Clean Coalition

Clean Coalition

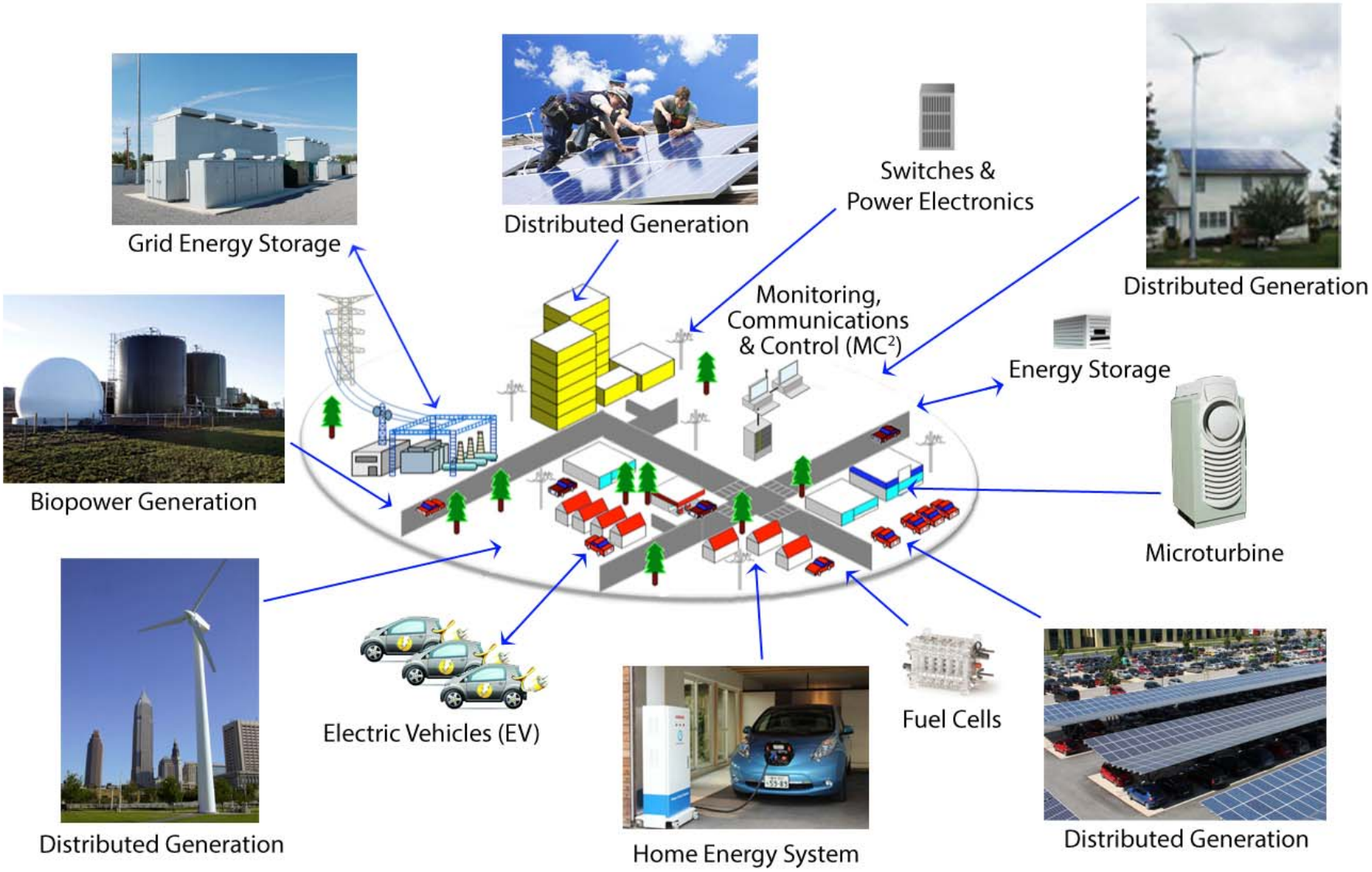
Making Clean Local Energy Accessible Now

Distributed Generation + Intelligent Grid

Optimizing Value for Ratepayers

Craig Lewis
Executive Director
Clean Coalition
650-796-2353 mobile
craig@clean-coalition.org

Clean Coalition Vision = Clean Local Energy



Wholesale DG is the Critical & Missing Segment

Clean Coalition

Project Size

Central Generation
Serves Remote Loads

Wholesale DG
Serves Local Loads

Retail DG
Serves Onsite Loads

Behind the Meter

Distribution Grid

Transmission Grid

Wholesale DG has Superior Value

Total Ratepayer Cost of Solar

	Distribution Grid					T-Grid
PV Project size and type	**100kW roof**	**500kW roof**	**1 MW roof**	**1 MW ground**	**5 MW ground**	**50 MW ground**
Required PPA Rate	**16¢**	**15¢**	**13¢**	**9-11¢**	**8-10¢**	**7-9¢**
T&D costs	**0¢**	**0¢**	**0¢**	**0¢**	**0¢**	**2-4¢**
Ratepayer cost per kWh	**16¢**	**15¢**	**13¢**	**9-11¢**	**8-10¢**	**9-13¢**

Sources: CAISO, CEC, and Clean Coalition, Nov2012; see full original analysis from Jul2011 at www.clean-coalition.org/studies

The most cost-effective solar is large WDG, not central station due to significant hidden T&D costs

