

Constructing a Solar Tariff Based on Dynamic Rate Design

Presented by Douglas Jester
to MPSC Solar Work Group (2014)

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Proposed Customer Options

	Net Metering	Solar Tariff	Standard Offer Contract
Self Service	Y	Y	Y
Community Solar	N	Y	Y
Utility Controlled	N	N	Green Power Program

Standard Offer Contract should be economically equivalent to the Solar Tariff, considering the value of certainty to utility.

Proposed Elements of Solar Tariff

- Bill Credit
- Dynamic Rate to Value Power
- Buy-net, Sell-net One-way Delivery Charge
- Renewable Energy Credits
- Externality Payments

Bill Credit

- Solar Tariff should be recognized as a credit on the customer's bill, up to the total bill amount.
- At the customer's option, they should be allowed by standing arrangement to:
 - Carry excess credits forward to future billing periods until they request payment for any outstanding credit;
 - Receive payment for outstanding credit in the billing period following the end of each calendar year; or
 - Receive payment for outstanding credit in each billing period.

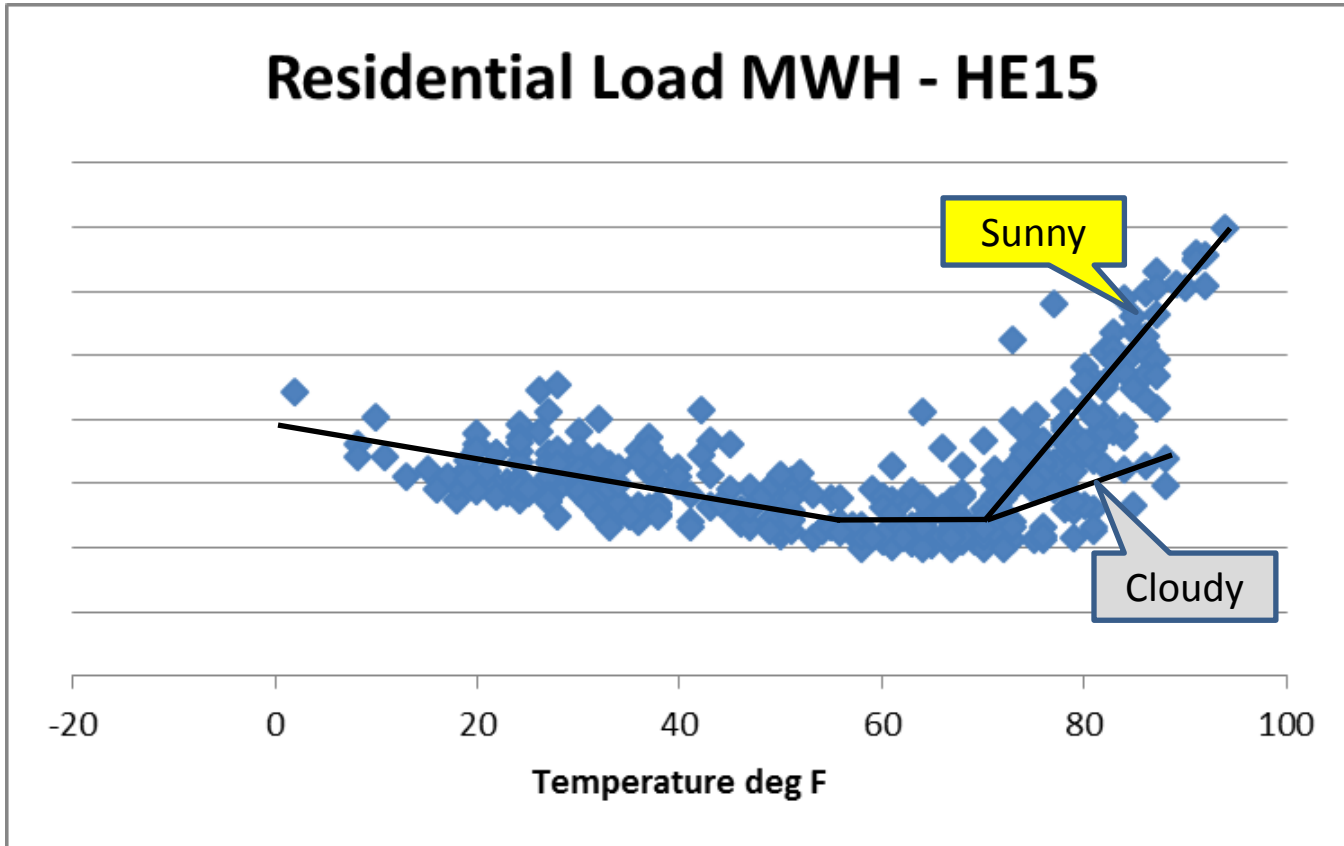
Dynamic Rate to Value Power

- Dynamic Rate is a tariff open to all customers, not specific to solar generation.
- Dynamic Rate should be specific to interconnection voltage (transmission, subtransmission, primary, secondary) due to line loss differences and Delivery Charge differences.

