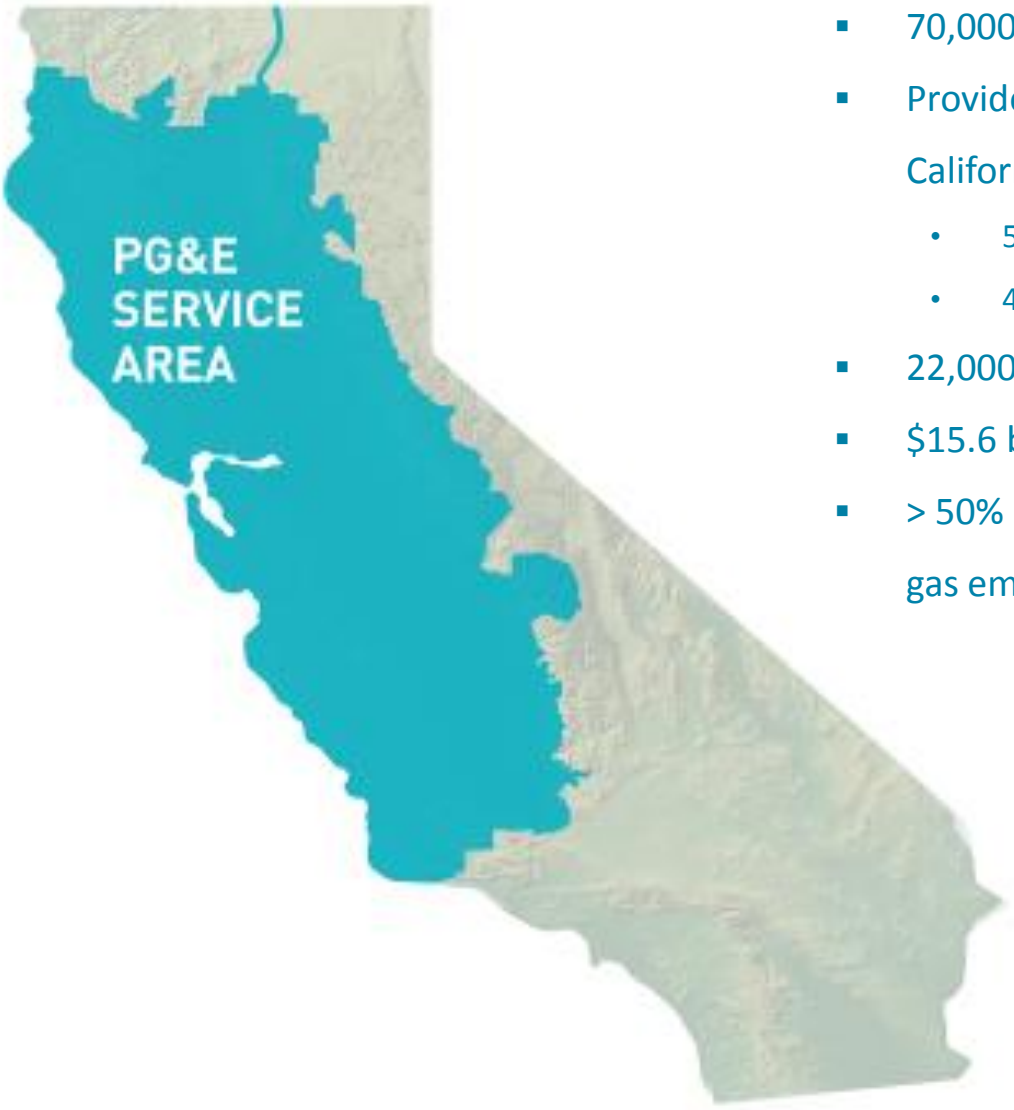
PG&E's Distribution Resource Plan

Opportunities and Challenges for Energy Efficiency

"Presented at the 2015 ACEEE National Conference on Energy Efficiency as a Resource"

About Pacific Gas and Electric Company (PG&E)

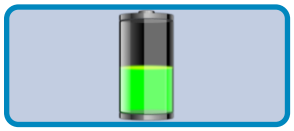


- 70,000 square-mile service area
- Provides energy services to 15 million Northern Californians
  - 5.1 million electric customer accounts
  - 4.3 million natural gas customer accounts
- 22,000 employees
- $15.6 billion in revenues
- > 50% of PG&E's electric supply comes from non-GHG gas emitting sources

AB 327 Added PUC Code Section 769

- Distributed Energy Resources (DER) means:

Distributed Renewable Generation



Energy Storage

Energy Efficiency

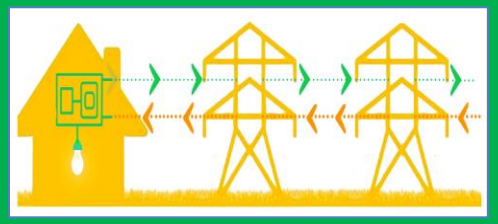
Demand Response

Electric Vehicles

- Submit a distribution resources plan proposal to the CPUC by July 1, 2015
  - Evaluate locational benefits and costs of DERs located on distribution system. This evaluation shall be based on reductions or increases in local generation capacity needs, avoided or increased investments in distribution infrastructure, safety benefits, reliability benefits, and any other savings the distributed resources provide to the electrical grid or costs to ratepayers of the electrical corporation.
  - Recommend standard tariffs, contracts, or other mechanisms for deployment of cost-effective DER
  - Propose effective coordination of existing commission-approved programs, incentives, and tariffs to maximize DER locational benefits
  - Identify additional utility spending to integrate cost effective DER into Distribution Planning to yield net benefits to ratepayers
  - Identify barriers to deployment of DER, including, but not limited to, safety standards related to technology or operation of the distribution system in a manner that ensures reliability

PUC Code Section 769

Electric Distribution Resource Plan (EDRP) OIR Objectives



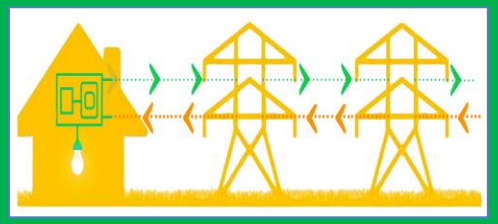
Modernize distribution system to accommodate expected DER growth through two-way power flow

Enable customer choice of new electric DER technologies and services

Identify and develop opportunities for DERs to realize grid benefits

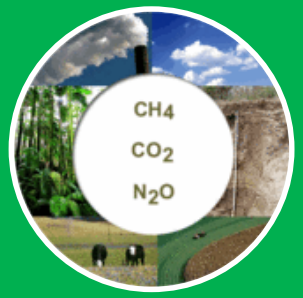
Identify Optimal Locations for deployment of DERs

Integrating DER (IDER) OIR Objectives



DRP establishes optimal locations and locational value for DERs

IDER establishes Sourcing Framework for DERs

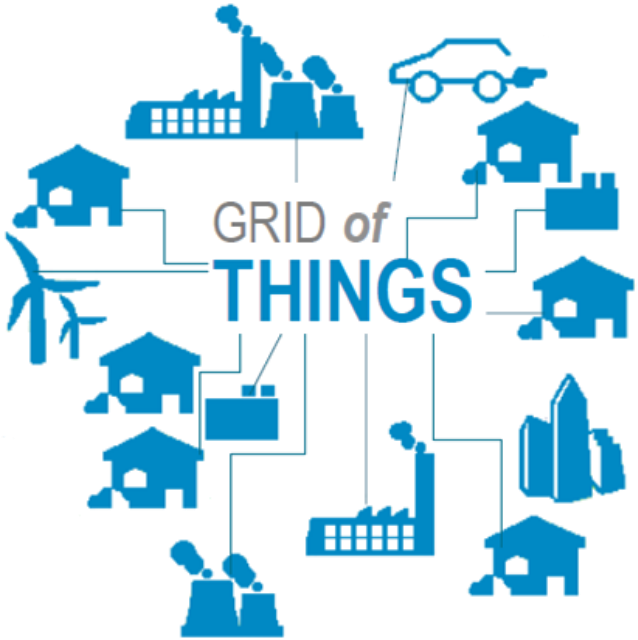


Sourcing to be done through some combination of Pricing, Programs and Procurement

Create a Sourcing Framework for Integration of DERs

PG&E's Policy and Vision

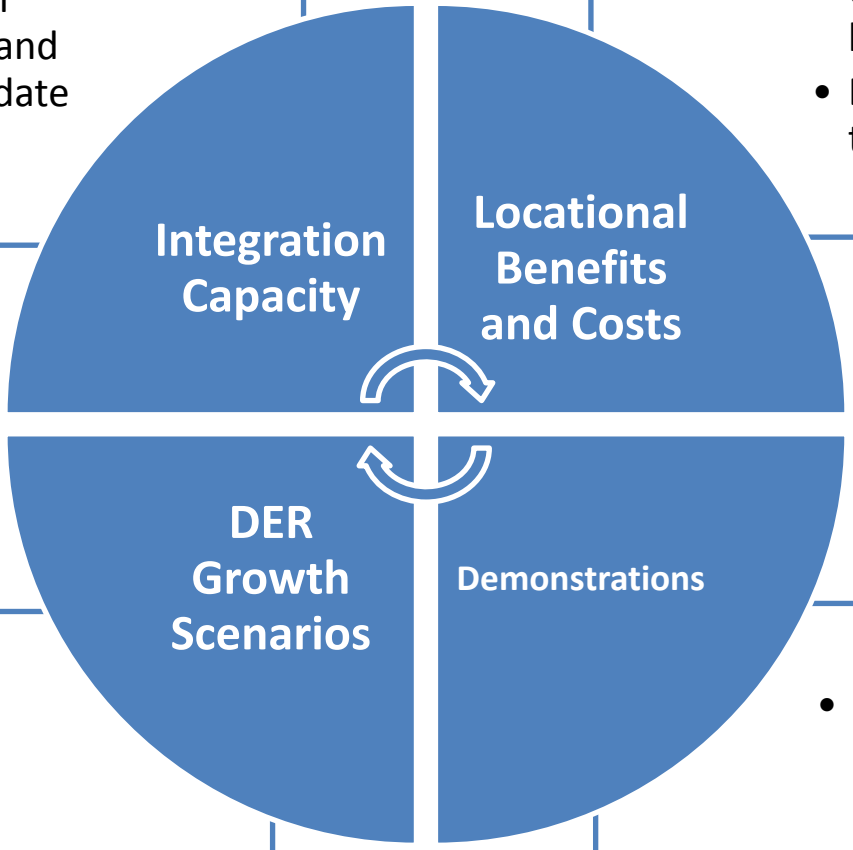
- DRP/IDSR will enable significant DER integration and support California's Clean Energy Vision
- PG&E's role is essential to achieving California's goals for safe, clean, affordable, reliable and resilient energy
- PG&E's initial EDRP serves as the technical foundation for integrating DER. IDER OIR's envisioned sourcing framework serves as the commercial foundation for integrating DER
- Achieving the long term EDRP/IDER vision will require coordinated electricity pricing and tariff reform, enhanced customer program delivery mechanisms and complementary DER procurement processes.



