Clean Coalition

Making Clean Local Energy Accessible Now

Renewables-driven Data Centers

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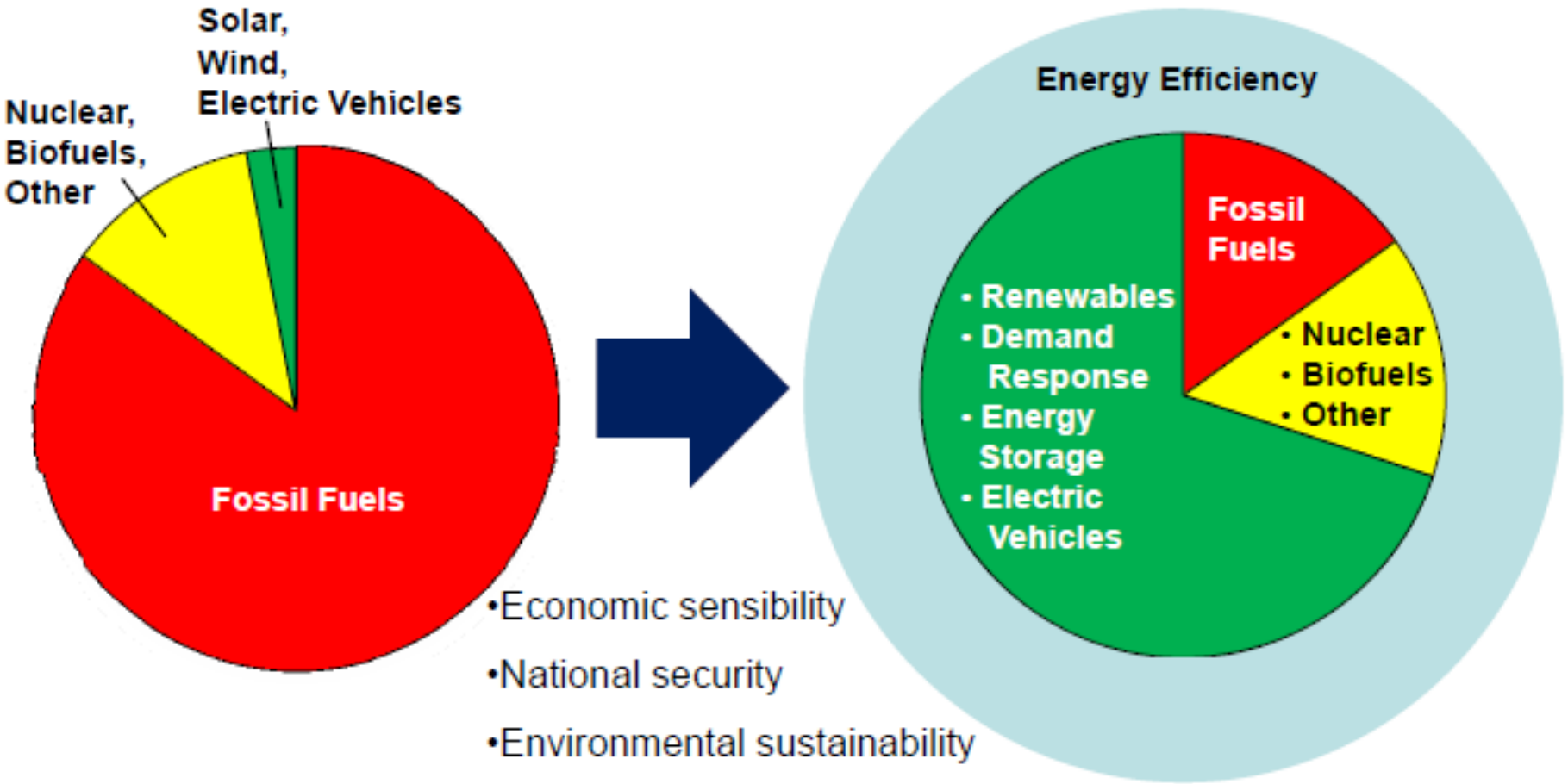
Clean Coalition (non-profit) Mission

To accelerate the transition to renewable energy and a modern grid through technical, policy, and project development expertise

Clean Coalition Vision



The $6 trillion energy market will transition to Smart Energy

WDG Unleashes Renewables

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Project Size

50+ MW

500 kW

5 kW

Wholesale DG

Serves Local Loads

Central Generation

Serves Remote Loads

Retail DG

Serves Onsite Loads

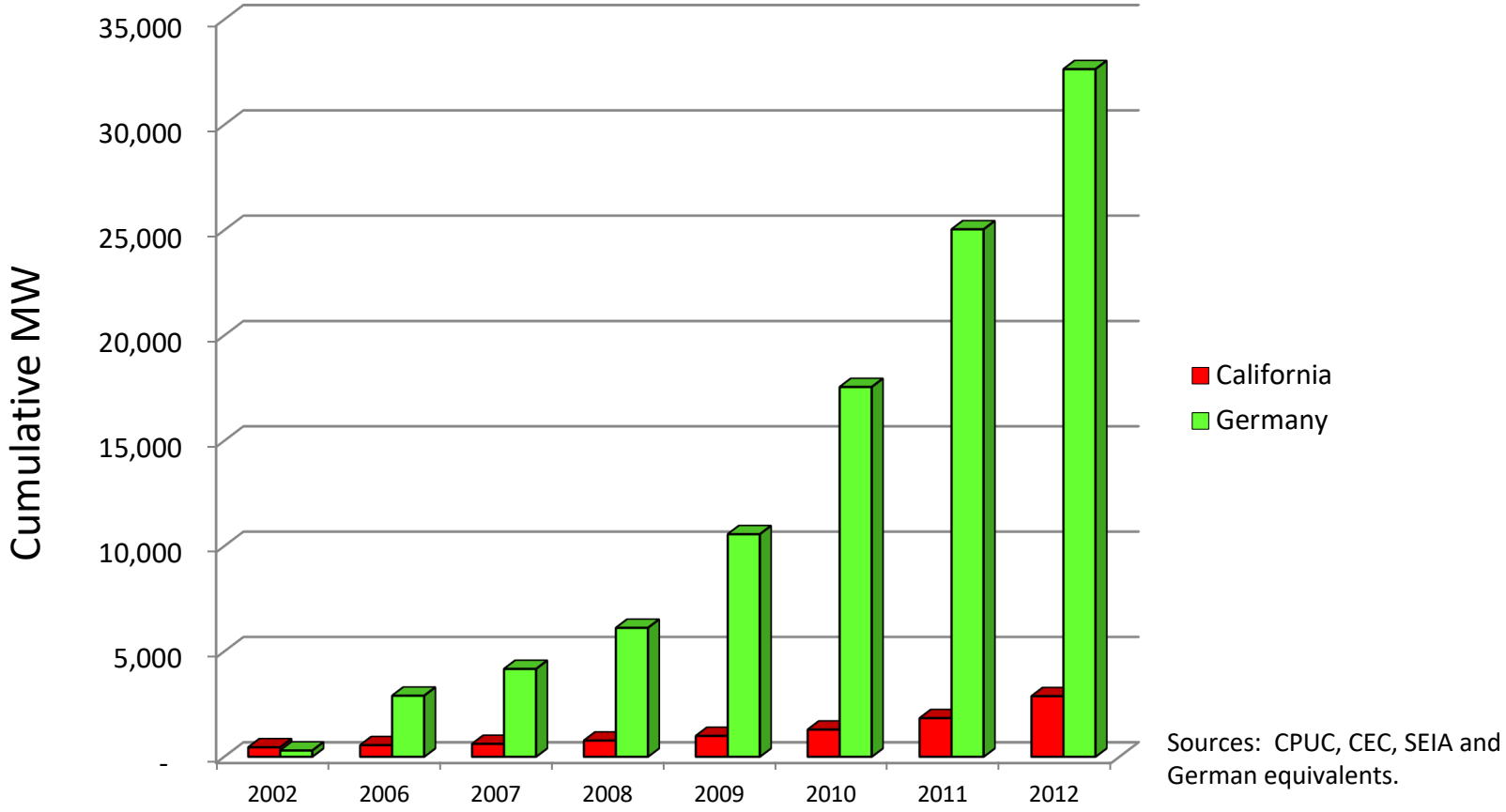
Behind the Meter

Distribution Grid

Transmission Grid

WDG Unleashed Solar in Germany

Solar Markets: Germany vs California (RPS + CSI + other)



Sources: CPUC, CEC, SEIA and German equivalents.

