Maximizing ROI & Resiliency with PV and Energy Storage

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Green Mountain Power- Rutland PV & ESS

IDEA2017 | Sustaining Our Success
108TH ANNUAL CONFERENCE & TRADE SHOW
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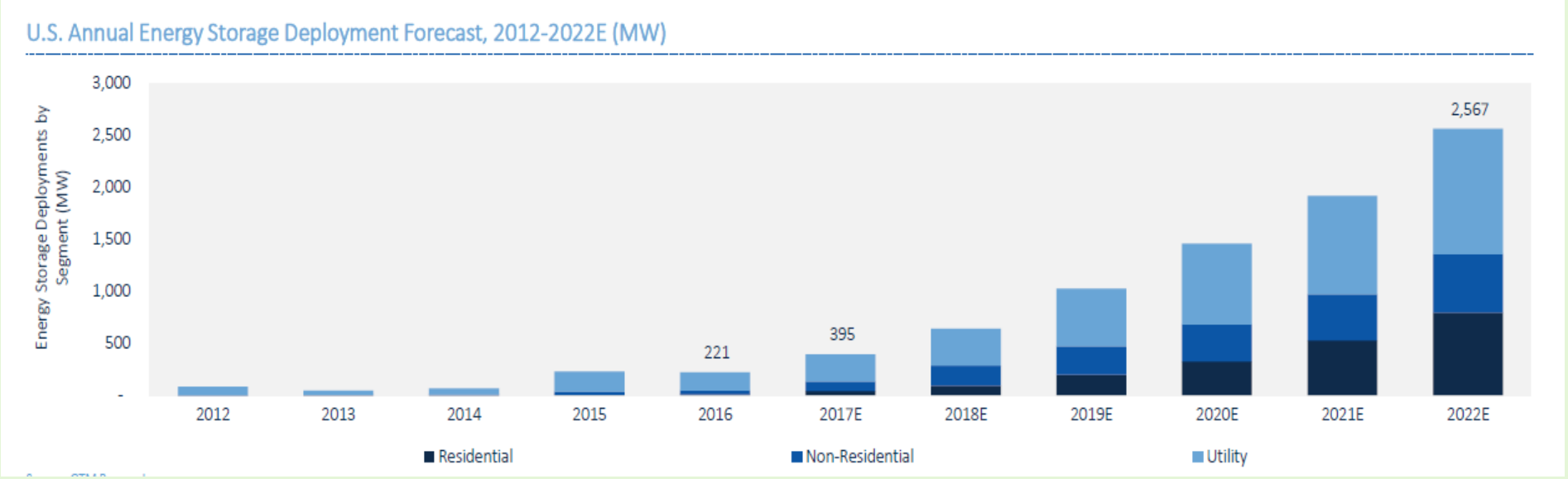
The U.S. deployed 233.7 MWh ESS in Q1 2017



GTM Research/ESA | U.S. Energy Storage Monitor: Q2 2017

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Sources of Revenue & Savings

1. Solar PV Clipping Recapture
2. Solar PV Low Voltage Harvesting
3. Demand Reduction
4. Energy Time Shifting
5. Energy Arbitrage
6. Capacity Firming
7. Frequency Support
8. Blackstart
9. Spinning Reserve

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Virtual Net Metering

Also called “Community Solar”

1. Crediting system when solar is not used on-site
2. Solar facility installed elsewhere in the utility service territory.
3. Subscribers share in the monthly credits on electric bills.

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Virtual Net Metering

1. In Vermont (thru 2016)- Virtual Net metering is available to systems up to 500 kW in **Capacity.**
2. On solar projects **Capacity** is defined as nameplate maximum AC KW of inverter.
3. Credit value is full residential value ($0.14/kWh). for **all** members of virtual net metered system
4. Green Mountain Power also credits $0.06 solar adder for 10 years.
5. Customer retains REC value- can also sell.