PG&E's Initial DRP serves as Technical Foundation for Integrating DERs into Planning and Operations

- Distribution feeder capacity to safely and reliably accommodate DER growth

- Quantification of DER locational value
- DER benefits and costs that impact rates



- Scenarios of DER portfolio growth
- Assess impacts to distribution grid

- Demonstration of DER integration into planning, operations and investment

Locational Benefits and Costs Methodology

Guidance on Locational Value Components

Start with DERAC*, add granularity and include new components

DERAC Components	
1	Energy
2	Losses
3	Generation Capacity
4	Ancillary Services
5	T&D Capacity
6	Environment
7	Avoided RPS

+

New /More Granular Components	
1	Distribution Capacity
2	Voltage and Power Quality
3	Reliability and Resiliency
4	Transmission Capital and Operating Expenditures
5	Flexible Resource Adequacy (RA) Procurement
6	Renewable Integration
7	Societal avoided costs
8	Public safety avoided costs

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PG&E Final Value Components	
1	Distribution Capacity
2	Voltage and Power Quality
3	Reliability and Resiliency
4	Transmission Capital and Operating Expenditures
5a	System or Local Area RA Procurement
5b	Flexible RA Procurement
6a	Generation Energy and GHG
6b	Energy Losses
6c	Ancillary Services
6d	RPS Procurement
7	Renewables Integration
8	Societal avoided costs
9	Public safety avoided costs

Key: Distribution Transmission Generation Societal

* E3's Distributed Energy Resources Avoided Cost Calculator (DERAC) estimates avoided costs uniformly across the ISO system

Example: Distribution Components (1- 3)

Value Component Definition: Avoided or increased cost associated with:

1) **Distribution Capacity (accommodates forecasted loads)**
2) Voltage & Power Quality (ensures power is delivered within specifications)
3) Reliability & Resiliency (ability to prevent / respond to routine / major outages)

Determining DERs' Impact: Distribution engineering tools are used to determine DERs' ability to meet criteria for

- **Right Time** (Coincides with a deficiency that requires investments)
- **Right Availability** (Performs in hours that coincide with deficiency)
- **Right Location** (Can be connected at a location that mitigates deficiency)
- **Right Size** (Can assure magnitude of impact is sufficient to mitigate deficiency)

Translating DER Impact Into Avoided or Increased Cost:
Present value of investment deferral (or acceleration) due to DER

Granularity of Locational Variation:
Anticipated to vary from feeder to feeder within PG&E service territory

Example: Distribution Capacity

Determining DERs' Impact: Distribution engineering tools are used to determine DERs' ability to meet criteria for