Guided Siting Saves Ratepayers 50%

SCE Share of 12,000 MW Goal

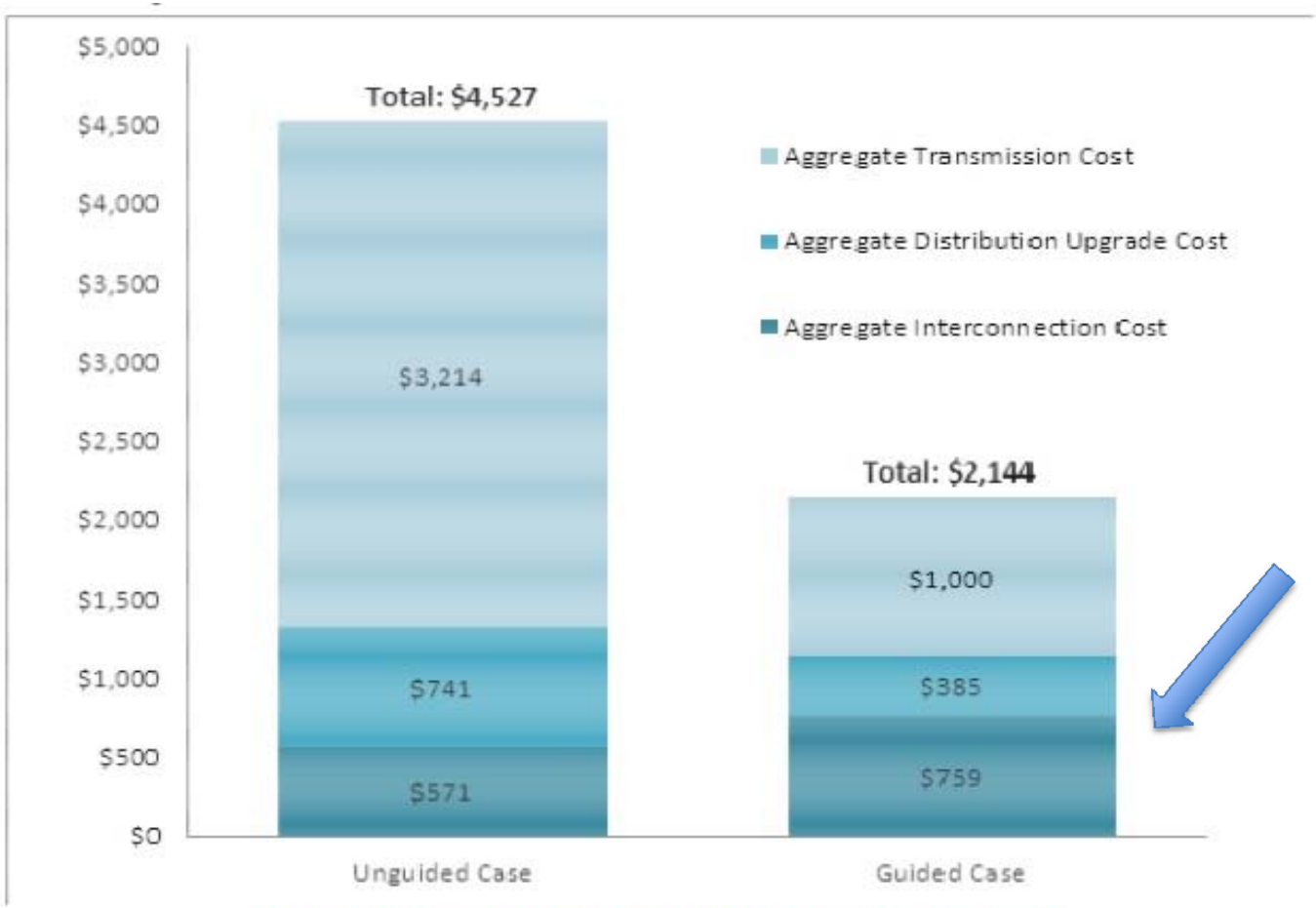


Figure 8: Total SCE System Costs of LER Proposal (Million USD)

