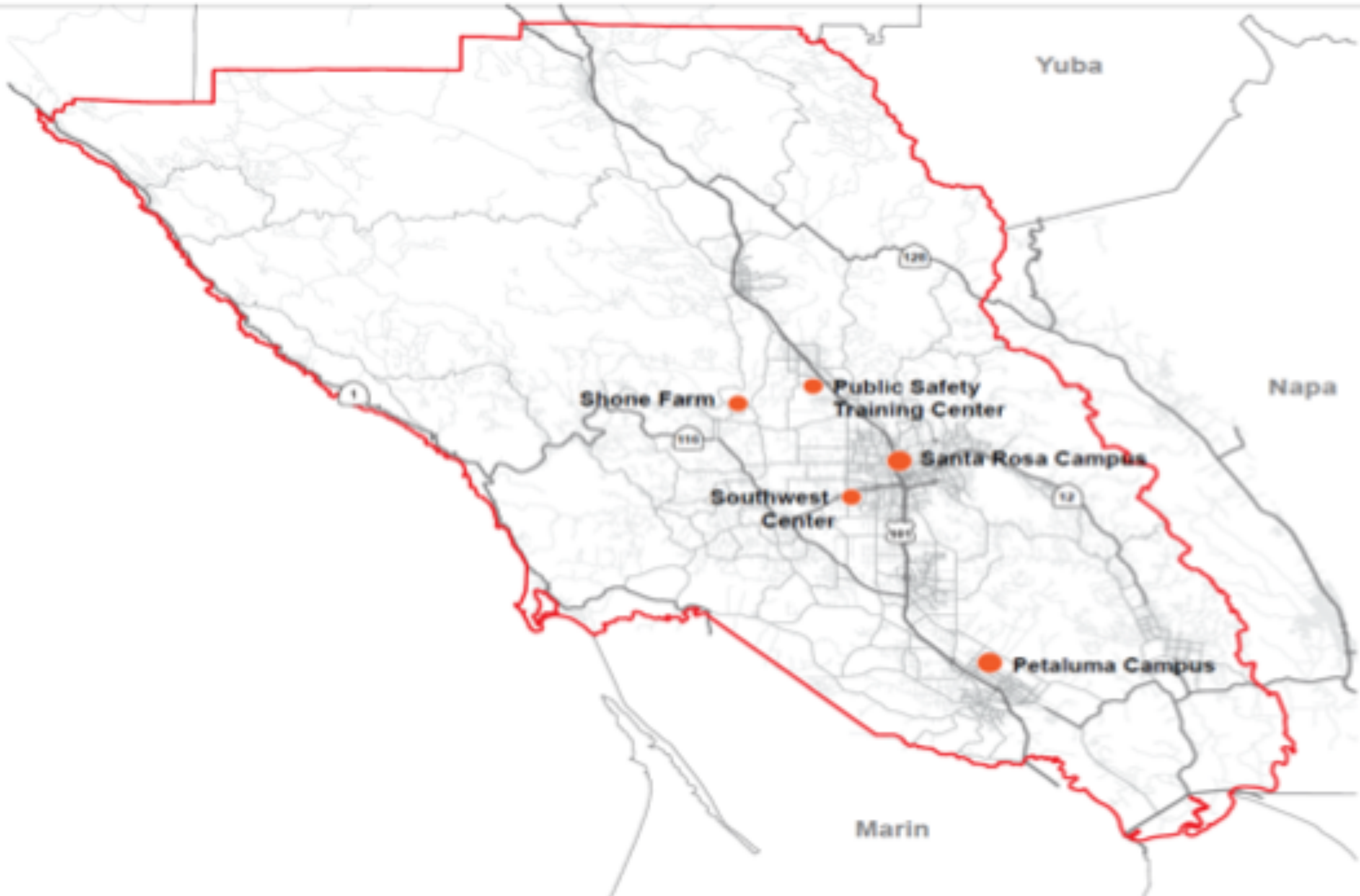
SRJC Urban Micro-grid Project

By David Liebman, Energy & Sustainability Manager, Sonoma County Junior College District

Sonoma County Junior College District



Goal E. Establishing a Strong Culture of Sustainability (Robert Ethington)

Establish a culture of sustainability that promotes environmental stewardship, economic vitality, and social equity.

- *Objective E1 - Expand, support, and monitor district-wide sustainability practices and initiatives;*
- *Objective E2 - Infuse sustainability across the curriculum and promote awareness throughout District operations;*
- *Objective E3 - Promote social and economic equity in the communities we serve;*
- *Objective E4 - Ensure economic sustainability by leveraging resources, partnering with our communities, and contributing to the economic growth of the region.*

SCJCD ZERO NET ENERGY DISTRICT (SOURCE)

Vision Plan - 2030 Energy and Water Goals

The Vision Plan is a masterplan that allows Sonoma County Junior College District to achieve as set of sustainability and other goals, i.e. the goals of the Vision Plan, as set out by the SCJCD 2030 committee.

This report is focused on the energy and water use reduction and efficiency goals of the Vision Plan, and how to achieve them. The Vision Plan aims to achieve the following energy and water use goals by the year 2030:

- Zero-Net Energy (ZNE) operation by 2030
- Carbon Neutral operation by 2030
- Zero-Net Non-Potable Water ready by 2030
- Maximize the use of non-potable water at the campus and building level by using available alternate water sources for toilet and urinal flushing, and landscape irrigation, and process cooling.

The Story So Far

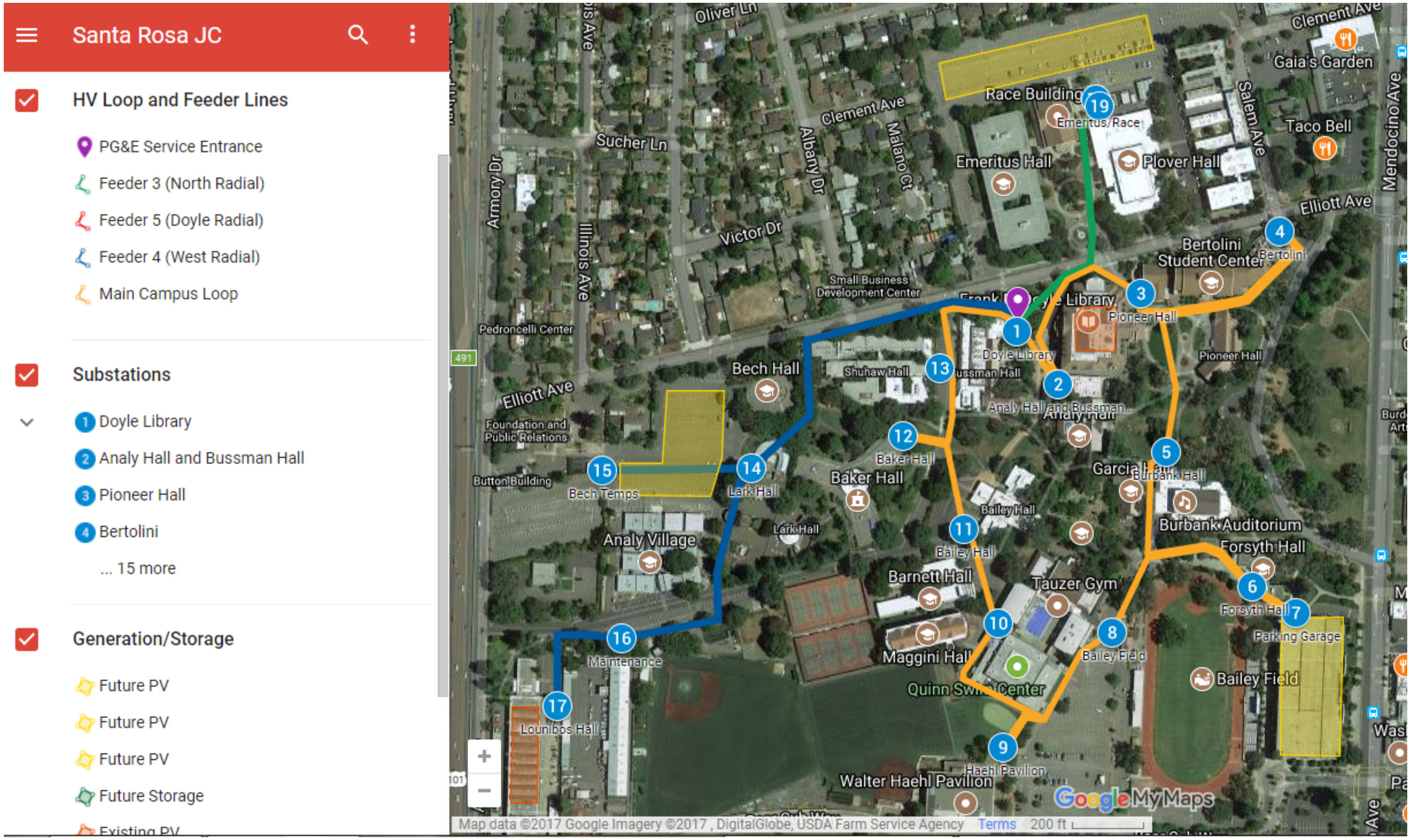
- Needed Funds for ambitious Goals. “Sustainability Can save the Budget!”
- Combined was able to gather $32.5 million dollars in Measure H funding along with Prop 39 funds, and Schedule Maintenance Dollars to pay for deep green projects, put us on track to reach our sustainability goals
- Led Upgrades, new central plant, geothermal condensing loop, solar.