Germany deployed over 10 times more solar than California in the decade from 2002 despite California having 70% better solar resource

Community Microgrid Vision

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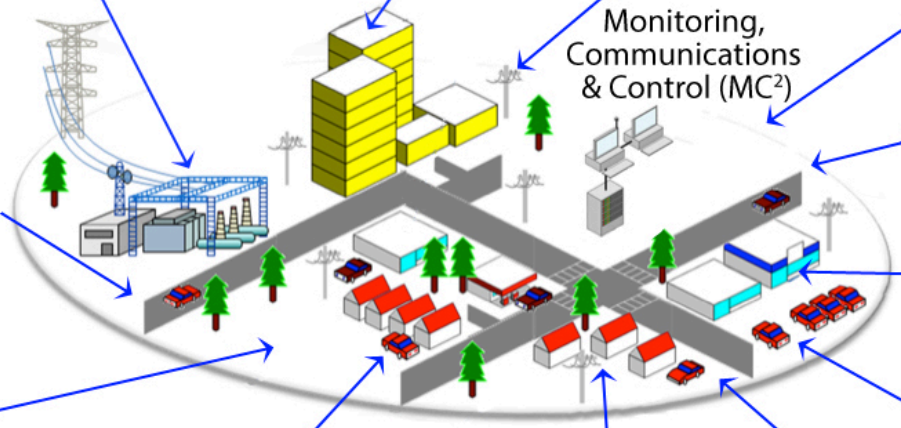
Grid Energy Storage

Distributed Generation

Switches & Power Electronics

Distributed Generation

Biopower Generation



Monitoring, Communications & Control (MC^2)

Energy Storage

Microturbine

Distributed Generation

Electric Vehicles (EV)

Home Energy System

Fuel Cells

Distributed Generation

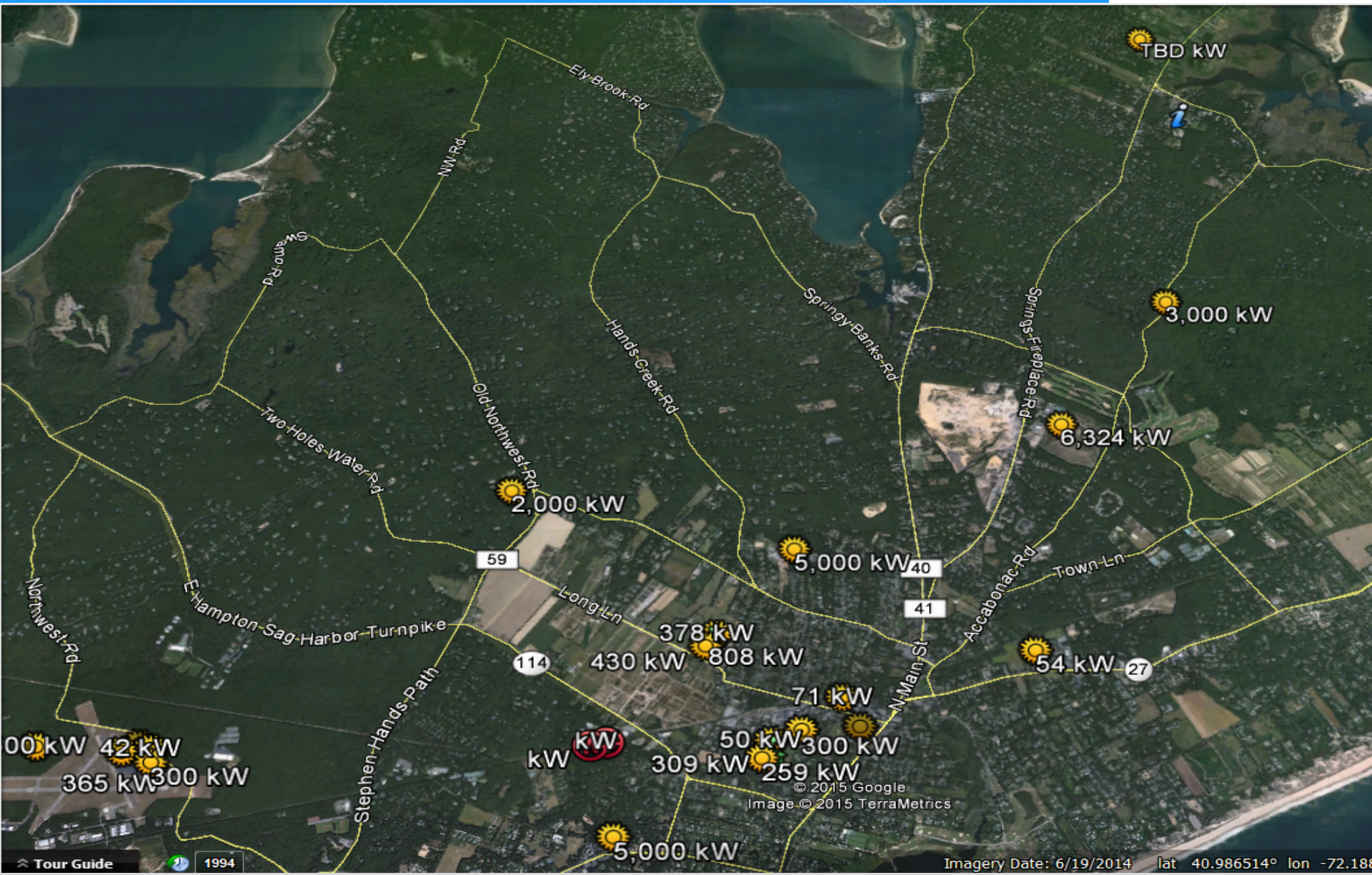
What is a Community Microgrid?

A Community Microgrid is a new approach for designing and operating the electric grid, stacked with local renewables.

Key features:

- A targeted and coordinated local grid area served by one or more distribution substations
- High penetrations of local renewables and other Distributed Energy Resources (DER) such as energy storage and demand response
- Staged capability for ongoing renewables-driven power backup for critical and prioritized loads across the grid area
- A solution that can be readily extended throughout a utility service territory – and replicated into any utility service territory around the world

Long Island Community Microgrid – Map View



Long Island Community Microgrid - Diagram

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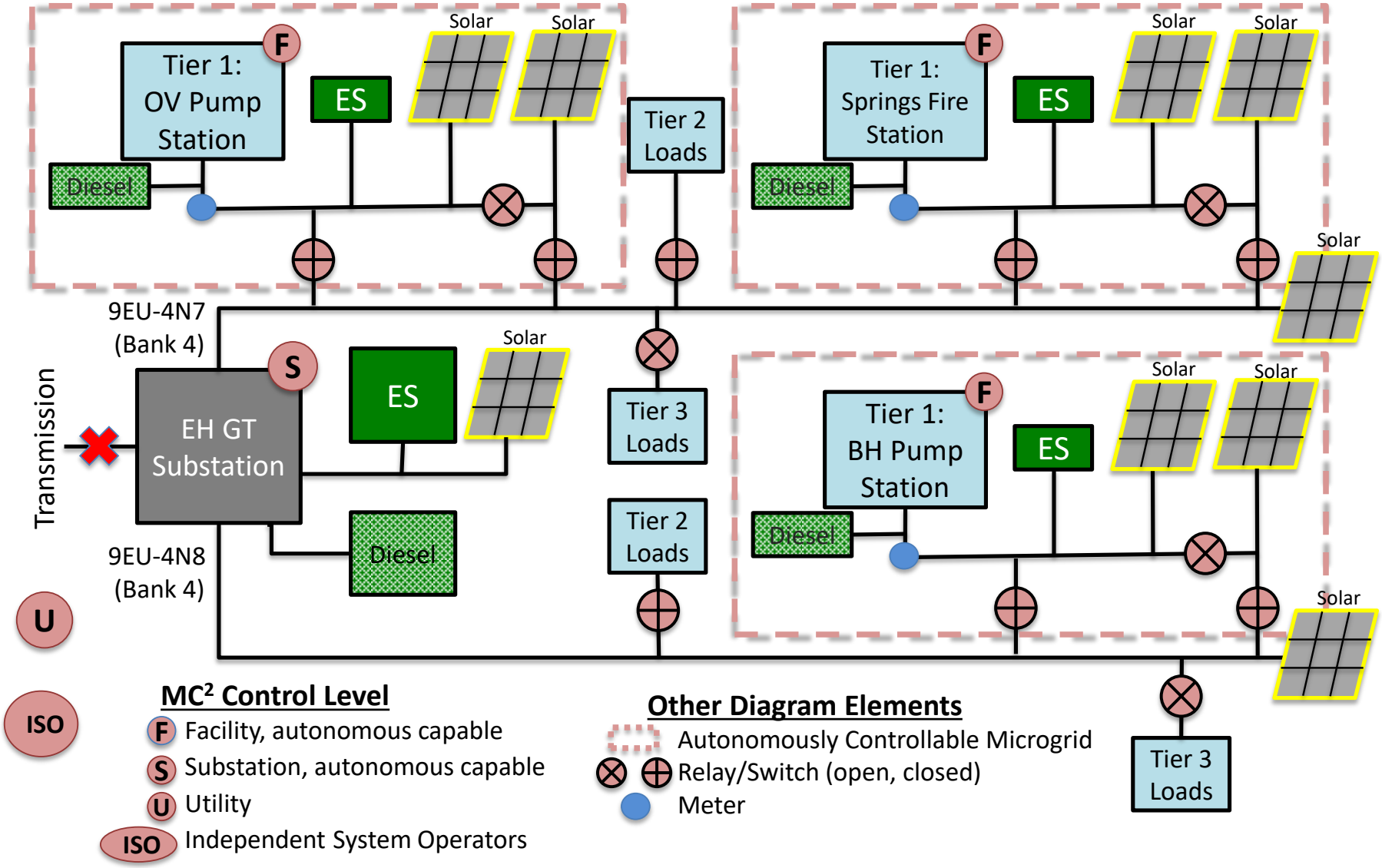