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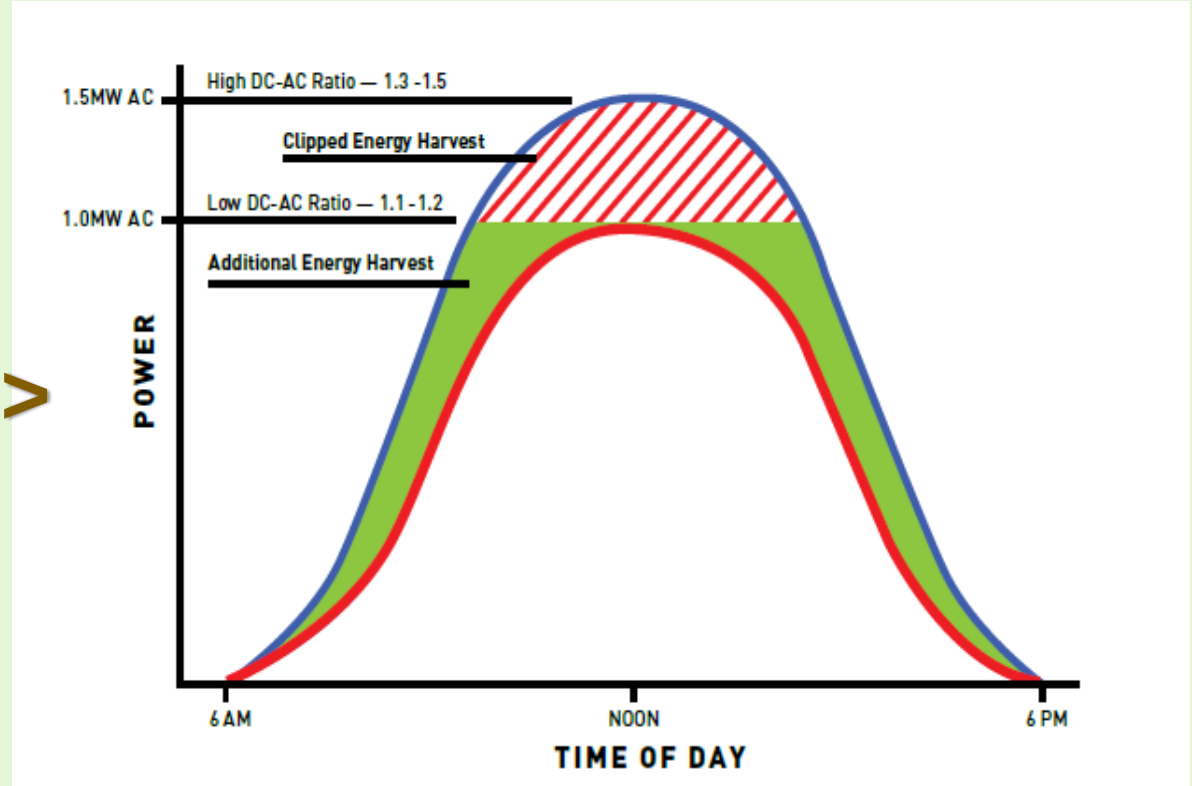
Solar Clipping Recapture

