Rate Impact of Net Metering

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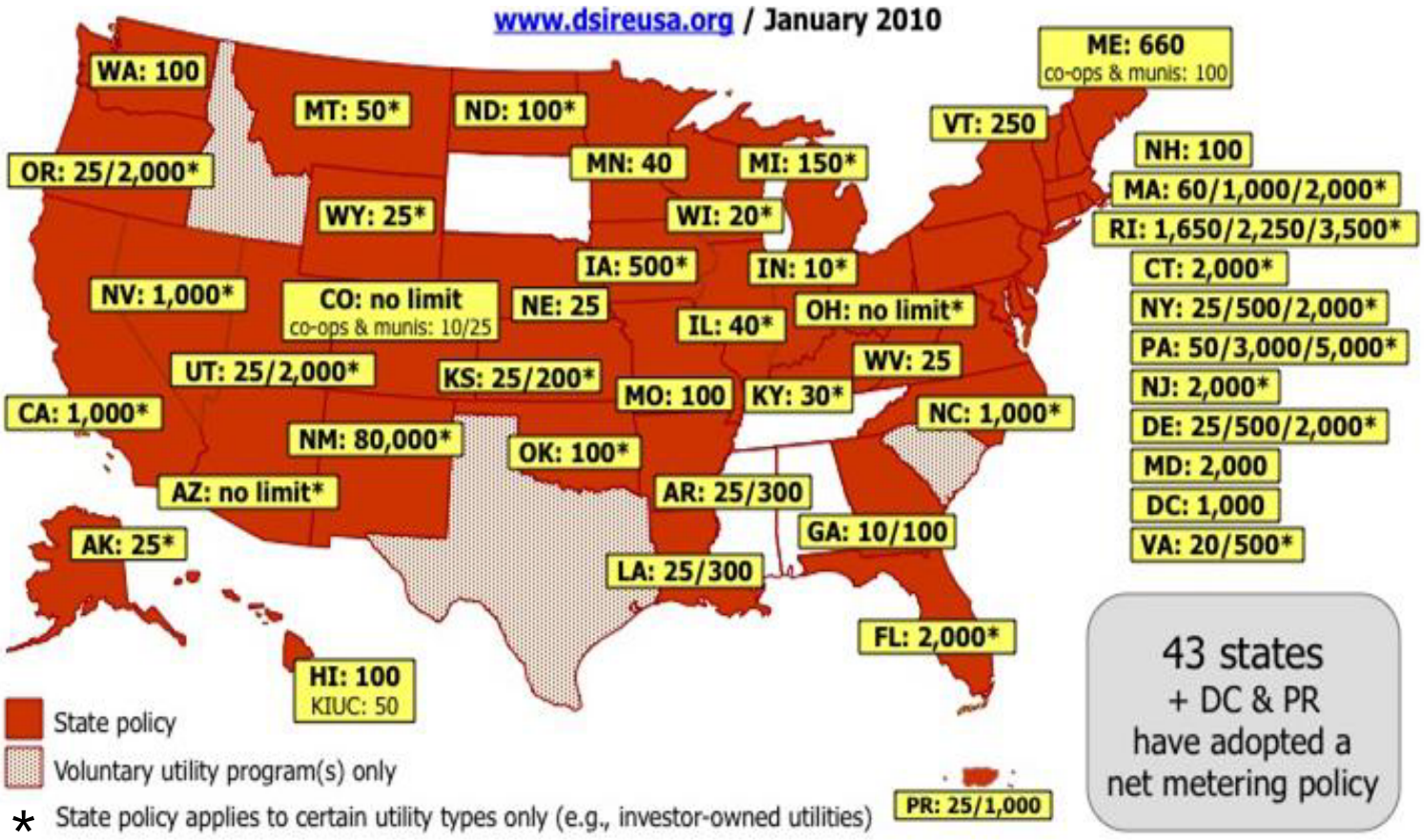
Scope

- Impact of net metering on utility rates for customers without distributed generation
- Proposes an approach for states or individual utilities to use
- Includes discussion of related studies and California PUC approach in Rulemaking 08-03-008
- Focuses on impact of net metered solar energy
- Does not consider impacts on the local economy, jobs or the environment
- Does not calculate impacts for specific state or utility

Rate Impact

- Comprehensive study released by California PUC in March, 2010
- CPUC appropriately splits rate impacts of on-site use of solar energy from net metering rate impacts
- CPUC report finds very minor rate impact, even with California's steeply tiered rates and more than 60% of the nation's installed solar energy
- Minor rate impact indicated by other studies
- Various assumptions about costs and benefits addressed here