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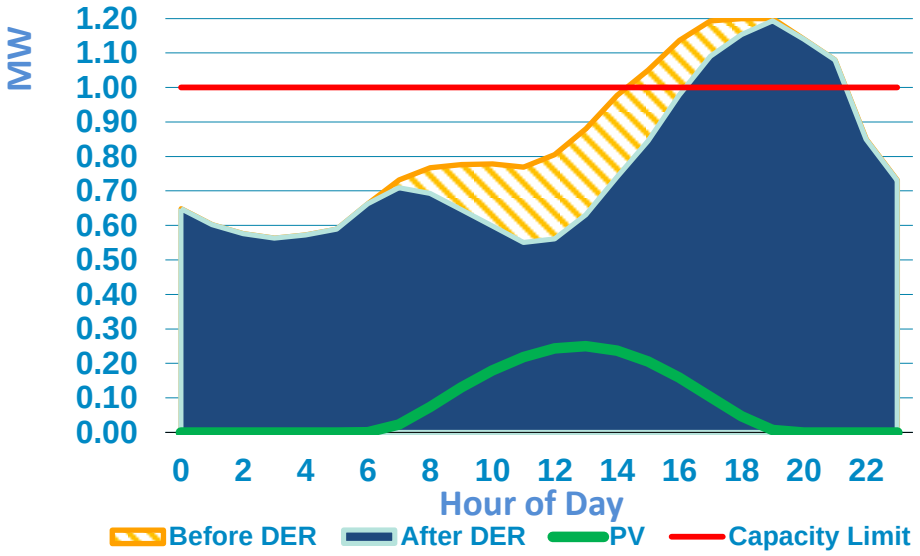
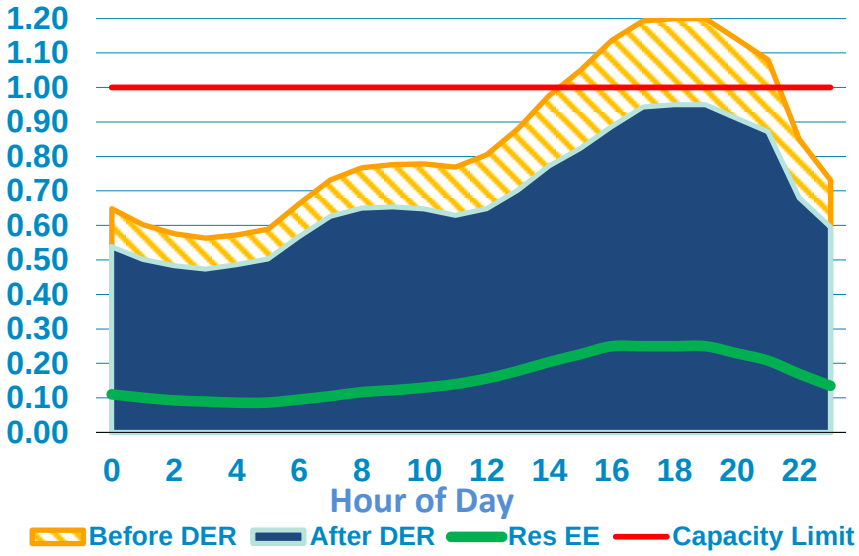




DER Growth Scenarios

DER Growth Scenarios - Goal

- Better understand the magnitude and location of potential DER adoption to inform distribution system planning

PG&E Interpretation of DRP Guidance on DER Growth Scenarios

- **Scenario 1 - "Trajectory"**

  PG&E's best current estimate of expected DER adoption

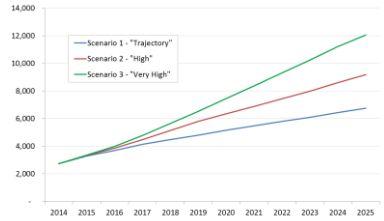
- **Scenario 2 – "High Growth"**

  Reflects ambitious levels of DER deployment that are possible with increased policy interventions and/or **technology/market innovations**

- **Scenario 3 – "Very High Growth"**

  Likely to materialize only with significant policy interventions such as: zero net energy (ZNE) requirements and deeper GHG reduction targets.

Approach to Developing DER Growth Scenarios

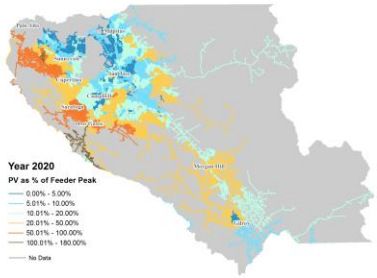


System-Level Forecasts Based On:

- Market analyst reports
- CPUC potential studies (EE)
- Existing procurement requirements
- Internal PG&E analysis

Geographic Dispersion/Allocation to Circuit Varied by DER:

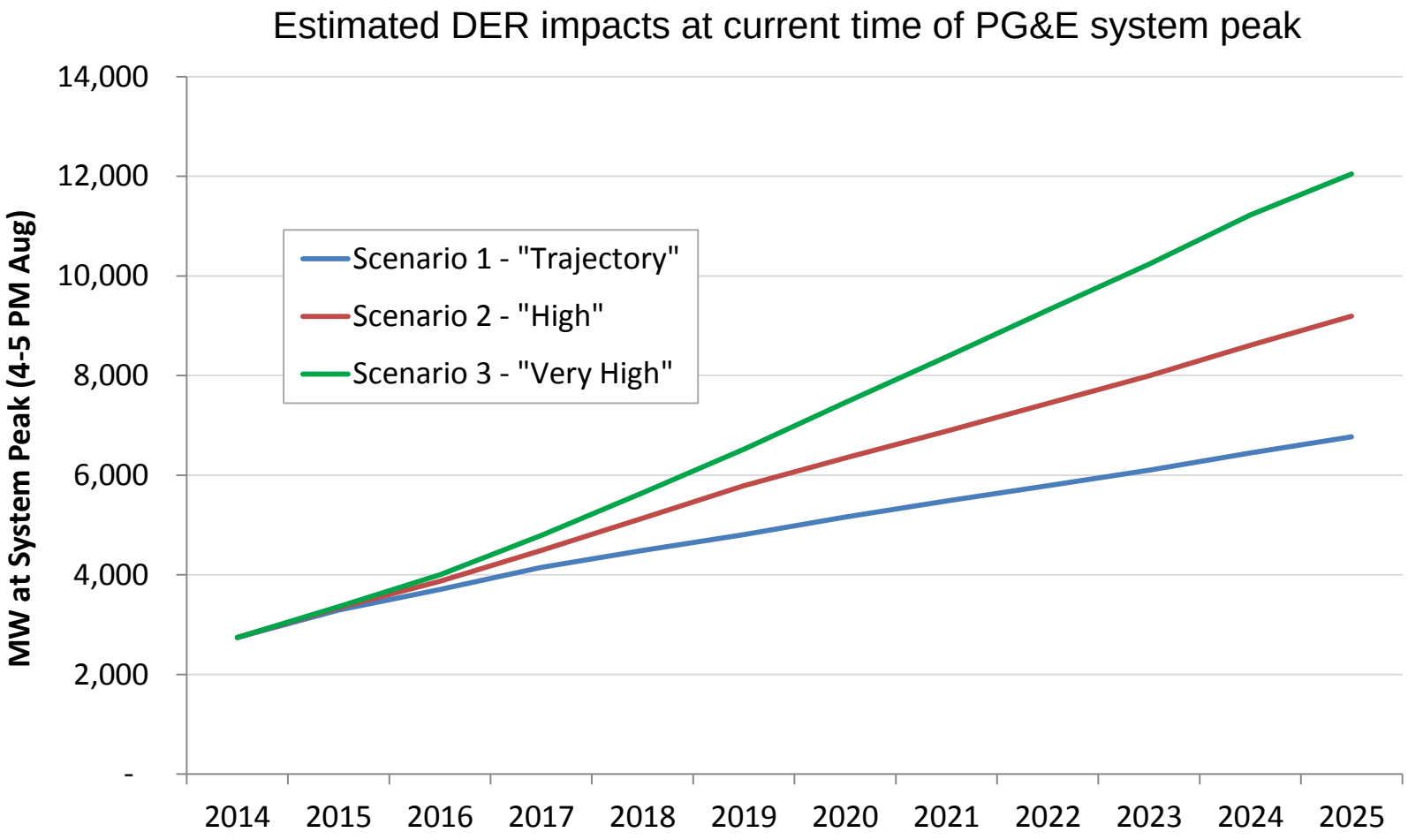
- DG deployment allocated based on key adoption drivers identified through multivariate regression analysis
- Location-specific DR load reductions developed using established econometric models and experimental design techniques
- **EE location specific scenarios based on potential studies and allocations based on customer composition in local areas**
- Wholesale energy storage deployment allocated based on siting assumptions attributed to three generic project configurations



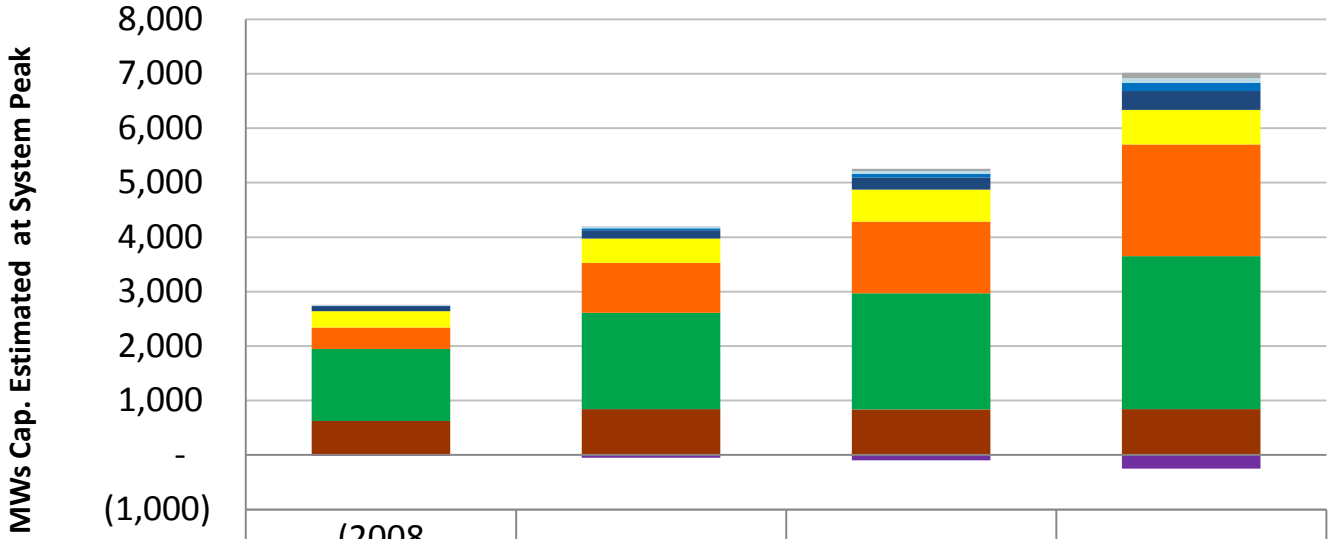
Key Findings

1. DER growth may result in a significant net reduction in peak load
2. **EE & Retail PV account for majority of DER capacity growth**
3. DER deployment is likely to be clustered
4. Understanding customer load and adoption patterns is important for estimating potential DER growth
5. Distribution system impacts from DER growth depend on:
    - Local load patterns
    - DER technology generation/operation profiles
    - DER communications, controls, dispatchability and services provided