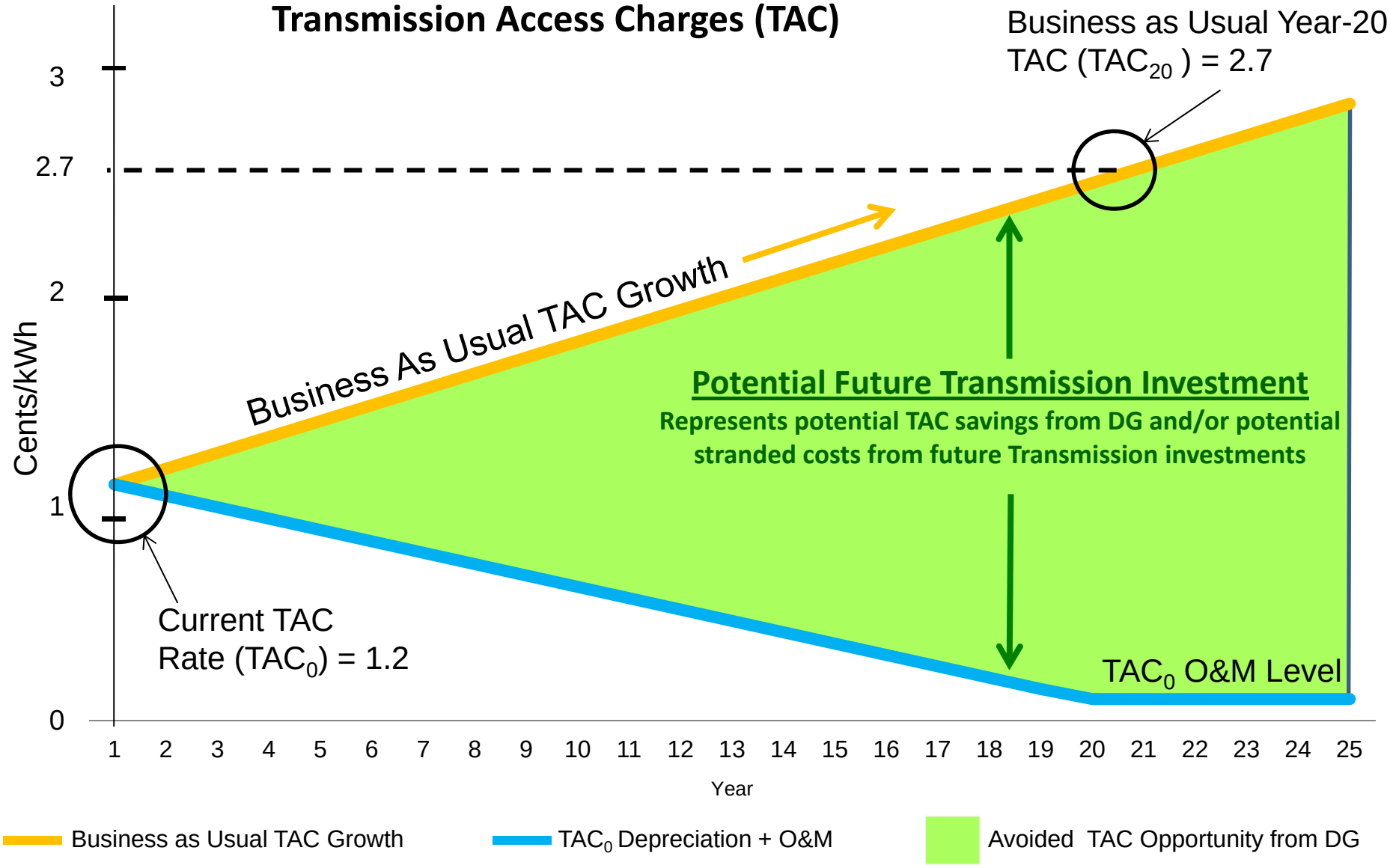
Note that interconnection costs are higher in the Guided Case. Siting costs may also be higher. Applicants will seek their lowest cost if they get no value from "preferred locations".