Net Metering Programs

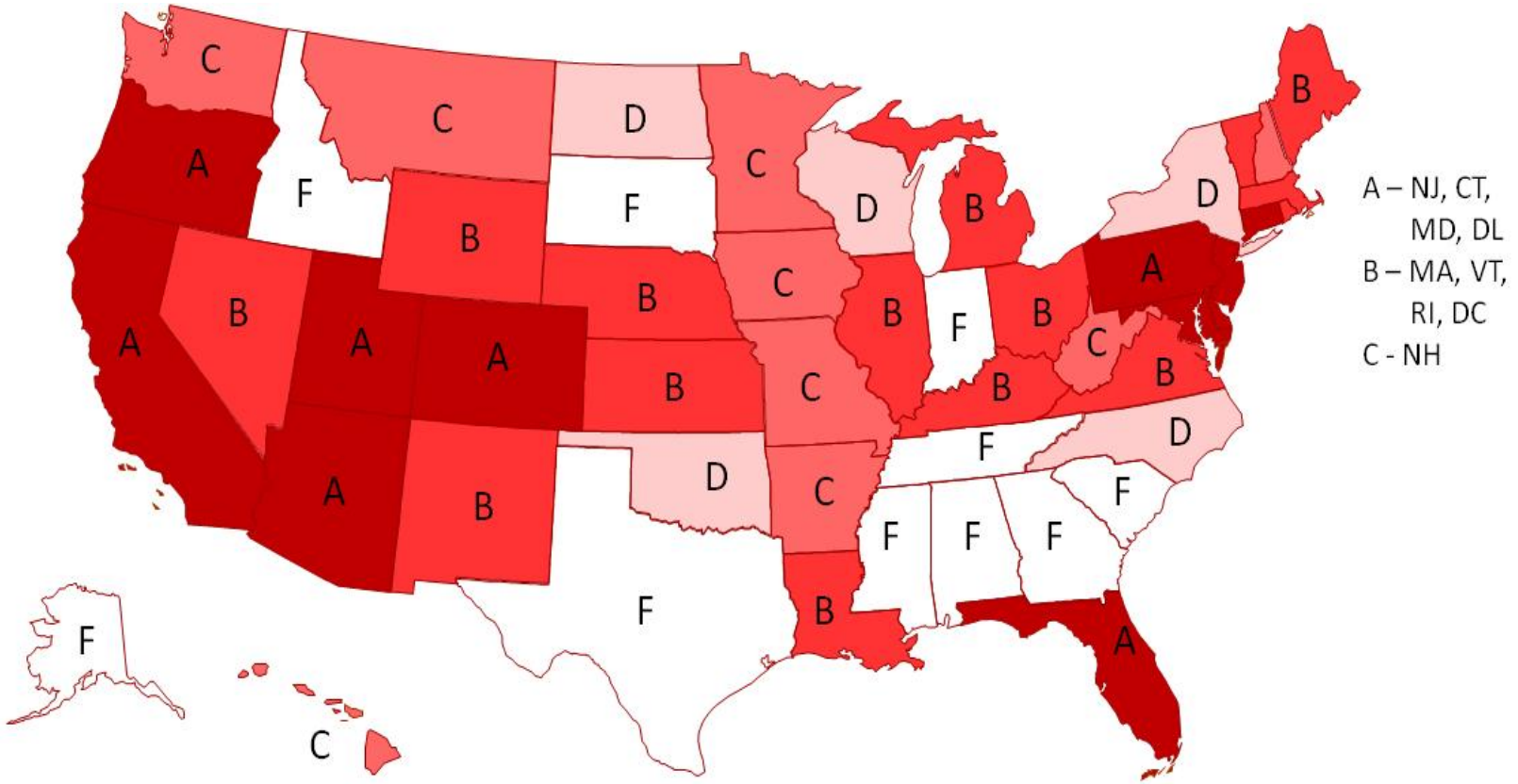


Note: Numbers indicate individual system capacity limit in kW. Some limits vary by customer type, technology and/or application. Other limits might also apply.

Major Net Metering Issues

- Program capacity
- Facility size capacity
- Rollover of excess generation
- Standby charges and other fees
- Applicability (all utilities, all customers)
- Meter aggregation
- *Community Solar*

Net Metering Grades



Grading from NNEC's *Freeing the Grid 2009* report at www.freeingthegrid.org

Grade Correlation with Capacity

2008 Installed Capacity State Rank	2008 MW_{DC}	2008 Market Share	Cumulative MW_{DC}	Freeing the Grid 09 Score
1. California	178.7	62%	528	A
2. New Jersey	22.5	8%	70	A
3. Colorado	21.7	7%	36	A
4. Nevada	14.9	5%	34	B
5. Hawaii	8.6	3%	14	C
6. New York	7.0	2%	22	D
7. Arizona	6.4	2%	25	A
8. Connecticut	5.3	2%	9	A
9. Oregon	4.8	2%	8	A
10. North Carolina	4.0	1%	4.7	D

Rate Impact Studies

- *The Value of Distributed Photovoltaics to Austin Energy and the City of Austin* (Hoff, Perez, Braun, Gerry, Kuhn, & Norris, 2006)
- *Distributed Renewable Energy Operating Impacts and Valuation Study* (R.W. Beck, Inc., 2009) - value of distributed solar generation for Arizona Public Service
- *Integration of PV in Demand Response Programs*, (Perez et. al. June, 2006) considering capacity benefits for Rochester Gas&Electric, ConEd & SMUD
- Other studies, but we're not attempting an anthology
- More coming, especially in the southwest – at order of utility commissions in NV, UT, CO, AZ and NM

