Onsite Generation in CA: Potential Ratepayer Savings and Key Barriers

Final Version

June 11, 2014

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Executive Summary

Executive Summary (1 of 3)

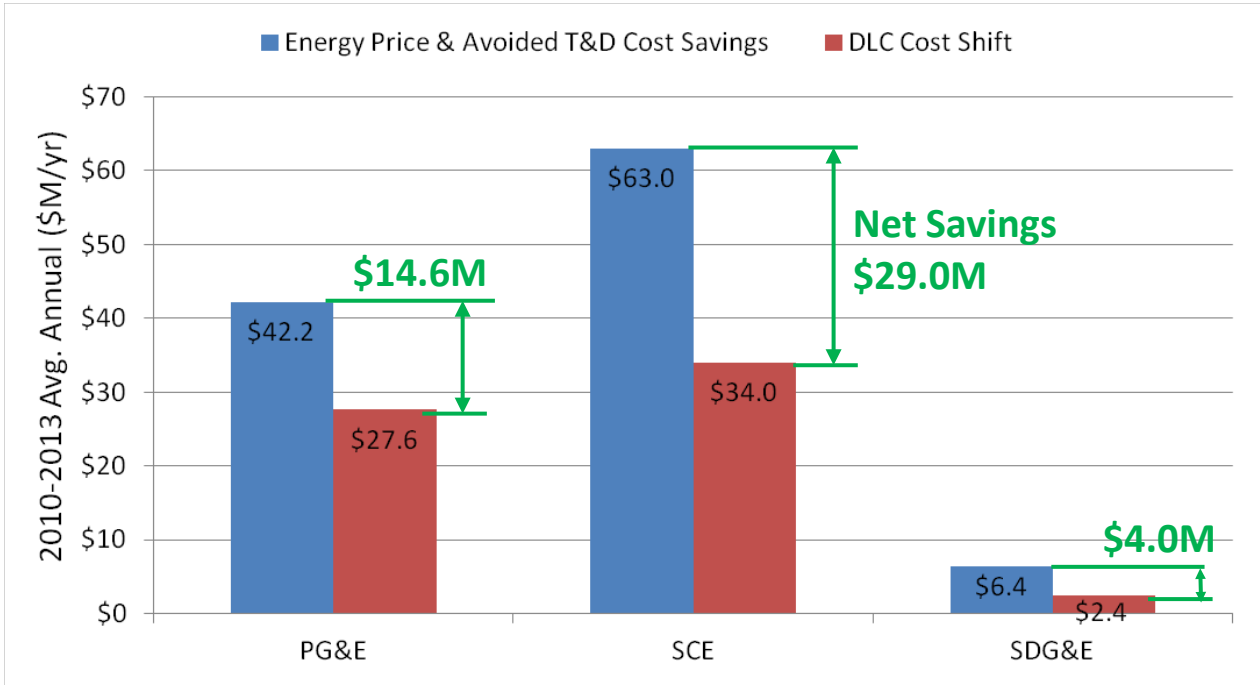
- Distributed Generation (DG)
  - Utility customers are willing to invest their own capital to install non-exporting onsite generation to help power and, in some cases, also provide heat for their facilities
  - Since DG displaces customer grid demand behind their meter, demand on the grid is reduced, providing several potential benefits to all ratepayers
  - Benefits include: reduced wholesale energy prices, reduced energy losses, avoided transmission and distribution (T&D) costs, reduced capacity requirements, and increased grid reliability.
- Key Barrier to DG – Nonbypassable Charges Applied to Onsite Generation
  - Nonbypassable charges (NBCs) are charges that are applied to ratepayer bills and assessed based on the amount of electricity consumed from the grid (cents/kWh)
  - Customers that install onsite generation that is not eligible for a net energy metering (NEM) tariff are required to pay NBCs for electricity produced and consumed onsite
  - NBCs applied to electricity produced and consumed onsite are referred to as Departing Load Charges (DLCs) and create an economic barrier to the installation of DG
  - The reason against allowing all DG to pay NBCs based only on electricity purchased from the grid has historically been that it's seen as a "cost shift" to non-participating ratepayers
  - It has been viewed as a cost shift because DG reduces electricity consumption from the grid which decreases the amount of NBCs collected, and this decrease has to be made whole by then increasing the rate at which NBCs are charged for all ratepayers
  - Note: Given the way in which NBCs are assessed (based on grid consumption), a cost shift occurs any time there is a reduction in grid consumption, regardless of what causes the reduction (energy efficiency, demand response, going out of business, NEM DG, etc)

Executive Summary (2 of 3)

- Analysis Overview
  - The cost shift that occurs when DG customers only pay NBCs based on grid purchases, referred to here as the "DLC cost shift", only looks at one side of the equation and does not account for the potential savings provided by DG
  - If the savings are larger than the cost shift, then there is actually net savings for all ratepayers
  - The main objective of this analysis was to quantify the savings from 1) lower wholesale energy prices and 2) avoided T&D costs, and then compare these savings to the DLC cost shift
  - In quantifying these savings, we took a different approach than existing forward-looking analyses and utilized historical data to perform a retrospective analysis
  - This analysis did not include the potential savings from reduced capacity requirements, congestion price savings, grid resiliency and security, or lower emissions
- Analysis Methodology
  - Quantifying Energy Price Savings (3 steps):
  - Used historical CAISO hourly energy price and demand data for 2010 through 2013 to quantify the impact that reduced demand (resulting from DG) would have had on market energy prices
  - Used FERC Form-1 data to determine each IOU's exposure to changes in market prices
  - Used published values from the CPUC, EPA, and CEC to estimate grid energy losses
  - Quantifying T&D Avoided Cost Savings:
  - Used published values from a recent CPUC decision on the cost effectiveness of demand response activities

Executive Summary (3 of 3)

- Results
  - In all cases and in all IOUs, the sum of the energy price savings and avoided T&D cost savings outweigh the DLC cost shift
  - Shown below is the results from our "base case" analysis that shows the 4 year average annual savings for each IOU for the period of 2010 through 2013
  - These savings translate into an average household savings of $0.09-0.19/month



Contributors & Third-Party Validation

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- Contributors
  - This analysis was performed by EtaGen Inc., an energy startup company located in Menlo Park, CA, with input from other industry leaders
  - Please submit any questions or requests to info@etagen.com
- Third-Party Validation
  - An independent review of this analysis was performed by Aspen Environmental Group, an energy, economic, environmental consulting firm located in Sacramento, CA
  - Aspen concluded the following:

    "Aspen reviewed the methodology, the workbook calculations, and the assumptions EtaGen used in its analysis. We conclude that the methodology is sound. We find the workbook calculations to be implemented correctly (i.e., the workbook functions as intended) and the assumptions EtaGen used to be conservative."
  - The full review paper is available upon request
- Supporters
  - The third-party validation was supported by EtaGen, California Clean DG Coalition (CCDC), and the Southern California Gas Company

Main Presentation

Benefits of Distributed Generation

- Non-exporting DG provides several grid-related benefits that are valuable to all ratepayers
- Since non-exporting DG is located behind the meter, it lowers demand on the grid
- Lowering demand on the grid leads to:
  - Lower CAISO energy prices
  - Avoided T&D costs
  - Cleaner electricity

Who Benefits from DG?

Benefit	DG Owner	Other Ratepayers
Lower CAISO Energy Prices	✓	✓
Avoided T&D Costs	✓	✓
Cleaner Electricity	✓	✓

DG financed by private capital benefits both the DG owner as well as all other ratepayers

Major Barrier to DG Installations

Non-Bypassable Charges (NBCs) applied to on-site generation

- NBCs are a part of every ratepayers bill (with exception of low income ratepayers via the CARE program)
- NBCs are charged based on energy consumption from the grid ($/MWh)
- When a customer installs onsite generation, the IOUs still apply certain NBCs to the electricity that is generated onsite
- In other words, customers are charged NBCs for both electricity purchased from the grid and electricity generated onsite
- NBCs applied to onsite generation are called **Departing Load Charges (DLCs)**
- Note: DLCs are different than stand-by charges (SBCs), which are applied based on onsite capacity ($/kW per month) and meant to pay for reserve grid capacity in the event of an outage of the onsite generation

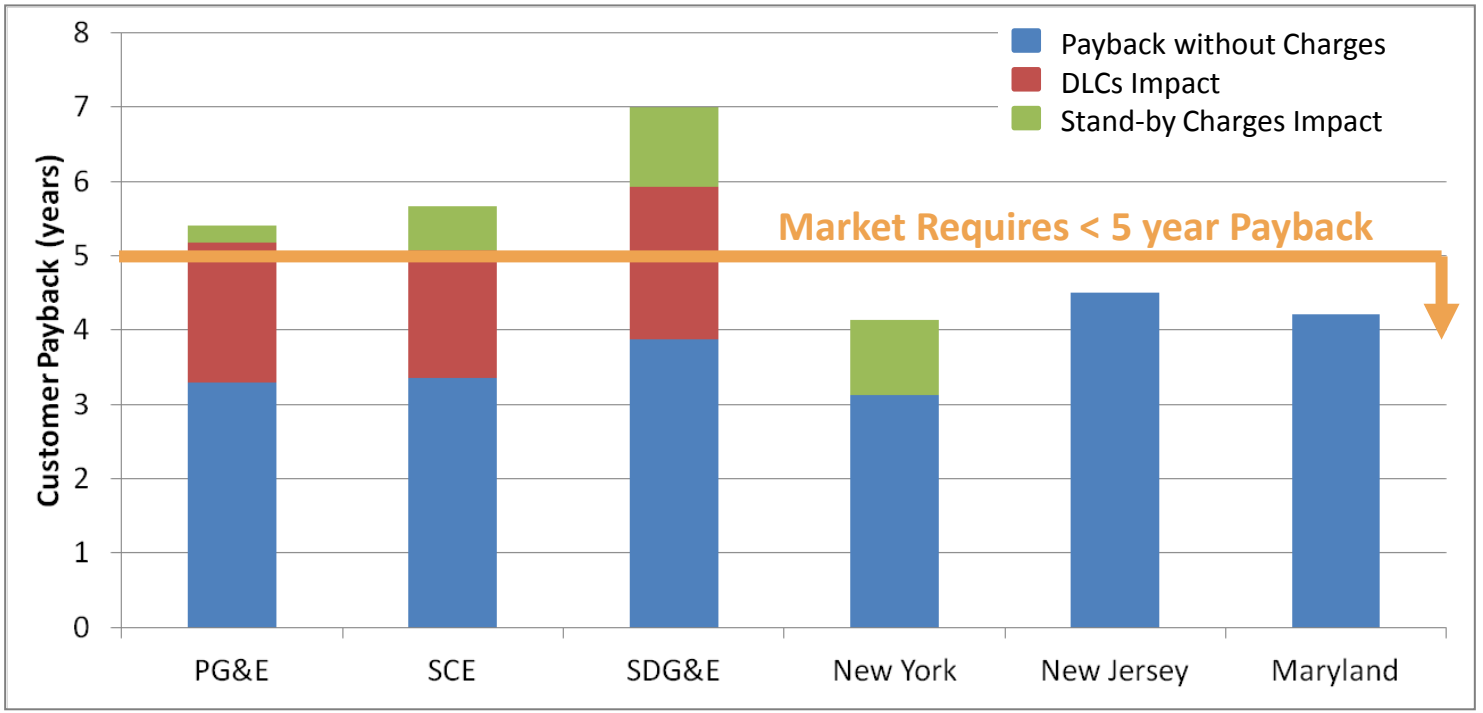
Summary of Departing Load Charges

Charges in $/MWh (2013 Tariff Values)	PG&E (E-19)	SCE (TOU-8)	SDG&E (AL-TOU)
Public Purpose Programs (PPP)	13.30	10.48	6.43
DWR Bond Charge	4.93	4.93	4.93
Competitive Transition Charge (CTC)*	2.76	0.77	2.79
Nuclear Decommissioning (ND)	0.50	0.14	(0.34)
Total ($/MWh)	21.49	16.32	13.81

- NEM tariff, EE, and DR customers pay NBCs only on grid purchases
- Reason against allowing more technologies to pay NBCs only on grid electricity purchases has historically been that it's seen as a "cost shift" to non-participating ratepayers

Tariffs chosen are typical of commercial buildings. Other tariffs for industrial and residential customers have different DLC values.
* CHP systems are exempt from CTC charge.