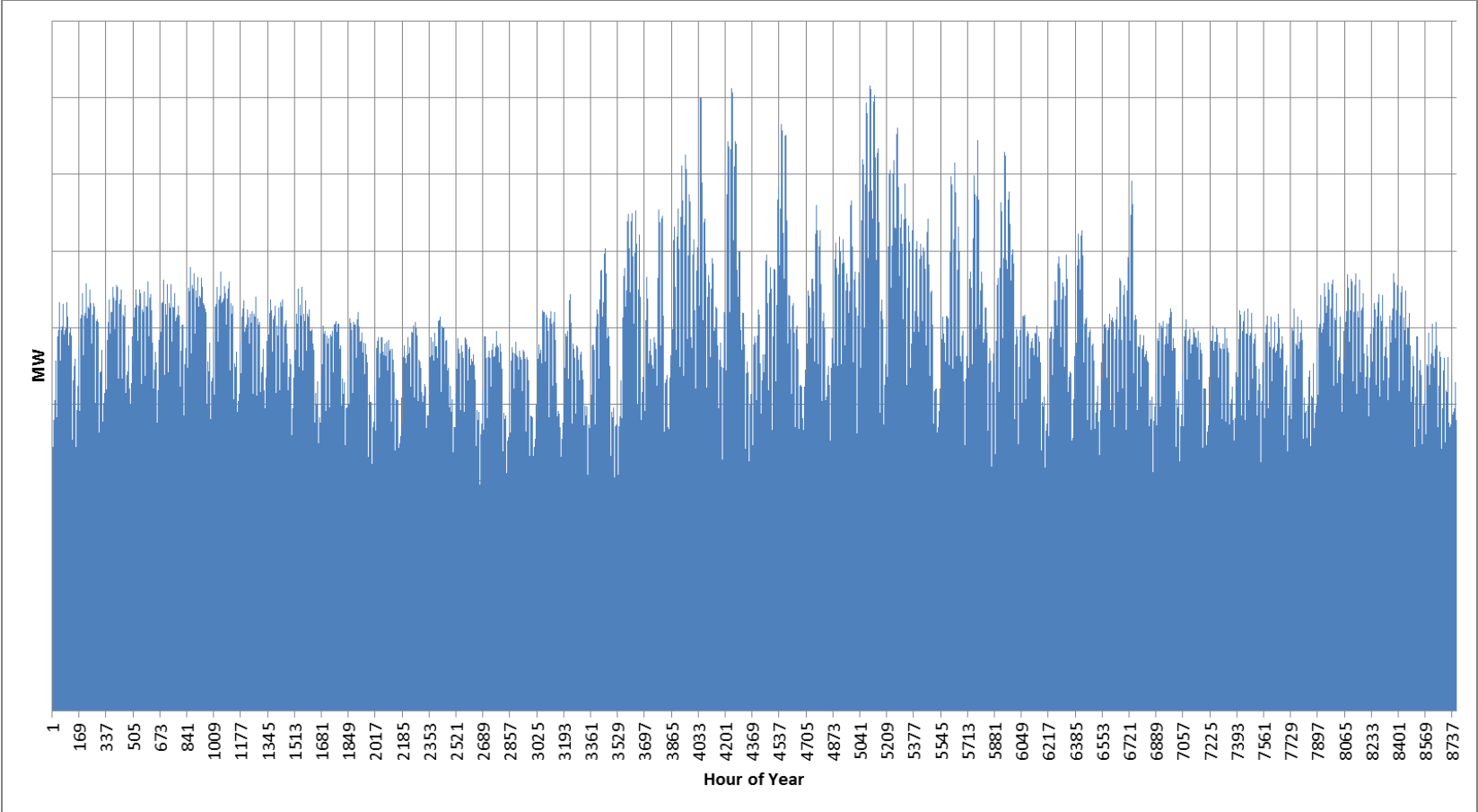
Advantages of Using Dynamic Rate

- Recognizes that sunlight drives load and price of power
- Integrates “value of solar” calculation with standard ratemaking
- Automatically adjusts to different solar technologies (tracking, tilt, etc) and incents better solar deployment