MC² Control Level

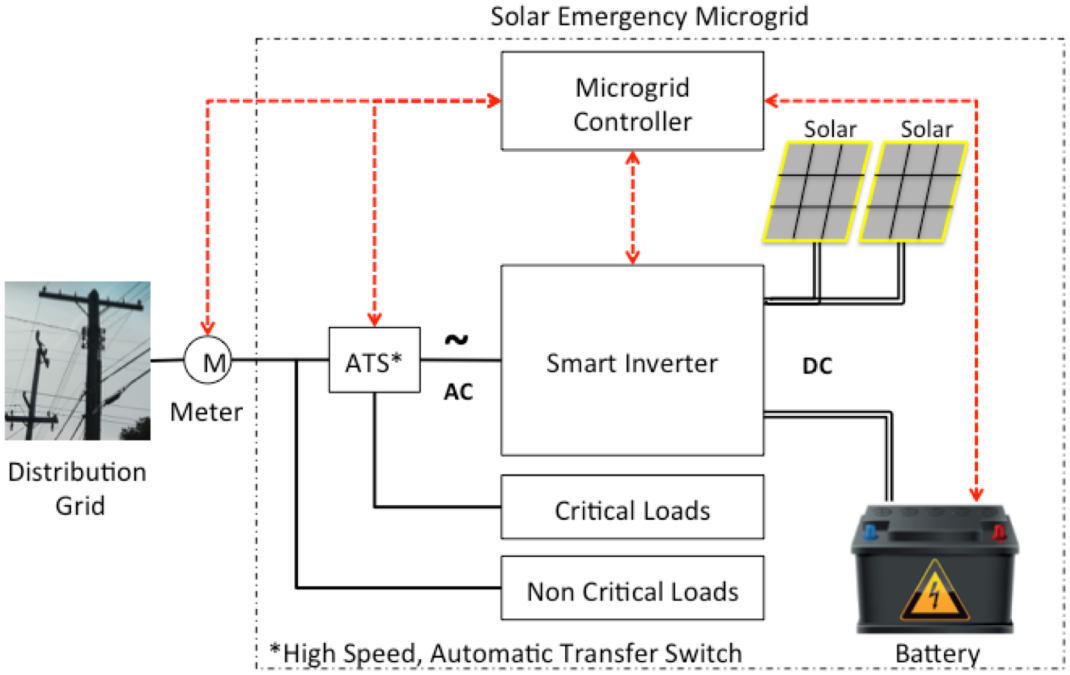
- F Facility, autonomous capable
- S Substation, autonomous capable
- U Utility
- ISO Independent System Operators

Other Diagram Elements

- Autonomously Controllable Microgrid
- Relay/Switch (open, closed)
- Meter

Solar Emergency Microgrid overview

- A Solar Emergency Microgrid (SEM) has 3 basic components:
  - Solar; energy storage; and monitoring, communications & control
- A SEM provides indefinite back-up power for critical loads
  - Ideal for police and fire stations, emergency operations centers and shelters, critical communications and water infrastructure, etc
- Displaces dirty, expensive, non-renewable diesel generators



UCSB Community Microgrid – Area Map

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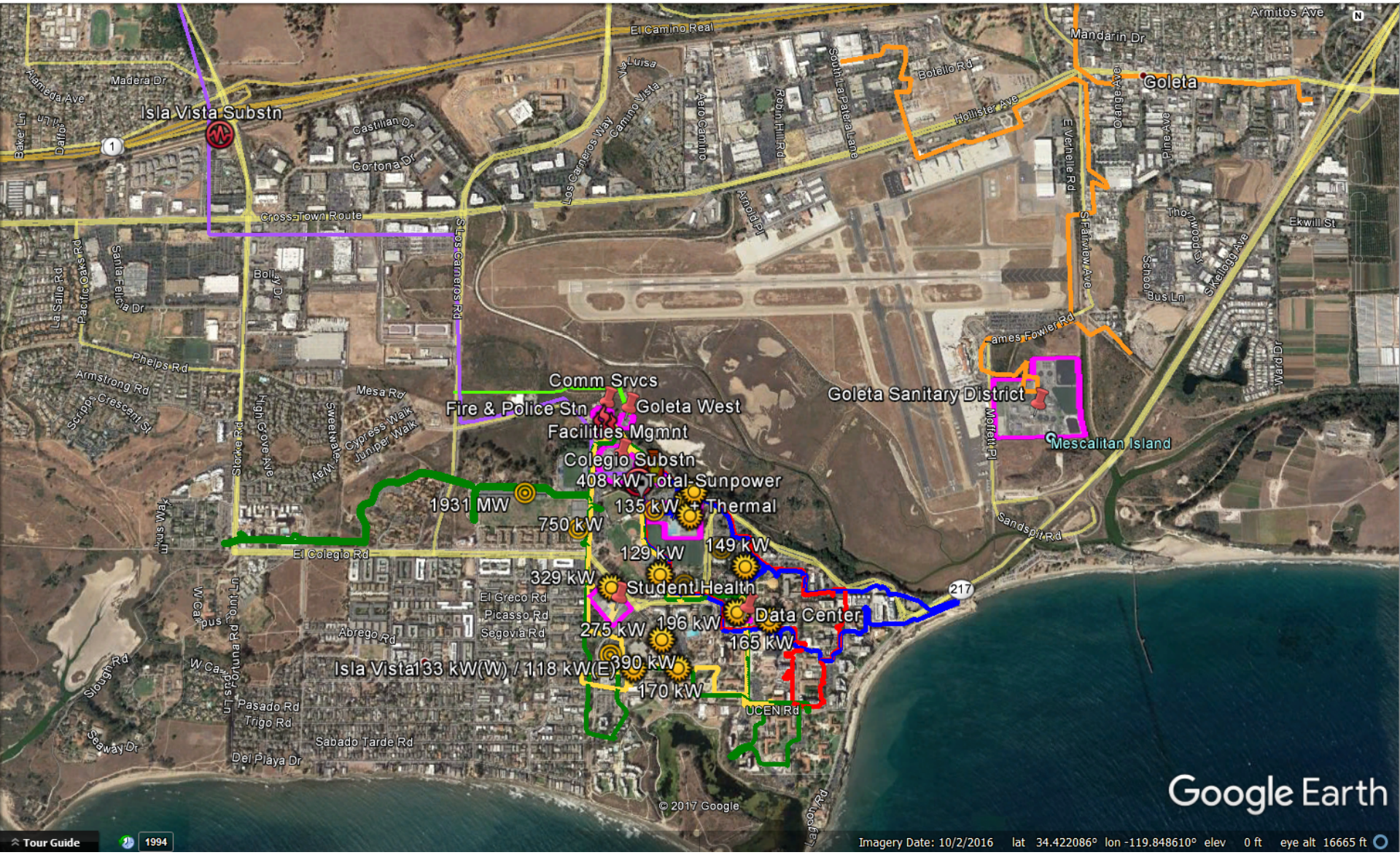