DLC Impact on DG Customer Economics



- CA is the only state that has DLCs for onsite generation
- DLCs make CA uncompetitive and prohibit DG installations
- DLCs prohibit all ratepayers from realizing the benefits of DG

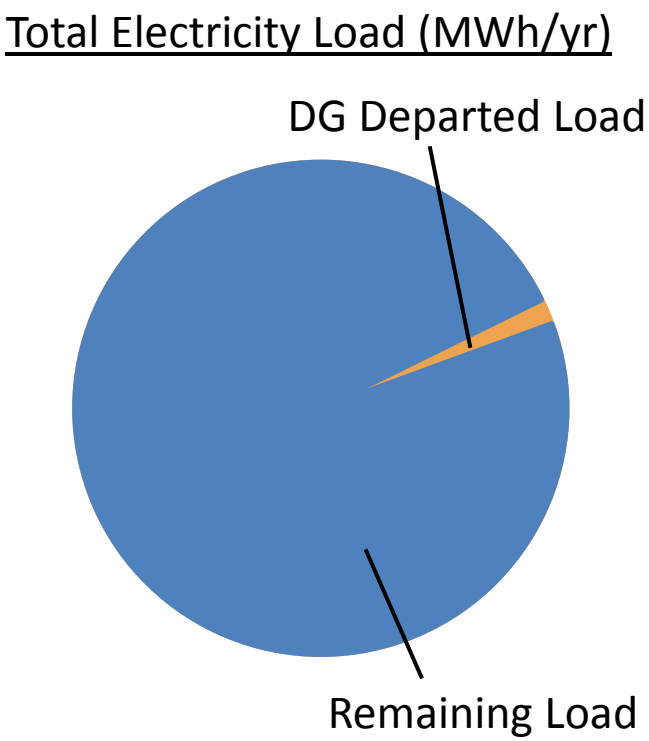
5 year payback based on conversations with over 50 potential customers.
Model accounts for higher gas prices on East Coast. PG&E $5.29, SCE $5.44, SDG&E $5.66, ConEd $8.90, JCPL $7.39, PEPCO $7.06 ($/MMBTU).

Understanding the "Cost Shift"

- If DG owners pay NBCs only on electricity purchased from the grid (i.e., they don't pay DLCs), then not as much money is collected for the individual programs
- Since the programs that NBCs go towards have a required amount of money that needs to be collect each year, when load decreases because of DG, the rate of each NBC needs to be increased in order to collect enough money
- It is this increase in NBCs rates which is referred to as a "Cost Shift"
- All programs will still be fully funded, just with different rates for each NBC
- This rate increase applies to all ratepayer purchases from the grid, including the amount DG owners still purchases from the grid
- Because of how NBCs are collected (based on electricity purchased from the grid), any and all reductions in electricity load is technically a Cost Shift

DG Impact on IOU & Ratepayer Costs

- DG Departed Load
  - If NBCs are only collected on grid electricity purchases, then NBCs will need to increase for all ratepayers (the "DLC cost shift")
- Remaining Load
  - Experiences the DLC cost shift
  - Experiences lower in energy prices and avoided T&D costs due to the lower demand on the grid
- Major Question:
  - Are the energy price and T&D savings greater than the DLC cost shift?
  - If so, then DG without DLCs can provide a net savings for all ratepayers

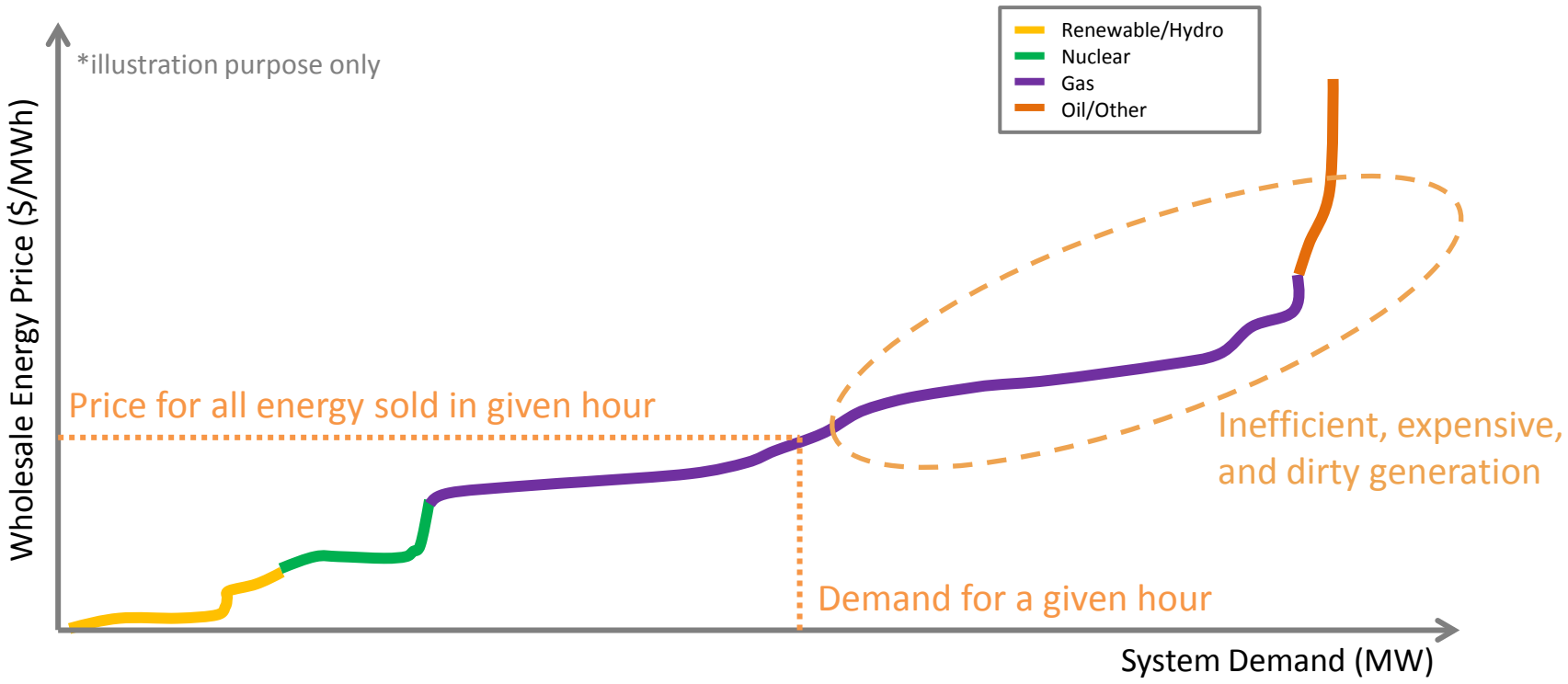


In Answering this Question...

- Took a different approach from existing analyses and reports
- Used historical data for 2010-2013 to perform a retrospective analysis to estimate the impact that 500 MW of DG would have had on energy prices and T&D costs
- Utilized actual CAISO data and published CPUC, CEC, EPA, and FERC data and values to perform this analysis

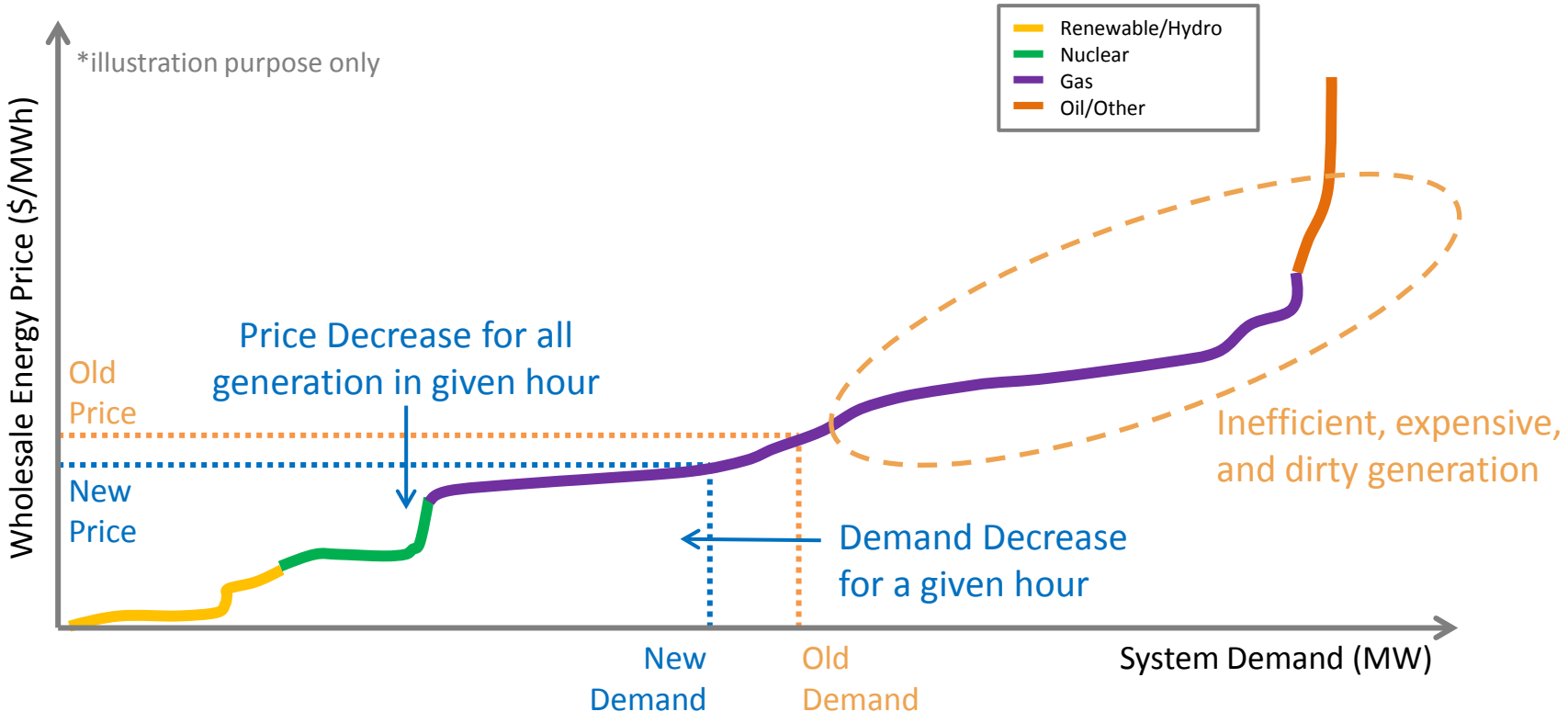
- Took a conservative approach and did not include the value of:
  - reductions in CAISO congestion prices
  - reductions in future capacity requirements (i.e., resource adequacy)
  - savings to non-IOU customers and Direct Access customers that purchase in the CAISO market
  - environmental benefits
  - grid resiliency and security benefits

Fundamentals of Market Pricing



CAISO system demand sets the market clearing energy price for every hour per year in the Day Ahead Market (DAM)

Impact of Demand Decrease on Prices



Lowering system demand in a given hour results in having lower price setter, and therefore lower energy price

Analysis: Impact of 500 MW of DG on IOU and Ratepayer Costs

IOU Energy Cost Savings (3 steps)

- Combined the information from Steps 1-3 to estimate the IOU avoided energy costs

Step 1: CAISO Energy Price Reduction

- Used historical 2010-2013 CAISO hourly DAM energy price and demand data to estimate the impact that a 500 MW reduction grid demand would have had on hourly energy prices

Step 2: IOU Purchases from CAISO

- Used FERC Form 1 data to estimate the amount of energy each IOU purchased that was exposed to CAISO prices via direct CAISO purchases and purchases from Qualifying Facilities (QFs). Used this information to estimate the IOU cost savings from lower CAISO energy prices