Finding 1: DER growth may result in a significant net reduction in peak load



Finding 2: Estimated impact at peak greatest for energy efficiency and retail solar



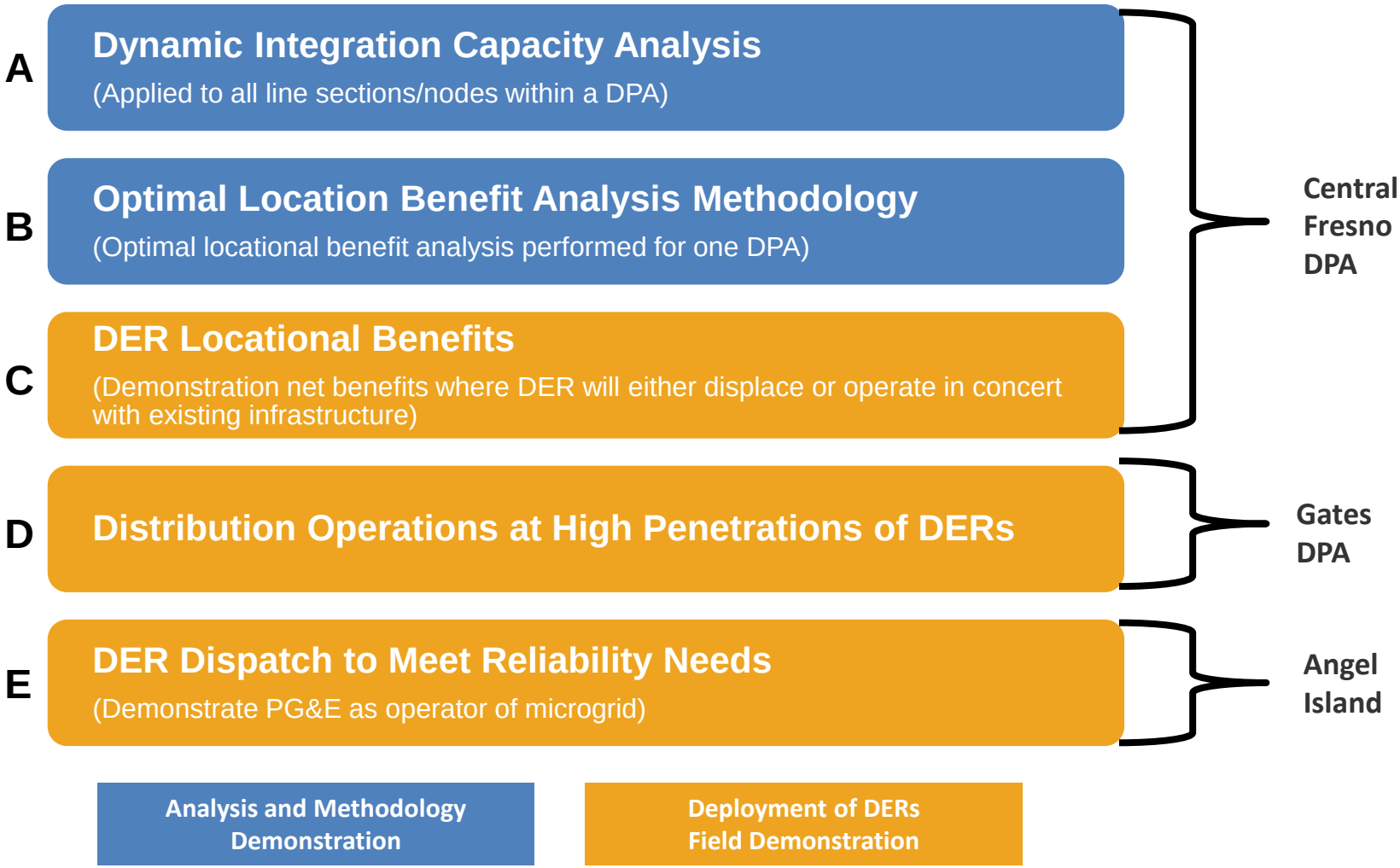
	(2008 -2014)	2017	2020	2025
Distributed Wholesale Energy Storage	6	6	40	97
CHP from Feed in Tariffs	9.6	30	50	83
Retail Storage	7.4	34	68	156
Retail Non-PV DG	92	153	220	347
Wholesale DG	302	443	590	631
Retail PV	396	916	1,317	2,052
Energy Efficiency	1,318	1,770	2,134	2,809
Demand Response	627	845	834	841
Electric Vehicles	(16)	(48)	(95)	(248)