Effective when DC to AC ratio > 1.30+



Graphic by Dynapower

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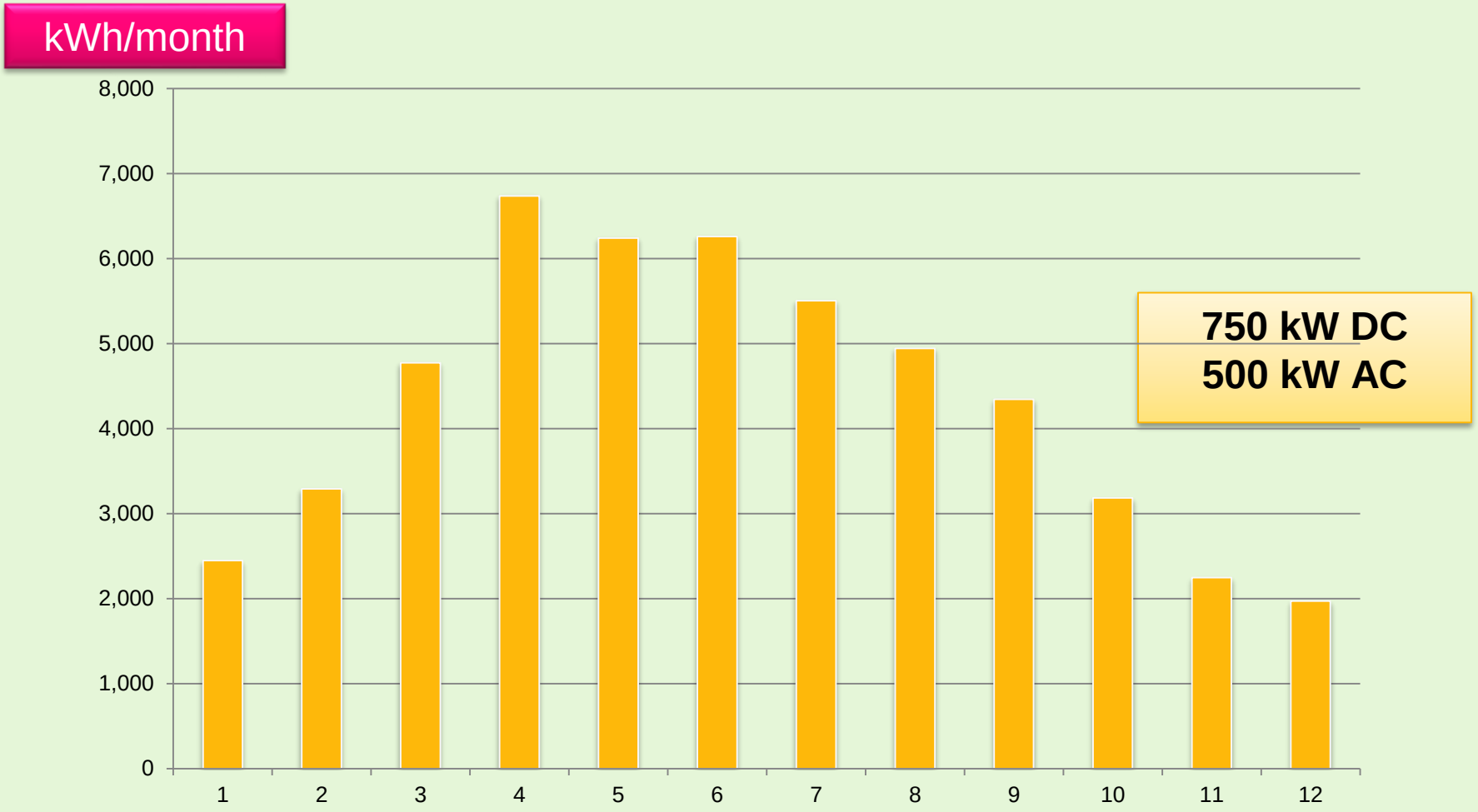
Solar Clipping Recapture