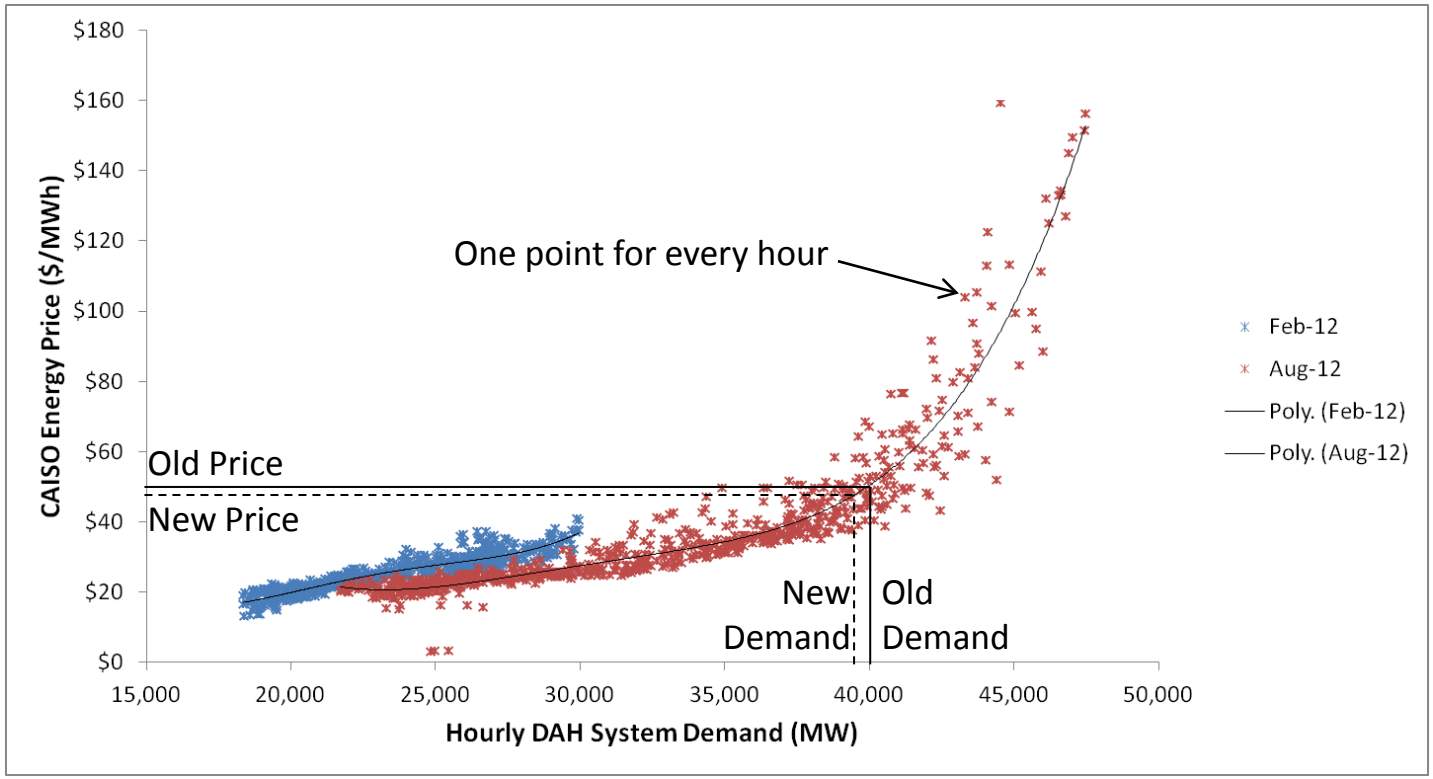
Step 3: IOU T&D Energy Losses

- Used published EPA, CEC, and CPUC values to estimate the amount of energy lost due to T&D

IOU T&D Cost Savings

- Used values published in CPUC Decision 10-12-024 to estimate the IOU avoided T&D costs

Step 1: Estimating Impact on CAISO Energy Prices from Decreased Demand by DG



- Used polynomial fits for monthly CAISO data to estimate the price change due to lower demand on grid

Step 2: Estimating the Amount of IOU Purchases from CAISO Market

FERC Form 1 Data	PG&E 2010	PG&E 2011	PG&E 2012	PG&E 2013
Energy Data (MWh)				
CAISO Area Total Purchases	102,867,639	104,056,017	107,081,145	106,455,042
IOU Total Purchases	91,005,743	88,284,683	90,503,660	83,802,189
% of CAISO Area Purchases	*88%*	*85%*	*85%*	*79%*
IOU CAISO Total Purchases	15,673,120	15,260,575	14,848,305	16,910,480
% of IOU Total Purchases	*17%*	*17%*	*16%*	20%
IOU QF Purhcases	14,638,711	14,053,080	10,828,775	9,867,095
% of IOU Total Purchases	*16%*	*16%*	*12%*	12%
Cost Data (MWh)				
IOU CAISO Total Purchases	$741,949,363	$372,311,817	$654,193,085	$703,457,296
IOU QF Purhcases	$787,270,028	$685,808,962	$464,327,706	$521,212,064

- Similar data for SCE and SDG&E in Appendix
- Assumed that CAISO purchases are made in hours in which IOU demand was greater than IOU-contracted or IOU-owned available resources
- Assumed that only 75% of QF purchases are exposed to market prices and that only 80% of the cost of QF purchases is energy cost (both conservative assumptions)

Step 3: Estimating the Amount of IOU Energy Losses from T&D

Source	Energy Losses from T&D
EPA Analysis: eGrid v9, released 2014, based on 2010 data	WECC: 6.84%
CEC Report: A Review of Transmissions Losses in Planning Studies, 2011	CA Average Losses (2002-2008): 5.4 - 6.9% IOU Peak Losses (2002-2008): PG&E: 7.7 - 9.8% SCE: 7.1 - 8.9% SDG&E: 6.2 - 8.8%
CPUC SGIP Decision 11-09-015	7.8%
Used in Analysis for All IOUs	**6%**

- Since IOU electricity has line losses and DG electricity doesn't, IOUs have to procure more electricity than what is produced by the DG in order to meet the displaced load (i.e., to have an apples-to-apples comparison)

IOU Avoided T&D Costs

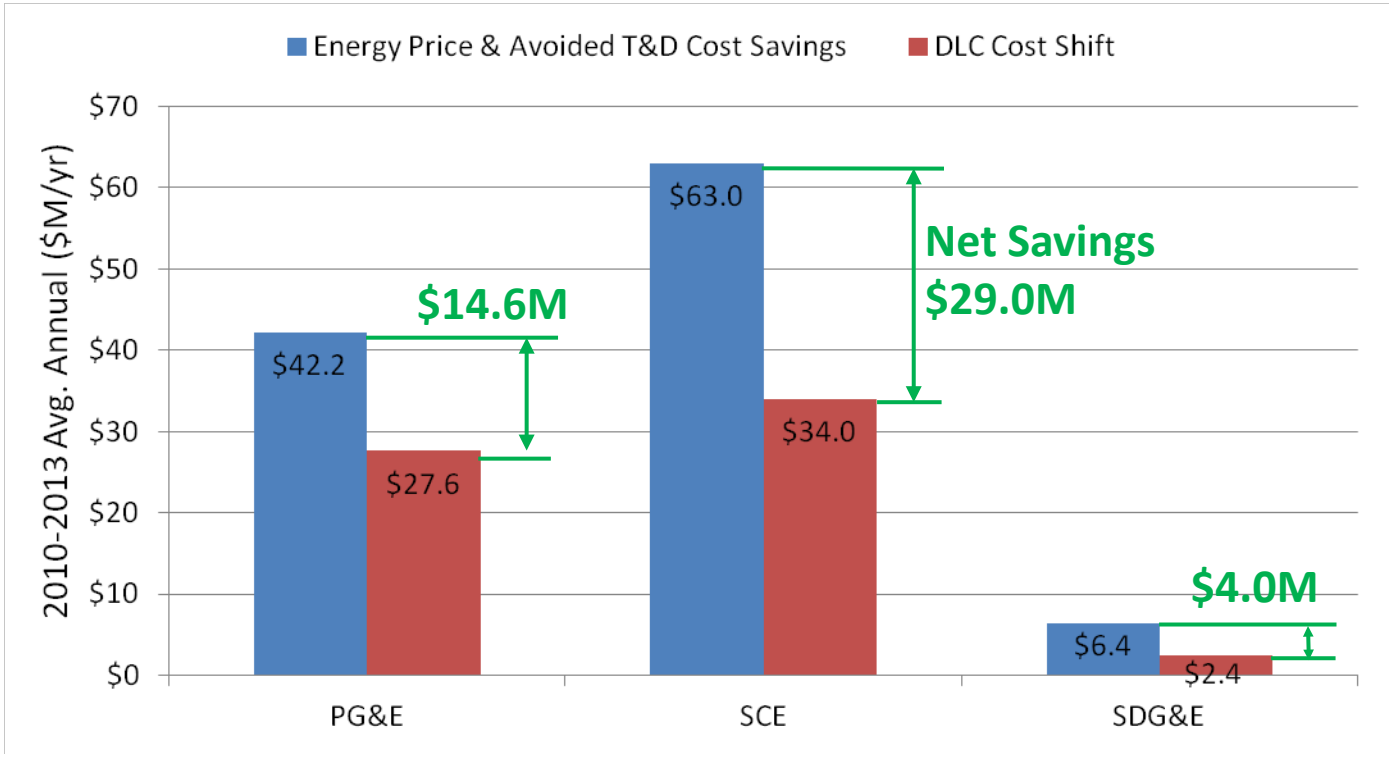
CPUC Decision 10-12-024

2012 Avoided Costs Values ($/kW-yr)	PG&E	SCE	SDG&E
Transmission & Sub-Transmission	$19.58	$23.85	$21.50
Distribution	$57.03	$30.71	$53.28
Total (used in this analysis)	**$76.61**	**$54.56**	**$74.78**

- CPUC published these values to quantify the avoided T&D costs provided by demand response and energy efficiency programs
- Both programs reduce demand on the grid in the same manner that non-exporting DG reduces demand on the grid
- Assumed these 2012 avoided values for all four years analyzed

Decision 10-12-024: "Decision Adopting a Method for Estimating the Cost-Effectiveness of Demand Response Activities"

Analysis Results: IOU Costs Savings vs. DLC Cost Shift from 500 MW of DG



→ DG would have provided a Net Savings in All IOU Territories

→ Average household savings of $0.09-0.19 per month

2013 CHP DLCs ($/MWh): PG&E 18.73, SCE 15.55, SDG&E 11.02. DG: 500 MW, 90% capacity factor. Household consumption: 500 kWh/month

Analysis Results: IOU Costs Savings vs. DLC Cost Shift from 500 MW of DG

Average Annual Results Steady Hours Case	PG&E 4 yr avg	SCE 4 yr avg	SDG&E 4 yr avg
DG Capacity (MW)	190	282	28
DG Load (MWh)	1,474,581	2,188,900	217,301
Displaced Load (MWh)	1,568,703	2,328,617	231,171
FERC Form 1 Energy Data (MWh)			
CAISO TAC Area Total Purchases	105,114,961	105,395,970	21,170,700
IOU Total Purchases	85,899,069	76,022,598	16,472,276
% of CAISO Area Purchases	*82%*	*72%*	*78%*
IOU CAISO Total Purchases	15,673,120	17,112,544	3,039,913
% of IOU Total Purchases	*18%*	*21%*	*19%*
IOU QF Purhcases	12,346,915	24,481,005	1,089,245
% of IOU Total Purchases	*14%*	*33%*	*7%*
Impact of DG ($)			
Savings			
CAISO Energy Price Savings	*$16,614,846*	*$22,327,761*	*$3,281,276*
QF Energy Price Savings	*$11,050,586*	*$25,328,585*	*$1,034,997*
T&D Avoided Cost Savings	*$14,554,754*	*$15,386,898*	*$2,093,619*
Total Savings	$42,220,186	$63,043,244	$6,409,892
Costs			
DLC Cost Shift	$27,618,897	$34,037,390	$2,394,655
Net Savings	**$14,601,289**	**$29,005,853**	**$4,015,237**
Avg Household Savings ($/month)			
at 500 kW/mohth	**$0.087**	**$0.191**	**$0.124**