Transmission costs would be born by ratepayers

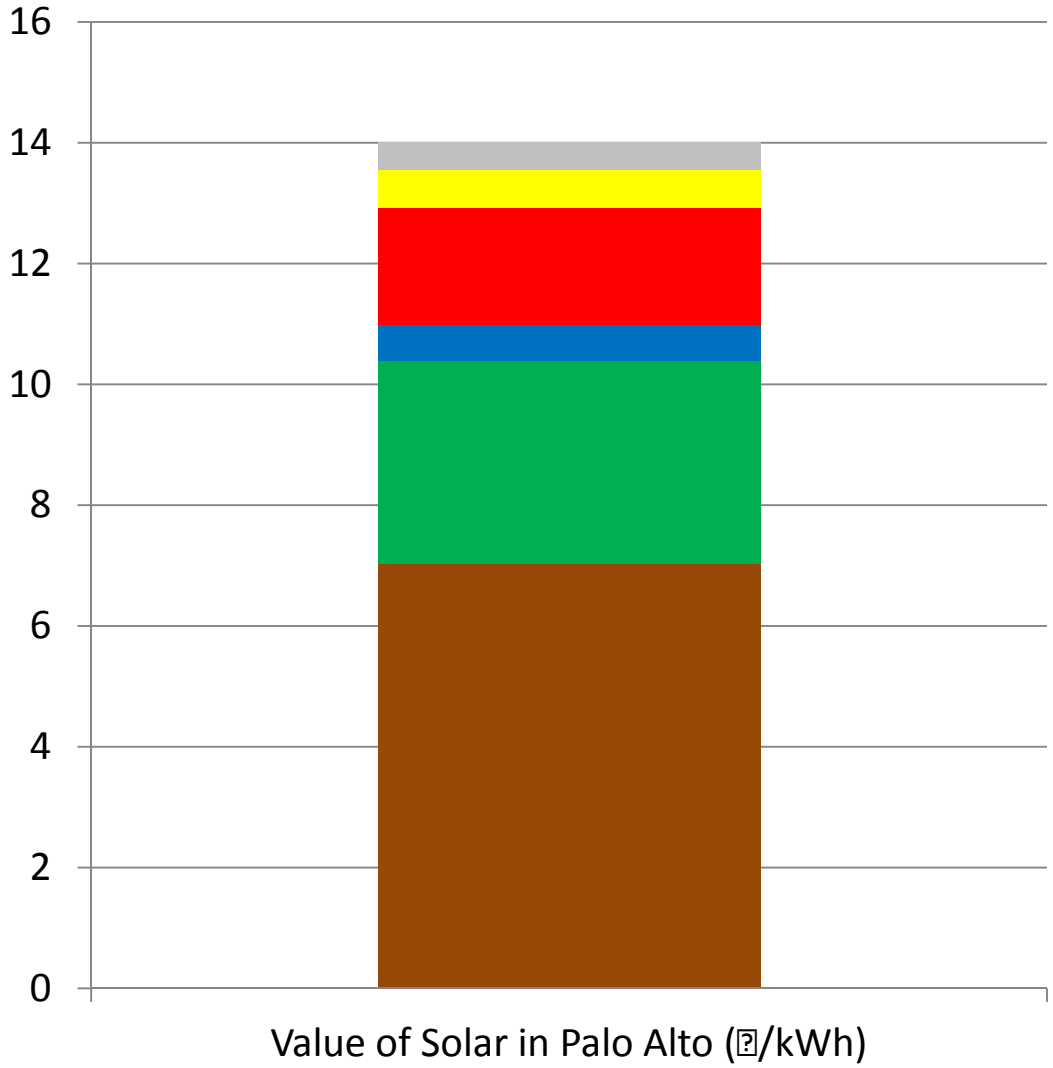
Sources: SCE Report May 2012

Avoided Transmission in CA = $80 Billion over 20 yrs

Clean Coalition



Transmission Costs Exceed 3 cents/KWh in CA

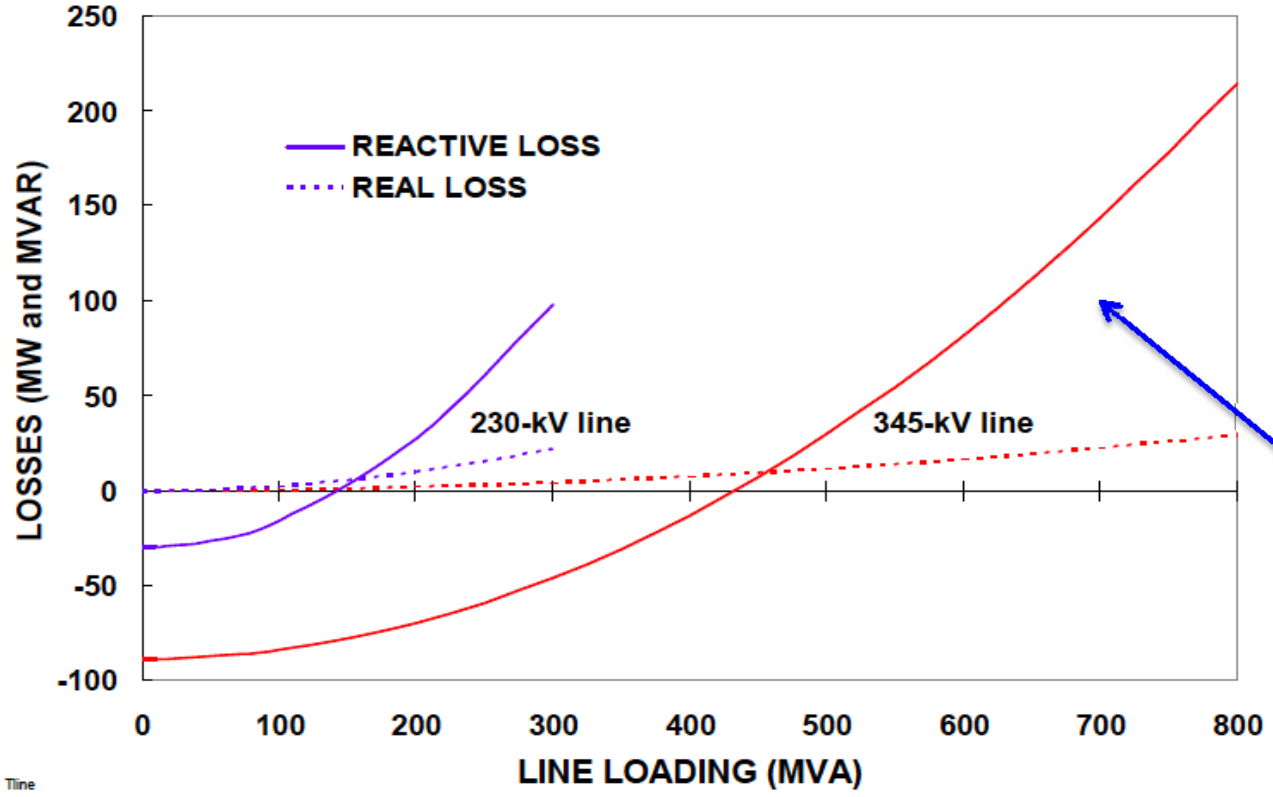


"Palo Alto CLEAN will expand clean local energy production while only increasing the average utility bill by a penny per month" -- Yiaway Yeh, Mayor of Palo Alto

Distributed Voltage Regulation – Location Matters

"The old adage is that reactive power does not travel well."

Oak Ridge National Laboratory (2008)



T&D lines absorb 8-20x more reactive power than real power.

Prevent Blackouts: When a transmission path is lost, remaining lines are heavily loaded and losses are higher.