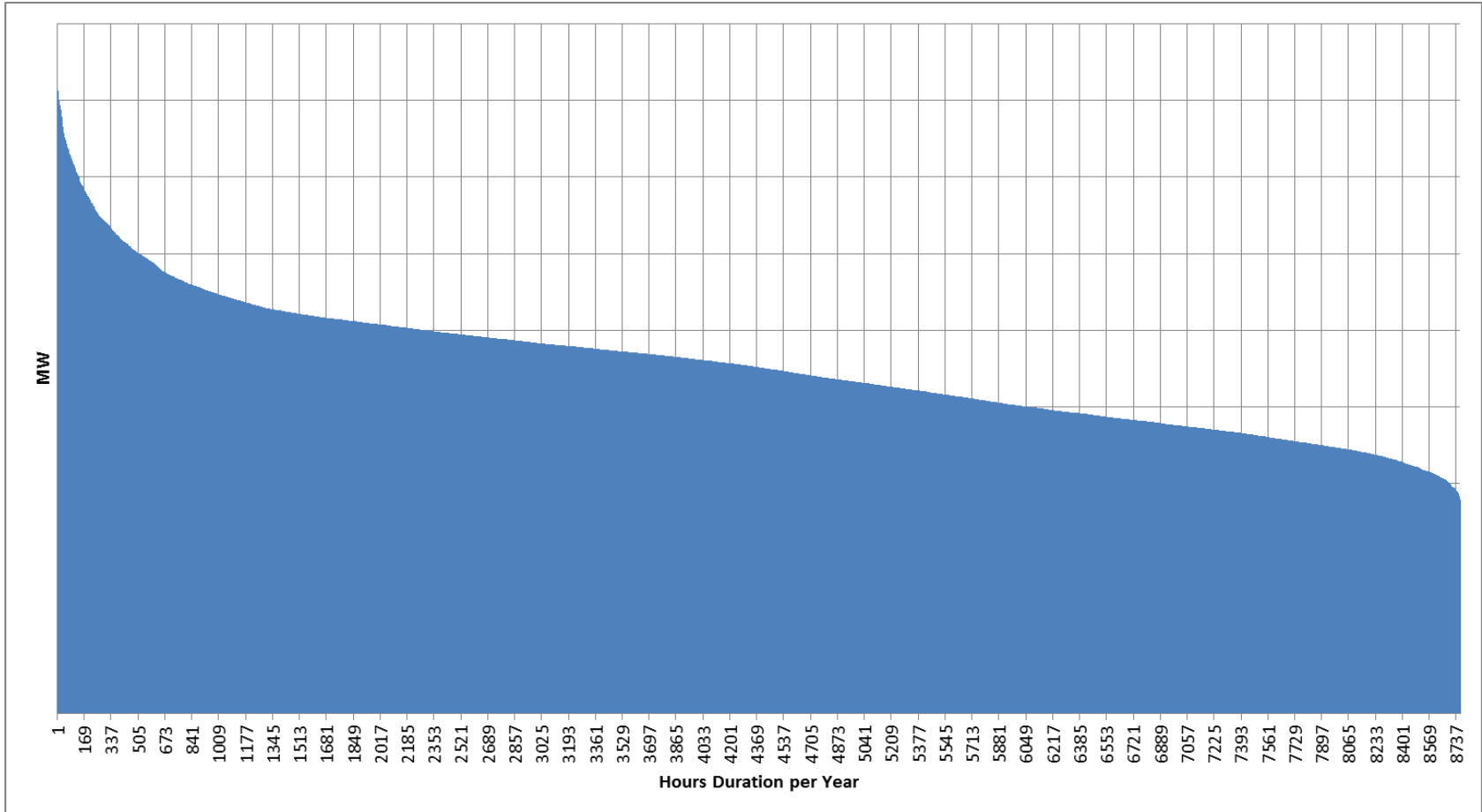
Sunlight Drives Load (and Price)