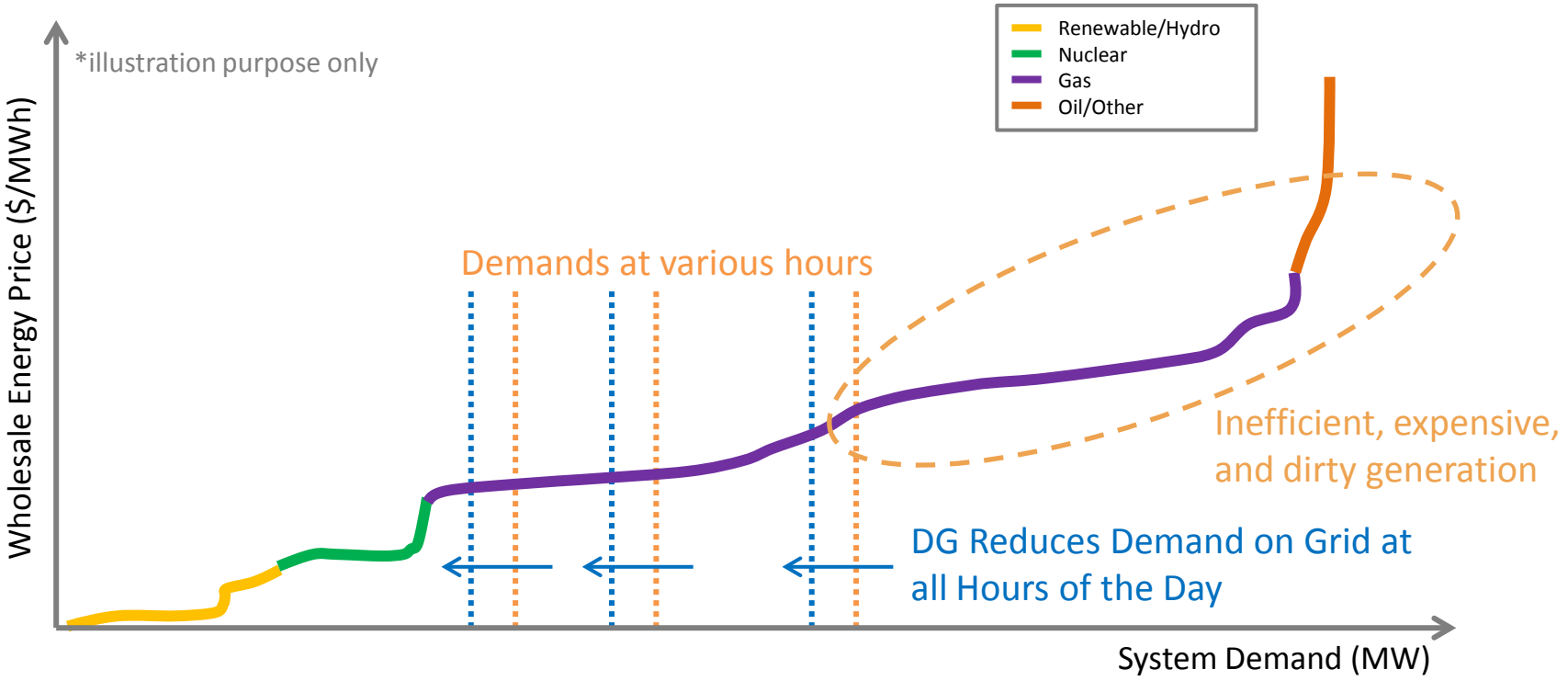
→ DG would have provided a Net Savings in All IOU Territories

2013 CHP DLCs ($/MWh): PG&E 18.73, SCE 15.55, SDG&E 11.02. DG: 90% capacity factor, 500 MW total.

Again, Conservative Analysis

- Does not include savings from reductions in congestion prices, which are part of the price each IOU pays for electricity from CAISO, called the Locational Marginal Price (LMP)
- Does not include similar savings that could be realized in the CAISO's real-time market
- Does not include the value of reductions in future capacity requirements (i.e., resource adequacy requirements)
- Does not include the value of savings to non-IOU customers and Direct Access customers that purchase in the CAISO market
- Does not include AB32 cost savings for years 2010-2012 (2013 energy prices included GHG allowance costs)
- Does not include the value of external environmental benefits
- Does not include the value of grid resiliency and security benefits

Summary of DG Benefits



→ DG reduces demand on grid leading to lower energy prices
→ DG reduces peak load on grid leading to lower T&D costs
→ DG reduces the amount of inefficient, expensive, dirty generation

Appendix

References

References

- CAISO Data
  - oasis.caiso.com (works best in FireFox)
- FERC Form 1 Data
  - http://www.ferc.gov/docs-filing/forms/form-1/data.asp
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  - "A Review of Transmissions Losses in Planning Studies", CEC Report, 2011, Link
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  - EPA eGrid v9, Link
- Relevant Reports
  - "Avoided Energy Supply Costs in New England: 2011 Report", Synapse Energy Economics, Link
  - "Avoided Energy Supply Costs in New England: 2013 Report", Synapse Energy Economics, Link
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  - "The effect of Departing Load Charges on the Costs and Benefits of Combined Heat and Power", ICF International, Link
  - "The Value of Distributed Solar Electric Generation to New Jersey and Pennsylvania" , Clean Power Research, Link
  - "2013 Updated Solar PV Value Report: Arizona Public Service", SAIC, Link
  - "Minnesota Value of Solar: Methodology", Clean Power Research, Link

Analysis Results Summary

Analysis Results Summary: 500 MW of DG

DG Distribution Model	Operating Hours Case	Net Savings ($M) PG&E	Net Savings ($M) SCE	Net Savings ($M) SDG&E
Market-Price Exposure	Steady	$14.6	$29.0	$4.0
	All	$12.8	$28.3	$3.9
	Day	$18.6	$28.0	$3.9
	Shoulder	$16.0	$21.4	$3.1
Demand Exposure	Steady	$10.9	$33.9	$3.7
	All	$8.1	$34.4	$3.4
	Day	$18.5	$28.8	$4.4
	Shoulder	$16.9	$20.9	$3.8

Net Savings = Avoided CAISO Costs + Avoided QF Costs + Avoided T&D Costs – DLC Cost Shift, where the avoided CAISO and QF costs include T&D energy losses
Market-Price Exposure: PG&E 190 MW, SCE 282 MW, and SDG&E 28 MW
Demand Exposure: PG&E 241 MW, SCE 213 MW, and SDG&E 46 MW

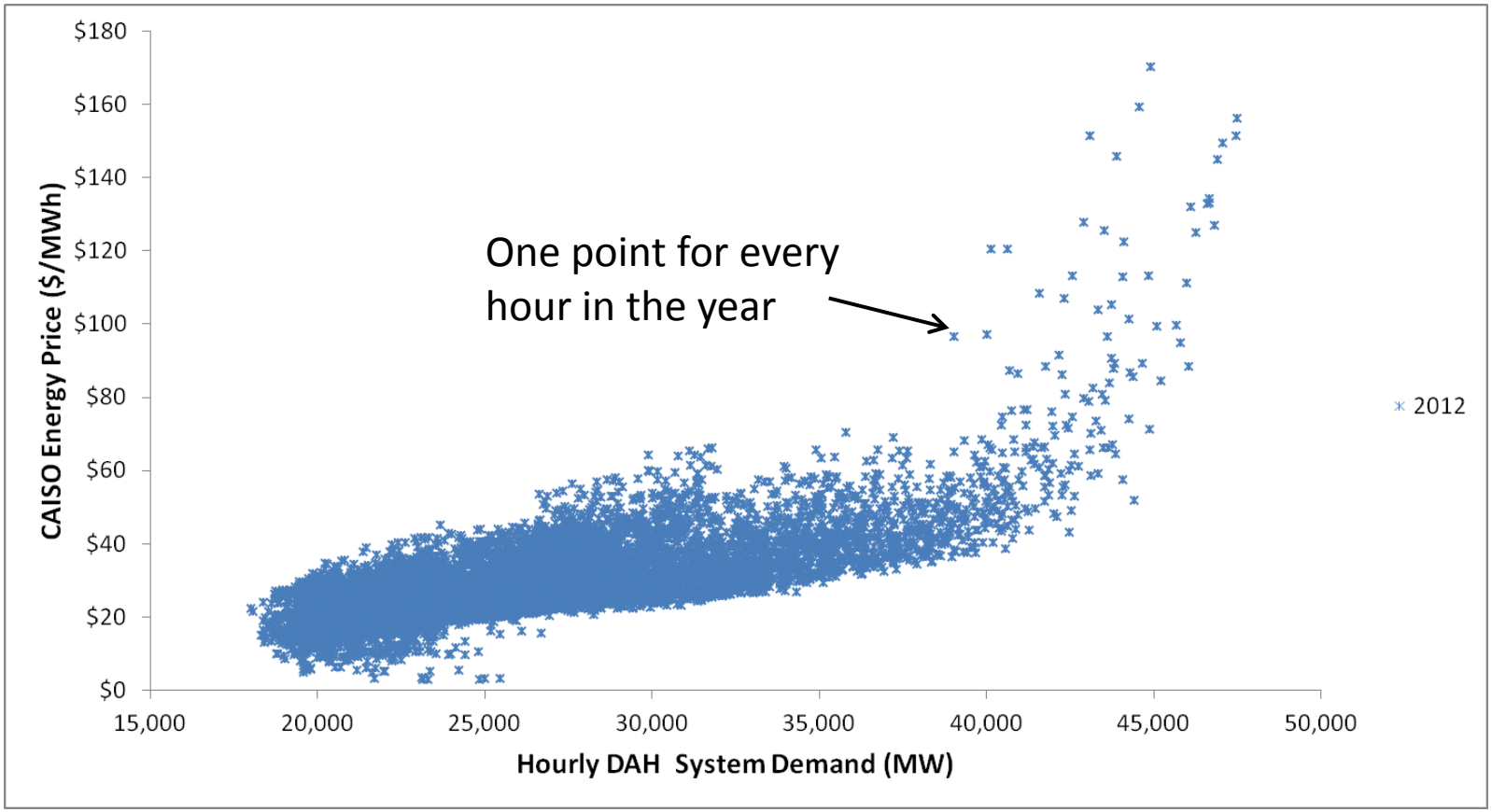
Analysis Results Summary: Differing Amount of DG for Steady Case

DG Distribution Model	Install DG Capacity	Net Savings ($M) PG&E	Net Savings ($M) SCE	Net Savings ($M) SDG&E
Market-Price Exposure	100 MW	$3.2	$6.2	$0.8
	500 MW	$14.6	$29.0	$4.0
	1,000 MW	$25.9	$53.1	$7.5
Demand Exposure	100 MW	$2.5	$7.2	$0.8
	500 MW	$10.9	$33.9	$3.7
	1,000 MW	$18.0	$63.4	$6.8

Net Savings = Avoided CAISO Costs + Avoided QF Costs + Avoided T&D Costs – DLC Cost Shift, where the avoided CAISO and QF costs include T&D energy losses.
All cases use the Steady Operating Hours Case
Market-Price Exposure: PG&E 190 MW, SCE 282 MW, and SDG&E 28 MW
Demand Exposure: PG&E 241 MW, SCE 213 MW, and SDG&E 46 MW

Energy Price Regression Model Methodology and Results

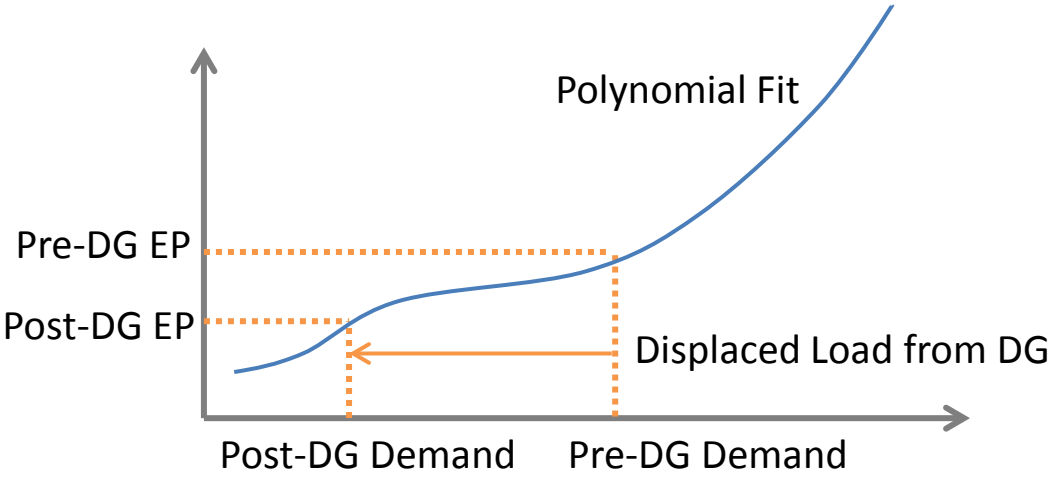
Regression Model:
Raw CAISO Price and Demand Data