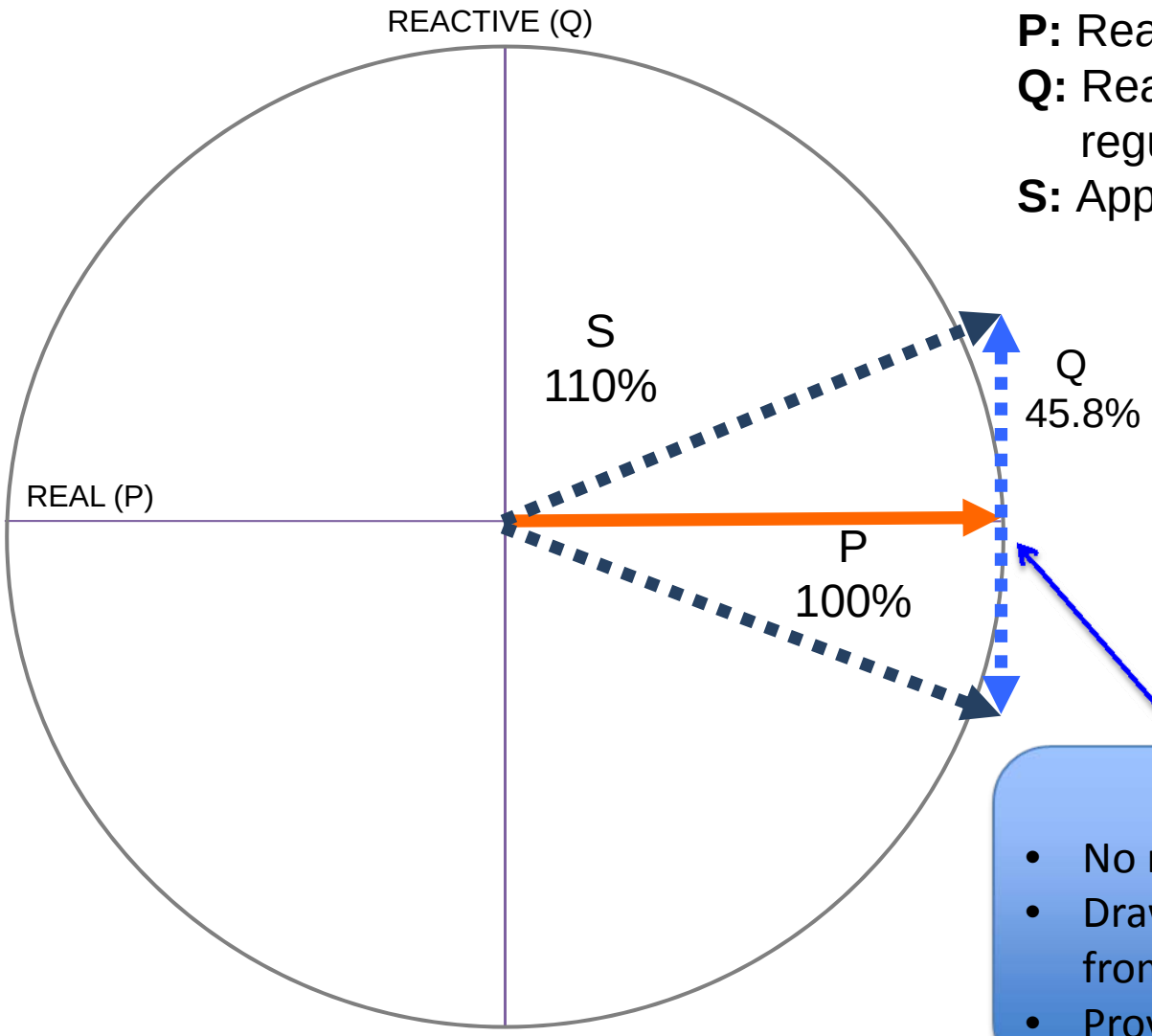
Figure 1-1. Transmission line absorption of reactive power.

Source: Oak Ridge National Laboratory (2008)

DG+IG Core Solutions for Voltage Regulation

Solutions	Benefits
Distributed Generation	• Provisions reactive power where it's needed most for regulation • Avoids line losses • Reduces congestion of transmission and distribution lines
Advanced Inverters (paired with solar, storage)	• Provisions distributed reactive power • Reacts automatically within fractions of a second (conventional resources can take minutes to react) • Converts real power from the grid to reactive power 24/7/365 • Oversized inverters can deliver reactive power without reducing DG real power output • Ride-through voltage events, remain attached longer than conventional spinning generators without harm • Modern inverters already have these advanced capabilities
Energy Storage (batteries, flywheel)	• Provisions both real and reactive power • Generally paired with advanced inverters

Advanced Inverters – Reactive Power (Oversized)



P: Real power (performs work)
Q: Reactive power (voltage regulation)
S: Apparent power (total power)

100 MW solar PV AC power
110 MW inverter
0.9 Power Factor
45.8 MVAr Reactive Power
100 MW Real Power

Oversized inverter:

- No reduction of PV real power
- Draws up to 10 MW real power from the grid
- Provides reactive power 24/7/365

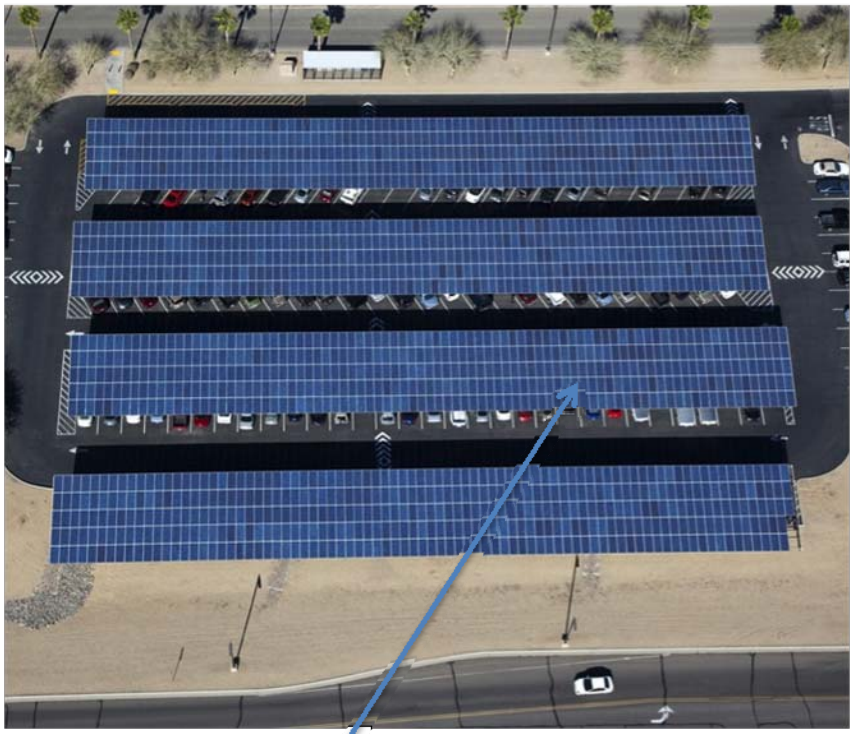
Advanced Inverters Gaining Broad Agreement

- WEIL Pushing for Smart Inverters
  - Western utility group called for policymakers to require smart inverters for all new solar facilities in August 2013 letter.
  - Framed issue in terms of DG causing problems that can be inexpensively solved with advanced inverters.
  - Pointed out that Germany required everyone to retrofit inverters.
- Accordingly, the Clean Coalition is educating policymakers about how DG combined with advanced inverters cost-effectively improves grid reliability and efficiency compared with conventional solutions.