SRJC Micro-Grid Project

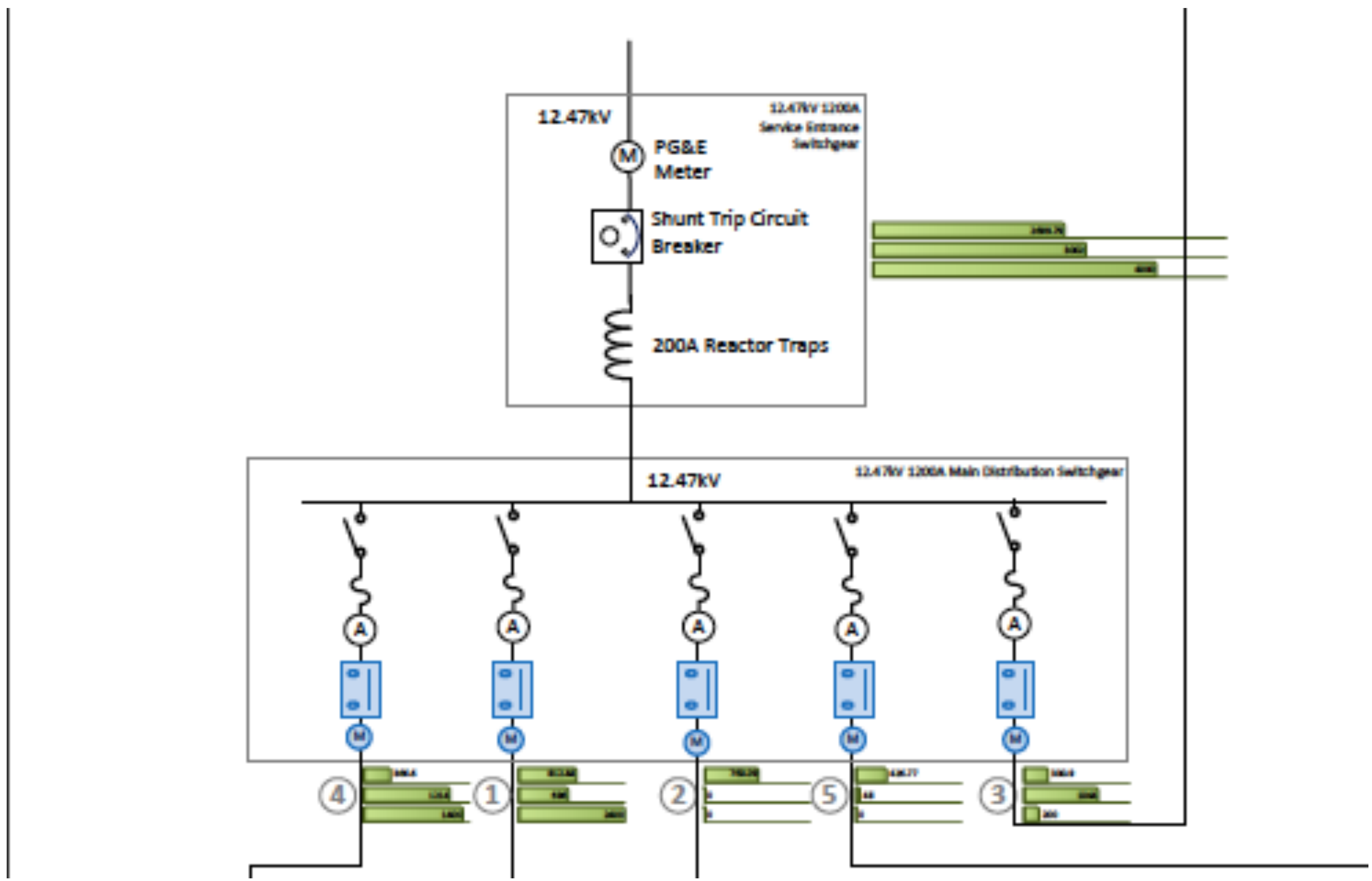
- Beat 33 of 36 proposals!
  - #2 = 93.25, #3 **SRJC = 89.00**, #4 = 86.25
  - Group 1 = 16, Group 2 = 11, **Group 3 = 36**
- Primary application (not Option 1)
- $5M funding combined with $14.4M for combined $19.4M Solar & battery Storage Micro-grid Project

Process

- Map out electrical infrastructure and Point of Common Coupling (PG&E meter and main breaker)



- Identify each building's electrical load and generation assets. Use Campus electrical meter and code based analysis per square footage if you don't have individual building submeters



- Match load to generation
- Come up with a load shedding strategy
- Identify buildings or building systems in priority from highest to lowest

	Monthly Energy (MWh)			Monthly Power (MW)		
Resource	**Average**	**Low**	**High**	**Average**	**Low**	**High**
TOTAL CAMPUS						
Building loads, total	**-863**	-574	-1109	**1.184**	900	**2.891**
Building loads, sheddable						
PV	**350**	176	502	**2.207**		
Storage	**4.0**			**2.000**		
% Percent generation of current load	-40.52%					
with fututre lighting reduction	-707					
future HVAC improvements (VFD's) c	-621					

Avg Daily Load (kW)	Adjusted Avg Peak (kW)	PV Power (kW)	Elect. Storage Power (kW)	Normalized Load kWh/yr	PV Generatio n (kWh/yr)	Normalized Load kWh/day	PV Generation (kwh/day)	Electricity Storage (kWh)
			-	0	-	0	-	-
			1,000.0	0	-	0	-	2,000.0
		1,044.0		0	1,537,486.	0	4,209.4	
20.3	46			**177,779**	-	**487**	-	
37.4	85			**327,457**	-	**897**	-	
41.8	96	170.0		**366,800**	250,357.0	**1,004**	685.4	
0.7	1.5			**5,730**	-	**16**	-	
0.8	1.7			**6,592**	-	**18**	-	
139.9	320	48.0		**1,226,726**	70,689.0	**3,359**	193.5	
1,181	2,700	3,002.0	3,000.0	**10,351,851**	**4,421,009**	**28,342**	**12,104**	**3,000**