Total Recapture per year at 52,000 kWh

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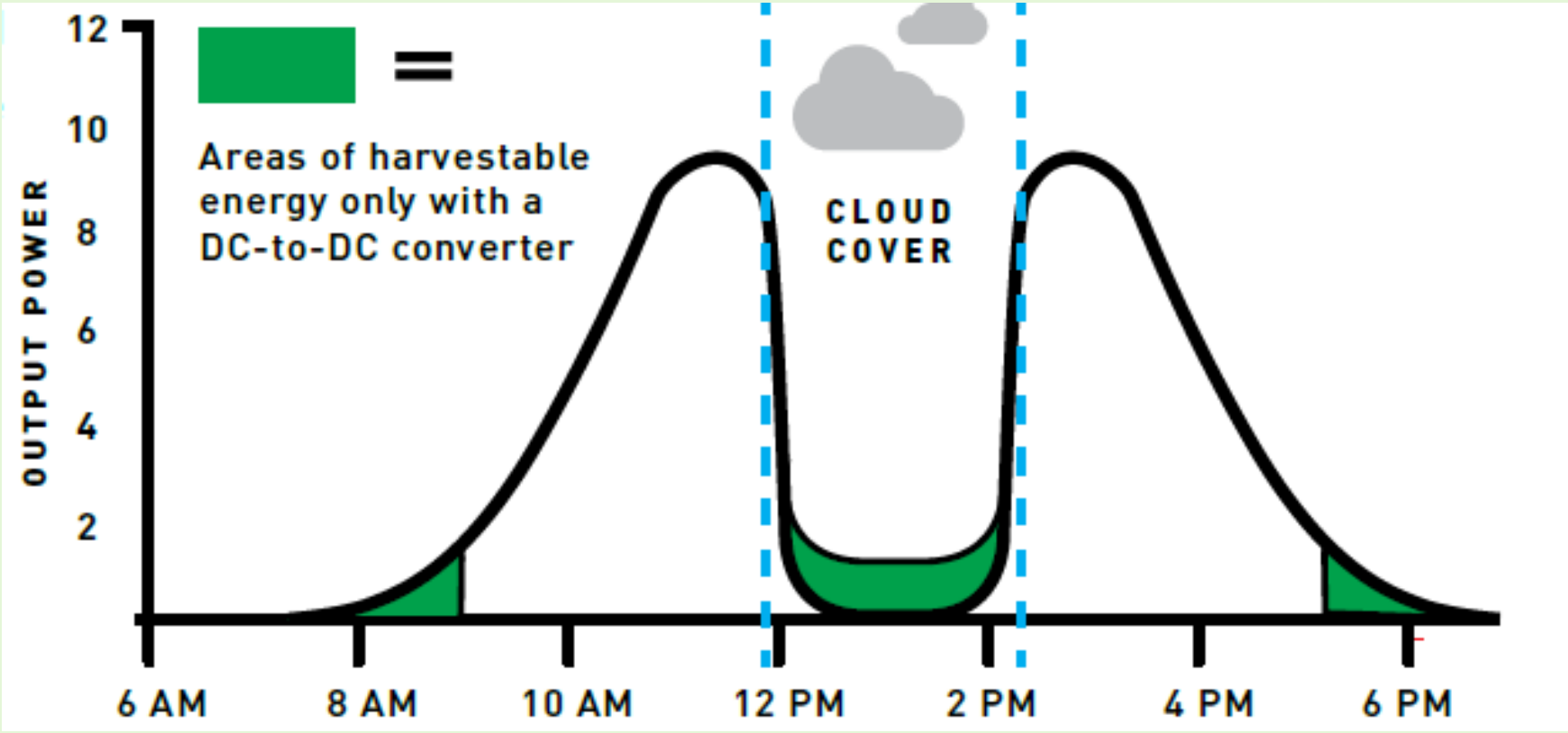
Low Voltage Harvesting Using ESS