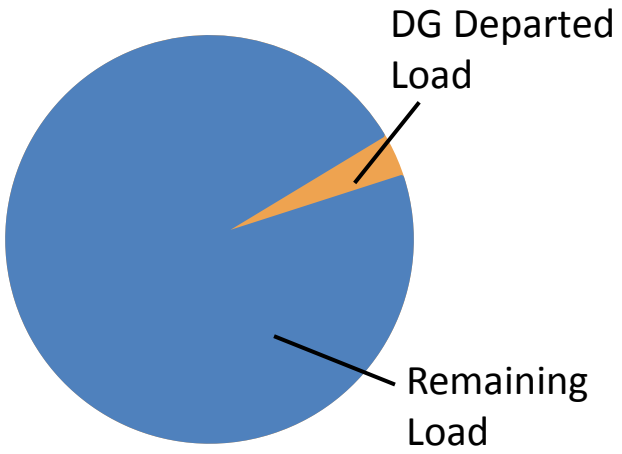


Regression Model: Analysis Methodology

- Fit polynomial regression lines to the actual CAISO energy and demand data for each month
- Used 4th order polynomial fits to capture the three major inflection points that correspond to the different resources of the supply stack (renewable/nuclear, combined cycle plants, & peaker plants)
- Used these fits to predict the energy price (EP) for every hour using the actual demand for that hour (pre-DG) and the actual demand minus the amount displaced load for that hour (post-DG)
- This gives the Pre-DG EP and Post-DG EP, respectively
- Used these EPs to calculate the annual cost that the remaining load would have paid Pre-DG and Post-DG
- The difference between Pre-DG and Post-DG is the “energy price savings” to the remaining load

Regression Model: Analysis Methodology





Pre-DG Cost [$/yr] = Remaning Load [MW] × Pre-DG EP [$/MWh] x Each Hour [hr]

Post-DG Cost [$/yr] = Remaning Load [MW] × Post-DG EP [$/MWh] x Each Hour [hr]

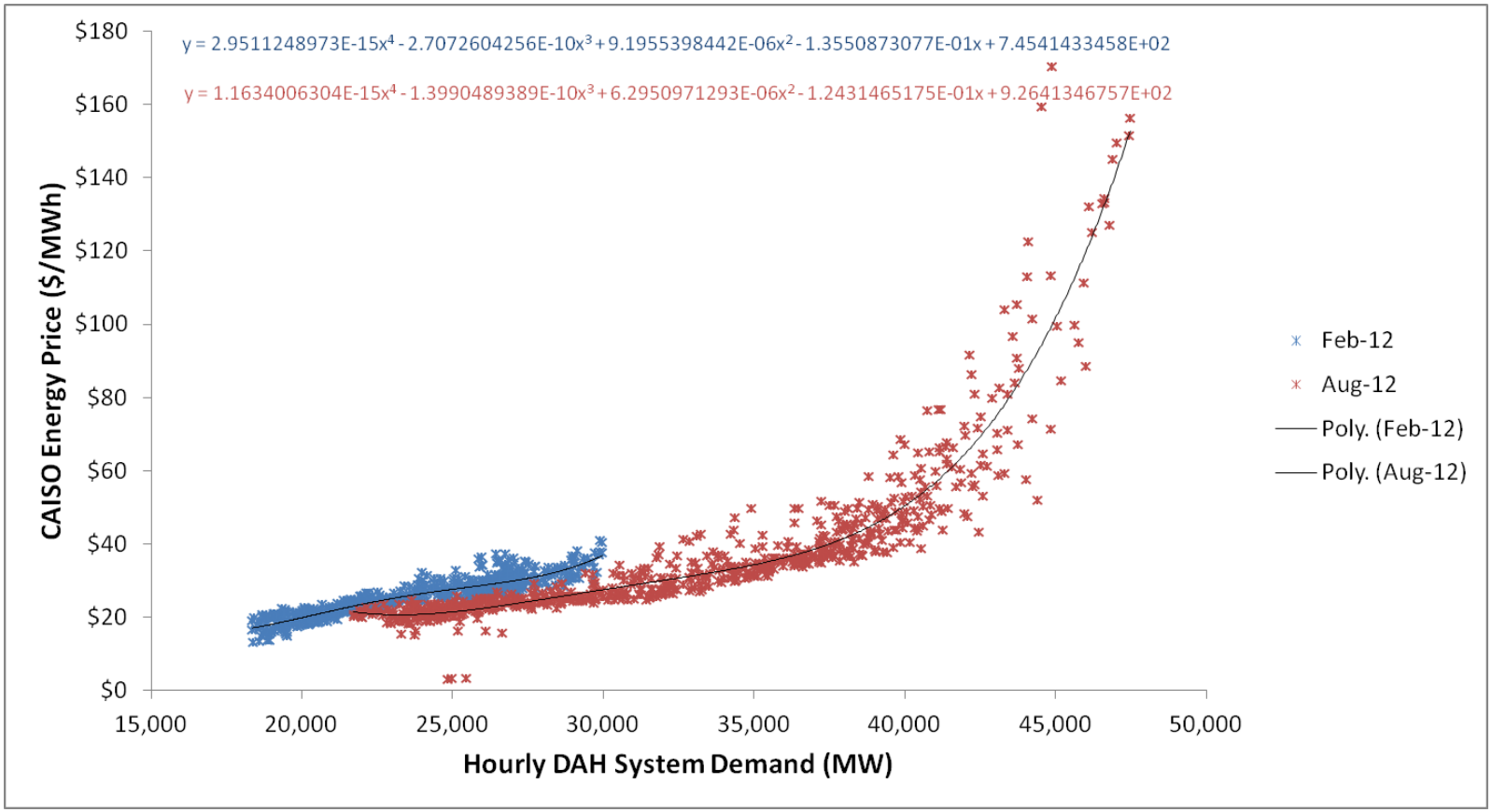
Energy Price Savings [$/yr] = Pre-DG Cost [$/yr] - Post-DG Cost [$/yr]

Regression Model
Accounting for T&D Losses

- 500 MW of DG actually offsets, or displaces, more than 500 MW of centralized generation because of line losses.
- The following equation accounts for T&D losses and allows for an apples-to-apples comparison:

$$\text{Displaced Load from DG} = \frac{\text{DG Output}}{\left(1 - \text{T\&D Losses [\%]}\right)}$$

Regression Model: Example Monthly Polynomial Fit



Regression Model: Model Validation

Model Comparisons Actual and Modeled Entire Load Costs	CAISO Energy 2010	CAISO Energy 2011	CAISO Energy 2012	CAISO Energy 2013
Actual CAISO Data	$8,579,733,552	$7,628,695,769	$7,457,811,080	$10,423,550,392
Regression Monthly Fit	$8,579,733,555	$7,628,695,783	$7,457,811,074	$10,423,550,412
% Diff.	*0.00000%*	*0.00000%*	*0.00000%*	*0.00000%*

Model Accurately Estimates Annual Costs

DG Operating Hour Scenarios: Four Cases Analyzed

- "Steady" Hours → used as Base Case
  - 100% of capacity 8AM through 10PM
  - 75% of capacity 10PM through 7AM
  - Equivalent to 89% capacity factor
- "All" Hours
  - 100% of capacity at all hours and days per year
- "Daytime" Hours
  - 100% of capacity 8AM through 6PM
  - 0% of capacity all other hours
  - Equivalent to 46% capacity factor
- "Shoulder" Hours
  - 100% of capacity 6AM through 9AM and 5PM through 8PM
  - 0% of capacity all other hours
  - Equivalent to 54% capacity factor

Regression Model Results: Steady Hours

Monthly Fit Steady Hours	CAISO Energy 2010	CAISO Energy 2011	CAISO Energy 2012	CAISO Energy 2013	CAISO Energy Four Year Avg.
DG Capacity (MW)	500	500	500	500	500
Actual Load (MWh)	228,668,971	229,940,923	234,902,979	233,670,315	231,795,797
DG Load (MWh)	3,878,125	3,878,125	3,888,750	3,878,125	3,880,781
Displaced Load (MWh)	4,125,665	4,125,665	4,136,968	4,125,665	4,128,491
Remaining Load (MWh)	224,543,306	225,815,259	230,766,011	229,544,650	227,667,306
Remaining Load Cost ($)					
Pre-DG	$8,426,237,762	$7,495,151,018	$7,330,019,259	$10,241,351,839	$8,373,189,969
Post-DG	$8,208,886,501	$7,198,931,263	$7,101,266,738	$10,010,111,404	$8,129,798,977
Energy Savings	**$217,351,261**	**$296,219,755**	**$228,752,521**	**$231,240,435**	**$243,390,993**
% Savings	***2.6%***	***4.0%***	***3.1%***	***2.3%***	***3.0%***
Remaining Load Rates ($/MWh)					
Pre-DG	$37.53	$33.19	$31.76	$44.62	$36.77
Post-DG	$36.56	$31.88	$30.77	$43.61	$35.70
Energy Savings	**$0.97**	**$1.31**	**$0.99**	**$1.01**	**$1.07**

Regression Model Results: All Hours

Monthly Fit All Hours	CAISO Energy 2010	CAISO Energy 2011	CAISO Energy 2012	CAISO Energy 2013	CAISO Energy Four Year Avg.
DG Capacity (MW)	500	500	500	500	500
Actual Load (MWh)	228,668,971	229,940,923	234,902,979	233,670,315	231,795,797
DG Load (MWh)	4,380,000	4,380,000	4,392,000	4,380,000	4,383,000
Displaced Load (MWh)	4,659,574	4,659,574	4,672,340	4,659,574	4,662,766
Remaining Load (MWh)	224,009,397	225,281,349	230,230,638	229,010,740	227,133,031
Remaining Load Cost ($)					
Pre-DG	$8,410,101,056	$7,482,853,440	$7,317,164,964	$10,221,303,243	$8,357,855,676
Post-DG	$8,167,033,474	$7,149,790,793	$7,069,296,671	$9,969,527,755	$8,088,912,173
Energy Savings	**$243,067,582**	**$333,062,647**	**$247,868,293**	**$251,775,488**	**$268,943,502**
% Savings	***2.9%***	***4.5%***	***3.4%***	***2.5%***	***3.3%***
Remaining Load Rates ($/MWh)					
Pre-DG	$37.54	$33.22	$31.78	$44.63	$36.79
Post-DG	$36.46	$31.74	$30.71	$43.53	$35.61
Energy Savings	**$1.09**	**$1.48**	**$1.08**	**$1.10**	**$1.18**

Regression Model Results: Daytime Hours

Monthly Fit Day Hours	CAISO Energy 2010	CAISO Energy 2011	CAISO Energy 2012	CAISO Energy 2013	CAISO Energy Four Year Avg.
DG Capacity (MW)	500	500	500	500	500
Actual Load (MWh)	228,668,971	229,940,923	234,902,979	233,670,315	231,795,797
DG Load (MWh)	2,007,500	2,007,500	2,013,000	2,007,500	2,008,875
Displaced Load (MWh)	2,135,638	2,135,638	2,141,489	2,135,638	2,137,101
Remaining Load (MWh)	226,533,333	227,805,285	232,761,489	231,534,676	229,658,696
Remaining Load Cost ($)					
Pre-DG	$8,491,306,478	$7,547,601,719	$7,382,518,807	$10,321,097,614	$8,435,631,154
Post-DG	$8,375,471,183	$7,394,817,691	$7,236,985,033	$10,183,310,910	$8,297,646,204
Energy Savings	**$115,835,294**	**$152,784,027**	**$145,533,774**	**$137,786,704**	**$137,984,950**
% Savings	***1.4%***	***2.0%***	***2.0%***	***1.3%***	***1.7%***
Remaining Load Rates ($/MWh)					
Pre-DG	$37.48	$33.13	$31.72	$44.58	$36.73
Post-DG	$36.97	$32.46	$31.09	$43.98	$36.13
Energy Savings	**$0.51**	**$0.67**	**$0.63**	**$0.60**	**$0.60**