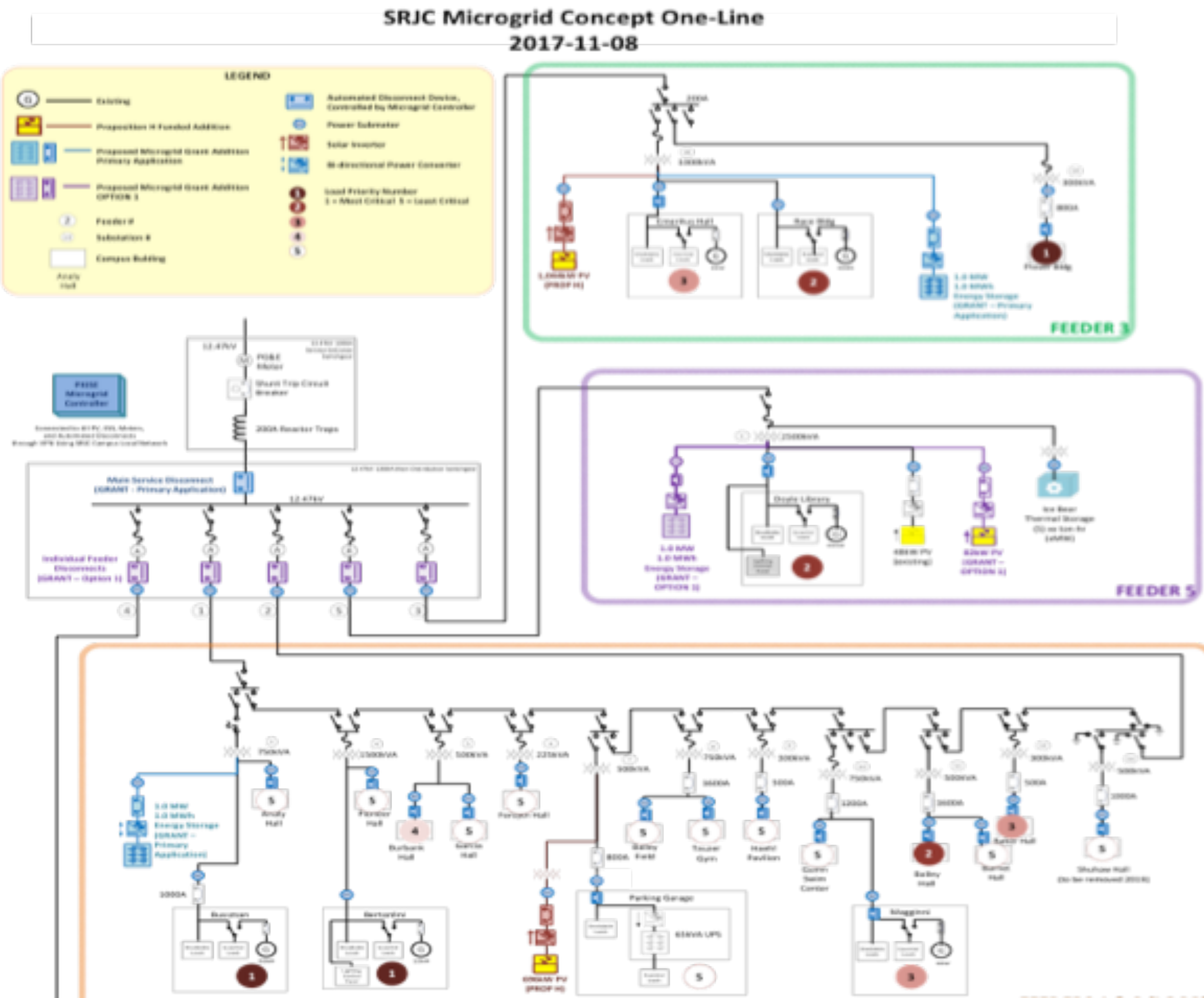
SRJC Micro Grid

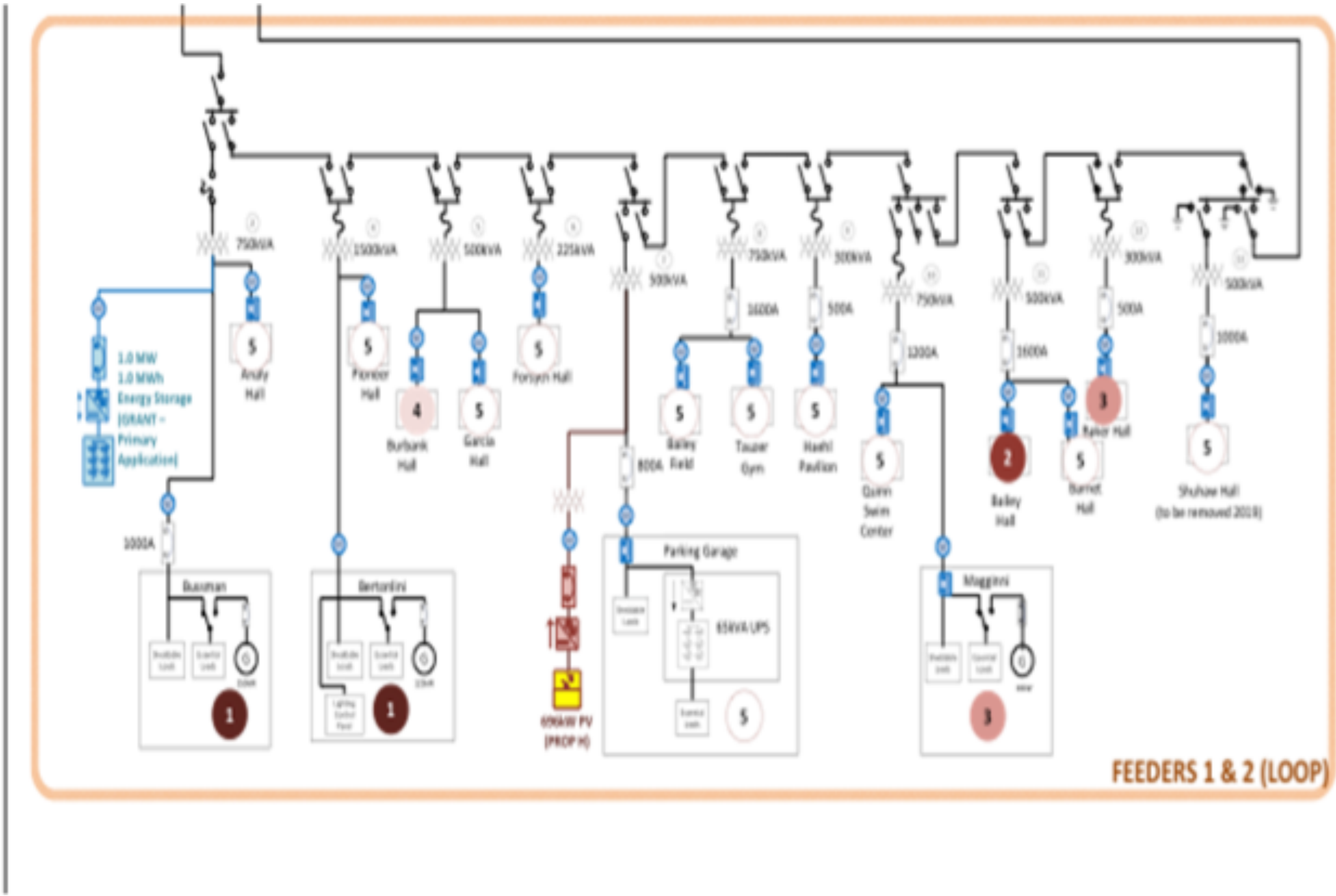
- **<u>Existing Infrastructure</u>**
- 5 Feeders owned by SRJC, single point of interconnection w/ PG&E
- 218kW PV in 2 locations
- Backup DG
- Total site load: 800kW to 2.6MW