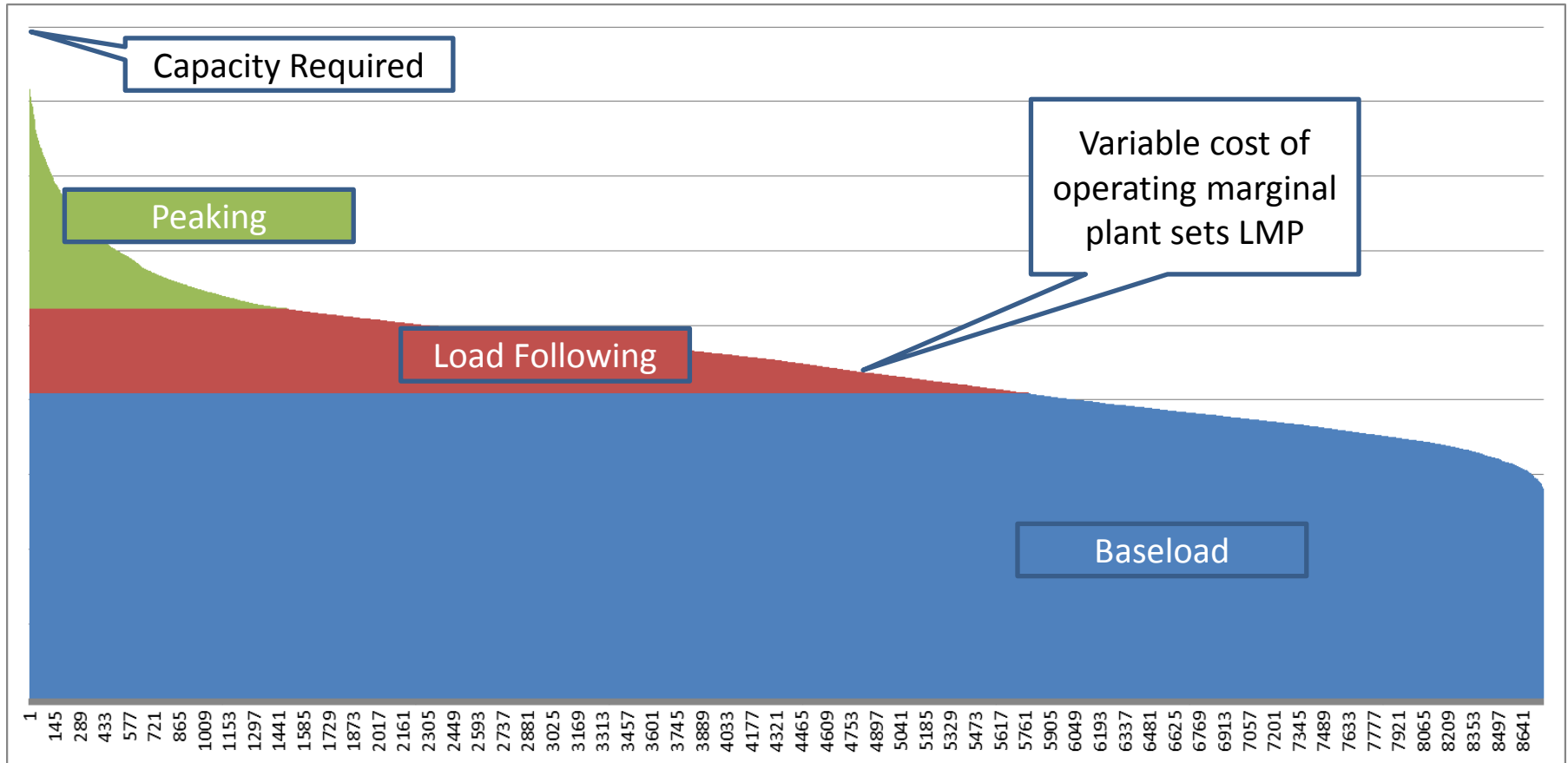
Annual Hourly Load



Annual Load Duration



Optimum Generation Portfolio



Properties of Optimal Generation Portfolio

- Hours per year when each technology is marginal depends on ratio of operating cost difference to plant cost difference
- Utility Required Revenue (Variable Costs + Depreciation + Return to Capital) *equals*
Annual Sum of LMP*Generation
+(Depreciation + Return to Capital) for Peaking Plant*Capacity Required
- Individual plant value equals
Annual Sum of LMP*Plant Generation
+ (Depreciation + Return to Capital) for Peaking Plant*Capacity Credit
- This is true for nondispatchable (e.g. solar) as well as dispatchable generators

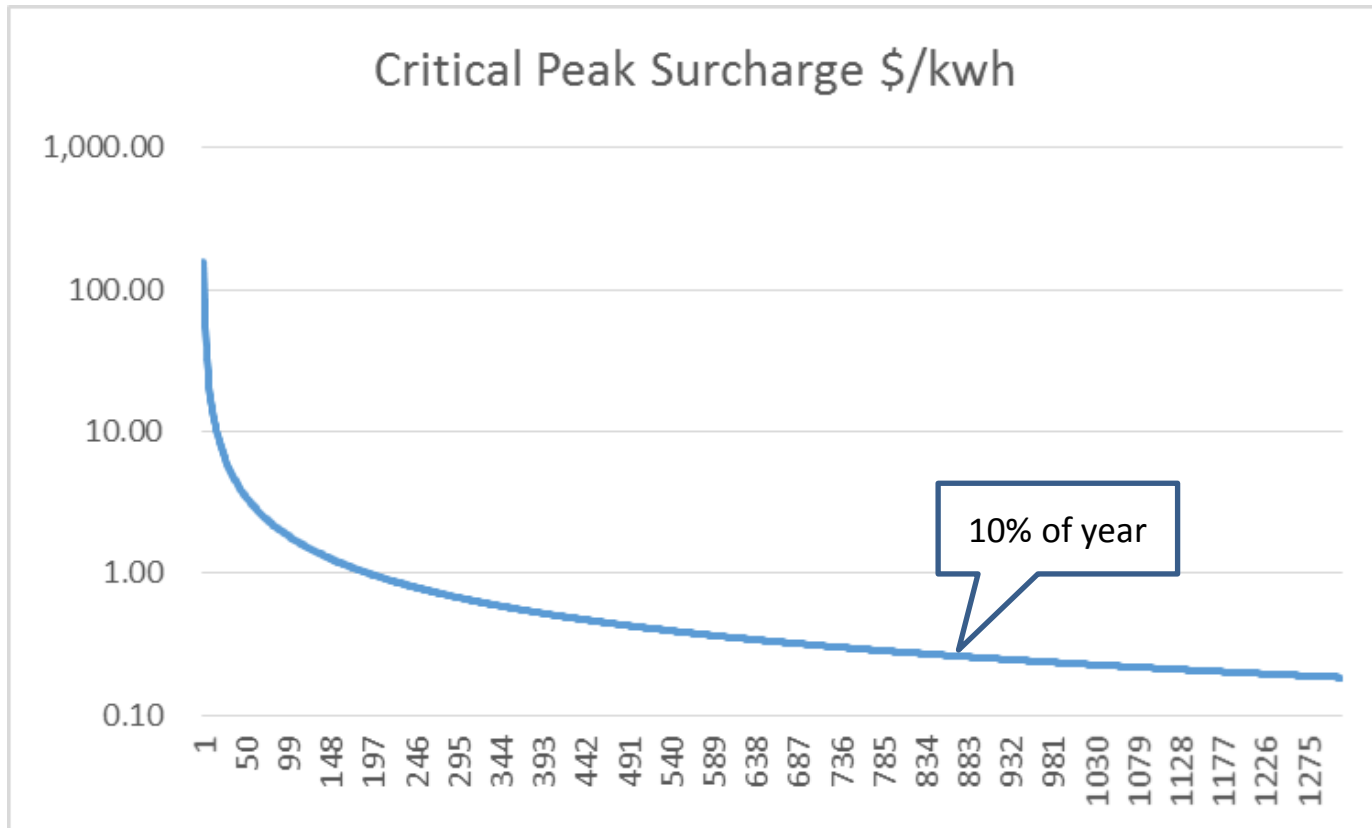
Example Solar Capacity Value Calculation