Regression Model Results: Shoulder Hours

Monthly Fit Shoulder Hours	CAISO Energy 2010	CAISO Energy 2011	CAISO Energy 2012	CAISO Energy 2013	CAISO Energy Four Year Avg.
DG Capacity (MW)	500	500	500	500	500
Actual Load (MWh)	228,668,971	229,940,923	234,902,979	233,670,315	231,795,797
DG Load (MWh)	1,460,000	1,460,000	1,464,000	1,460,000	1,461,000
Displaced Load (MWh)	1,553,191	1,553,191	1,557,447	1,553,191	1,554,255
Remaining Load (MWh)	227,115,780	228,387,732	233,345,532	232,117,123	230,241,542
Remaining Load Cost ($)					
Pre-DG	$8,517,671,890	$7,572,494,467	$7,406,544,945	$10,350,576,648	$8,461,821,987
Post-DG	$8,433,782,552	$7,460,878,760	$7,320,551,668	$10,252,132,419	$8,366,836,350
Energy Savings	**$83,889,338**	**$111,615,708**	**$85,993,277**	**$98,444,229**	**$94,985,638**
% Savings	***1.0%***	***1.5%***	***1.2%***	***1.0%***	***1.1%***
Remaining Load Rates ($/MWh)					
Pre-DG	$37.50	$33.16	$31.74	$44.59	$36.75
Post-DG	$37.13	$32.67	$31.37	$44.17	$36.34
Energy Savings	**$0.37**	**$0.49**	**$0.37**	**$0.42**	**$0.41**

Regression Model Results: Steady Hours with 100 MW of DG

100 MW of DG

Monthly Fit Steady Hours	CAISO Energy 2010	CAISO Energy 2011	CAISO Energy 2012	CAISO Energy 2013	CAISO Energy Four Year Avg.
DG Capacity (MW)	100	100	100	100	100
Actual Load (MWh)	228,668,971	229,940,923	234,902,979	233,670,315	231,795,797
DG Load (MWh)	775,625	775,625	777,750	775,625	776,156
Displaced Load (MWh)	825,133	825,133	827,394	825,133	825,698
Remaining Load (MWh)	227,843,838	229,115,791	234,075,585	232,845,182	230,970,099
Remaining Load Cost ($)					
Pre-DG	$8,549,034,397	$7,601,986,830	$7,432,252,711	$10,387,110,698	$8,492,596,159
Post-DG	$8,504,330,053	$7,540,773,488	$7,384,947,813	$10,338,884,612	$8,442,233,992
Energy Savings	**$44,704,344**	**$61,213,342**	**$47,304,898**	**$48,226,085**	**$50,362,167**
% Savings	***0.5%***	***0.8%***	***0.6%***	***0.5%***	***0.6%***
Remaining Load Rates ($/MWh)					
Pre-DG	$37.52	$33.18	$31.75	$44.61	$36.77
Post-DG	$37.33	$32.91	$31.55	$44.40	$36.55
Energy Savings	**$0.20**	**$0.27**	**$0.20**	**$0.21**	**$0.22**

Regression Model Results: Steady Hours with 1,000 MW of DG

1,000 MW of DG

Monthly Fit Steady Hours	CAISO Energy 2010	CAISO Energy 2011	CAISO Energy 2012	CAISO Energy 2013	CAISO Energy Four Year Avg.
DG Capacity (MW)	1,000	1,000	1,000	1,000	1,000
Actual Load (MWh)	228,668,971	229,940,923	234,902,979	233,670,315	231,795,797
DG Load (MWh)	7,756,250	7,756,250	7,777,500	7,756,250	7,761,563
Displaced Load (MWh)	8,251,330	8,251,330	8,273,936	8,251,330	8,256,981
Remaining Load (MWh)	220,417,641	221,689,594	226,629,042	225,418,985	223,538,816
Remaining Load Cost ($)					
Pre-DG	$8,272,741,968	$7,361,606,254	$7,202,227,443	$10,059,153,265	$8,223,932,233
Post-DG	$7,851,572,676	$6,789,972,808	$6,762,698,485	$9,618,945,374	$7,755,797,336
Energy Savings	**$421,169,292**	**$571,633,445**	**$439,528,958**	**$440,207,891**	**$468,134,897**
% Savings	***5.1%***	***7.8%***	***6.1%***	***4.4%***	***5.8%***
Remaining Load Rates ($/MWh)					
Pre-DG	$37.53	$33.21	$31.78	$44.62	$36.79
Post-DG	$35.62	$30.63	$29.84	$42.67	$34.69
Energy Savings	**$1.91**	**$2.58**	**$1.94**	**$1.95**	**$2.10**

IOU CAISO Purchase & QF Purchase Model Methodology

IOU CAISO Model: Analysis Methodology

Determining amount each IOU purchased from CAISO:

- Used data from FERC Form 1 to determine how much energy each IOU purchased from CAISO in 2010-2013

Determining when CAISO purchases occurred:

- Assumed that each IOU has a fixed amount of capacity and contract obligations, and when the IOU demand is greater than this amount they purchase the net amount from CAISO
- Used historical CAISO LMP data to find this demand threshold, which was determined such that the cost of all purchases from CAISO above this demand is equal to the FERC Form 1 reported costs of CAISO purchases
- Assumed that the ratio of IOU total annual demand to the TAC area total annual demand remained constant over all hours

Determining IOU CAISO savings:

- For every hour above the demand threshold, we determined the potential cost savings by multiplying the net amount of energy purchased from the CASIO minus the DG demand by the difference between the Pre-DG and Post-DG CAISO energy price (from the monthly regression analysis)

IOU QF Model: Analysis Methodology

Determining amount each IOU purchased from QFs:

- Used data from FERC Form 1 to determine how much energy each IOU purchased from Qualifying Facilities in 2010-2013

Determining when QF purchases occurred:

- Since QFs include renewable and natural gas generation, there is no real way to determine when purchases were made (at least with publically available data)
- Assumed that QF purchases are evenly distributed among all hours

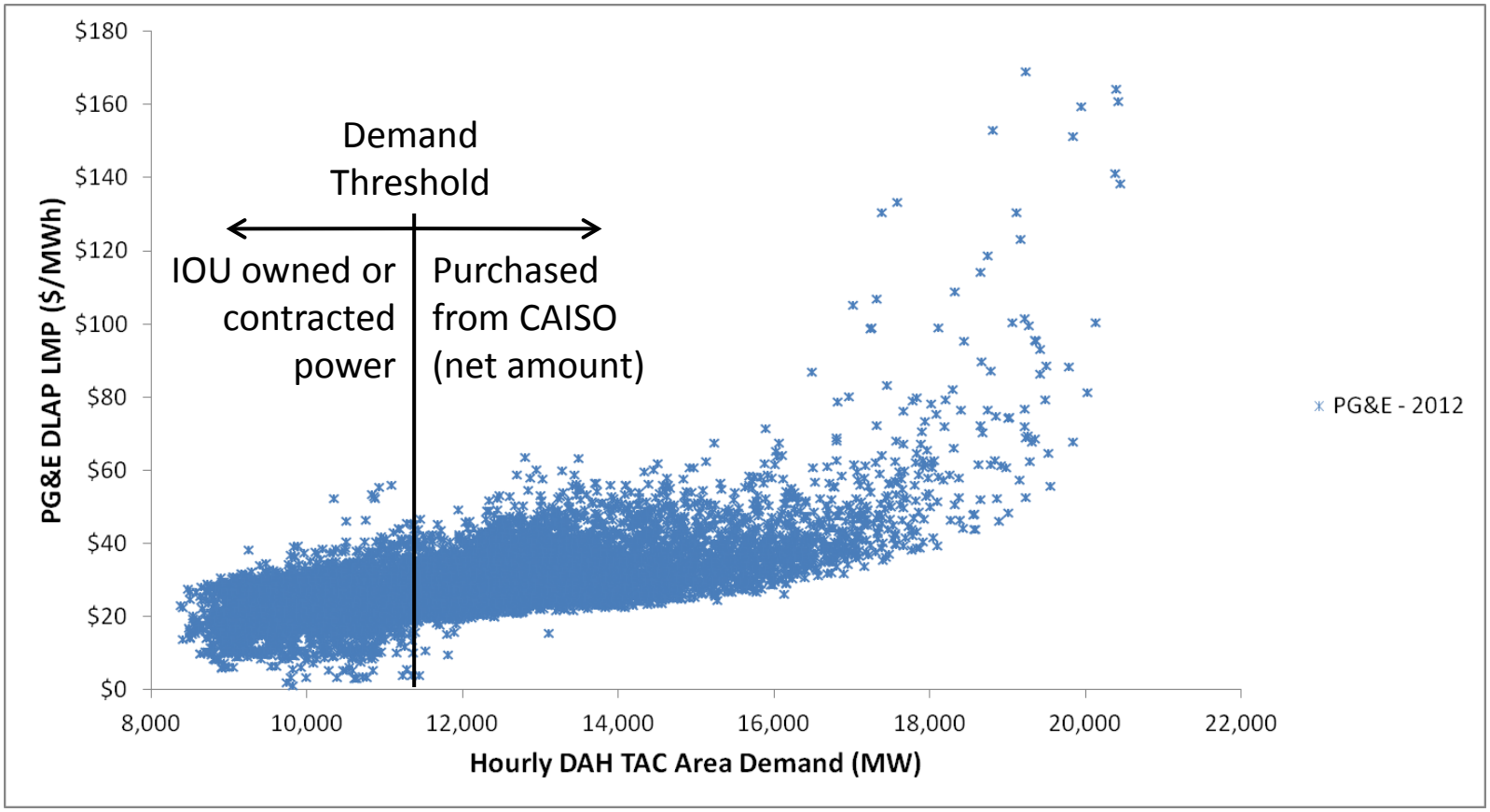
Determining IOU QF savings:

- Conservatively assumed that only a fraction of QF energy purchases were subject to market prices, depending on their contract terms.
  - This “Market Factor” was assumed be 75%
- Conservatively assumed that only a fraction of the potential CAISO reduction in energy prices would be realized by those QFs exposed to market prices (to account for fixed O&M and other payments)
  - This “Price Factor” was assumed to be 80%
- The savings from QF energy purchases is calculated by multiplying the amount spent on QF purchases in a given year by the percent reduction in CAISO energy prices in that year (from Step 2) and then by both the Market and Price Factors

IOU CAISO & QF Model: Distributing the DG within IOUs

- CAISO energy prices are determined by system demand, and therefore it wasn't necessary to specify where the DG was located in order to determine the Pre- and Post-DG energy prices
- However, in order to determine each IOU's avoided CAISO and QF purchases, avoided T&D costs, and DLC cost shift, we need to make an assumption about where the DG is located
- We chose to distribute the 500 MW of DG two ways based on:
  - **Market-Price Distribution:** based on each IOU's exposure to market prices through both direct CAISO purchases and QF purchases relative to all IOU exposure
    - PG&E: 190 MW (38%)
    - SCE: 282 MW (56.4%)
    - SDG&E: 28 MW (5.6%)
  - **Demand Distribution:** based on each IOU's demand relative to all IOU demand
    - PG&E: 241 MW (48.2%)
    - SCE: 213 MW (42.6%)
    - SDG&E: 46 MW (9.2%)
- Both yielded significant savings, with the Market-Price Distribution yielding the most equitable distribution of savings across the IOUs

IOU CAISO Model: Illustration of CAISO Methodology



Although it looks like there are a lot of points above the threshold, it is only 17% of the total amount of energy procured by PG&E (i.e., there are more points clustered below the threshold)