- WEIL Group includes:
  - SCE, SDG&E, PG&E, SMUD, LADWP
  - Arizona Public Service
  - Portland General Electric
  - Salt River Project
  - Several others

Replacing SONGS with PV + Advanced Inverters

VS



Huntington Beach
290 MVars
(minus line losses =
261 MVars)

570 MW of local solar with advanced inverters, oversized by 10% set at 0.9 Power Factor = **261 MVArs**

WDG Priority: High Capacity, Lower Cost

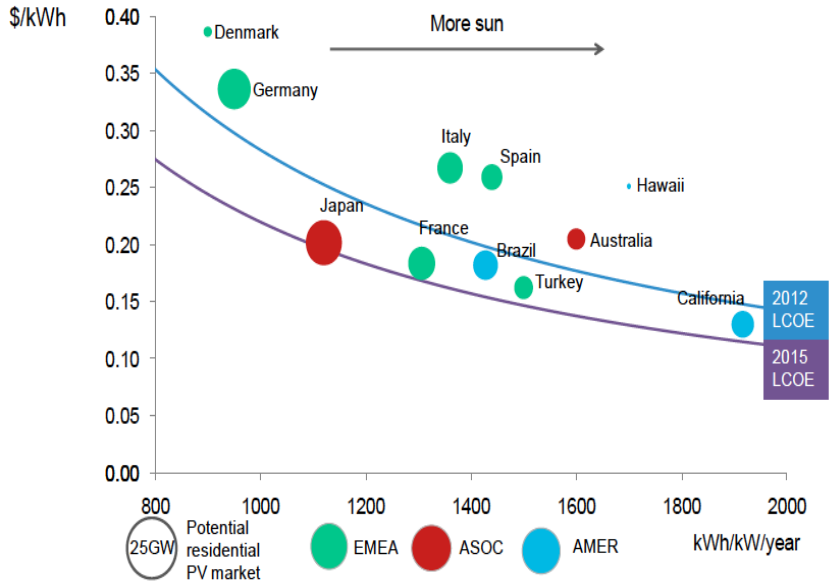
Clean Coalition

Huge Untapped Resource

- 76 GW of rooftop capacity in California
- 111 GW of ground capacity >1 MW in urban areas
- 20 GW near rural substations
  - Many Studies: NREL, E3, KEMA, UCLA, LABC….

Lower Cost

- Outdated Price Awareness
- Cheaper than Peaker
- Competitive with New CCNG



Replace SONGS – Energy Storage Potential

Clean Coalition

Targets proposed by CPUC include 745 MW storage in Southern California

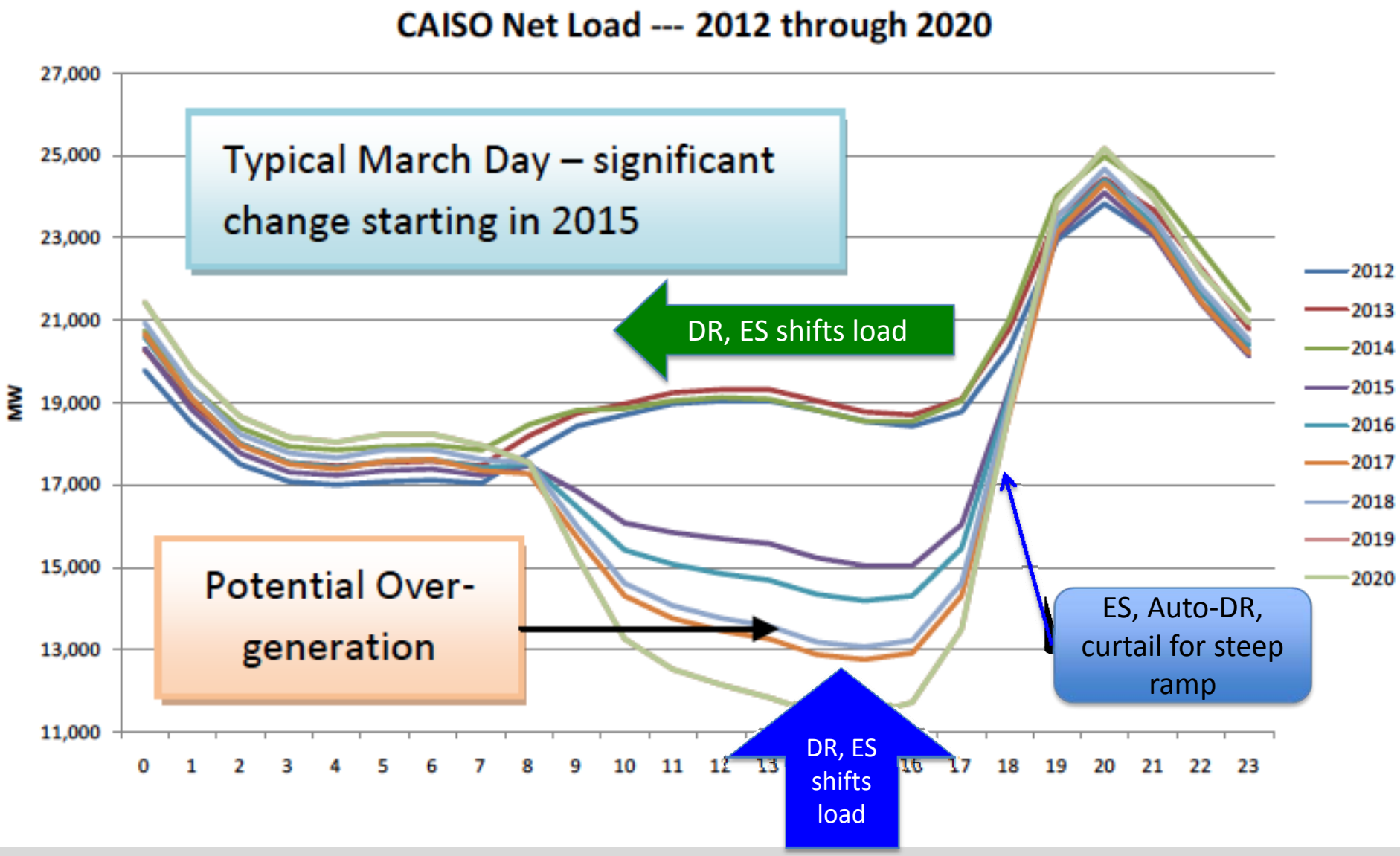
Table 1 – Initial Proposed Energy Storage Procurement Targets (in MW)