Factor	Value
DTE D-1 Rate > 17kwh/day	\$0.1326/kwh
Distribution Charge	\$0.05/kwh
Power Supply Charge	\$0.0826/kwh
Secondary Customer Line Loss	11.5%
Power Supply Cost FOB Substation	\$0.0731/kwh
Load-weighted LMP	\$0.0353/kwh
Imputed Capacity Cost FOB Substation	\$0.0378/kwh
Imputed DTE Capacity Cost per year	\$1,745,737,359
Imputed DTE Capacity Cost FOB Substation	~\$158.703/kw-yr
Imputed DTE Capacity Cost FOB Secondary Customer	~\$179.325/kw-yr
Solar ELCC	52% kw/nameplate-kw
Solar Capacity Value	\$93.249/nameplate-kw-yr
Solar Generation per Solar Nameplate	1113 kwh/nameplate-kw-yr
Solar Capacity Value per Annual Solar Output	\$0.0837/kwh

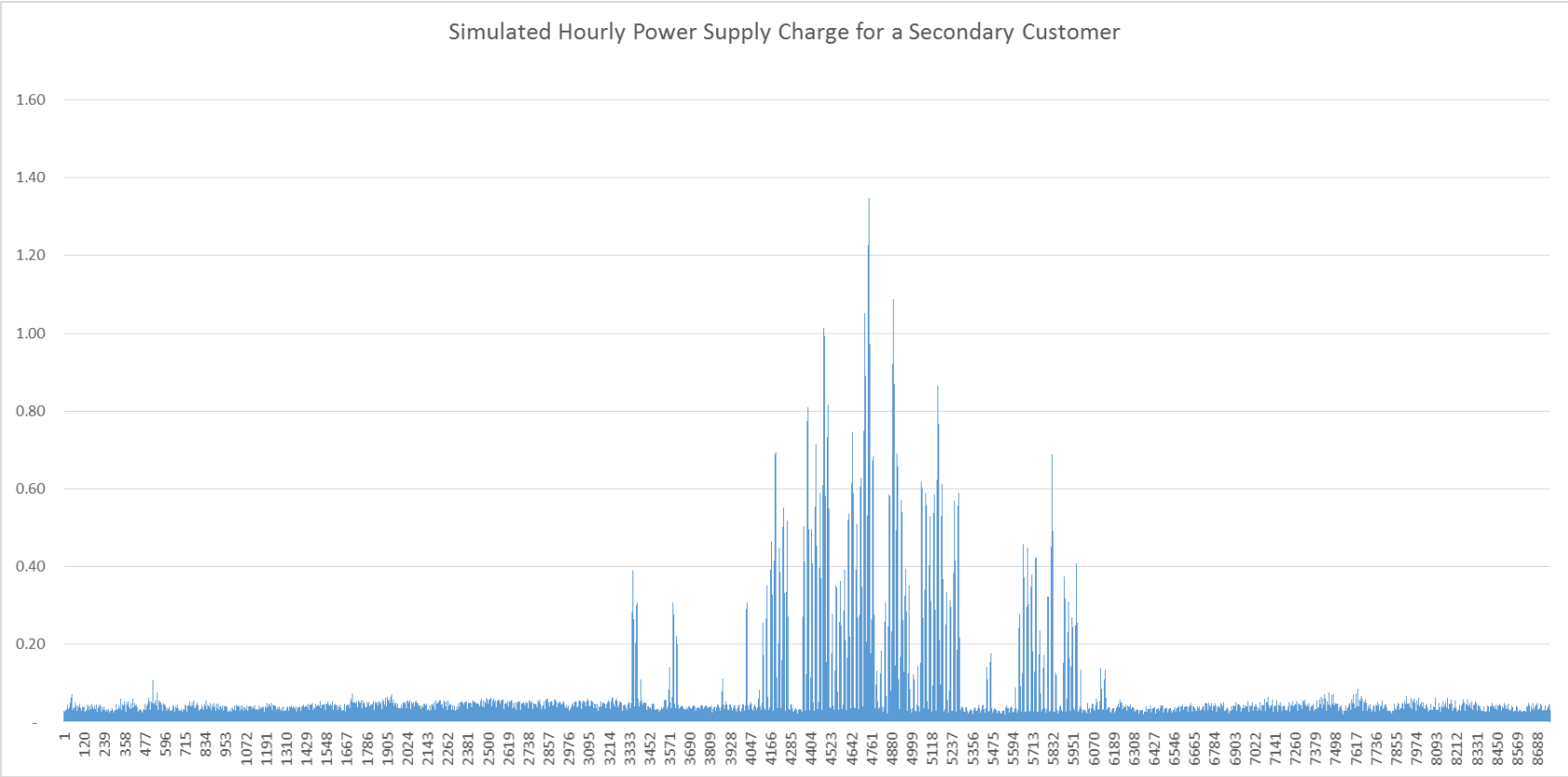
Dynamic Pricing Setup

- Hourly Price per kwh announced day ahead
- Sum of
 - + Delivery Charge
 - + LMP/(1-% line loss)
 - + Capacity Charge/(1-% line loss)
- Capacity Charge allocated over high load hours either
 - Constant amount per kwh, or
 - Amount per kwh that increases with load