IOU CAISO & QF Model: CAISO Purchase Equations

Demand Threshold set such that Actual CAISO Purchase Cost from FERC Form 1 equals:

Actual LMP [$/MWh] x (Actual Demand – Demand Threshold) [MW] x All Hours [hr]

IOU CAISO Energy Price Savings equals:

(Actual Demand – Demand Threshold - Displaced Load) [MW] x
(Pre-DG EP – Post-DG EP) [$/MWh] x All Hours [hr]
where: Displaced Load = DG Output/(1-T&D Losses [%])

IOU QF Energy Price Savings equals:

Actual Cost of QFs x % CAISO Energy Price Reduction x Market Factor x Price Factor

The % CAISO Energy Price Reduction is a function of Operating Case (i.e., Steady Hours, All Hours, Day Hours, and Shoulder Hours)

IOU CAISO & QF Model: FERC Form 1 for PG&E

FERC Form 1 Data	PG&E 2010	PG&E 2011	PG&E 2012	PG&E 2013
Energy Data (MWh)				
CAISO Area Total Purchases	102,867,639	104,056,017	107,081,145	106,455,042
IOU Total Purchases	91,005,743	88,284,683	90,503,660	83,802,189
% of CAISO Area Purchases	*88%*	*85%*	*85%*	*79%*
IOU CAISO Total Purchases	15,673,120	15,260,575	14,848,305	16,910,480
% of IOU Total Purchases	*17%*	*17%*	*16%*	20%
IOU QF Purhcases	14,638,711	14,053,080	10,828,775	9,867,095
% of IOU Total Purchases	*16%*	*16%*	*12%*	12%
Cost Data (MWh)				
IOU CAISO Total Purchases	$741,949,363	$372,311,817	$654,193,085	$703,457,296
IOU QF Purhcases	$787,270,028	$685,808,962	$464,327,706	$521,212,064

*2010 CAISO purchase information was not reported, so we assumed it was the average of the next three years (2011-2013)

IOU CAISO & QF Model: FERC Form 1 for SCE

FERC Form 1 Data	SCE 2010	SCE 2011	SCE 2012	SCE 2013
Energy Data (MWh)				
CAISO Area Total Purchases	104,916,656	104,796,946	106,274,599	105,595,678
IOU Total Purchases	66,171,019	70,629,073	82,942,608	84,347,690
% of CAISO Area Purchases	*63%*	*67%*	*78%*	*80%*
IOU CAISO Total Purchases	6,121,400	8,063,158	28,931,932	25,333,686
% of IOU Total Purchases	*9%*	*11%*	*35%*	*30%*
IOU QF Purhcases	24,649,292	24,405,318	24,159,440	24,709,969
% of IOU Total Purchases	*37%*	*35%*	*29%*	*34%*
Cost Data (MWh)				
IOU CAISO Total Purchases	$402,303,050	$413,374,259	$1,215,931,625	$1,462,218,383
IOU QF Purhcases	$1,387,380,857	$1,454,843,605	$1,288,591,056	$1,565,998,507

IOU CAISO & QF Model: FERC Form 1 for SDG&E

FERC Form 1 Data	SDG&E 2010	SDG&E 2011	SDG&E 2012	SDG&E 2013
Energy Data (MWh)				
CAISO Area Total Purchases	20,884,672	21,088,439	21,547,252	21,162,437
IOU Total Purchases	15,847,189	16,022,028	16,740,696	17,279,191
% of CAISO Area Purchases	*76%*	*76%*	*78%*	*82%*
IOU CAISO Total Purchases	3,882,144	3,849,749	3,125,718	1,302,040
% of IOU Total Purchases	*24%*	*24%*	*19%*	*8%*
IOU QF Purhcases	1,217,427	1,035,640	1,019,211	1,084,702
% of IOU Total Purchases	*8%*	*6%*	*6%*	*7%*
Cost Data (MWh)				
IOU CAISO Total Purchases	$158,926,492	$97,131,380	$146,455,899	$98,374,985
IOU QF Purhcases	$66,997,945	$56,138,458	$49,032,213	$63,020,332

* QF purchases were not reported in FERC Form 1. We used CEC Form S-2 to determine the amount of QF energy that was purchased, then assumed that for every year the rate of those purchases was equal to the average rate of PG&E and SCE purchases in that year.

Detailed Analysis Results

Analysis Results:
Steady Hours – Market-Exposure Distribution

Average Annual Results	PG&E	SCE	SDG&E
Steady Hours Case	**4 yr avg**	**4 yr avg**	**4 yr avg**
DG Capacity (MW)	190	282	28
DG Load (MWh)	1,474,581	2,188,900	217,301
Displaced Load (MWh)	1,568,703	2,328,617	231,171
FERC Form 1 Energy Data (MWh)			
CAISO TAC Area Total Purchases	105,114,961	105,395,970	21,170,700
IOU Total Purchases	85,899,069	76,022,598	16,472,276
% of CAISO Area Purchases	*82%*	*72%*	*78%*
IOU CAISO Total Purchases	15,673,120	17,112,544	3,039,913
% of IOU Total Purchases	*18%*	*21%*	*19%*
IOU QF Purhcases	12,346,915	24,481,005	1,089,245
% of IOU Total Purchases	*14%*	*33%*	*7%*
Impact of DG ($)			
Savings			
CAISO Energy Price Savings	*$16,614,846*	*$22,327,761*	*$3,281,276*
QF Energy Price Savings	*$11,050,586*	*$25,328,585*	*$1,034,997*
T&D Avoided Cost Savings	*$14,554,754*	*$15,386,898*	*$2,093,619*
Total Savings	$42,220,186	$63,043,244	$6,409,892
Costs			
DLC Cost Shift	$27,618,897	$34,037,390	$2,394,655
Net Savings	**$14,601,289**	**$29,005,853**	**$4,015,237**
Avg Household Savings ($/month)			
at 500 kW/mohth	**$0.087**	**$0.191**	**$0.124**

Analysis Results:
All Hours – Market-Exposure Distribution

Average Annual Results All Hours Case	PG&E 4 yr avg	SCE 4 yr avg	SDG&E 4 yr avg
DG Capacity (MW)	190	282	28
DG Load (MWh)	1,665,409	2,472,169	245,422
Displaced Load (MWh)	1,771,712	2,629,967	261,087
FERC Form 1 Energy Data (MWh)			
CAISO TAC Area Total Purchases	105,114,961	105,395,970	21,170,700
IOU Total Purchases	85,899,069	76,022,598	16,472,276
% of CAISO Area Purchases	*82%*	*72%*	*78%*
IOU CAISO Total Purchases	15,673,120	17,112,544	3,039,913
% of IOU Total Purchases	*18%*	*21%*	*19%*
IOU QF Purhcases	12,346,915	24,481,005	1,089,245
% of IOU Total Purchases	*14%*	*33%*	*7%*
Impact of DG ($)			
Savings			
CAISO Energy Price Savings	*$17,189,714*	*$23,336,885*	*$3,359,664*
QF Energy Price Savings	*$12,277,017*	*$28,061,758*	*$1,147,260*
T&D Avoided Cost Savings	*$14,554,754*	*$15,386,898*	*$2,093,619*
Total Savings	$44,021,485	$66,785,541	$6,600,543
Costs			
DLC Cost Shift	$31,193,108	$38,442,229	$2,704,552
Net Savings	**$12,828,377**	**$28,343,312**	**$3,895,992**
Avg Household Savings ($/month)			
at 500 kW/mohth	**$0.076**	**$0.188**	**$0.121**

Smaller savings than Steady Hours case because DG doesn't provide as large of savings during night hours, but still pays DLCs

Analysis Results:
Daytime Hour – Market-Exposure Distribution

Average Annual Results	PG&E	SCE	SDG&E
Day Hours Case	**4 yr avg**	**4 yr avg**	**4 yr avg**
DG Capacity (MW)	190	282	28
DG Load (MWh)	763,312	1,133,077	112,485
Displaced Load (MWh)	812,034	1,205,402	119,665
FERC Form 1 Energy Data (MWh)			
CAISO TAC Area Total Purchases	105,114,961	105,395,970	21,170,700
IOU Total Purchases	85,899,069	76,022,598	16,472,276
% of CAISO Area Purchases	*82%*	*72%*	*78%*
IOU CAISO Total Purchases	15,673,120	17,112,544	3,039,913
% of IOU Total Purchases	*18%*	*21%*	*19%*
IOU QF Purhcases	12,346,915	24,481,005	1,089,245
% of IOU Total Purchases	*14%*	*33%*	*7%*
Impact of DG ($)			
Savings			
CAISO Energy Price Savings	*$12,220,325*	*$16,036,879*	*$2,509,115*
QF Energy Price Savings	*$6,110,086*	*$14,202,691*	*$578,740*
T&D Avoided Cost Savings	*$14,554,754*	*$15,386,898*	*$2,093,619*
Total Savings	$32,885,164	$45,626,467	$5,181,474
Costs			
DLC Cost Shift	$14,296,841	$17,619,355	$1,239,586
Net Savings	**$18,588,323**	**$28,007,112**	**$3,941,888**
Avg Household Savings ($/month)			
at 500 kW/mohth	**$0.110**	**$0.183**	**$0.121**

Larger savings than Steady Hours case because DG doesn't provide as large of savings during night hours, but still pays DLCs

Analysis Results:
Shoulder Hours – Market-Exposure Distribution

Average Annual Results	PG&E	SCE	SDG&E
Shoulder Hours Case	**4 yr avg**	**4 yr avg**	**4 yr avg**
DG Capacity (MW)	190	282	28
DG Load (MWh)	555,136	824,056	81,807
Displaced Load (MWh)	590,571	876,656	87,029
FERC Form 1 Energy Data (MWh)			
CAISO TAC Area Total Purchases	105,114,961	105,395,970	21,170,700
IOU Total Purchases	85,899,069	76,022,598	16,472,276
% of CAISO Area Purchases	*82%*	*72%*	*78%*
IOU CAISO Total Purchases	15,673,120	17,112,544	3,039,913
% of IOU Total Purchases	*18%*	*21%*	*19%*
IOU QF Purhcases	12,346,915	24,481,005	1,089,245
% of IOU Total Purchases	*14%*	*33%*	*7%*
Impact of DG ($)			
Savings			
CAISO Energy Price Savings	*$7,563,522*	*$9,110,549*	*$1,511,797*
QF Energy Price Savings	*$4,231,585*	*$9,744,491*	*$398,398*
T&D Avoided Cost Savings	*$14,554,754*	*$15,386,898*	*$2,093,619*
Total Savings	$26,349,861	$34,241,938	$4,003,813
Costs			
DLC Cost Shift	$10,397,703	$12,814,076	$901,517
Net Savings	**$15,952,159**	**$21,427,861**	**$3,102,296**
Avg Household Savings ($/month)			
at 500 kW/mohth	**$0.094**	**$0.141**	**$0.095**

Only larger savings, compared to Day Hours, in SDG&E due to value of daytime reductions

Analysis Results:
Steady Hours – Market-Exposure Distribution

100 MW of DG

Average Annual Results	PG&E	SCE	SDG&E
Steady Hours Case	**4 yr avg**	**4 yr avg**	**4 yr avg**
DG Capacity (MW)	38	56	6
DG Load (MWh)	294,916	437,780	43,460
Displaced Load (MWh)	313,741	465,723	46,234
FERC Form 1 Energy Data (MWh)			
CAISO TAC Area Total Purchases	105,114,961	105,395,970	21,170,700
IOU Total Purchases	85,899,069	76,022,598	16,472,276
% of CAISO Area Purchases	*82%*	*72%*	*78%*
IOU CAISO Total Purchases	15,673,120	17,112,544	3,039,913
% of IOU Total Purchases	*18%*	*21%*	*19%*
IOU QF Purhcases	12,346,915	24,481,005	1,089,245
% of IOU Total Purchases	*14%*	*33%*	*7%*
Impact of DG ($)			
Savings			
CAISO Energy Price Savings	*$3,577,417*	*$4,806,447*	*$698,780*
QF Energy Price Savings	*$2,252,157*	*$5,166,306*	*$211,059*
T&D Avoided Cost Savings	*$2,910,951*	*$3,077,380*	*$418,724*
Total Savings	$8,740,524	$13,050,133	$1,328,563
Costs			
DLC Cost Shift	$5,523,779	$6,807,478	$478,931
Net Savings	**$3,216,745**	**$6,242,655**	**$849,632**
Avg Household Savings ($/month)			
at 500 kW/mohth	**$0.019**	**$0.040**	**$0.026**