Austin Energy Study (2006)

- Just looking at value (benefits), not costs
- Value in 2006 of 10.9¢ - 11.8¢ per kWh; exceeds rates
- Highest value when solar modules oriented to 30º west of due south to capture afternoon sun coincident with utility peak demand
- Benefits considered:
  - Value of energy production
  - Generation capacity value
  - Transmission & distribution (T&D) deferrals
  - Reduced transformer and line losses
  - Environmental benefits
  - Natural gas price hedge
- Benefits identified that deserve consideration:
  - Disaster recovery
  - Reactive power control

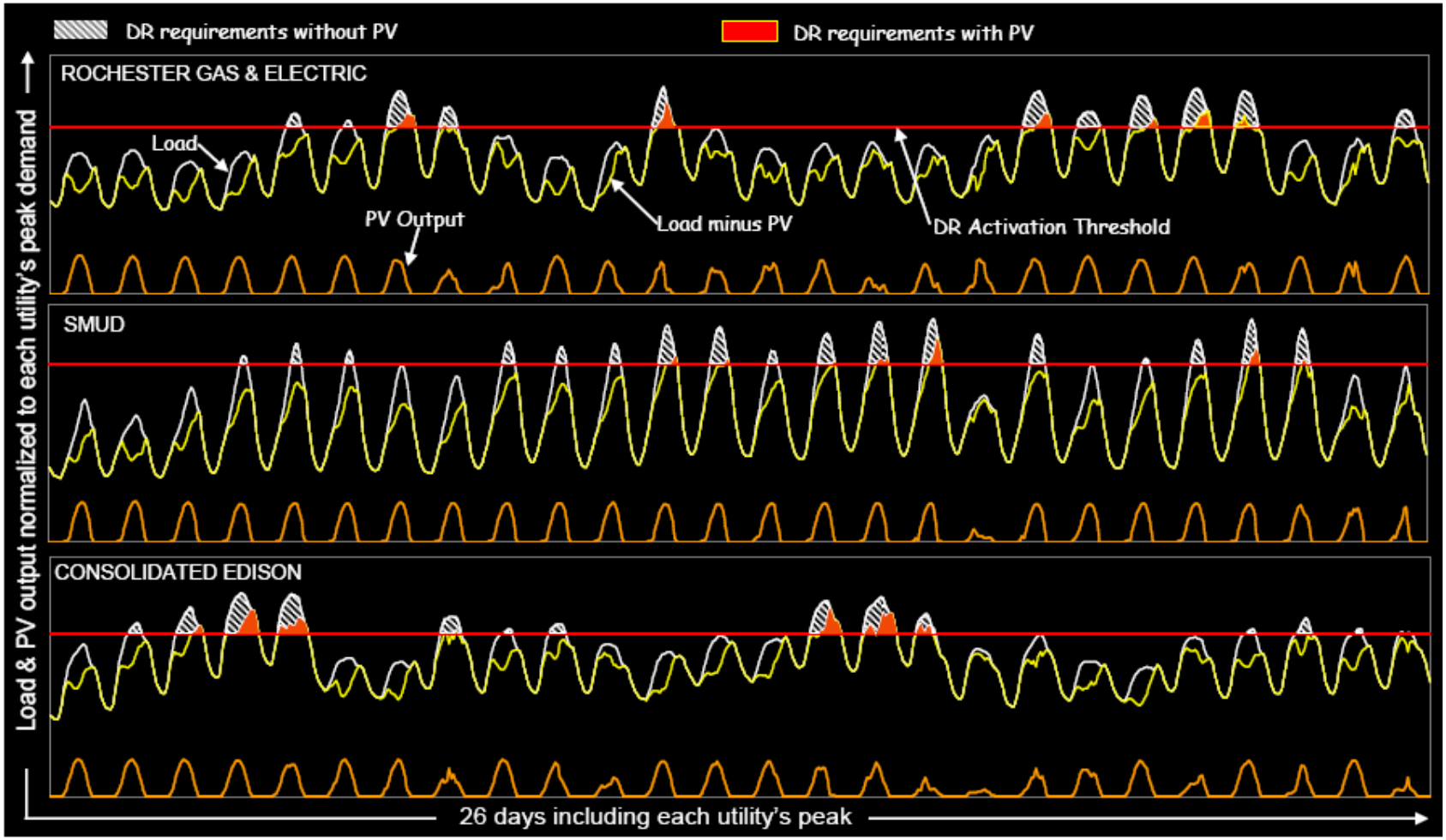
Arizona Public Service Study (2008)

- “Operating impacts and valuation study” mostly addressing net metering values
- 5.4¢ to 5.6¢ per kWh value in 2010
- Subset of quantified benefits from Austin Energy study, excluding environmental benefits and natural gas hedge
- No capacity benefits in displacing “lumpy” utility generation and T&D projects until 2025, and only in high penetration scenario
- Limits capacity benefits given shift to later afternoon peak, but doesn’t analyze SW-facing modules

Perez et al Solar & DR Study (2008)

- Analysis of value of photovoltaics (PV) if firmed with demand response for Rochester Gas & Electric, ConEd & SMUD
- Reliability analysis given dispersed solar energy generation – predictable output
- Concludes SW facing modules have highest capacity value
- Not discussed – reverse demand response given high PV penetration (lower AC temperatures mid-afternoon and return to normal AC temperatures in the evening to meet utility peak given high distributed PV penetration)

Solar Coupled with Demand Response



Perez study, showing PV rated capacity of 20% of utility peak demand. Peak line at 90% of utility peak. DR in orange.