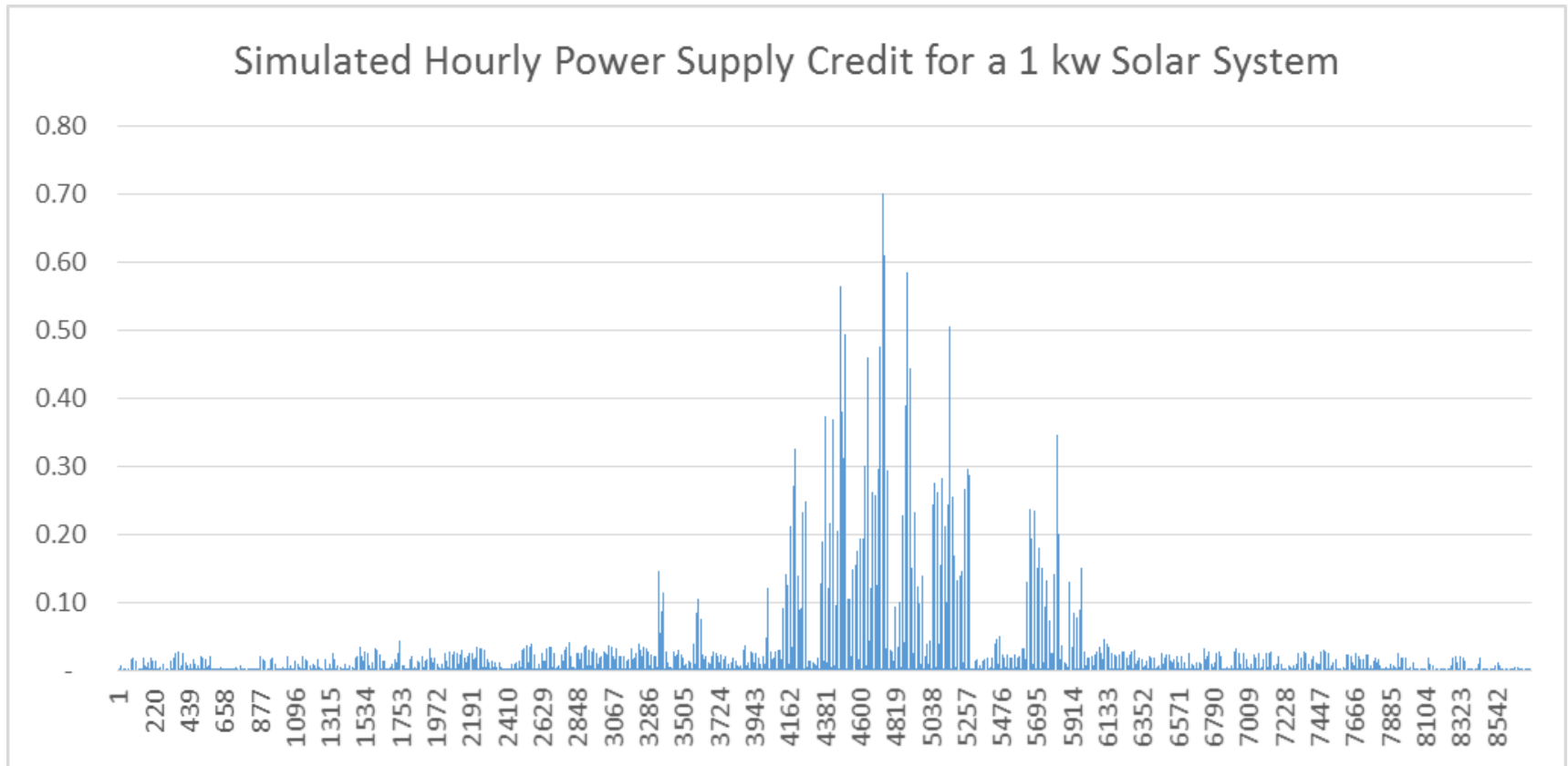
Capacity Cost Allocation



Dynamic Pricing through the Year



Solar Power Value through the Year



Example Solar Credit Calculation (Fixed South-facing Array)

Factor	Value
DTE D-1 Rate > 17kwh/day	\$0.1326/kwh
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Solar Power Supply Credit	\$0.1050/kwh

Buy-net, Sell-net One-way Delivery Charge

- If you use energy from your own generating system, you're effectively "credited" at the retail electricity rate since that's energy that you're simply not buying from the utility.
- If you produce more electricity than you are using at any given moment, you send that excess electricity back to the grid, and are credited at the retail rate less the delivery charge.
- If you are not producing electricity or your load exceeds what you are producing, you simply buy the net additional electricity from the utility at the standard retail rate.