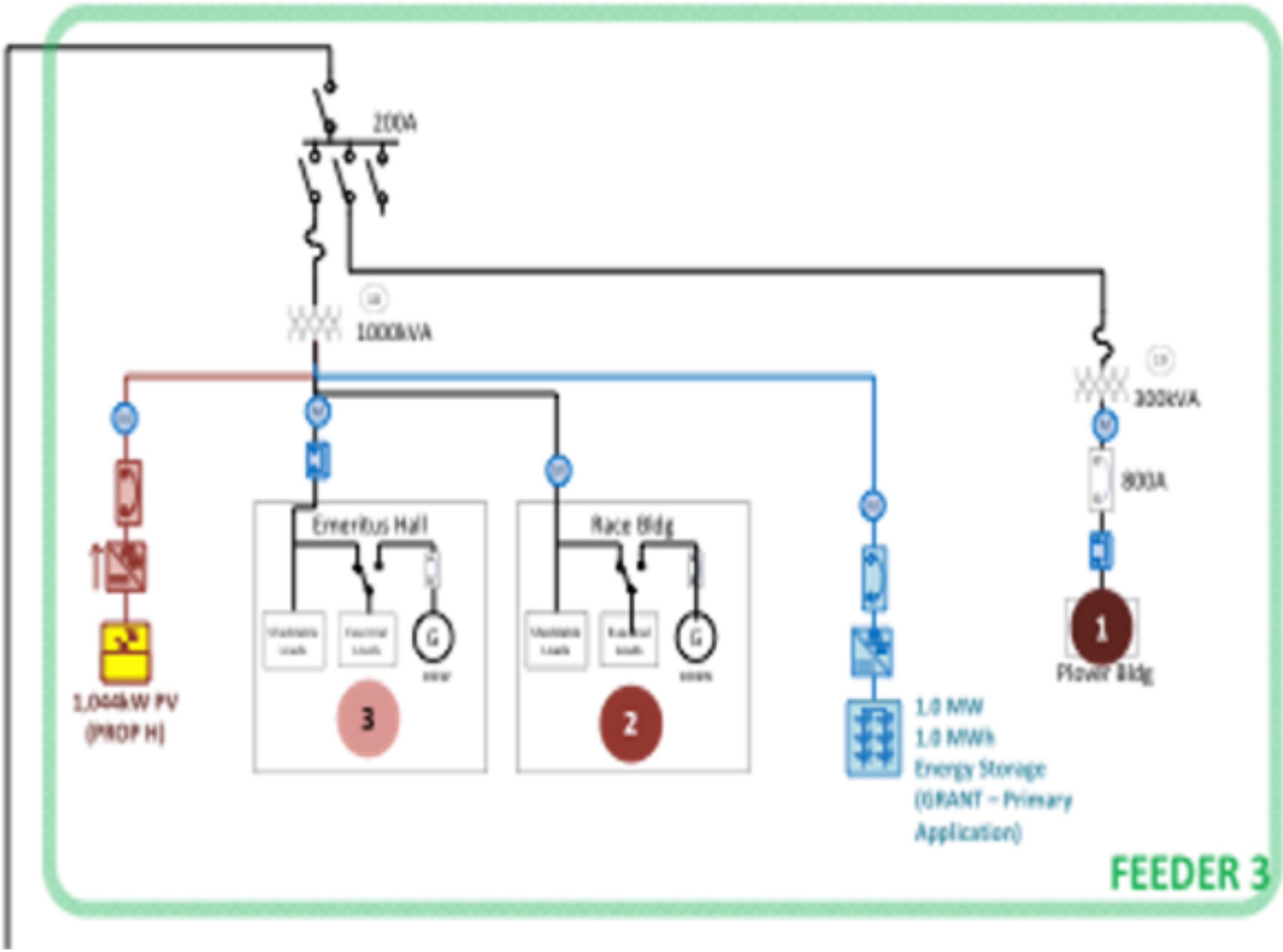
- **<u>Planned DER's</u>**
- 2.7MW of PV, distributed on 3 feeders
- 1MW, 2MWh Energy storage on feeder 3

- **<u>Proposed Grant Additions</u>**
- 2MW, 2MWh additional storage, in 2 locations
- Microgrid control (PXiSE) of DER's
- Intelligent load management & submetering
- Active feeder interconnection and separation

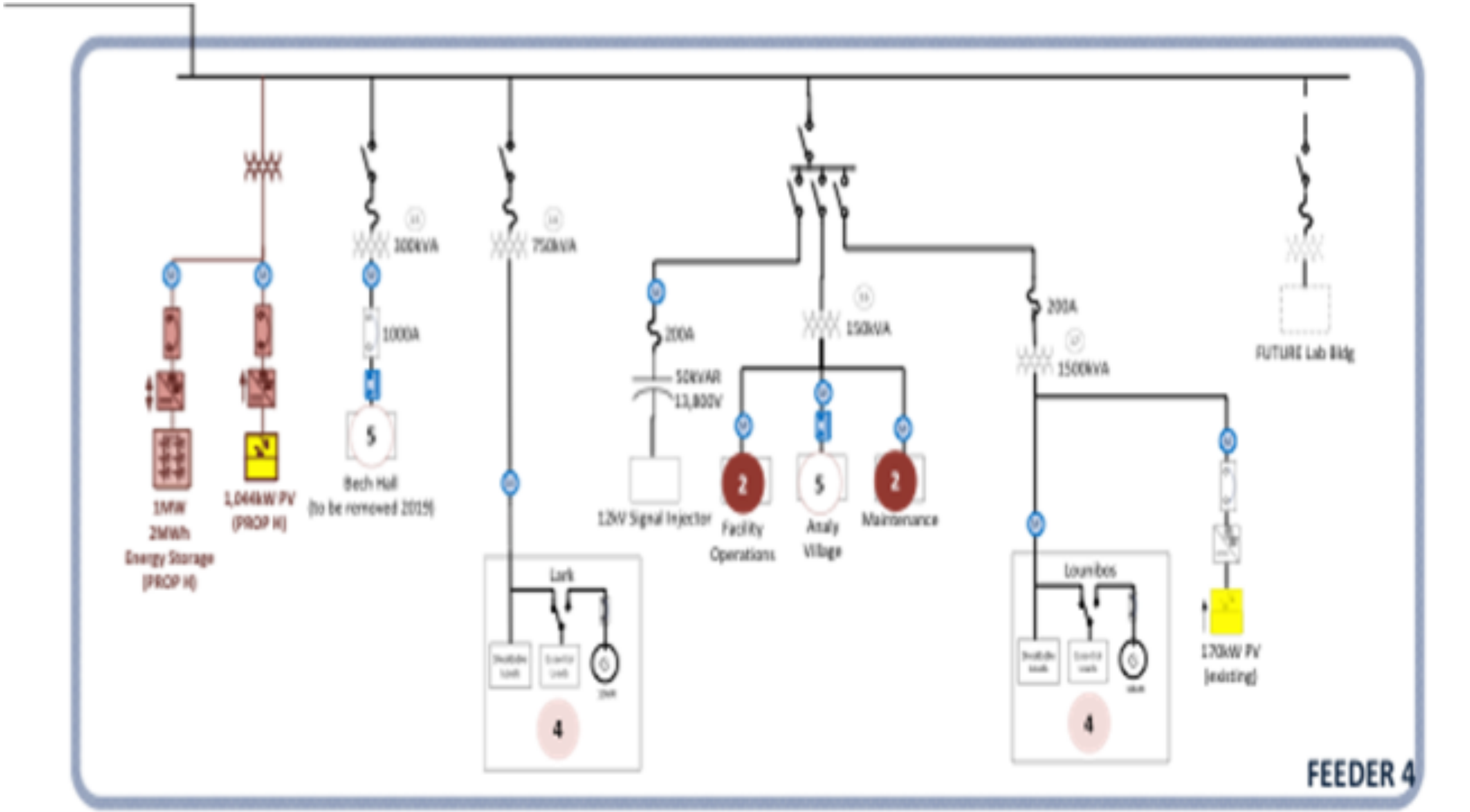
One line Diagram




750kVA
1500kVA
500kVA
225kVA
500kVA
750kVA
300kVA
750kVA
500kVA
300kVA
500kVA
1.0 MW
1.0 MWh
Energy Storage
(GRANT –
Primary
Application)
Andy
Hall
Pioneer
Hall
Burbank
Hall
Garcia
Hall
Forsyth Hall
1600A
500A
1200A
1600A
500A
1000A
Bailey Field
Tauzer
Gym
Hashi
Pavilion
Quinn
Swim
Center
Bailey
Hall
Barnet
Hall
Baker Hall
Shuhaw Hall
(to be removed 2018)
800A
1000A
Bussman
Bertolini
Parking Garage
65kVA UPS
Magginni
696kW PV
(PROP H)
FEEDERS 1 & 2 (LOOP)