Use case category, by utility	2014	2016	2018	2020	Total
Southern California Edison					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
Subtotal SCE	**90**	**120**	**160**	**210**	**580**
Pacific Gas and Electric					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
Subtotal PG&E	**90**	**120**	**160**	**210**	**580**
San Diego Gas & Electric					
Transmission	10	15	22	33	80
Distribution	7	10	15	23	55
Customer	3	5	8	14	30
Subtotal SDG&E	**20**	**30**	**45**	**70**	**165**
Total - all 3 utilities	**200**	**270**	**365**	**490**	**1,325**

DG+IG Solutions for Balancing Power & Frequency

Solutions	Benefits
Demand Response	• Automated demand response can address power imbalances within fractions of a second • Reduces or shift load away from peak hours to free up other resources to provide real power
Energy Storage (batteries, flywheel)	• Supplies and absorbs power • Can reduce or shift load • Can react automatically within fractions of a second
Forecasting	• Forecasting improvements will reduce unpredicted differences between scheduled supply and actual supply
Curtailment (proactive ramp control)	• Reduce output from intermittent generators for proactive ramp control to smooth out short term impulse

DG+IG Keeps Power in Balance



Renewables are Reliable

Clean Coalition

Country	Percent of electrical generation in 2007 from non-hydro renewables	2007 SAIDI – outage duration (minutes)	2007 SAIFI – outage frequency (number of outage events)
Denmark	29.4%	23	0.5
Germany	12%	24	0.5
United States	2.8%	240	1.5

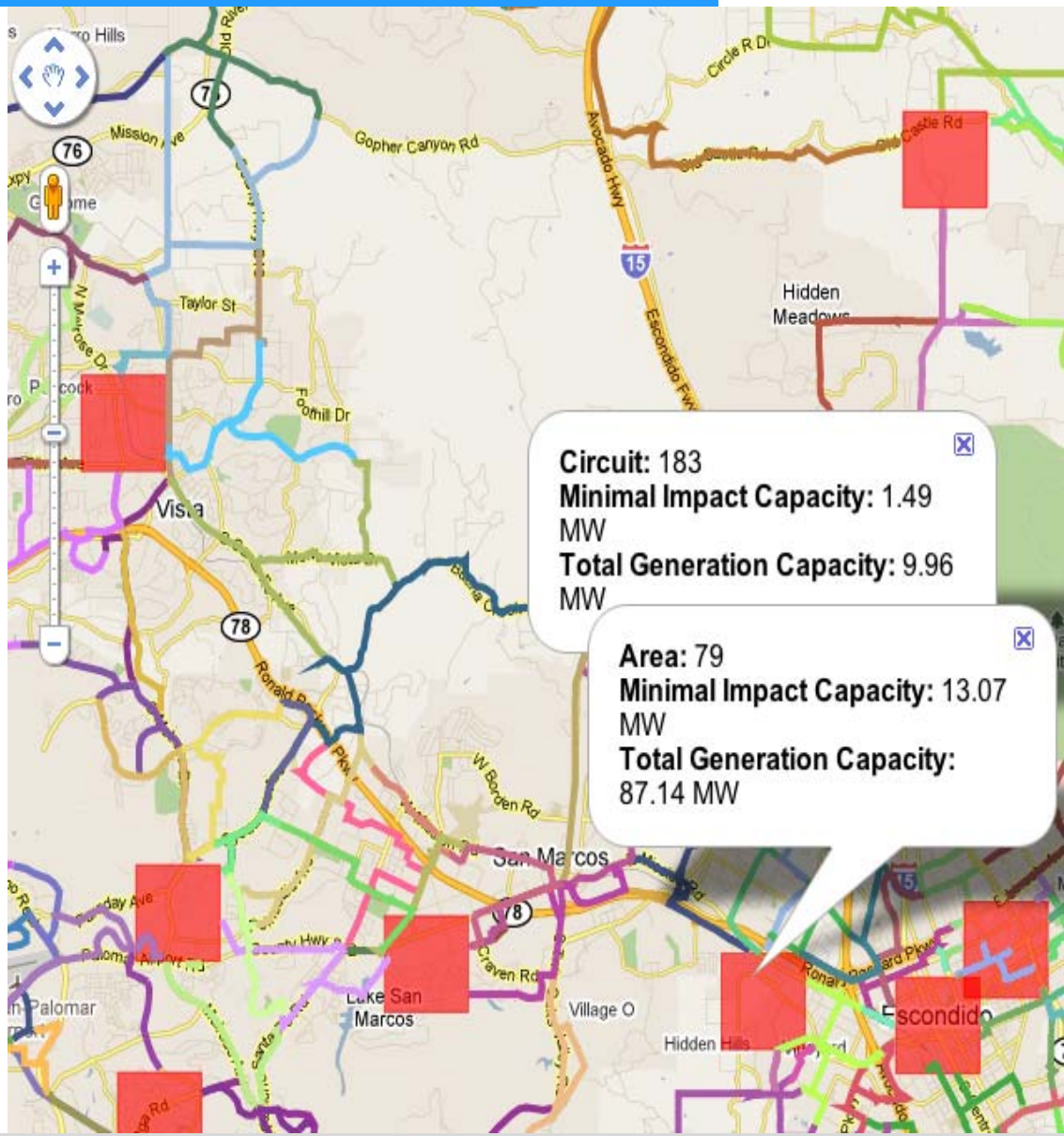
Sources: Galvin Electricity Initiative, Electric Reliability: Problems, Progress and Policy Solutions, February 2011
U.S. Energy Information Administration, International Energy Statistics, 2011