Close to linear relationship between savings and size of program (while holding distribution among IOUs constant)

Analysis Results:
Steady Hours – Market-Exposure Distribution

1,000 MW of DG

Average Annual Results	PG&E	SCE	SDG&E
Steady Hours Case	**4 yr avg**	**4 yr avg**	**4 yr avg**
DG Capacity (MW)	380	564	56
DG Load (MWh)	2,949,161	4,377,799	434,602
Displaced Load (MWh)	3,137,406	4,657,233	462,342
FERC Form 1 Energy Data (MWh)			
CAISO TAC Area Total Purchases	105,114,961	105,395,970	21,170,700
IOU Total Purchases	85,899,069	76,022,598	16,472,276
% of CAISO Area Purchases	*82%*	*72%*	*78%*
IOU CAISO Total Purchases	15,673,120	17,112,544	3,039,913
% of IOU Total Purchases	*18%*	*21%*	*19%*
IOU QF Purhcases	12,346,915	24,481,005	1,089,245
% of IOU Total Purchases	*14%*	*33%*	*7%*
Impact of DG ($)			
Savings			
CAISO Energy Price Savings	*$30,357,083*	*$40,774,043*	*$6,088,774*
QF Energy Price Savings	*$21,671,923*	*$49,615,721*	*$2,028,038*
T&D Avoided Cost Savings	*$29,109,508*	*$30,773,795*	*$4,187,238*
Total Savings	$81,138,513	$121,163,559	$12,304,050
Costs			
DLC Cost Shift	$55,237,795	$68,074,780	$4,789,310
Net Savings	**$25,900,718**	**$53,088,779**	**$7,514,740**
Avg Household Savings ($/month)			
at 500 kW/mohth	**$0.157**	**$0.362**	**$0.236**

Close to linear relationship between savings and size of program (while holding distribution among IOUs constant)

Analysis Results:
Steady Hours – Demand Distribution

Average Annual Results	PG&E	SCE	SDG&E
Steady Hours Case	**4 yr avg**	**4 yr avg**	**4 yr avg**
DG Capacity (MW)	241	213	46
DG Load (MWh)	1,868,648	1,653,795	358,338
Displaced Load (MWh)	1,987,923	1,759,357	381,210
FERC Form 1 Energy Data (MWh)			
CAISO TAC Area Total Purchases	105,114,961	105,395,970	21,170,700
IOU Total Purchases	85,899,069	76,022,598	16,472,276
% of CAISO Area Purchases	*82%*	*72%*	*78%*
IOU CAISO Total Purchases	15,673,120	17,112,544	3,039,913
% of IOU Total Purchases	*18%*	*21%*	*19%*
IOU QF Purhcases	12,346,915	24,481,005	1,089,245
% of IOU Total Purchases	*14%*	*33%*	*7%*
Impact of DG ($)			
Savings			
CAISO Energy Price Savings	*$16,363,006*	*$22,639,736*	*$3,198,316*
QF Energy Price Savings	*$11,050,586*	*$25,328,585*	*$1,034,997*
T&D Avoided Cost Savings	*$18,444,370*	*$11,625,375*	*$3,452,463*
Total Savings	$45,857,962	$59,593,696	$7,685,776
Costs			
DLC Cost Shift	$34,999,778	$25,716,518	$3,948,883
Net Savings	**$10,858,184**	**$33,877,178**	**$3,736,893**
Avg Household Savings ($/month)			
at 500 kW/mohth	**$0.065**	**$0.223**	**$0.117**

Analysis Results:
All Hours – Demand Distribution

Average Annual Results All Hours Case	PG&E 4 yr avg	SCE 4 yr avg	SDG&E 4 yr avg
DG Capacity (MW)	241	213	46
DG Load (MWh)	2,110,473	1,867,816	404,711
Displaced Load (MWh)	2,245,184	1,987,038	430,544
FERC Form 1 Energy Data (MWh)			
CAISO TAC Area Total Purchases	105,114,961	105,395,970	21,170,700
IOU Total Purchases	85,899,069	76,022,598	16,472,276
% of CAISO Area Purchases	*82%*	*72%*	*78%*
IOU CAISO Total Purchases	15,673,120	17,112,544	3,039,913
% of IOU Total Purchases	*18%*	*21%*	*19%*
IOU QF Purhcases	12,346,915	24,481,005	1,089,245
% of IOU Total Purchases	*14%*	*33%*	*7%*
Impact of DG ($)			
Savings			
CAISO Energy Price Savings	*$16,901,658*	*$23,702,396*	*$3,267,690*
QF Energy Price Savings	*$12,277,017*	*$28,061,758*	*$1,147,260*
T&D Avoided Cost Savings	*$18,444,370*	*$11,625,375*	*$3,452,463*
Total Savings	$47,623,045	$63,389,529	$7,867,412
Costs			
DLC Cost Shift	$39,529,161	$29,044,538	$4,459,915
Net Savings	**$8,093,883**	**$34,344,991**	**$3,407,497**
Avg Household Savings ($/month)			
at 500 kW/mohth	**$0.048**	**$0.227**	**$0.107**

Smaller savings than Steady Hours case because DG doesn't provide as large of savings during night hours, but still pays DLCs

Analysis Results:
Daytime Hour – Demand Distribution

Average Annual Results	PG&E	SCE	SDG&E
Day Hours Case	**4 yr avg**	**4 yr avg**	**4 yr avg**
DG Capacity (MW)	241	213	46
DG Load (MWh)	967,300	856,082	185,493
Displaced Load (MWh)	1,029,043	910,726	197,332
FERC Form 1 Energy Data (MWh)			
CAISO TAC Area Total Purchases	105,114,961	105,395,970	21,170,700
IOU Total Purchases	85,899,069	76,022,598	16,472,276
% of CAISO Area Purchases	*82%*	*72%*	*78%*
IOU CAISO Total Purchases	15,673,120	17,112,544	3,039,913
% of IOU Total Purchases	*18%*	*21%*	*19%*
IOU QF Purhcases	12,346,915	24,481,005	1,089,245
% of IOU Total Purchases	*14%*	*33%*	*7%*
Impact of DG ($)			
Savings			
CAISO Energy Price Savings	*$12,052,564*	*$16,236,509*	*$2,450,189*
QF Energy Price Savings	*$6,110,086*	*$14,202,691*	*$578,740*
T&D Avoided Cost Savings	*$18,444,370*	*$11,625,375*	*$3,452,463*
Total Savings	$36,607,020	$42,064,575	$6,481,391
Costs			
DLC Cost Shift	$18,117,532	$13,312,080	$2,044,128
Net Savings	**$18,489,488**	**$28,752,495**	**$4,437,263**
Avg Household Savings ($/month)			
at 500 kW/mohth	**$0.110**	**$0.188**	**$0.137**

Larger savings than Steady Hours case because DG doesn't provide as large of savings during night hours, but still pays DLCs

Analysis Results:
Shoulder Hours – Demand Distribution

Average Annual Results Shoulder Hours Case	PG&E 4 yr avg	SCE 4 yr avg	SDG&E 4 yr avg
DG Capacity (MW)	241	213	46
DG Load (MWh)	703,491	622,605	134,904
Displaced Load (MWh)	748,395	662,346	143,515
FERC Form 1 Energy Data (MWh)			
CAISO TAC Area Total Purchases	105,114,961	105,395,970	21,170,700
IOU Total Purchases	85,899,069	76,022,598	16,472,276
% of CAISO Area Purchases	*82%*	*72%*	*78%*
IOU CAISO Total Purchases	15,673,120	17,112,544	3,039,913
% of IOU Total Purchases	*18%*	*21%*	*19%*
IOU QF Purhcases	12,346,915	24,481,005	1,089,245
% of IOU Total Purchases	*14%*	*33%*	*7%*
Impact of DG ($)			
Savings			
CAISO Energy Price Savings	*$7,442,603*	*$9,254,700*	*$1,470,943*
QF Energy Price Savings	*$4,231,585*	*$9,744,491*	*$398,398*
T&D Avoided Cost Savings	*$18,444,370*	*$11,625,375*	*$3,452,463*
Total Savings	$30,118,558	$30,624,565	$5,321,804
Costs			
DLC Cost Shift	$13,176,387	$9,681,513	$1,486,638
Net Savings	**$16,942,171**	**$20,943,053**	**$3,835,165**
Avg Household Savings ($/month)			
at 500 kW/mohth	**$0.100**	**$0.137**	**$0.118**

Only larger savings, compared to Day Hours, in SDG&E due to value of daytime reductions

Analysis Results:
Steady Hours – Demand Distribution

100 MW of DG

Average Annual Results	PG&E	SCE	SDG&E
Steady Hours Case	**4 yr avg**	**4 yr avg**	**4 yr avg**
DG Capacity (MW)	48	43	9
DG Load (MWh)	373,730	330,759	71,668
Displaced Load (MWh)	397,585	351,871	76,242
FERC Form 1 Energy Data (MWh)			
CAISO TAC Area Total Purchases	105,114,961	105,395,970	21,170,700
IOU Total Purchases	85,899,069	76,022,598	16,472,276
% of CAISO Area Purchases	*82%*	*72%*	*78%*
IOU CAISO Total Purchases	15,673,120	17,112,544	3,039,913
% of IOU Total Purchases	*18%*	*21%*	*19%*
IOU QF Purhcases	12,346,915	24,481,005	1,089,245
% of IOU Total Purchases	*14%*	*33%*	*7%*
Impact of DG ($)			
Savings			
CAISO Energy Price Savings	*$3,566,902*	*$4,819,372*	*$695,330*
QF Energy Price Savings	*$2,252,157*	*$5,166,306*	*$211,059*
T&D Avoided Cost Savings	*$3,688,874*	*$2,325,075*	*$690,493*
Total Savings	$9,507,933	$12,310,753	$1,596,882
Costs			
DLC Cost Shift	$6,999,956	$5,143,304	$789,777
Net Savings	**$2,507,977**	**$7,167,450**	**$807,106**
Avg Household Savings ($/month)			
at 500 kW/mohth	**$0.015**	**$0.046**	**$0.025**

Close to linear relationship between savings and size of program (while holding distribution among IOUs constant)

Analysis Results:
Steady Hours – Demand Distribution

1,000 MW of DG

Average Annual Results	PG&E	SCE	SDG&E
Steady Hours Case	**4 yr avg**	**4 yr avg**	**4 yr avg**
DG Capacity (MW)	482	426	92
DG Load (MWh)	3,737,296	3,307,591	716,676
Displaced Load (MWh)	3,975,847	3,518,713	762,421
FERC Form 1 Energy Data (MWh)			
CAISO TAC Area Total Purchases	105,114,961	105,395,970	21,170,700
IOU Total Purchases	85,899,069	76,022,598	16,472,276
% of CAISO Area Purchases	*82%*	*72%*	*78%*
IOU CAISO Total Purchases	15,673,120	17,112,544	3,039,913
% of IOU Total Purchases	*18%*	*21%*	*19%*
IOU QF Purhcases	12,346,915	24,481,005	1,089,245
% of IOU Total Purchases	*14%*	*33%*	*7%*
Impact of DG ($)			
Savings			
CAISO Energy Price Savings	*$29,401,480*	*$41,972,354*	*$5,771,774*
QF Energy Price Savings	*$21,671,923*	*$49,615,721*	*$2,028,038*
T&D Avoided Cost Savings	*$36,888,739*	*$23,250,750*	*$6,904,925*
Total Savings	$87,962,142	$114,838,825	$14,704,737
Costs			
DLC Cost Shift	$69,999,557	$51,433,035	$7,897,766
Net Savings	**$17,962,586**	**$63,405,790**	**$6,806,971**
Avg Household Savings ($/month)			
at 500 kW/mohth	**$0.110**	**$0.428**	**$0.218**

Close to linear relationship between savings and size of program (while holding distribution among IOUs constant)