UCSB Community Microgrid – Phase 1

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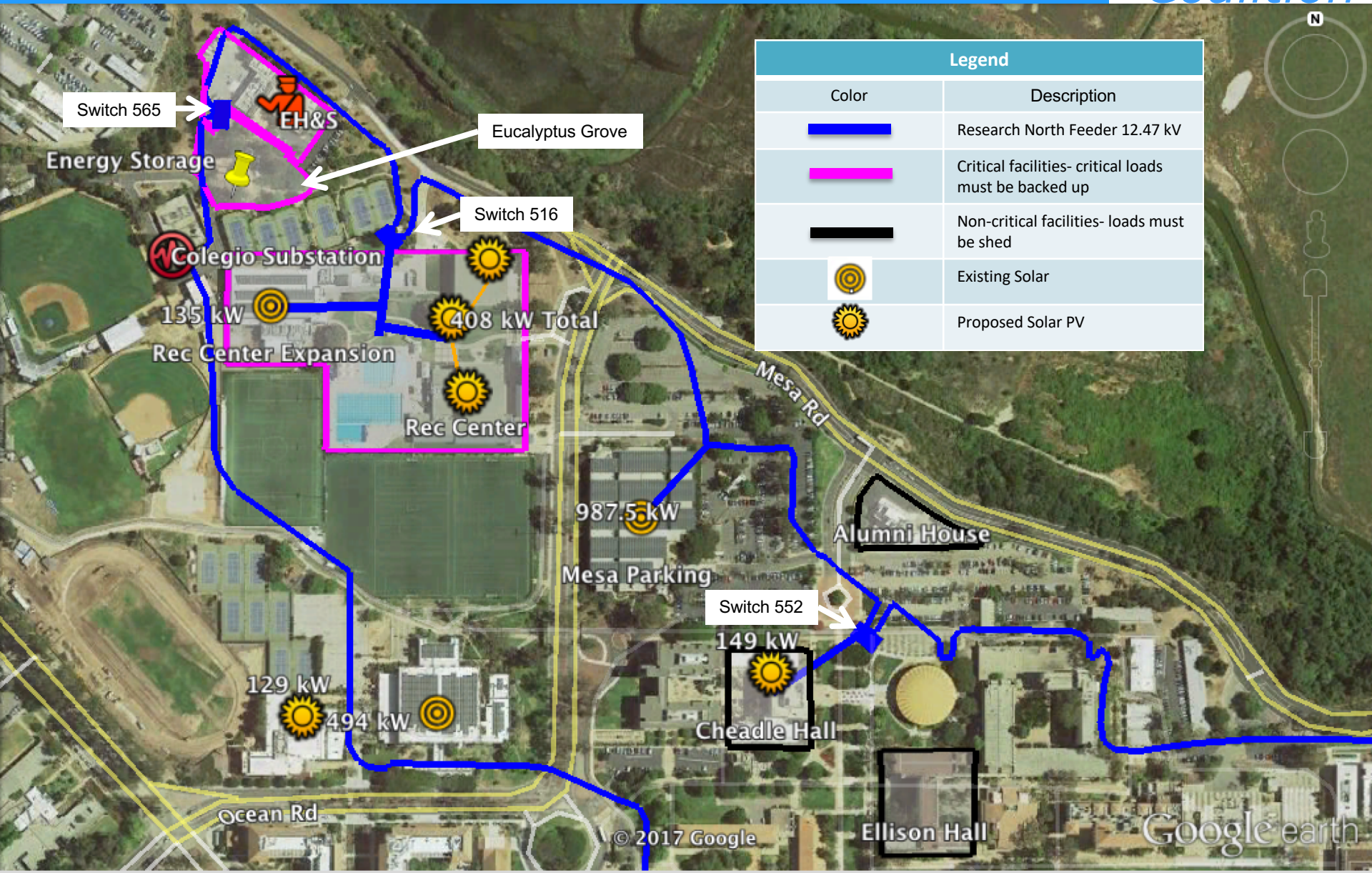

UCSB Community Microgrid – Phase 1 + 2

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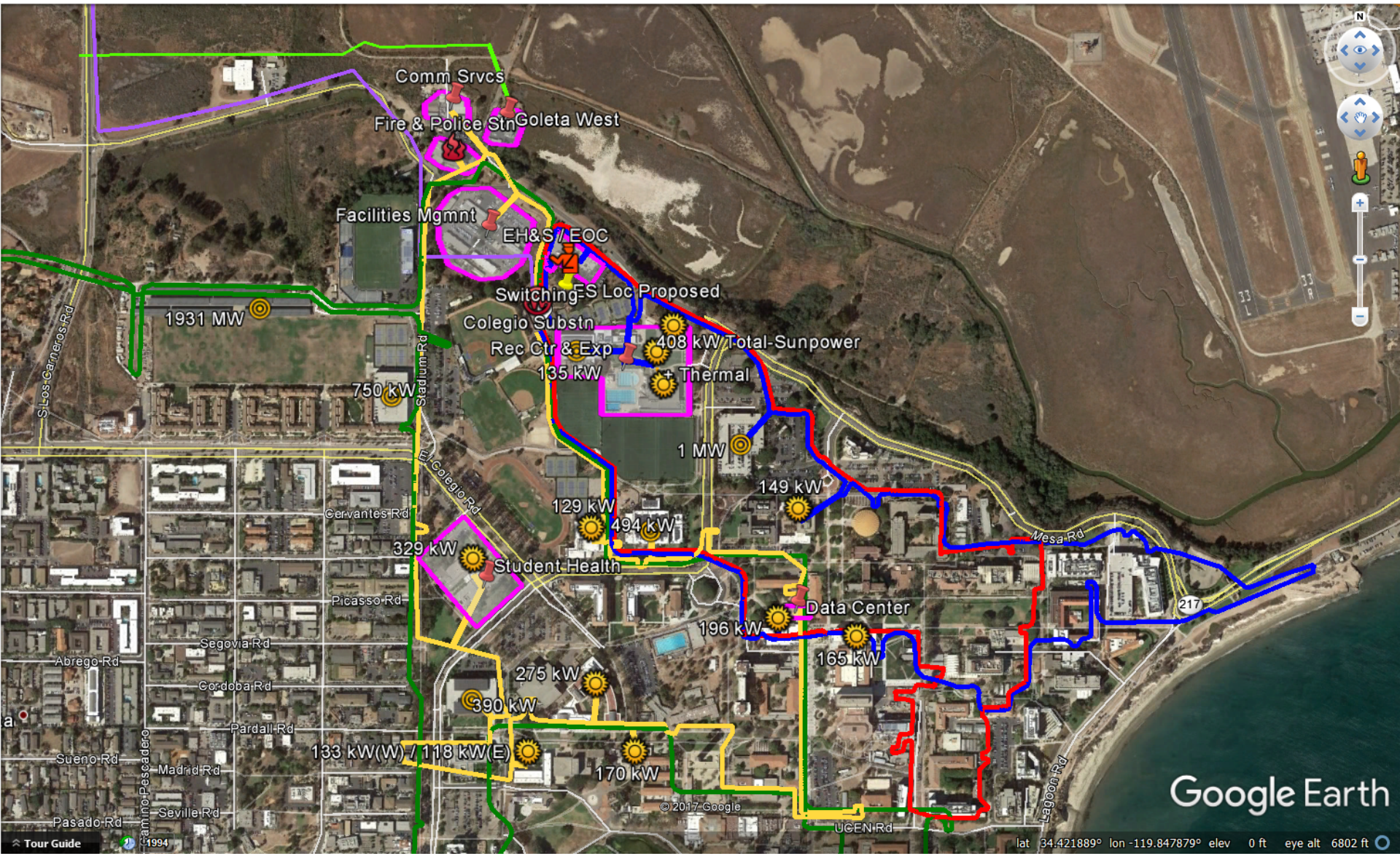

UCSB Community Microgrid – Phase 1

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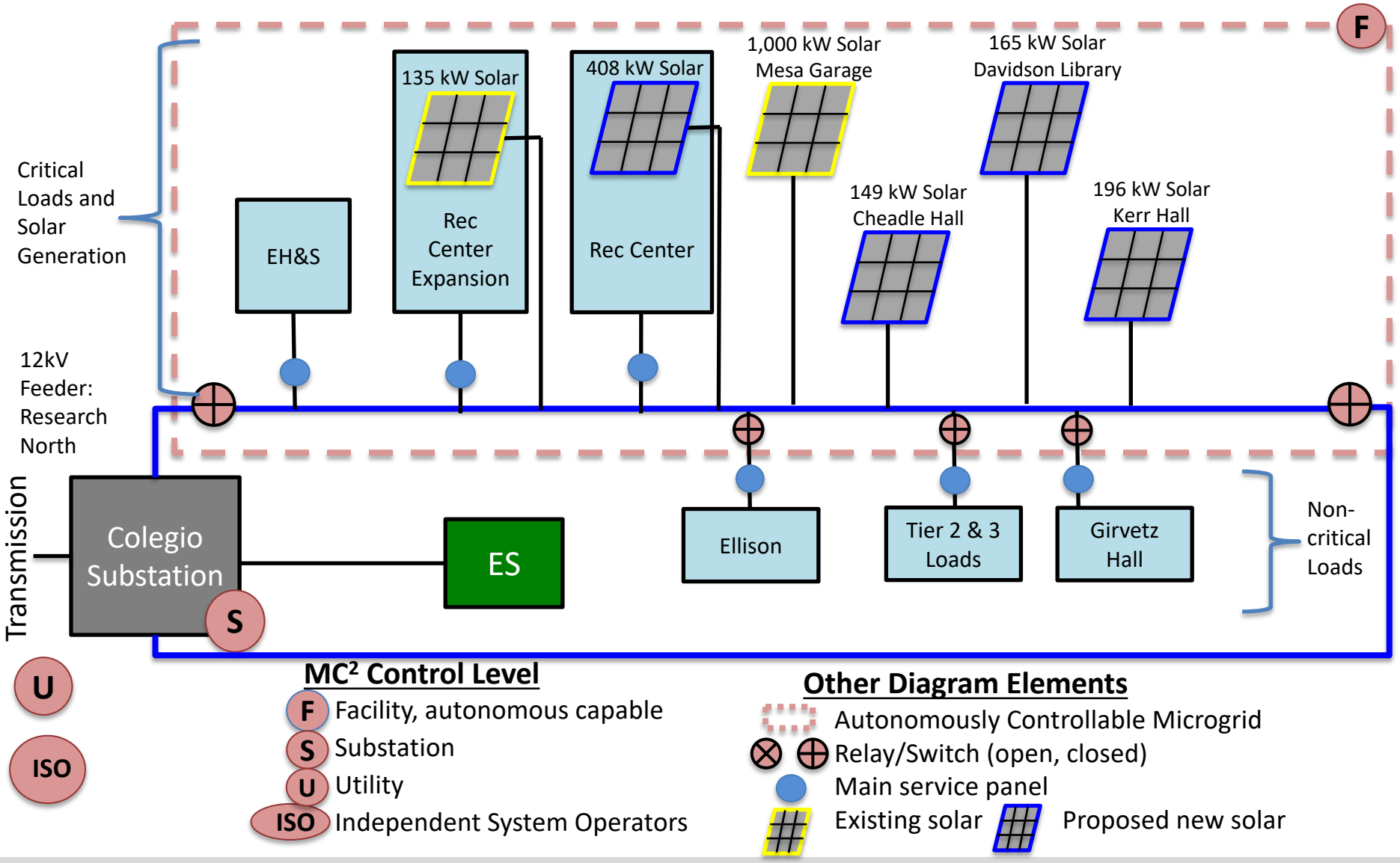