Distribution Grid Upgrade Vision

- Utility Distribution Investment Planning (UDIP) will be a transparent process in which the utilities are held accountable for investing in ways that meet coordinated State goals.
  - Instead of reactive planning on a case-by-case basis, the utilities will step back and create a plan, then build deliberately for the future distribution grid.
  - By anticipating advanced capabilities in future upgrades, new technology will be far faster and easier to incorporate and cost less for consumers, developers and the State.
- Recent documents from the CEC and Southern California Edison reflect the growing acceptance of this vision of the grid.
  - SCE's report from May of 2012 notes that overall grid upgrade costs will be cut by more than half, and transmission investments will be reduced by more than two-thirds, if DG siting is based on a 'guided' planning process.
  - The recent workshop on climate change adaptation at the energy commission highlighted the importance of a smart grid and locating energy generation very close to load in mitigating the impacts of extreme weather events.

Data Availability is Improving

- More D-grid information is being made accessible through improved interconnection maps
- But, improved information does not necessarily translate into transparent upgrade assessments
- Data in maps must be relevant to how interconnection studies are performed



DG+IG Projects Begin with Grid Modeling & Simulation

Clean Coalition

Demand Response

GRIDIANT

GRIDresponse
Intelligent Demand Response

Generation Reduction (MW): 1.3591

Total Dispatched (MW): 1.0093

Demand Side Resources

DR-R | DR-C | DG | Storage

Dispatch | Recall | Criterion

Automatic | Manual | Show All | Clear Selections

System Generation (MW): 47.2911

Total Available to Dispatch (MW): 14.7336

Available to Dispatch per Resource Type (MW)

DR-R:	DR-C:	DG:	Storage:
3.2064	3.4272	5.8000	2.3000

Type	Rank	ID	Load kW	ICAP kW	Total MW
DRR	1	TXB204038B	10.89	1.63	0.0016
DRC	2	TXB203908B	56.00	8.40	0.0100
DRC	3	TXB203914B	56.00	8.40	0.0184
DRC	4	TXB203919B	56.00	8.40	0.0268
DRC	5	TXB204013B	56.00	8.40	0.0352
DRR	6	TXB203901B	28.00	4.20	0.0394
ST	7	ST203901B	0.00	100.00	0.1394
DRR	8	TXB204017B	28.00	4.20	0.1436
DRR	9	TXB204023B	28.00	4.20	0.1478
DRC	10	TXB204014B	56.00	8.40	0.1562
DRC	11	TXB203913B	56.00	8.40	0.1646
DRR	12	TXB203918B	28.00	4.20	0.1688
DG	13	DG203918B	0.00	200.00	0.3688
DRC	14	TXB203895B	56.00	8.40	0.3772
DRR	15	TXB204015B	28.00	4.20	0.3814
DRC	16	TXB203900B	56.00	8.40	0.3898
DRR	17	TXB204018B	28.00	4.20	0.3940
DRC	18	TXB204001B	336.00	50.40	0.4444
DRC	19	TXB204002B	336.00	50.40	0.4948
DRR	20	TXB203917B	28.00	4.20	0.4990
ST	21	ST203917B	0.00	100.00	0.5990
DRC	22	TXB204024B	196.00	29.40	0.6284

Map | Data Table

Map | Satellite | Hybrid

Los Indios

Buchegallo

Resource Suitability

	DR	DG	ST
Excellent	●	■	▲
Good	●	■	▲
Average	●	■	▲
Mediocre	●	■	▲
Dispatched	●	■	▲

Paramillo National Park
Parque Nacional

Map data ©2012 Google - Terms of Use

DG+IG Policy Recommendations

- Integrate Grid Planning
  - Transparent and public T&D planning processes
  - Proactively evaluate DG+IG alternatives to new transmission investments
  - Necessary to meet goals re: renewables, EVs, costs, local job creation, resilience
- Implement Full Cost & Value Accounting
  - Investments should reflect the full spectrum of rate impacts, economic growth, health, safety, and environmental sustainability
  - Prevent bias against DG+IG (e.g. hidden transmission costs)
- Monetize DG+IG Grid Services
  - Establishing markets that compensate at full value of grid services is fundamental to optimizing value for ratepayers
- Prioritize DG+IG Development in High Value Locations
  - Identify preferred locations on the grid based on transparent cost & value criteria
  - Set “Local Portfolio Standard” targets
- Update Technical Standards:
  - Update national technical standards (IEEE/ UL) to allow DG+IG to provide grid services to the fullest potential