Rate Impact for Nonparticipants

- Prior studies focused on distributed PV value
- California PUC study, addressed next, considers rate impact – looking at cost of lost revenues versus value (benefits) of PV
- Questionable whether rate impact reflects "subsidization" of solar energy by nonparticipating customers versus direct impact from the inverted block rate structure seen in California, which is designed to encourage customers to take steps to control their load
- Viewed as a power exchange of daytime kWh for nighttime kWh, or summer kWh for winter kWh, net metering might probably has a positive value

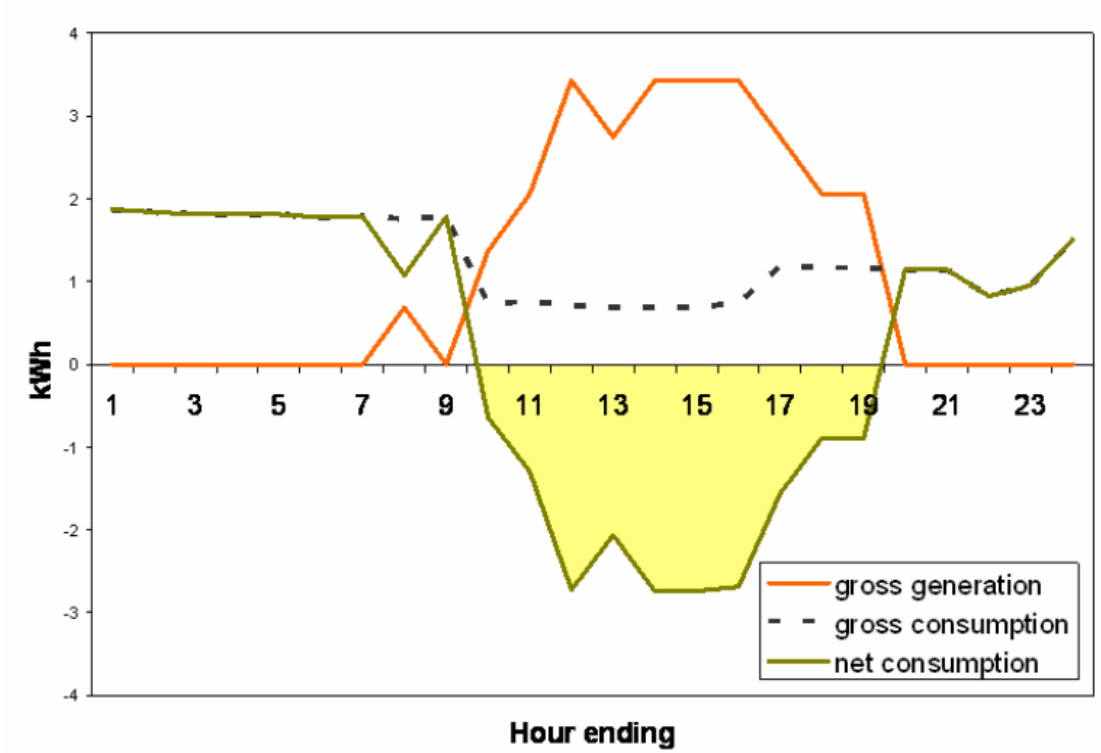
California NEM Valuation Study

- Study required by the Legislature (PU Code 2827(c)(4) - "report on the…costs and benefits of net energy metering.")
  - Evaluation is very narrow – costs and benefits of *exported energy* only
- Work on the methodology began in R.04-03-017
- Performed by Energy and Environmental Economics, Inc. (E3)
- Released March 10, 2010
- Available at: http://www.cpuc.ca.gov/PUC/energy/DistGen/nem_eval.htm

Framework for Evaluation

- 20-year period of evaluation (NPV)
- Costs to Ratepayers
  - IOU Revenue impacts from exported energy (NEM customer Bill Credits)
  - Administrative Costs (incremental billing costs)
- Benefits to Ratepayers
  - Avoided Cost of exported energy