UCSB Community Microgrid – Phase 2

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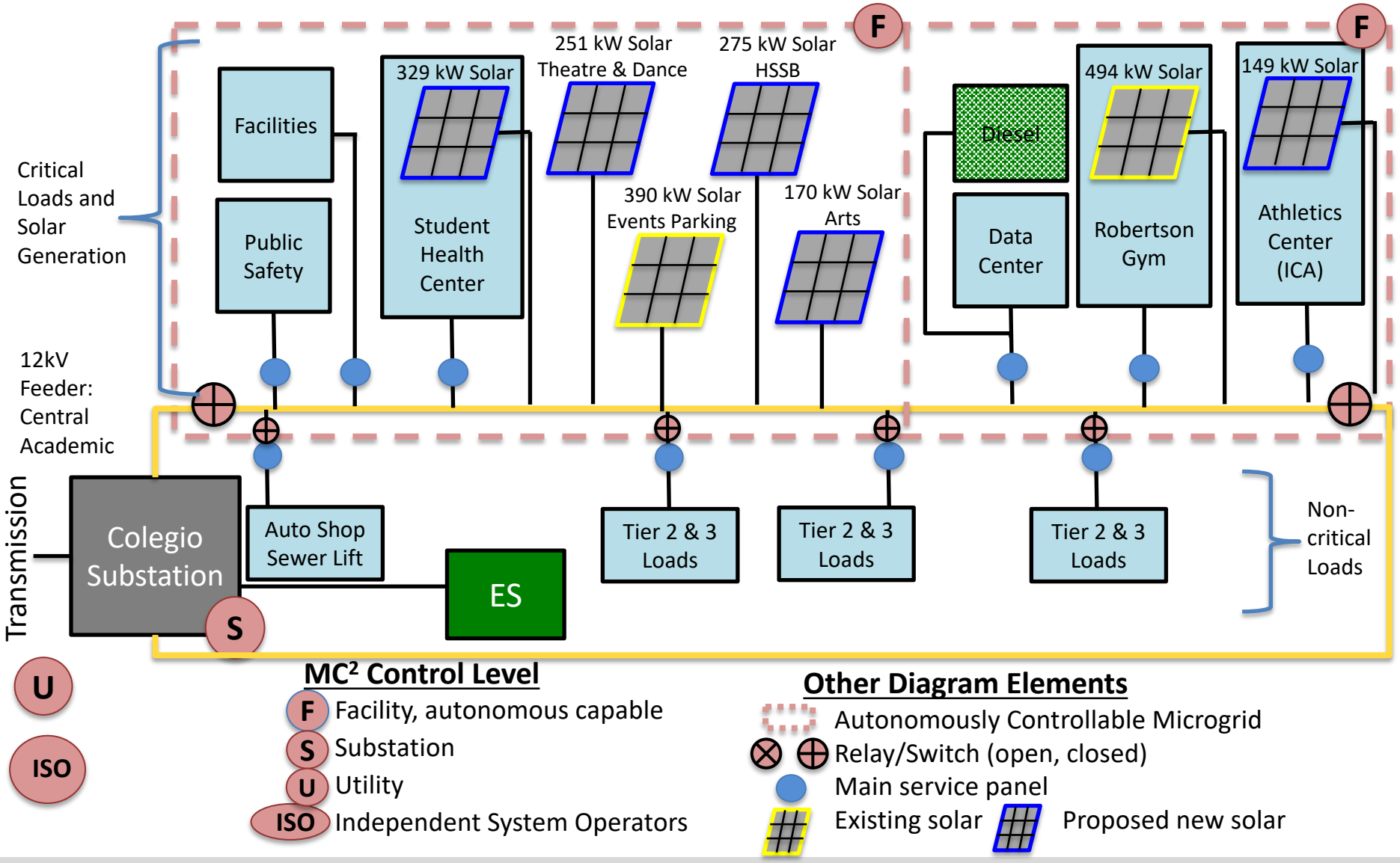

Renewables for Data Center Energy & Resilience

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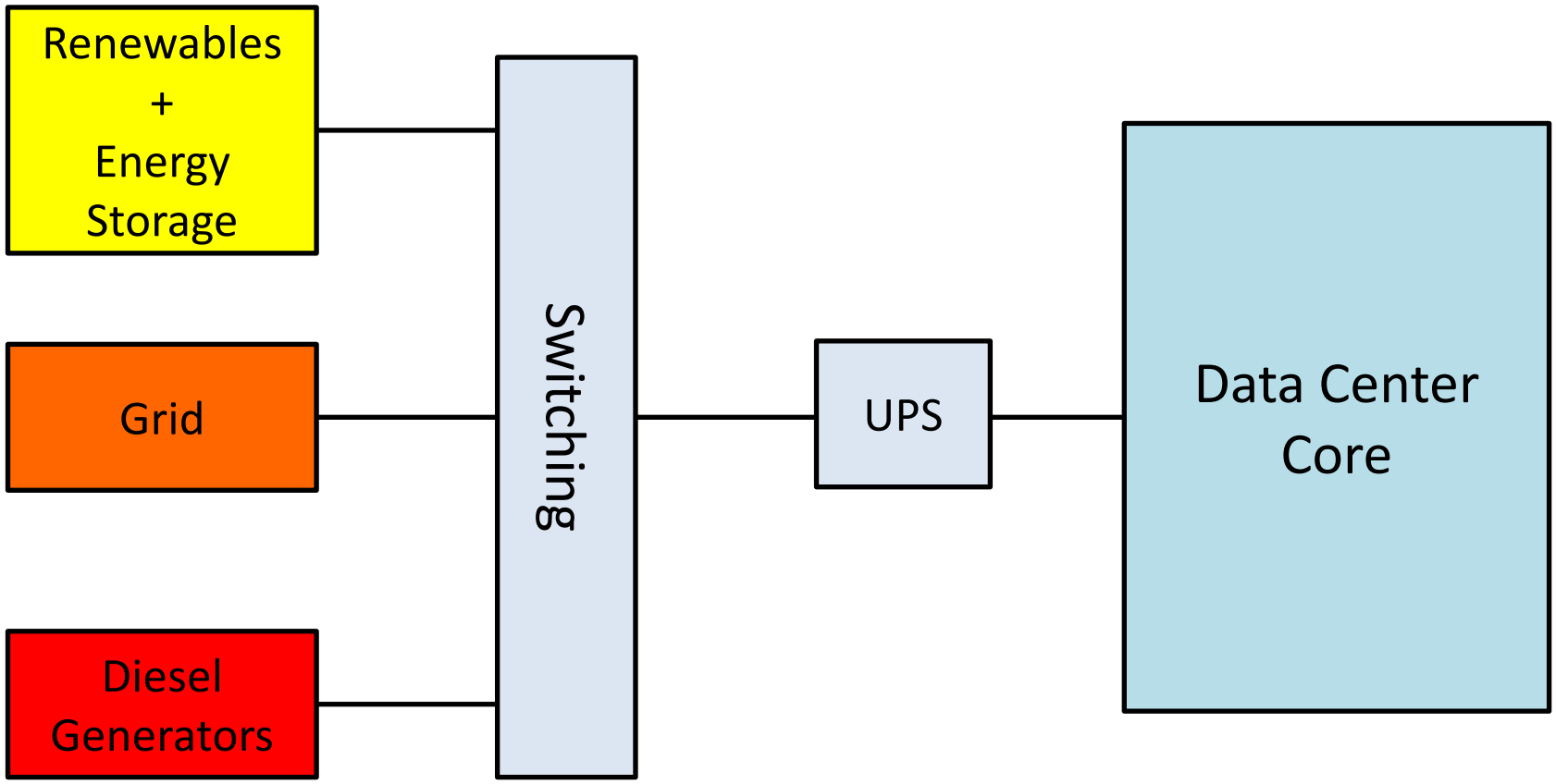
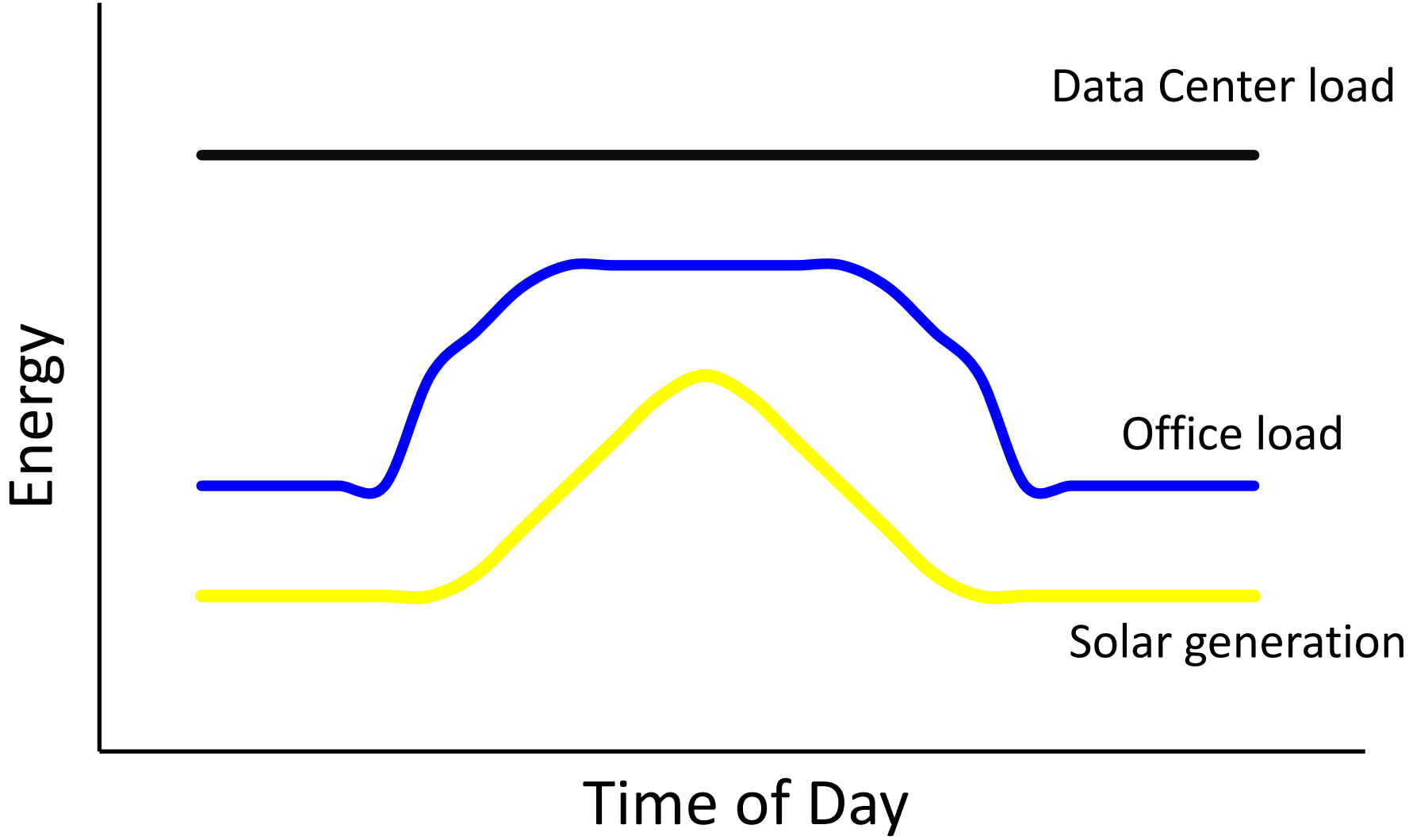