Graphic by Dynapower

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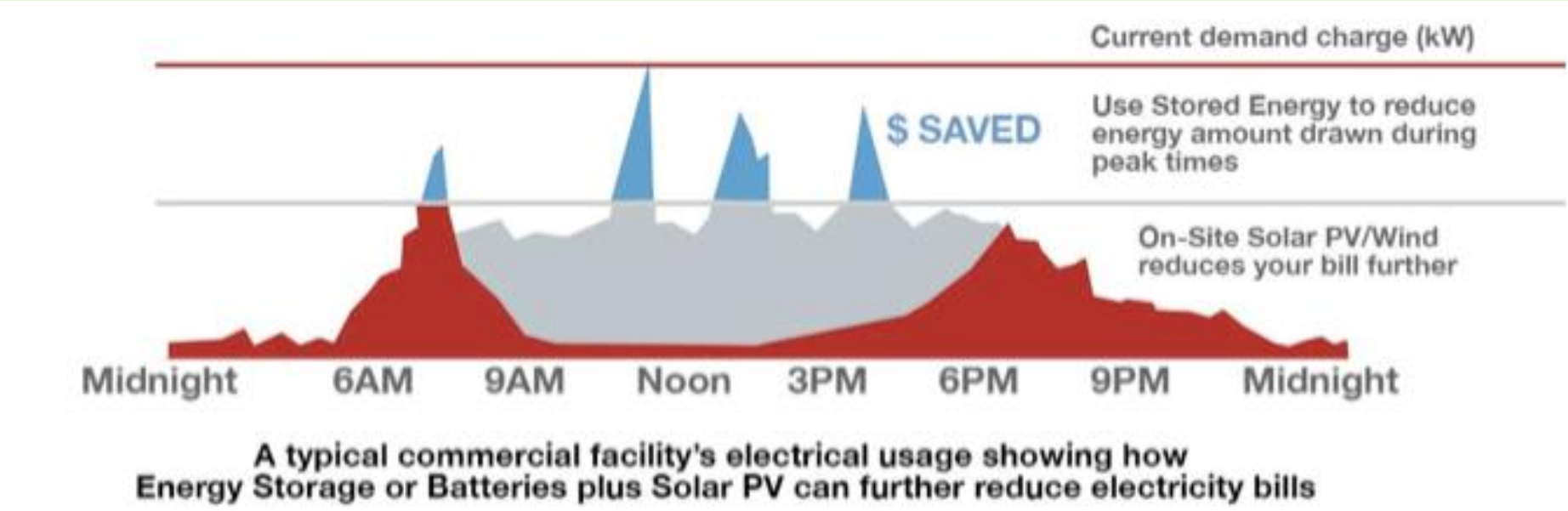
Demand Reduction

Based on the highest capacity you required during the given billing period, typically a 15-minute interval during that billing cycle.



A typical commercial facility's electrical usage showing how Energy Storage or Batteries plus Solar PV can further reduce electricity bills

Graphic by Freshenergy.co.za

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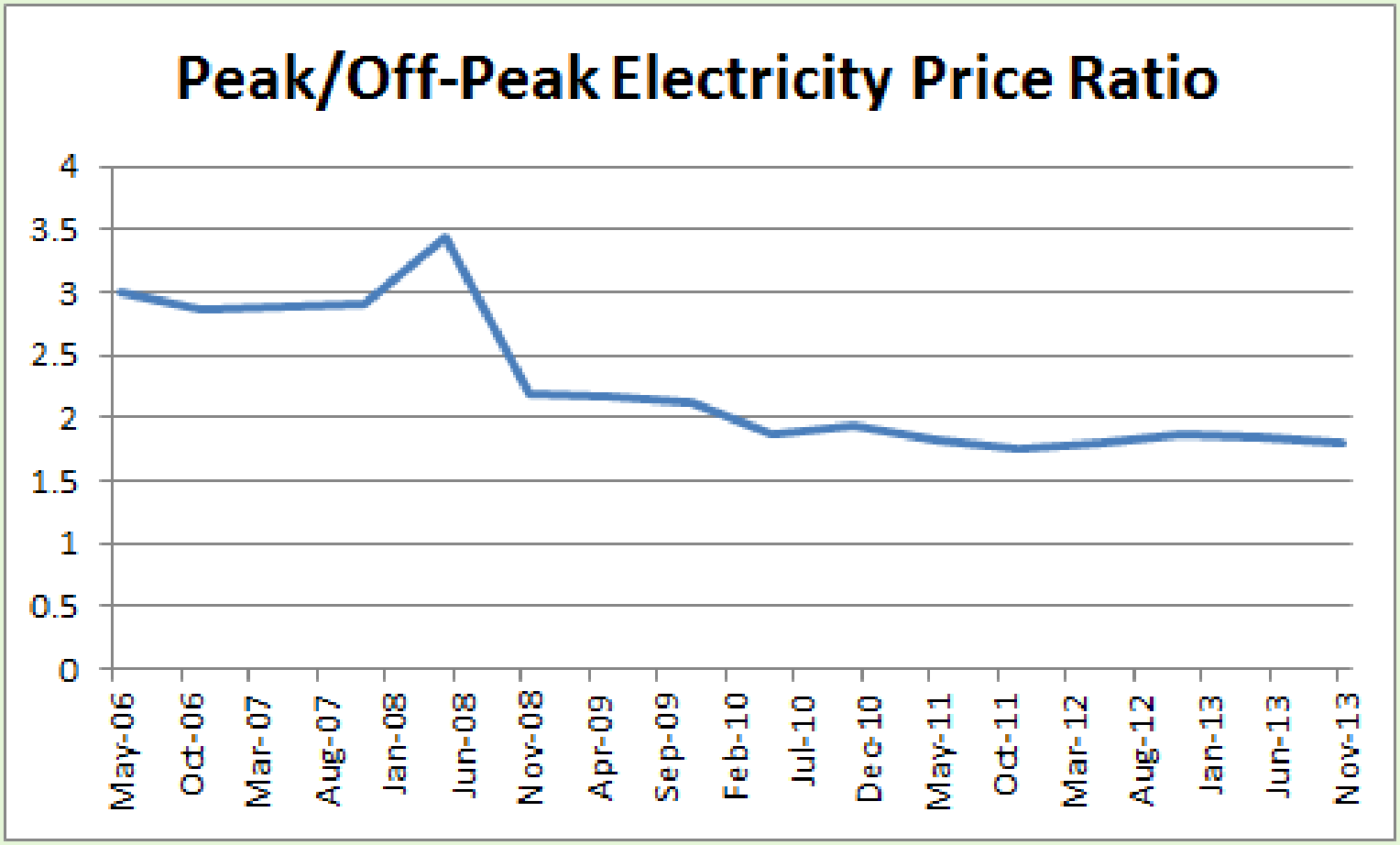
Demand Reduction