Figure 3: PV production and net load for a sample residential NEM customer



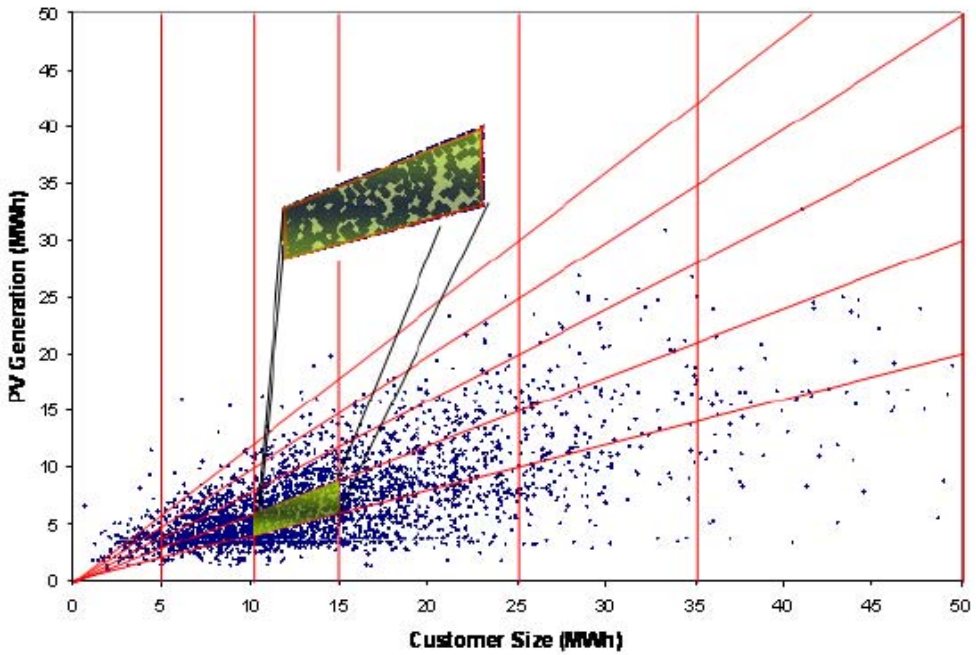
Graphic from Net Energy Metering (NEM) Cost-Effectiveness Evaluation, January 2010, p. 19

Data Quality

- Hurdle
  - 41,244 NEM customers
    - Hourly generation and consumption data needed to calculate detailed bill impacts and avoided costs
    - Data simply not available – only 626 accounts had such data
  - Solution – develop methodology to estimate amount and timing of export
    - 1. Develop annual gross consumption estimates for all customers
    - 2. Develop annual gross generation estimates for all customers
    - 3. Sort customers into “bins” of similar customers
    - 4. Estimate representative hourly generation and consumption profiles for each bin to arrive at net consumption over time

Result:

"Binning" of Account Data

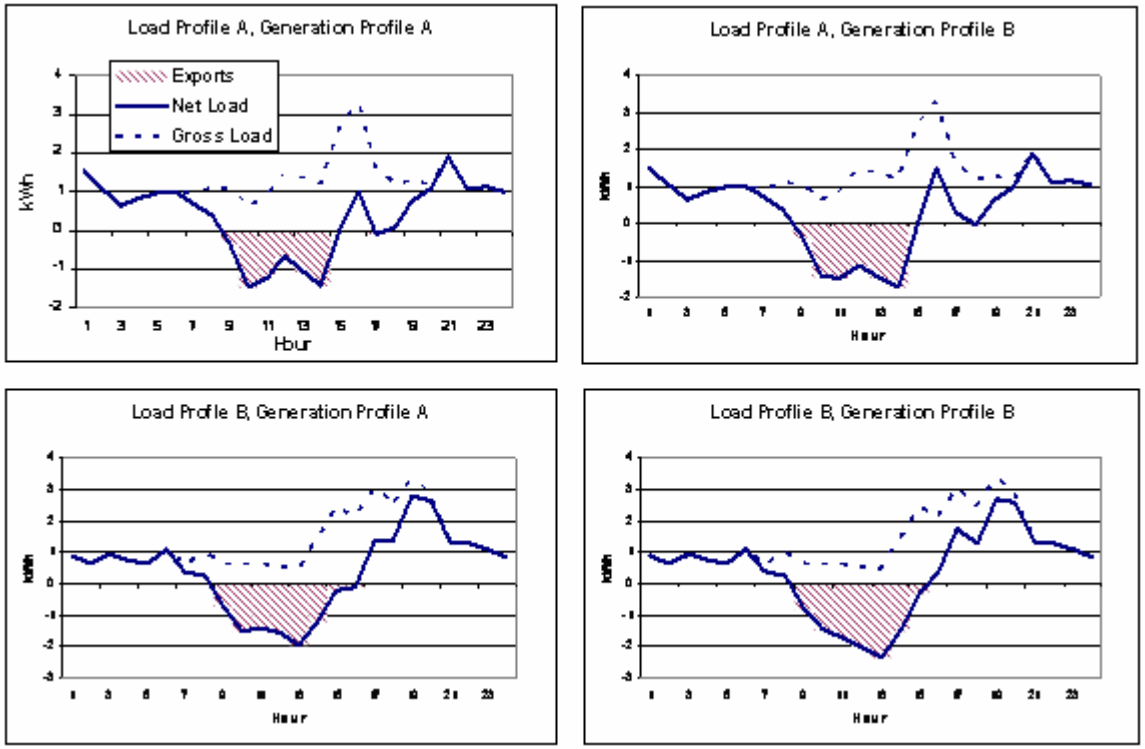


- 86 groupings like chart above – Utility, Climate zone, Customer Class, Rate
- 1,253 bins like the one highlighted – Customer Size, Ratio of Generation to Load.