Solar and Load Profiles – Data Center Challenge



Local Solar + Energy Storage = Indefinite Energy

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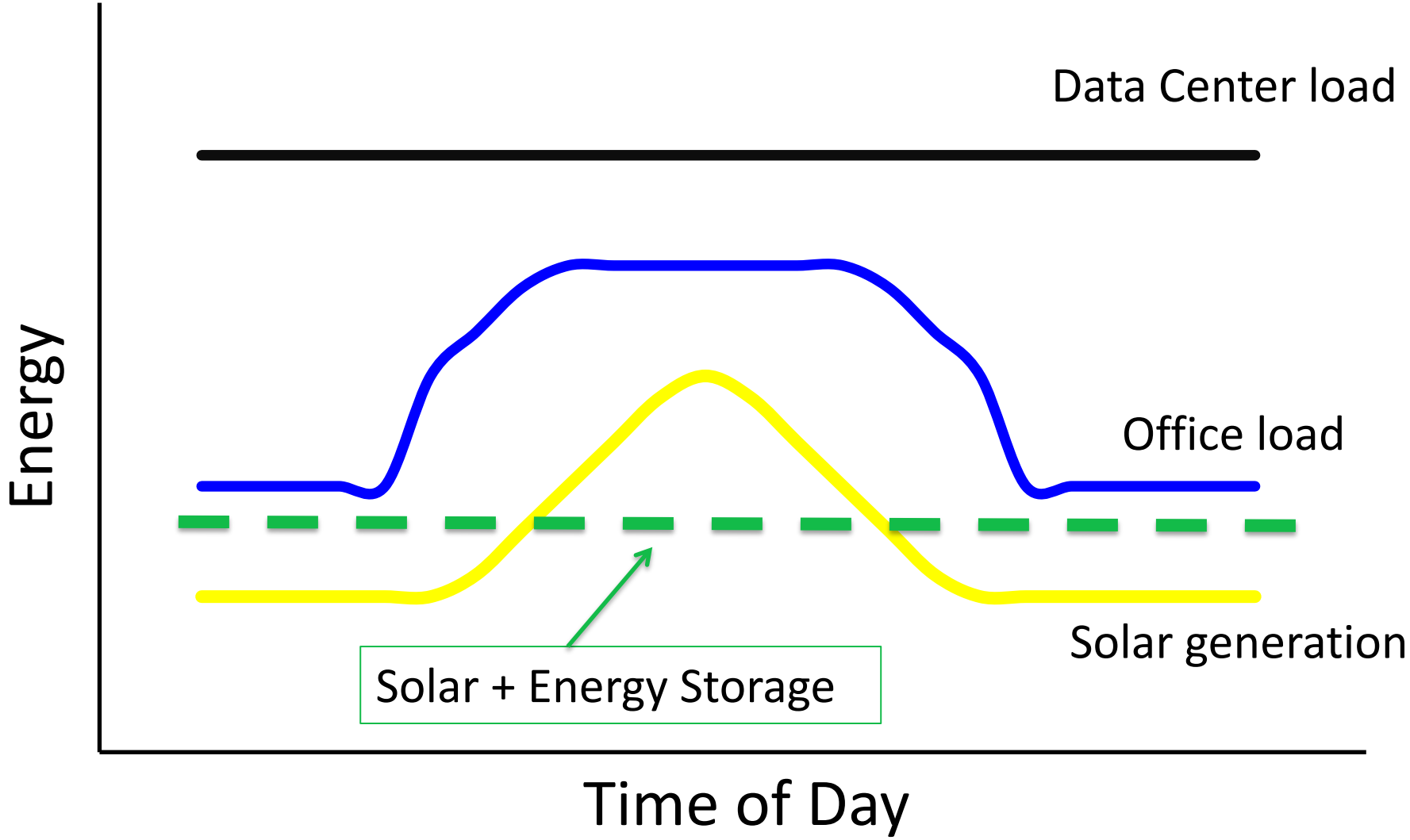

Local Solar + Energy Storage to Replace 1MW of Diesel

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- Assumptions
  - 20% solar capacity factor (typical for MW-scale solar in California)
  - Worst solar day is 10% of average (ie, 2% capacity factor)
  - 2 acres of siting required per 1 MW of solar
  - Requires 24x7x365 performance
- Calculations
  - 24 MWh of replenishment solar required daily (1 MW x 24 hr)
  - 50 MW of solar required (50 MW x .02 capacity factor x 24 hr)
  - 24 MWh of energy storage required

Opportunity: Local renewables + energy storage can provide indefinite backup power.

Challenge: Data centers have large flat loads; 100% solar is tough.