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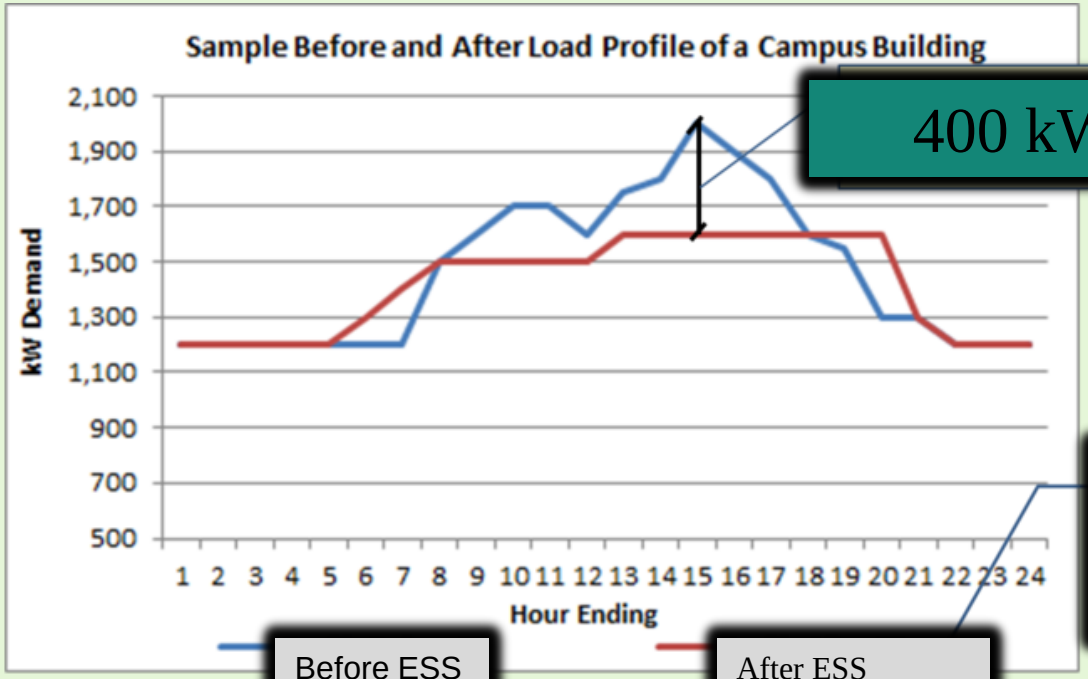
Demand Reduction