Graphic from Net Energy Metering (NEM) Cost-Effectiveness Evaluation, January 2010, p. 30

Net Consumption Shapes

For each bin:
calculate hourly gross consumption profiles and hourly gross generation shapes => representative net consumption shapes



Graphic from Net Energy Metering (NEM) Cost-Effectiveness Evaluation, January 2010, p. 32

Costs

- Calculation of Bill Impacts - based on work above – need to calculate bill without solar and bill with solar to garner bill savings
- Hurdle
  - Complexity of California Rates
    - Residential Rates
      - Default tariff – inverted block rate structure
        - » PG&E – 5 tiers
        - » SCE – 5 tiers
        - » SDG&E – 4 tiers
      - Options: Time-of-Use (TOU), “solar friendly” rate
    - Commercial & Industrial – very complex
      - Range from kWh rates similar to residential to TOU, “solar friendly” rates, agricultural rates, etc
  - Solution: Bills must be calculated with Tiers and TOU rates in mind

Costs

Bill Impacts May Vary Widely

Gross Load	1,200 kWh / month
Gross PV Output	400 kWh / month
Export Energy	0 kWh

No bill impacts from NEM

Gross Load	1,200 kWh / month
Gross PV Output	400 kWh / month
Export Energy	36 kWh

	Old Bill	New Bill
Tier 4	302	0
Tier 3	314	180
Tier 2	134	134
Tier 1	450	450
Total	1200	764

All in Tier-3

Gross Load	1,200 kWh / month
Gross PV Output	1,231 kWh / month
Export Energy	747 kWh

	Old Bill	New Bill
Tier 4	302	0
Tier 3	314	0
Tier 2	134	0
Tier 1	450	0
Total	1200	0

Multiple Tiers, much in Tier-1

	Carryover Credit
Tier 4	0
Tier 3	0
Tier 2	0
Tier 1	31
Total	31

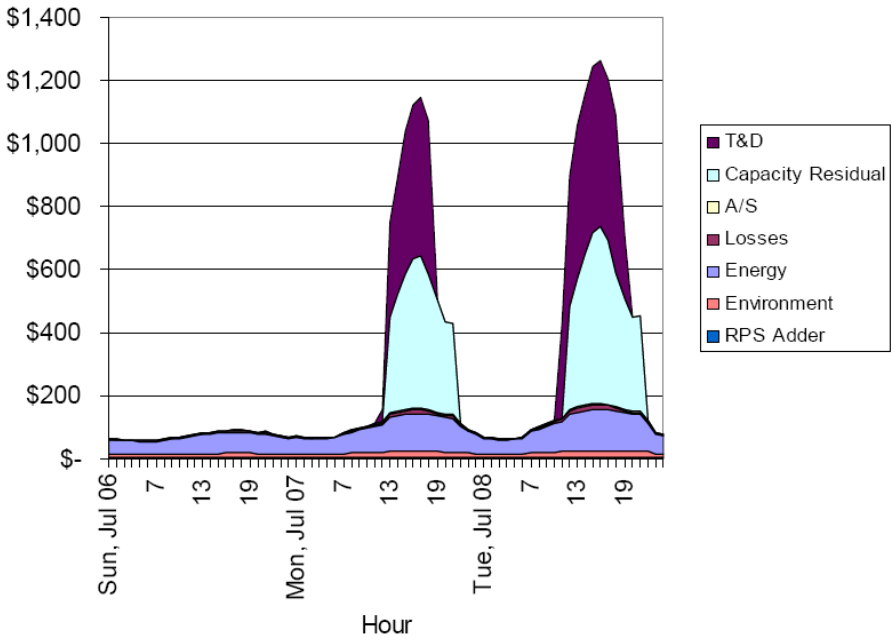
Graphic from Net Energy Metering (NEM) Cost-Effectiveness Evaluation, Presentation, March 16, 2010, slide 17

Costs

- Administrative Costs
  - Weighted average monthly incremental NEM billing cost per customer (residential/non-residential)
    - PG&E - $18.31/18.31
    - SCE - $3.02/2.55
    - SDG&E $5.96/17.44
  - Annual billing cost = # customers in each category x monthly incremental billing cost x 12
    - Assumed cost was constant in nominal dollars over the 20 year study period

Benefits

- Avoided Costs – components of hourly marginal cost
  - Energy Generation
  - Line losses
  - Ancillary services
  - System capacity
  - T&D capacity
  - Environmental benefits
  - RPS Adder