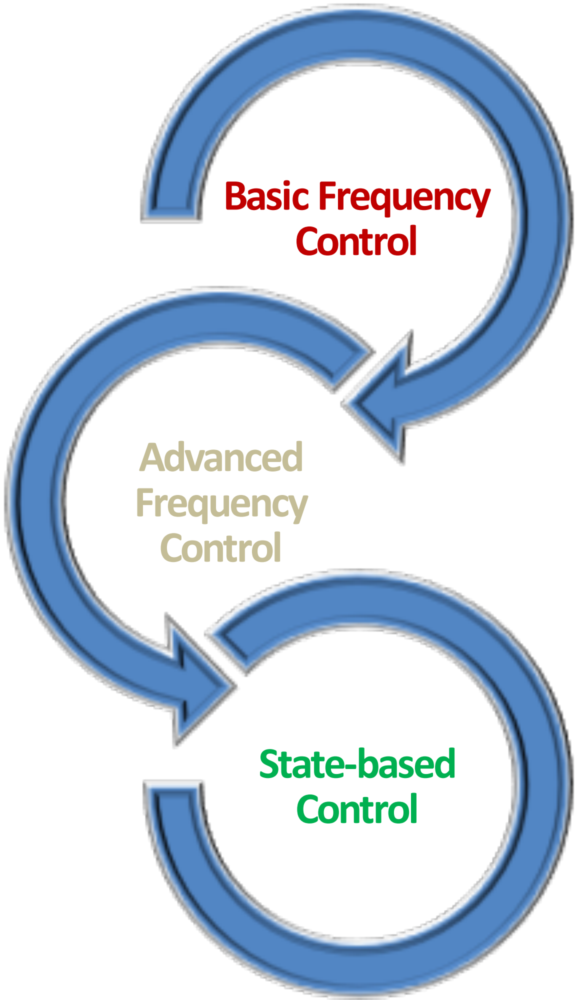
200A
1000kVA
300kVA
800A
Emeritus Hall
Race Bldg
3
2
1
Plover Bldg
1,044kW PV
(PROP H)
1.0 MW
1.0 MWh
Energy Storage
(GRANT – Primary
Application)
FEEDER 3


300kVA
750kVA
150kVA
1500kVA
1000A
200A
200A
50kVAR
13,800V
1MW
2MWh
Energy Storage
(PROP H)
1,044kW PV
(PROP H)
Bech Hall
(to be removed 2019)
Lark
12kV Signal Injector
Facility
Operations
Analy
Village
Maintenance
Lounibos
170kW PV
(existing)
FUTURE Lab Bldg
FEEDER 4

Configuration

- Control algorithm designed specifically for grid control
  - Voltage angle tracking
  - Event detection
  - Optimization
  - Asset management
- Scalable
  - DERs can be added or removed
- Objectives can be changed as environment changes
- Off the shelf hardware

PXiSE's High-speed and Precision Control Capabilities Enable electric Grids to Reach Any % of Renewables



Renewables	Requirements
Up to 40%	➢ Require 24/7 minimum combustion generation ➢ Use energy storage as backup
Up to 70%	➢ Power battery as primary frequency control & energy battery for storage ➢ Coordinate startup / shutdown of combustion generation
Up to 100%	➢ Phasor data at key nodes for 'state measurements" ➢ State dispatch analysis and scheduling

Benefits

- Additional annual cost savings to the district **($48,370.18 yr)** Participation in PG&E's demand response programs **($26 - $48,000.00 yr**)
- Potential new value added revenue streams (Frequency Regulation and Voltage Control as a service or load enabling in negative Price Hotspots)
- Proposal includes allocation of dollars for developing Trade specific knowledge on Micro-grids and curriculum around installation, operation, and maintenance.
- Improve emergency operations by preventing power outages – importance demonstrated even more with the recent fires
- First large scale commercial micro-grid in Sonoma County (100% based on renewable energy)
- Benefits to capital planning for deciding now which feeders should solar and loads now be on to maximize infrastructure benefits and micro-grid functionality

Electrification

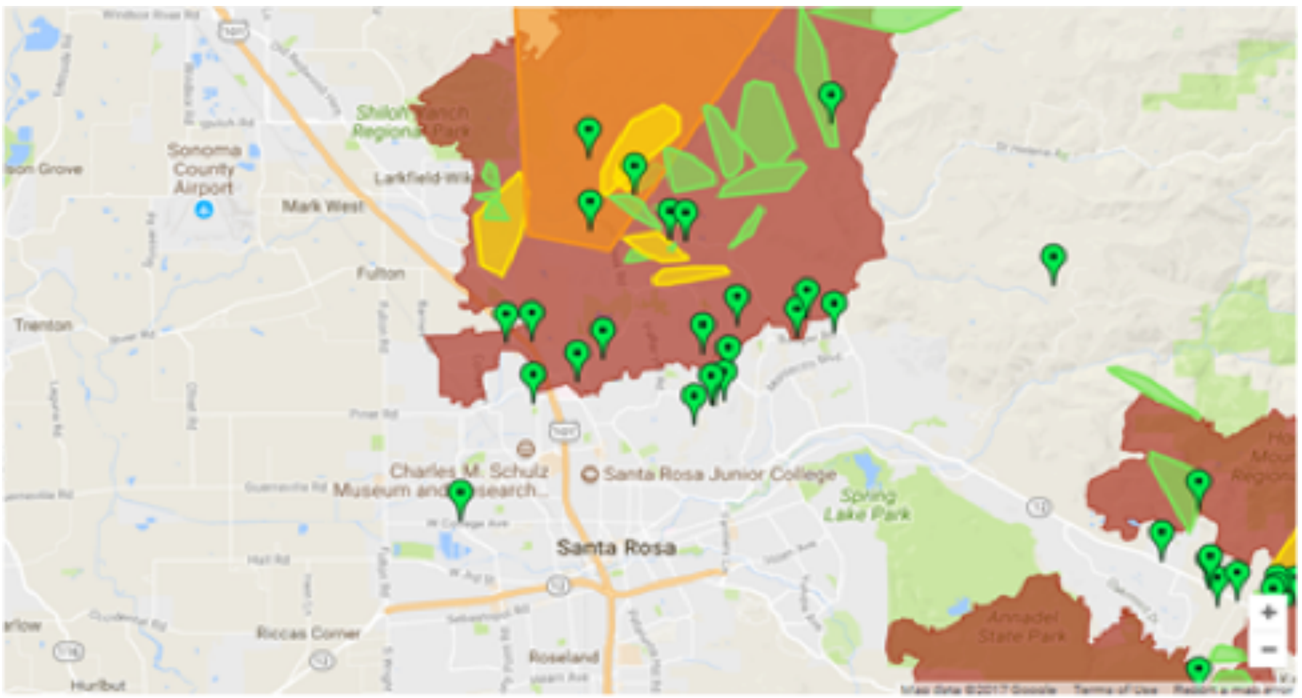
- By creating a system where you are now matching load, generation and storage for self sufficiency you begin to incentivize electrification to cover cost
- Cost of Gas per KBTU is **$0.012**
- Cost of Electricity is **$0.046** (4 times the cost of Gas per KBTU)
- But Demand charge is about **38%** of cost per KBTU and Peak Kwh is around **46%**.
- Utilizing Microgrid capabilities we could significantly change the cost of electricity which can help make electrification a more cost effective option
- Important connect with Electric Vehicles and how micro-grids can interact with vehicle to grid technology. Help the grid mitigate the future effects of more and more electric vehicles on the grid.
- You can pass lower electricity costs down to consumers or charge normal rate and recoup costs.