Buy-net , Sell-net Illustrative Example

Assume a customer that consumes 1000 kwh per month, delivery charge is \$0.04 per kwh, and that there are only two periods – day and night.

Load Reduction	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	110%	120%
Total Monthly Load (kwh)	1000	900	800	700	600	500	400	300	200	100	0	-110	-200
Daytime Load with Efficiency	500	450	400	350	300	250	200	150	100	50	0	n/a	n/a
Nighttime Load with Efficiency	500	450	400	350	300	250	200	150	100	50	0	n/a	n/a
Delivery Payment with Efficiency	40	36	32	28	24	20	16	12	8	4	0	n/a	n/a
Daytime Generation with Solar	0	100	200	300	400	500	600	700	800	900	1000	1100	1200
Daytime Gross Load	500	500	500	500	500	500	500	500	500	500	500	500	500
Daytime Net Load	500	400	300	200	100	0	-100	-200	-300	-400	-500	-600	-700
Nighttime Gross/Net Load	500	500	500	500	500	500	500	500	500	500	500	500	500
Delivery Payment Net Metering	40	36	32	28	24	20	16	12	8	4	0	-4	-8
Delivery Payment Buy-All, Sell-all	40	40	40	40	40	40	40	40	40	40	40	40	40
Delivery Payment Buy-net, Sell-net	40	36	32	28	24	20	20	20	20	20	20	20	20



Example Solar Credit Calculation

(Fixed South-facing Array, Net Zero Energy, Average Customer)

Factor	Value
DTE D-1 Rate > 17kwh/day	\$0.1326/kwh
Distribution Charge	\$0.05/kwh
Power Supply Charge	\$0.0826/kwh
Secondary Customer Line Loss	11.5%
Power Supply Cost FOB Substation	\$0.0731/kwh
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Solar Capacity Value	\$93.249/nameplate-kw-yr
Solar Generation per Solar Nameplate	1113 kwh/nameplate-kw-yr
Solar Capacity Value per Annual Solar Output	\$0.0837/kwh
Average Solar Power Supply Credit	\$0.1050/kwh
Buy-net, Sell-net Delivery Charge Savings	39.45%
Average Delivery Charge Savings on Gross Consumption	\$0.0197/kwh
Average Customer Credit per kwh Solar Generation	\$0.1147/kwh

Renewable Energy Credits

- 3.114 RECs per MWH Solar Generation
- At \$5.75 per REC, above example Solar Tariff for Net Zero customer is breakeven with Net Metering.
- Recent REC transaction price of \$3.60 per REC yields customer taxable income of \$0.0112 per kwh.

Example Solar Credit Calculation (Fixed South-facing Array, Net Zero Energy)

Factor	Value
DTE D-1 Rate > 17kwh/day	\$0.1326/kwh
Distribution Charge	\$0.05/kwh
Power Supply Charge	\$0.0826/kwh
Secondary Customer Line Loss	11.5%
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Solar Capacity Value	\$93.249/kw-yr
Solar Generation per Solar Nameplate	1113 kwh/kw-yr
Solar Capacity Value per Annual Solar Output	\$0.0837/kwh
Average Solar Power Supply Credit	\$0.1050/kwh
Buy-net, Sell-net Delivery Charge Savings	39.45%
Average Delivery Charge Savings on Gross Consumption	\$0.0197/kwh
Average Customer Credit per kwh Solar Generation	\$0.1247/kwh
REC Income	\$0.0112/kwh
Total Average Solar Credit without Externality Credit	\$0.1356/kwh