Other Plays for Local Renewables + Energy Storage

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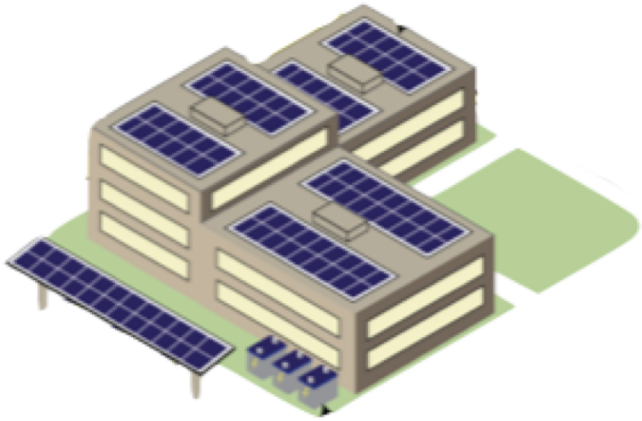
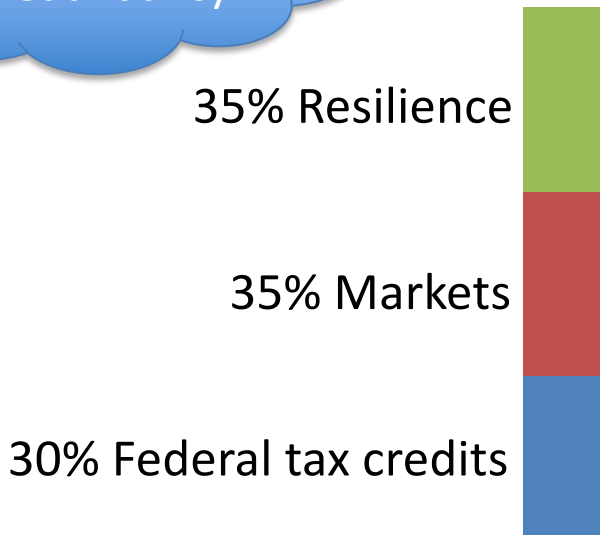
- Diversify renewables
  - Wind & solar generation profiles are highly complementary
  - One 3MW wind turbine averages 24 MWh/day



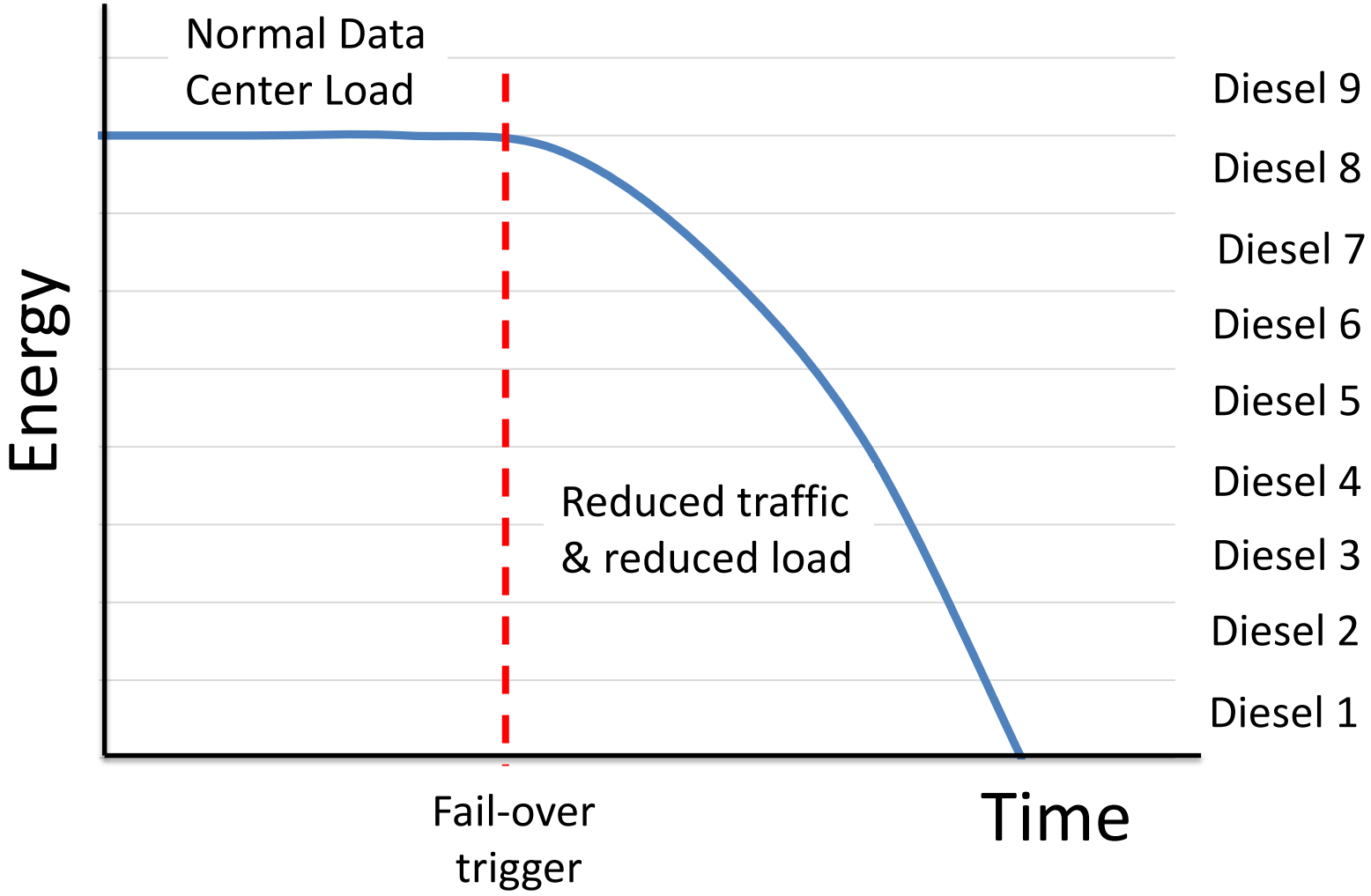
- Diversify geography
  - Demand Response (DR) combined with renewables + energy storage = big UPS
  - Fail-over strategies can allow significant reduction in energy usage

Cloud offers geo redundancy

- Monetize energy storage in markets like DR and frequency regulation
  - Markets typically cover 35% of energy storage costs while tax credits cover another 30%