Code lessons So Far

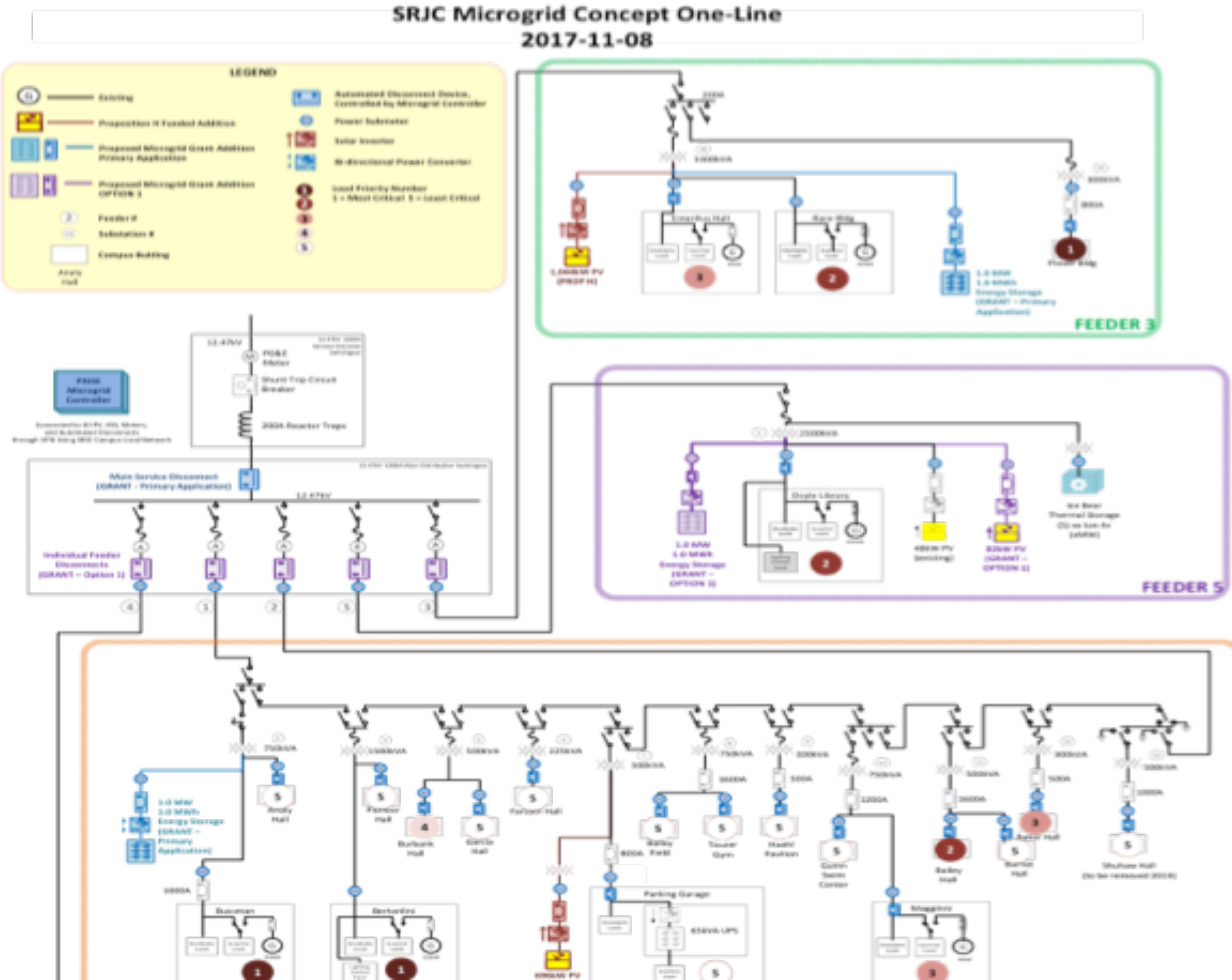
- Fire Life Safety Code for NFPA & NEC doesn't account for Microgrid
- Microgrid Power can be used for everything except Tier one Fire Life Safety Items
- Copied Richmond Kaiser Hospital Strategy (House, Microgrid, em gen power)
- Code allows Tier 1 power to come from approved EM power sources or Reliable Public Utility Connection (potential way for functioning Microgrid to provide these services to tier 1) if it can be approved as a reliable public utility connection

Resiliency

PG&E Wildfire and Outage Map, October 19, 2017



How we prioritized buildings



- Looking at using Cal-Adapt Tool for modeling information
- How do we generate a cost associated with resilience and adaptation?
- Fire days and Floods are becoming a thing in Sonoma County so how do we design for ventilation during fires, PG&E Wildland Fire Program, increase in CDD, and high intensity rainfall

Risks

- New technology and there could be some glitches in software which could effect PV and Battery usage. (Less cost savings)
- The battery storage is all commercially ready but is also newer technology so the risk is on battery maintenance and lifetime of equipment.
- Could send out a faulty signal which could shutdown a building. At which point someone from facilities will have to energize the building.
- Long project duration with CEC. From Jun 2018 - Jun 2022 if awarded grant.
- The battery storage technology is about the size of 4 parking spots. So finding appropriate space for the batteries (2 of them) that is not effecting parking.