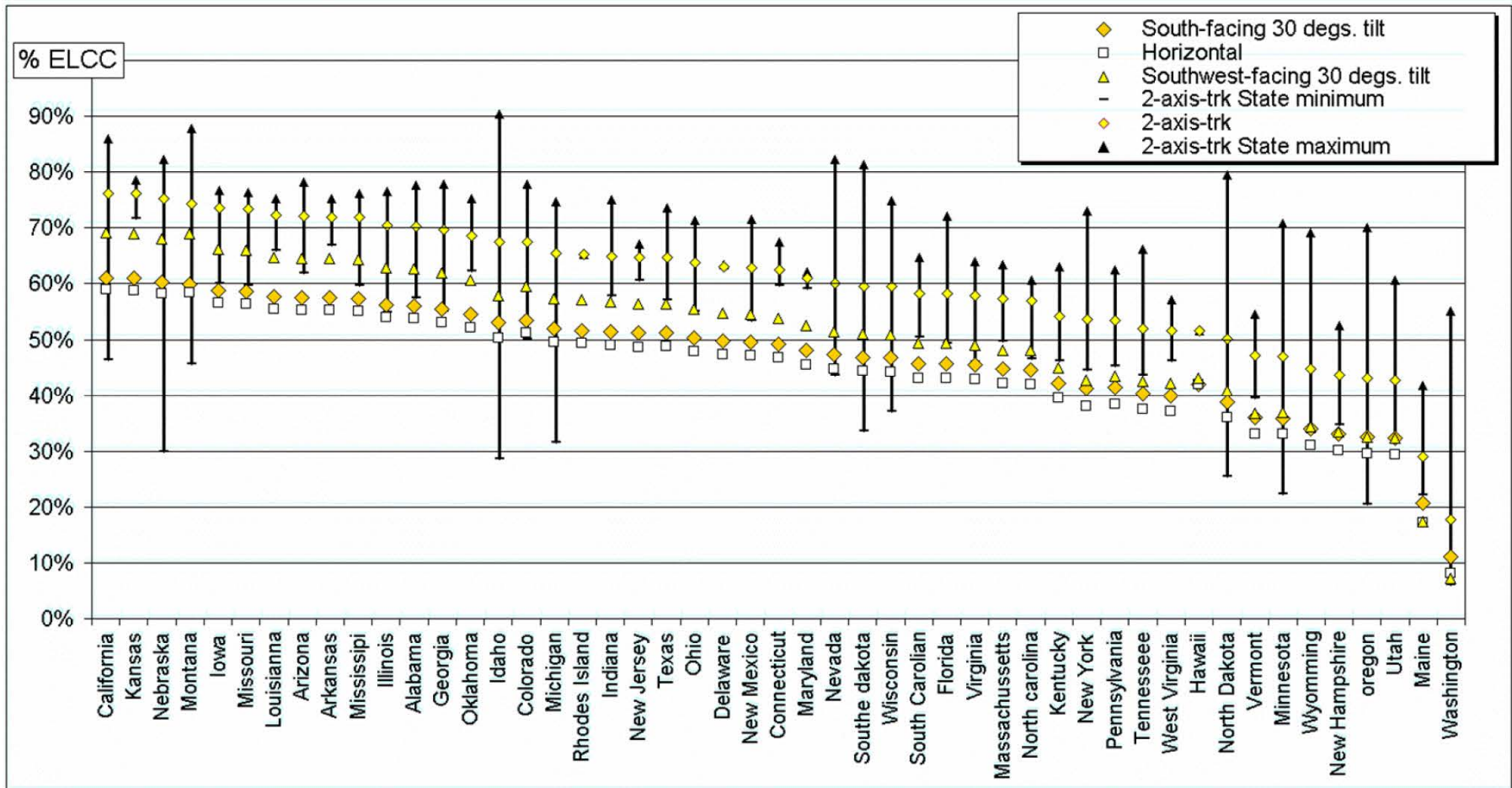
Externalities

- Accelerated Balance of System Experience Curve
- Voltage Support
- Mostly displaces CT and CC natural gas
 - Carbon Pollution
 - NOx
- Michigan Employment and Income
- Good guess is \$0.02 per kwh

Example Solar Credit Calculation (Fixed South-facing Array, Net Zero Energy)

Factor	Value
DTE D-1 Rate > 17kwh/day	\$0.1326/kwh
Distribution Charge	\$0.05/kwh
Power Supply Charge	\$0.0826/kwh
Secondary Customer Line Loss	11.5%
Power Supply Cost FOB Substation	\$0.0731/kwh
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Solar ELCC	52% kw/nameplate-kw
Solar Capacity Value	\$93.249/kw-yr
Solar Generation per Solar Nameplate	1113 kwh/kw-yr
Solar Capacity Value per Annual Solar Output	\$0.0837/kwh
Externality Payment	\$0.02/kwh
Average Solar Power Supply Credit	\$0.1250/kwh
Buy-net, Sell-net Delivery Charge Savings	39.45%
Average Delivery Charge Savings on Gross Consumption	\$0.0197/kwh
Average Customer Credit per kwh Solar Generation	\$0.1447/kwh
REC Income	\$0.0112/kwh
Total Average Solar Credit	\$0.1556/kwh

Capacity Credit of Solar Technologies



Example Solar Credit Calculation (Single-Axis Tracking, Net Zero Energy)

Factor	Value
DTE D-1 Rate > 17kwh/day	\$0.1326/kwh
Distribution Charge	\$0.05/kwh
Power Supply Charge	\$0.0826/kwh
Secondary Customer Line Loss	11.5%
Power Supply Cost FOB Substation	\$0.0731/kwh
Load-weighted LMP	\$0.0353/kwh
Imputed Capacity Cost FOB Substation	\$0.0378/kwh
Imputed DTE Capacity Cost per year	\$1,745,737,359
Imputed DTE Capacity Cost FOB Substation	~\$158.703/kw-yr
Imputed DTE Capacity Cost FOB Secondary Customer	~\$179.325/kw-yr
Solar ELCC	72% kw/nameplate-kw
Solar Capacity Value	\$129.114/kw-yr
Solar Generation per Solar Nameplate	1447 kwh/kw-yr
Solar Capacity Value per Annual Solar Output	\$0.0892/kwh
Externality Payment	\$0.02/kwh
Average Solar Power Supply Credit	\$0.1357/kwh
Buy-net, Sell-net Delivery Charge Savings	48.35%
Average Delivery Charge Savings on Gross Consumption	\$0.0242/kwh
Average Customer Credit per kwh Solar Generation	\$0.1599/kwh
REC Income	\$0.0112/kwh
Total Average Solar Credit	\$0.1711/kwh



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