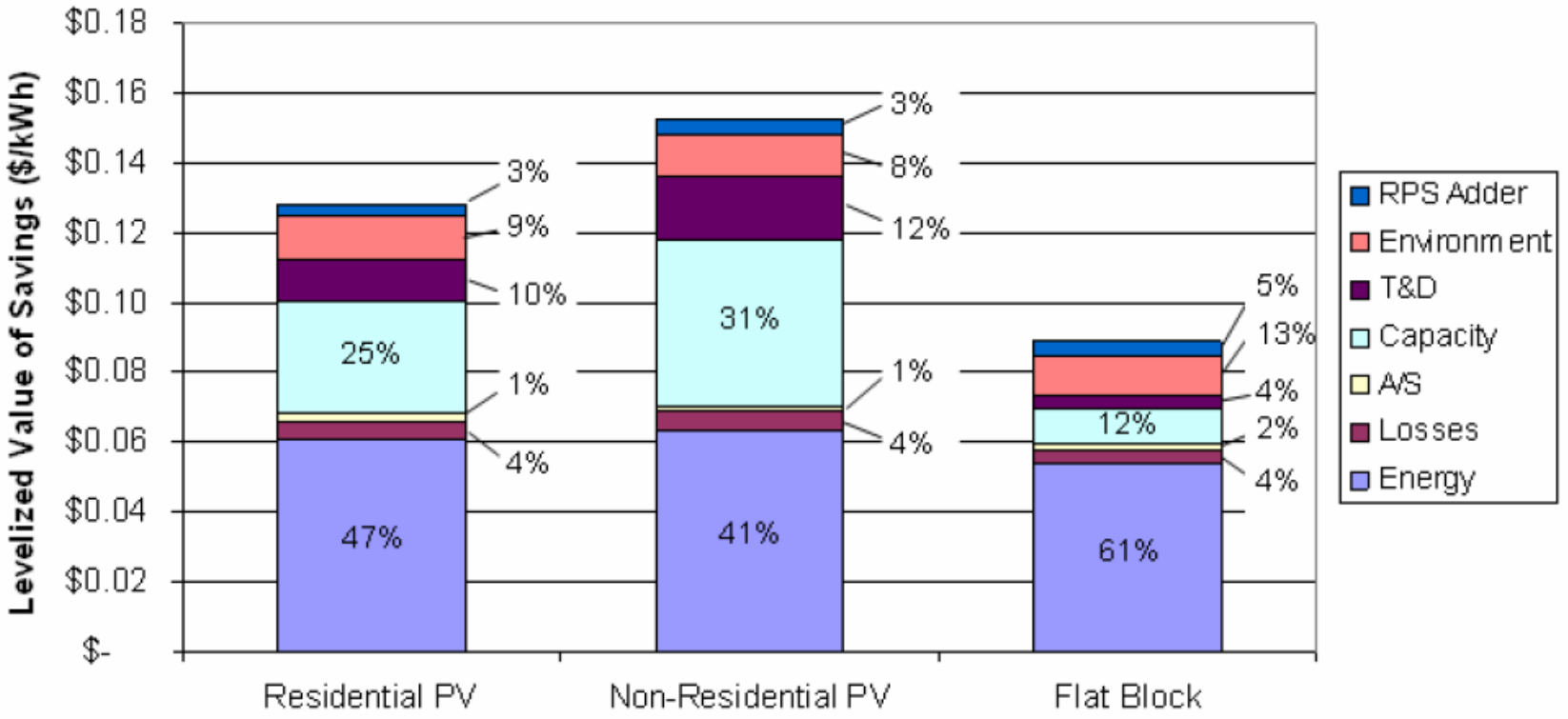


- Use components to produce hourly avoided costs for each climate zone for each year of analysis
- Apply the avoided costs to corresponding individual net-export shapes to calculate avoided costs for each load shape

Graphic from Net Energy Metering (NEM) Cost-Effectiveness Evaluation, Presentation, March 16, 2010, slide 45

Benefits

Figure 9: Levelized savings from avoided costs for two sample solar PV generation shapes compared to a flat block



Graphic from Net Energy Metering (NEM) Cost-Effectiveness Evaluation, January 2010, p. 43

Net Results

Table 28: 20-Year NPV Total Benefits and Costs of solar NEM, by Utility ($000s)

	Residential	Non-Residential	Total
PG&E			
Bill Impacts	($170,150)	($52,727)	($222,877)
Incremental Billing Cost	($51,301)	($3,262)	($54,563)
Avoided Cost (benefit)	$76,998	$31,923	$108,921
Total, PG&E	($144,452)	($24,066)	($168,519)
SCE			
Bill Impacts	($69,626)	($41,904)	($111,531)
Incremental Billing Cost	($2,830)	($632)	($3,462)
Avoided Cost (benefit)	$30,585	$40,526	$71,111
Total, SCE	($41,871)	($2,011)	($43,882)
SDG&E			
Bill Impacts	($25,834)	($13,668)	($39,503)
Incremental Billing Cost	($3,113)	($683)	($3,796)
Avoided Cost (benefit)	$13,652	$11,414	$25,066
Total, SDG&E	($15,296)	($2,937)	($18,232)
All Utilities			
Bill Impacts	($265,610)	($108,300)	($373,910)
Incremental Billing Cost	($57,244)	($4,577)	($61,821)
Avoided Cost (benefit)	$121,235	$83,864	$205,099
Total, All Utilities	($201,619)	($29,013)	($230,632)

Graphic from Net Energy Metering (NEM) Cost-Effectiveness Evaluation, January 2010, p. 47