The Role of Microgrids at a California Seaport

Christine Houston

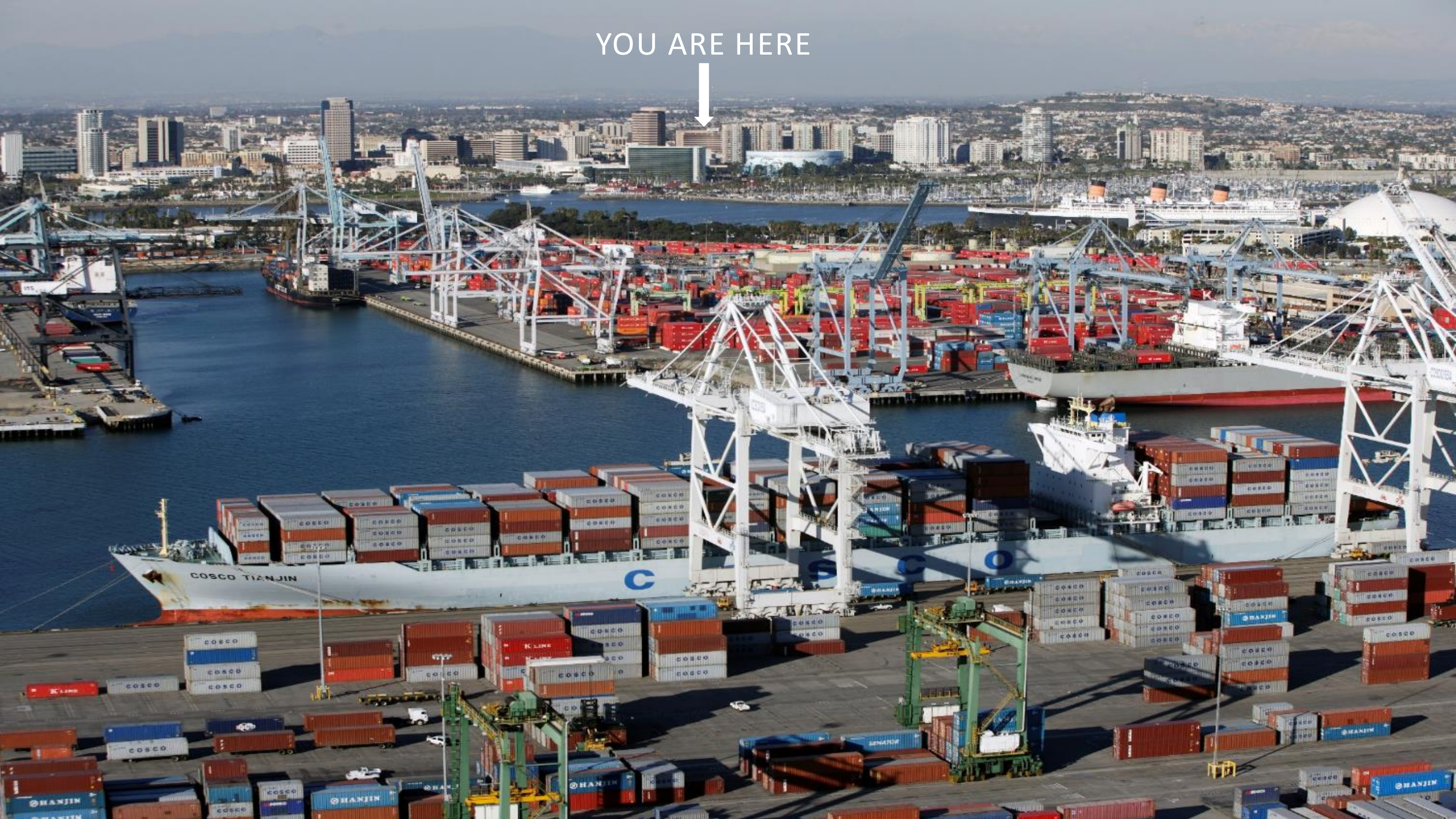
Manager of Sustainable Practices

The Port of Long Beach


ZPMC
LBCT


13:54:54
Live Recorded Alarms Investigation
SMP 6
DELL

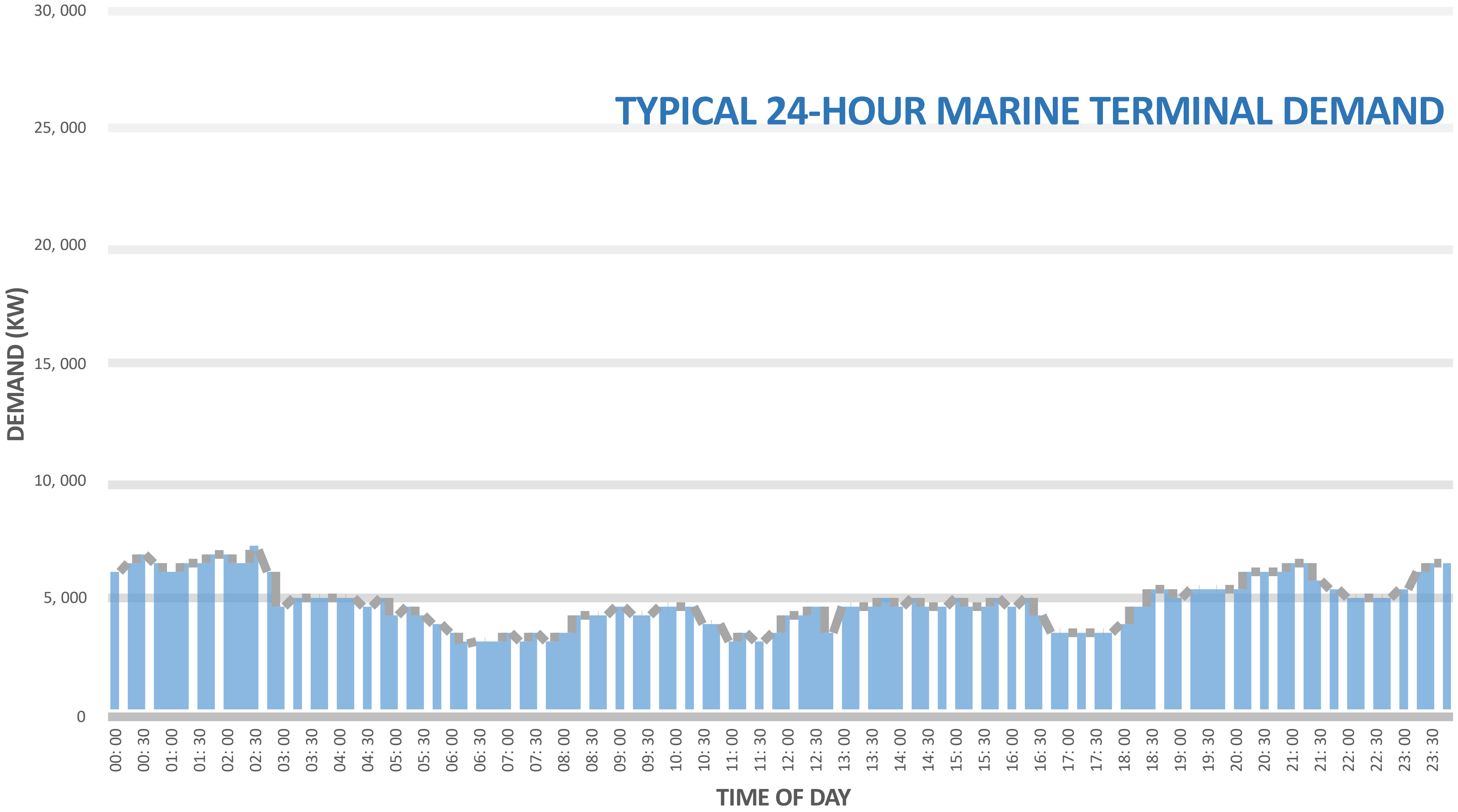

AGENCY REPS
ADMIN/FINANCE
PLANNING
COMMAND


YOU ARE HERE
COSCO TIANJIN

2017 CLEAN AIR ACTION PLAN GOALS:

ZE marine terminals by 2030

ZE on-road trucks by 2035



TYPICAL 24-HOUR MARINE TERMINAL DEMAND
DEMAND (KW)
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15, 000
10, 000
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00: 00
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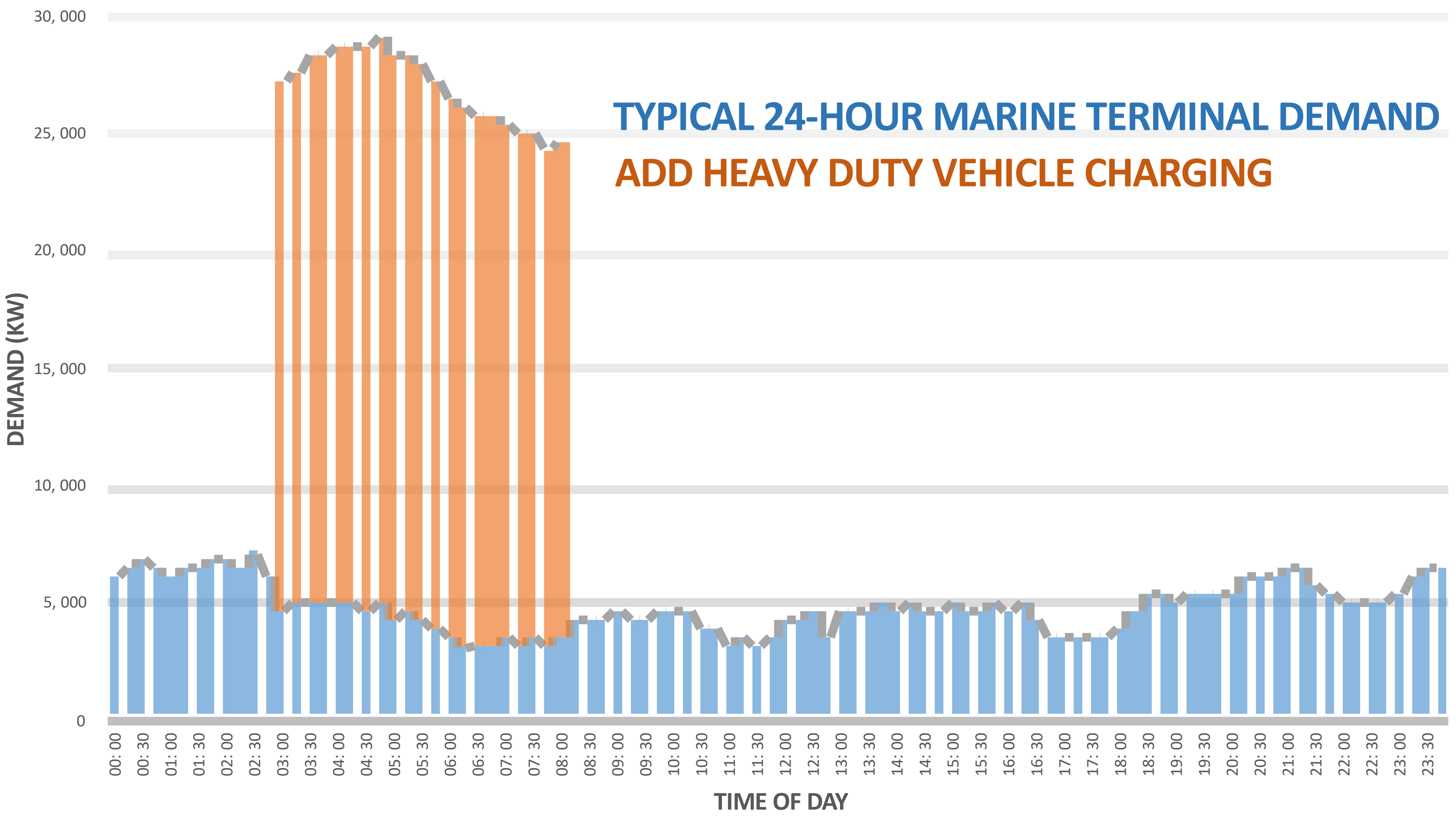
23: 00
23: 30
TIME OF DAY



TYPICAL 24-HOUR MARINE TERMINAL DEMAND
ADD HEAVY DUTY VEHICLE CHARGING
DEMAND (KW)
30, 000
25, 000
20, 000
15, 000
10, 000
5, 000
0
00: 00
00: 30
01: 00
01: 30
02: 00
02: 30
03: 00