Demand Response (DR) Opportunity



DR + Renewables + Energy Storage = Big UPS

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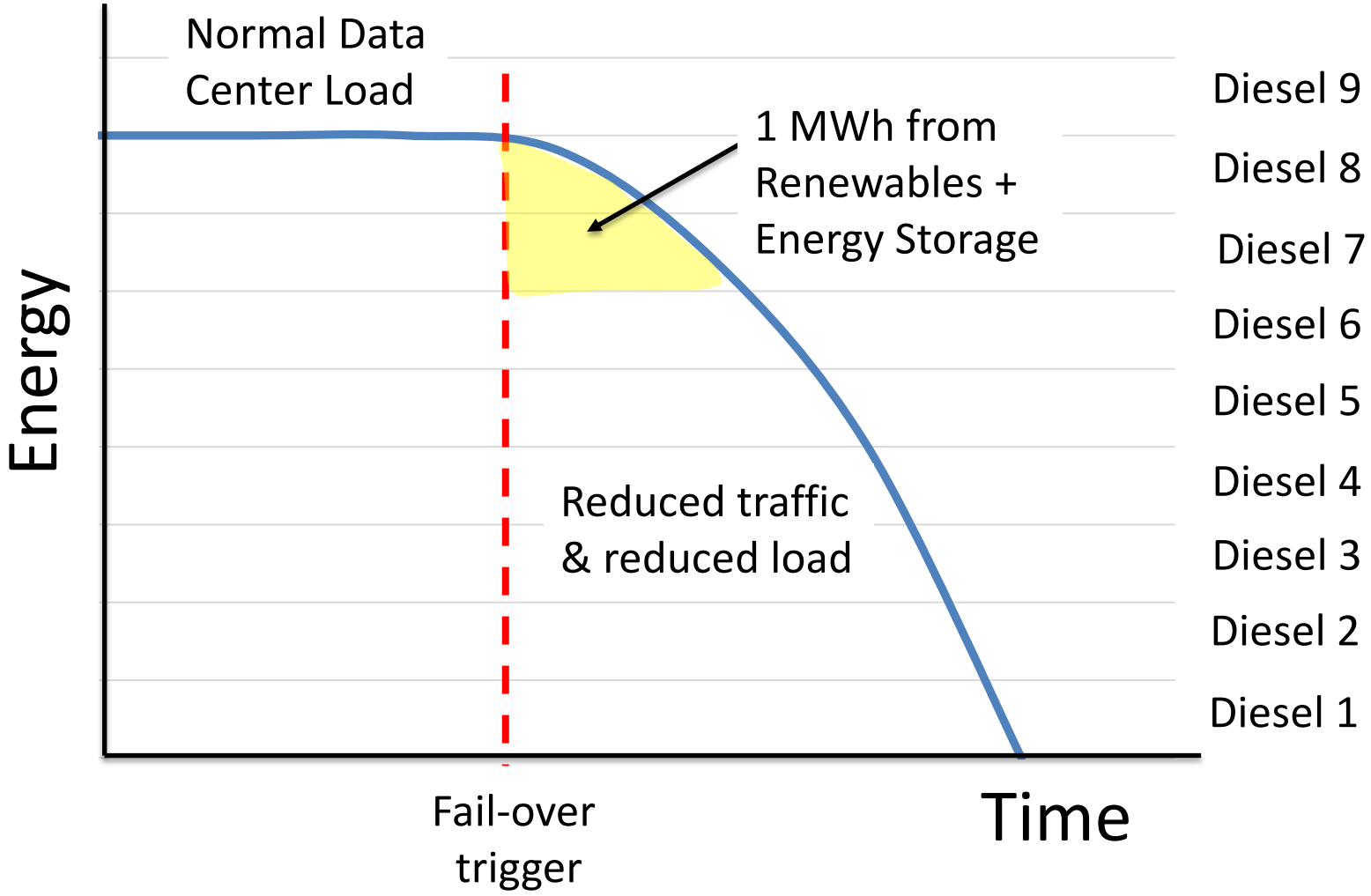
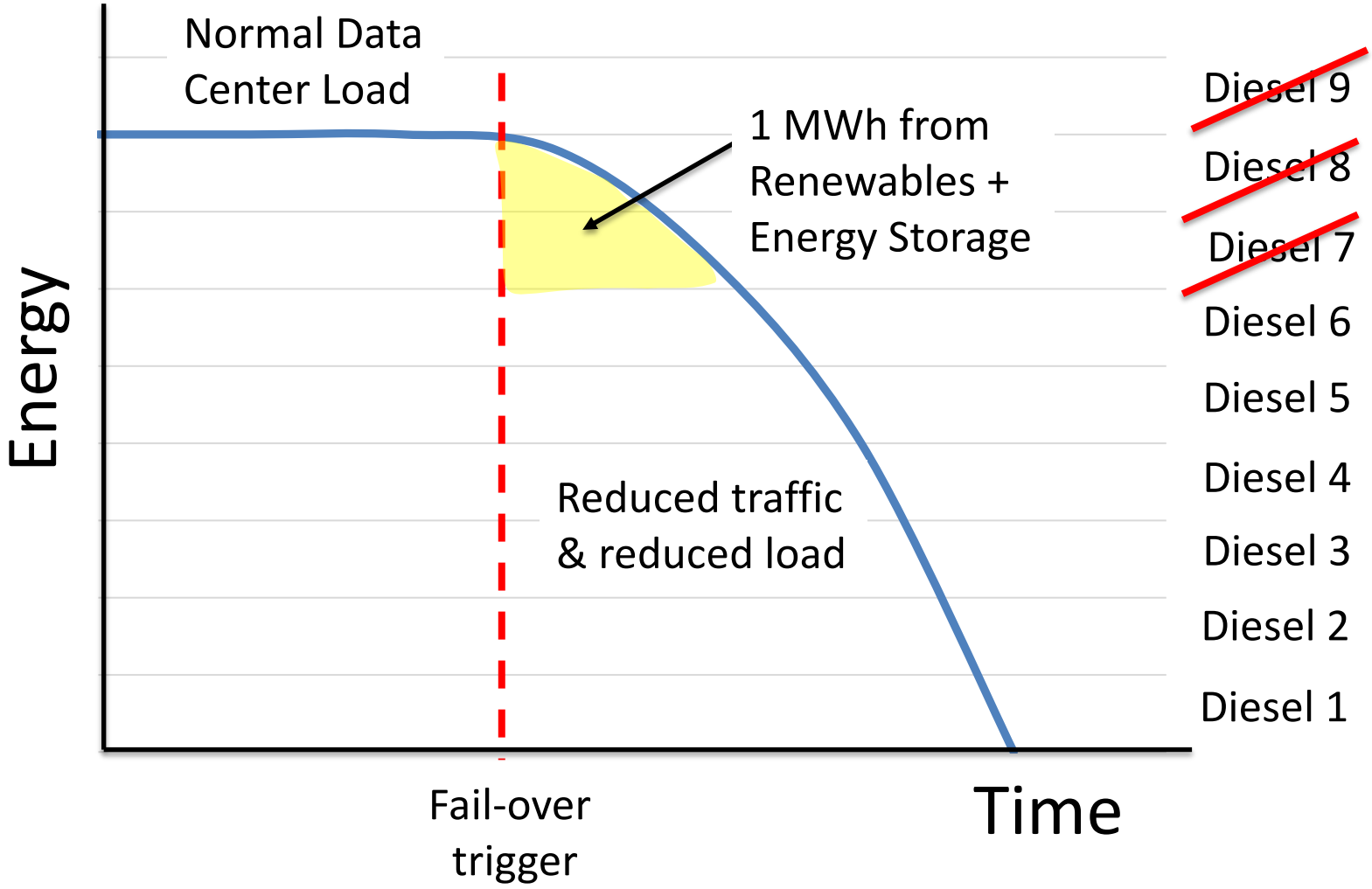


DR + Renewables + Energy Storage = Success



Multiple Pathways to Replacing 1MWh of Diesel

- 1 MWh of energy storage with small solar or other renewables

- 2 MW of solar supplies 1 MWh of energy on worst weather day in California

Replacing 1 MWh of Diesel with
local renewables + energy storage is easy

Seeking Data Center Pioneers

- Local renewables + energy storage is increasingly viable, including for a portion of data center requirements

- Challenges exist for data center pioneers to help overcome

The Clean Coalition is seeking data center pioneers to conquer the next renewables frontier!

Backup

German solar is mostly local (on rooftops)

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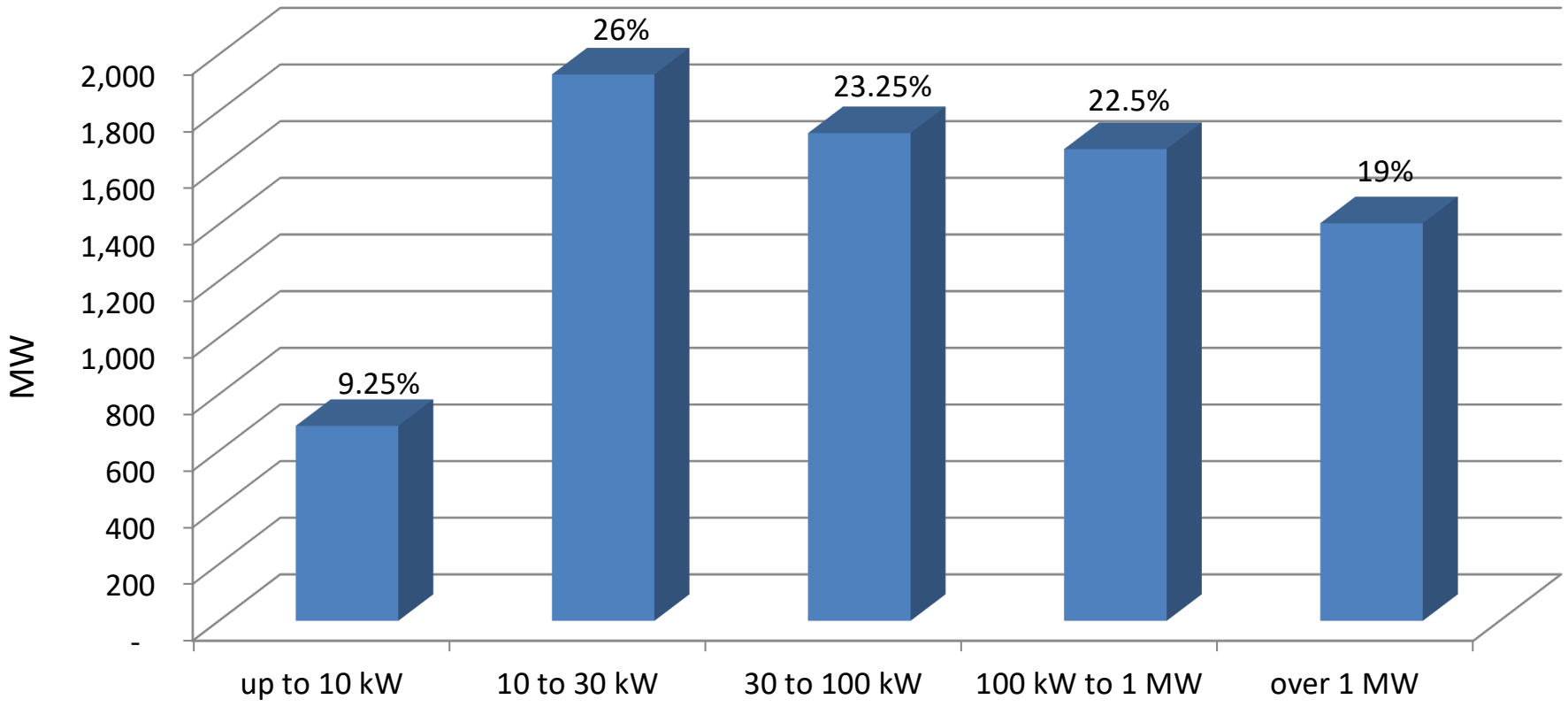
German Solar Capacity Installed through 2012



Source: Paul Gipe, March 2011

Germany's solar deployments are almost entirely sub-2 MW projects on built-environments and interconnected to the distribution grid (not behind-the-meter)

German rooftop solar is 4 to 6 cents/kWh today

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Project Size	Euros/kWh	USD/kWh	California Effective Rate $/kWh
Under 10 kW	0.1270	0.1359	0.0628
10 kW to 40 kW	0.1236	0.1323	0.0611
40.1 kW to 750 kW	0.1109	0.1187	0.0548
Other projects up to 750 kW*	0.0891	0.0953	0.0440

- Conversion rate for Euros to Dollars is €1:$1.07
- California's effective rate is reduced 40% due to tax incentives and then an additional 33% due to the superior solar resource

Replicating German scale and efficiencies would yield rooftop solar today at only between 4 and 6 cents/kWh to California ratepayers

* For projects that are not sited on residential structures or sound barriers.