Key Uncertainties and Limitations

- Utility currently has limited visibility, operational control and ability to influence geographic location of DER assets
- Deployment is currently optimized on customer economics, not utility cost drivers
- Historical DER consumer behavior may not be indicative of future patterns
- DER adoption is heavily determined by uncertain future policy developments
- Limited sample size for some technologies constrains PG&E's ability to elicit general trends that can be applied across our service area

Appendix A – EDRP Demonstration and Deployment Pilots

Demonstration and Deployment (Pilots)



Demonstration Pilots A, B and C

Proposed Area of Demonstration: Central Fresno DPA

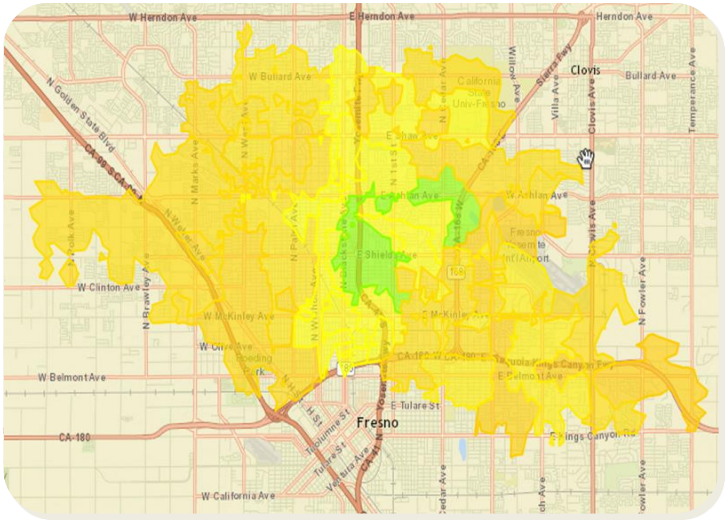
Scope of Pilots:

a) Dynamic Integrated Capacity Analysis

b) Optimal Location Benefit Analysis

c) Near term (0-3 years) and longer term (3 or more years) distribution infrastructure project deferral:

- **Phase 1 (Near Term) – Build off of on-going Targeted Demand Side Management (TDSM) pilot at four substations including Barton substation in Central Fresno DPA.**
- **Phase 2 (Longer Term) – Develop targeted aggregated DER portfolio (EE, DR, DG, storage) for deferring longer term capacity needs for Central Fresno DPA.**



Schedules:

Pilot A: Within 6 months of Commission approval of DRP

Pilot B: Within 12 months of Commission approval of DRP

Pilot C: Phase 1 – Implemented

Phase 2 – Detailed scope within 12 months of Commission approval.

Appendix B – TDSM Initiative

Goal of Targeted DSM

Develop a framework wherein customer-side programs can be integrated into a least cost planning framework to support distribution system reliability.

- ***Using TDSM to reschedule investments in T&D capacity has the potential to free up constrained capital to fund other more valuable projects in the Company. Shareholders like to see that the Company is deploying capital in an efficient manner.***

- ***Strong expectation from our regulators ,lawmakers and customers that we integrate DSM to the fullest extent possible into our energy procurement and asset planning activities -- California Energy Action Plan, the California Legislative Analysts Report and subsequent State Senate Utilities Committee hearings and the AB327 legislation /PUC 769 and as associated EDRP OIR and IDSR OIR.***

- ***Customer satisfaction increases significantly when customers engage with PG&E for demand side programs. Value add to our customer programs.***