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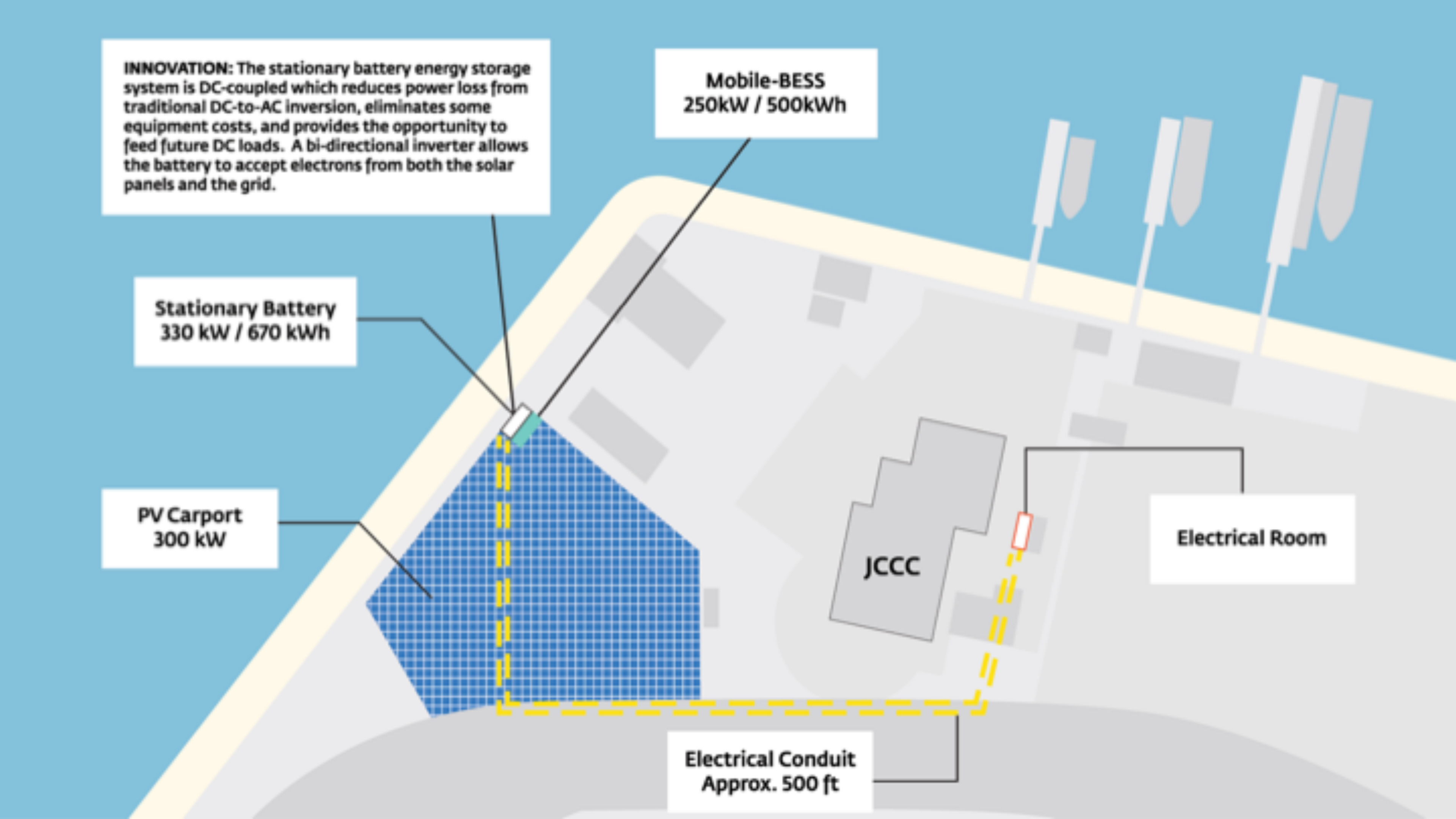
23: 30
TIME OF DAY


INNOVATION: The stationary battery energy storage system is DC-coupled which reduces power loss from traditional DC-to-AC inversion, eliminates some equipment costs, and provides the opportunity to feed future DC loads. A bi-directional inverter allows the battery to accept electrons from both the solar panels and the grid.
Mobile-BESS
250kW / 500kWh
Stationary Battery
330 kW / 670 kWh
PV Carport
300 kW
JCCC
Electrical Room
Electrical Conduit
Approx. 500 ft

OUTSIDE FUNDING CONSIDERATIONS

Port of LONG BEACH

PRO:

- "Free" money
- Legitimizes project
- Lowers risk to demonstrate emerging technology
- Incentivizes delivery schedule
- Boosts organization's visibility

CON:

- Administrative burden
- Rigid project scope
- Budget changes
- Possibility that demonstration isn't successful
- Long-term operation and maintenance costs

THANK YOU!