Annualized NEM Cost as percent of Utility Revenue

Through 2008, lifecycle annualized

	Net NEM Cost (Annualized $000s)	Total Revenue ($000s)	Percent	Implied Rate Increase ($/kWh)
PG&E	$14,380	$11,373,950	0.13%	0.00018
SCE	$3,745	$12,107,743	0.03%	0.00005
SDG&E	$1,556	$2,534,874	0.06%	0.00009
Total	**$19,681**	**$26,016,568**	**0.08%**	**0.00011**

2020 forecast, assuming achievement of CSI program goals

	Net NEM Cost (Annualized $000s)	Total Revenue ($000s)	Percent	Implied Rate Increase ($/kWh)
PG&E	$100,463	$15,921,596	0.63%	0.00106
SCE	$26, 164	$16,763,730	0.16%	0.00026
SDG&E	$10,871	$3,603,089	0.30%	0.00051
Total	**$137,497**	**$36,288,415**	**0.38%**	**0.00064**

Graphic from Net Energy Metering (NEM) Cost-Effectiveness Evaluation, Presentation, March 16, 2010, slide 56

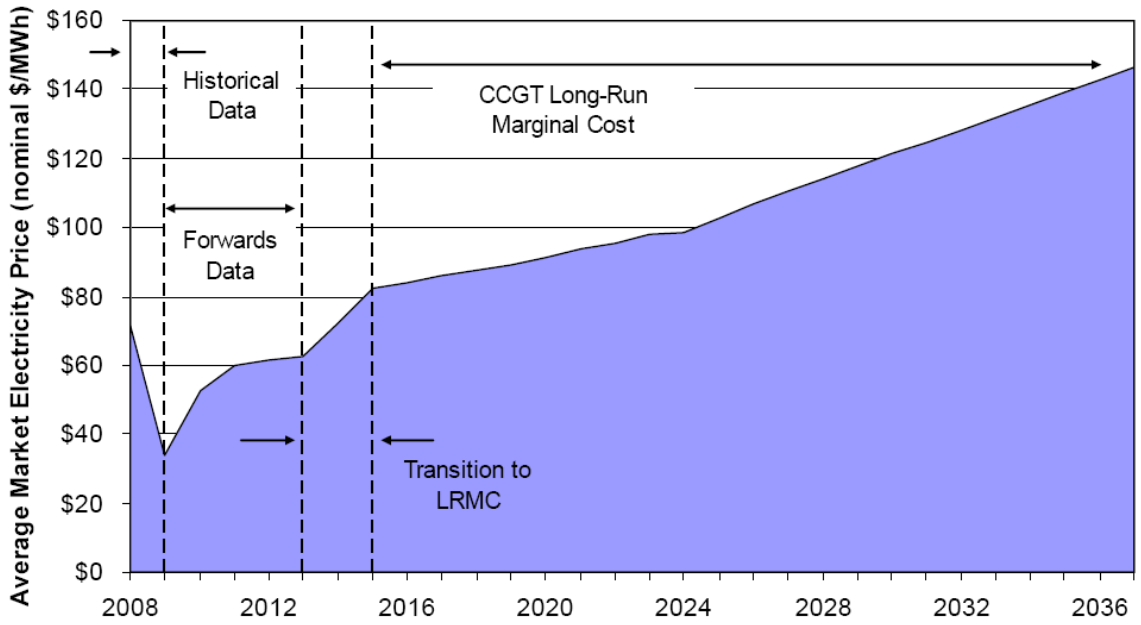
Sensitivity Analysis

- Billing costs
  - Base case assumption – incremental billing costs are constant over the 20 years
  - Sensitivity – no incremental billing costs
    - 27% reduction in overall cost component
- T&D Avoided Costs
  - Base case assumption – T&D avoided costs are similar to energy efficiency
  - Sensitivity – no T&D avoided costs
    - 8% reduction in benefits component
- Standby Charges
  - Base case assumption – customers are not assessed standby charges
  - Sensitivity – customers are charged standby charges
    - 13% increase in bill impacts (cost component)
- Interconnection costs
  - Base case assumption – NEM customers are excluded from interconnection costs
  - Sensitivity – include interconnection costs based on limited data available to E3
    - 10% increase in cost component

Discussion of California Study

- Strengths
  - Detailed analysis
  - Comprehensive list of benefits
- Weaknesses
  - Impact on natural gas market
  - Undervalued capacity benefit through use of “balance year” approach
  - Incremental Billing costs

Figure 9: Forecast of average market electricity prices



Graphic from Net Energy Metering (NEM) Cost-Effectiveness Evaluation, January 2010, Appendix A, p. 13

Conclusions

- To do analysis – some level of solar on a system is required
- Benefits to consider:
  - Avoided T&D line losses
  - Avoided Capacity and Energy Purchases
  - Avoided T&D investments and O&M
  - Environmental benefits – NO_x, SO_x, PM10 & CO_2
  - Natural Gas Market Price Impacts and price hedging
  - Avoided RPS generation purchases
  - Reliability benefits
- Costs – net metering bill credits & program admin
- Rate impacts study is very narrow – other benefits may be appropriate

Thank You!

Please send comments and study requests to:

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