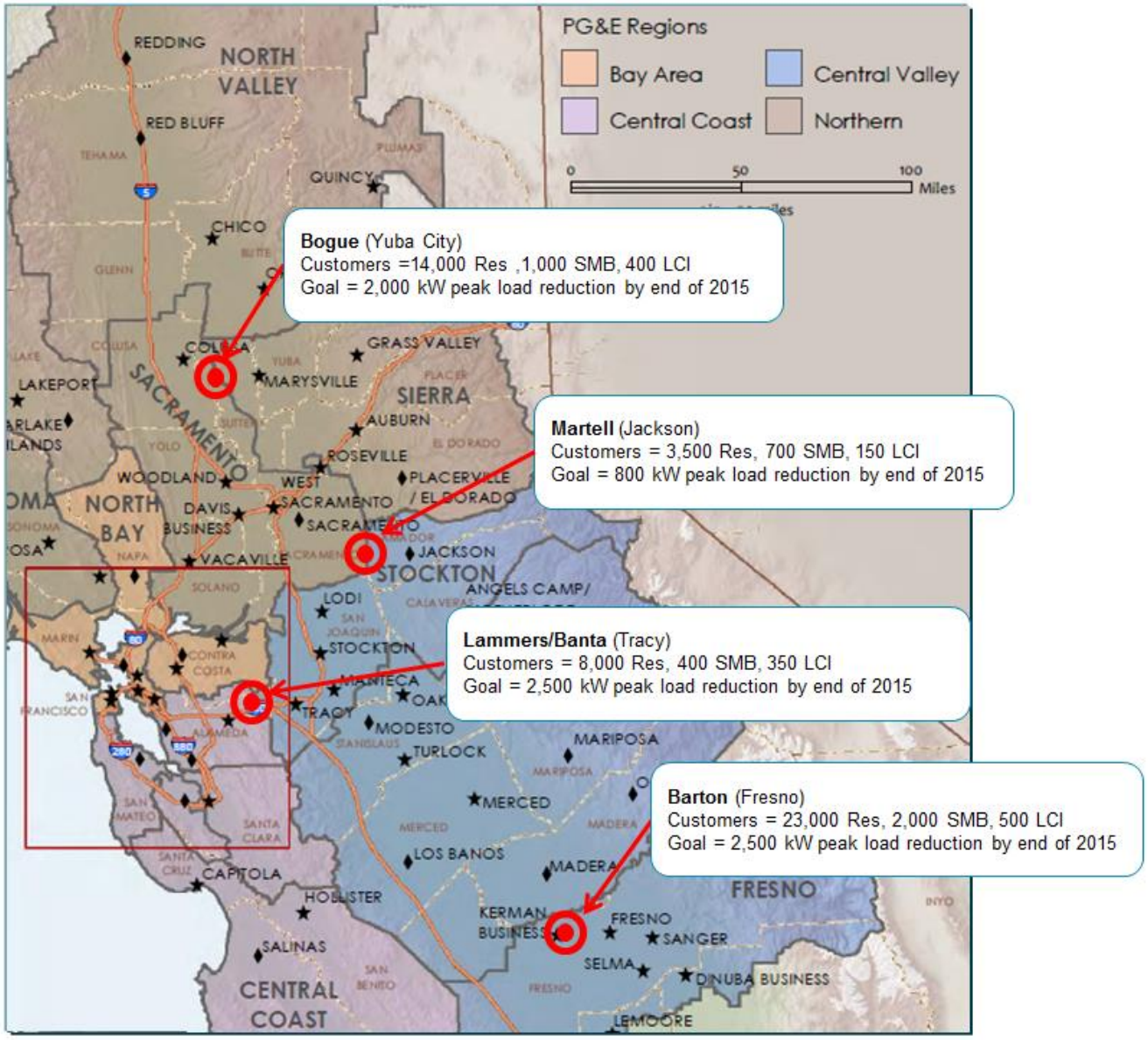
Goal of Targeted DSM

Develop a framework wherein customer-side programs can be integrated into a least cost planning framework to support distribution system reliability.

- Workstream I: Build capability to develop and implement targeted demand side solutions in response to identified reliability deficiencies at the distribution or transmission planning area, substation, bank or feeder level.

- Workstream II: Develop integrated planning framework wherein demand side resources are explicitly considered as mitigation for deficiencies identified in the annual T&D Planning Process.

Targeted Substations



TDSM Initiative Timeline

2014 TDSM Initiative

Jan-Mar, 2014
- LCI custom project targeted kicker incentive approved
- LCI targeted customer outreach begins

April-June, 2014
- Residential targeted kicker approved and implemented
- Added dedicated FSE staff

July-Sept, 2014
- SmartAC enhanced incentive and marketing approved and implemented
- GP engaged in targeted effort in Jackson and Yuba City

Oct-Dec, 2014
- Deemed LCI targeted kicker incentive approved.
- Filed PIP for locational components of residential and nonresidential EE programs.

2015 TDSM Initiative

Jan-Mar, 2015
- Added dedicated ES&S staff
- Engaged 3P, Re-engaged GP

April-June, 2015
- DER Alternative Planning standard developed and approved by EO
- Significant improvements made to GP and 3P processes

July-Sept, 2015
- Building tools and processes to support DER Alternative Planning Standard
- Engage in EO Planning process for 2017/2018 in-service date projects.

Oct-Dec, 2015
- Finalize DER Alternative Planning Standard tools and work processes
- Expand TDSM to target additional projects with 2017/2018 in-service dates.

Energy Efficiency Programs

Residential

- Advanced Home Upgrade – focuses on insulation, sealing leaks, pool pumps
- HVAC Quality Maintenance – HVAC performance
- Mobile Home Program – saving opportunities for hard to reach mobile home customers
- Cooling Optimizer - no-cost quality maintenance for multifamily HVAC units in the Fresno region

Non-Residential

- Deemed/Direct Install – Simple measures with “pre-calc” savings
- Custom – Complex projects with custom saving calculations
- Retrocommissioning (RCx) – focuses on improving the efficiency of what’s already in place
- New Construction/Savings by Design – Projects for new buildings

Demand Response Programs

Residential

- Smart AC – during emergency, device is remotely activated and air conditioner compressor will cycle ON/OFF
- Testing a localized behavioral demand response offering with OPower in summer 2015

Non-Residential

- Base Interruptible Program (BIP) – Curtail at least 15% of average demand w/ min. of 100 kW

Tools

Targeted DSM Dashboard

Hourly Load Disaggregation Tool

Distribution Planning Tools Enhancements

Locational Benefits Analysis Tools

***Learn about California's leading model for energy efficiency and how PG&E works with customers and partners to achieve success in saving energy*.**

www.CAEnergyEfficiencyModel.com

Thank you!