400 kW of ESS

Green Mountain Power Rates thru March 2017

Demand Rates at $ 11.210/ kW per month

Demand savings of 400 kW

Reduction as much as $ 54,000 per year

Energy Time Shifting- higher PPA rates

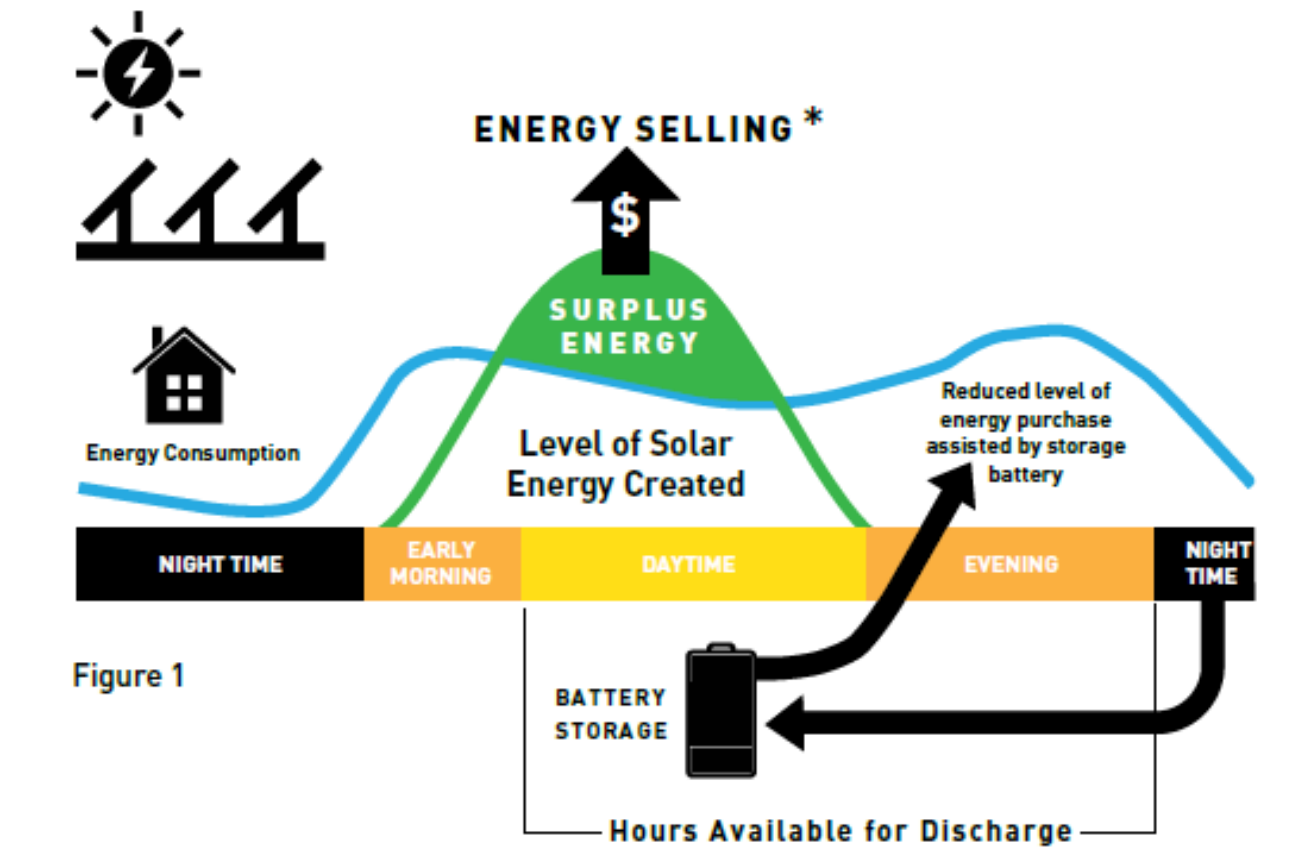


Figure 1

Graphic by Dynapower

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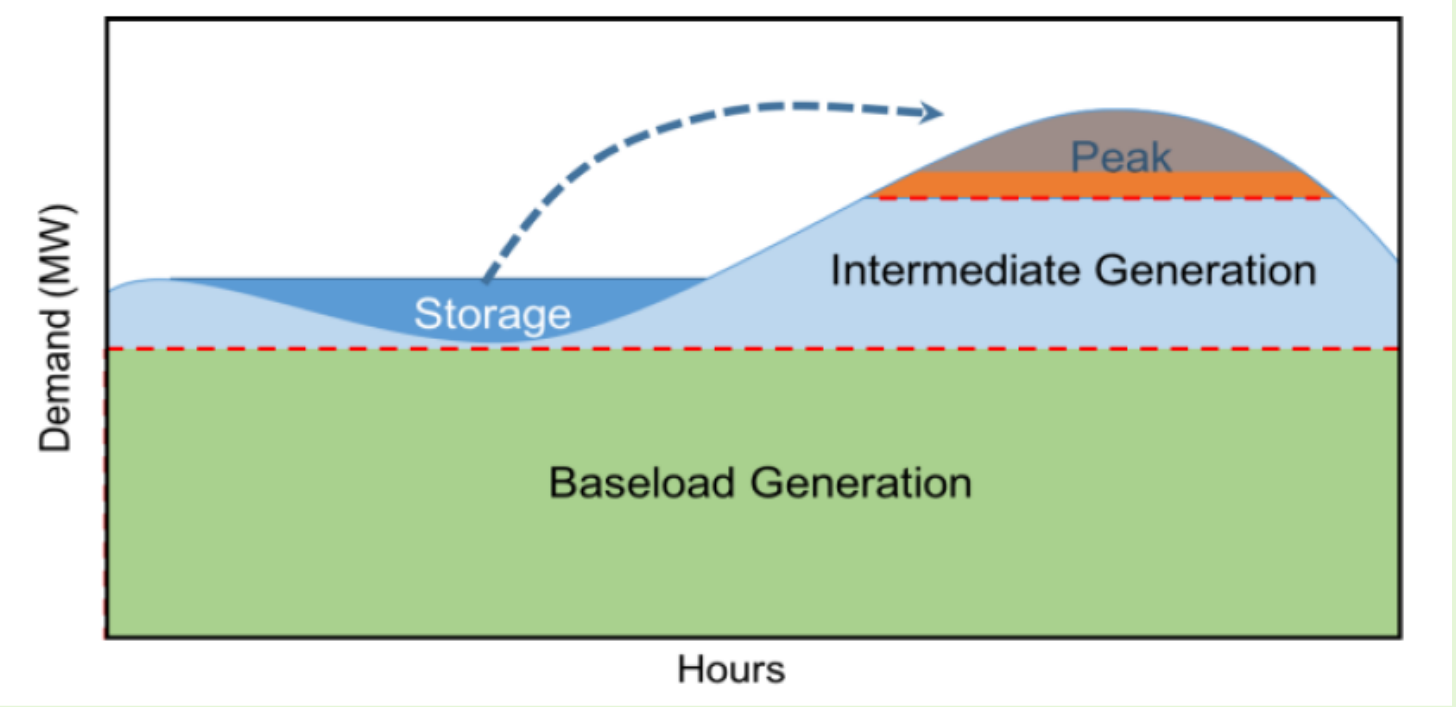
Energy Arbitrage

Purchase/produce electricity when Locational Marginal Price (LMP) is low, and sale when LMP is high.



Graphic by Dynapower

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Energy Arbitrage

Final Real-Time Locational Marginal Prices ($/MWh) 9/2/2014

Hour	HUB	WCMA	NEMA	SEMA	CT	RI	NH	VT	ME
1	44.23	44.35	44.48	44.03	44.40	44.39	43.85	43.75	41.88
2	38.15	38.31	38.22	37.84	38.36	38.17	37.74	37.75	36.11
3	32.98	33.11	33.01	32.68	33.09	32.96	32.67	32.54	31.54
4	28.23	28.34	28.26	28.01	28.26	28.19	28.02	27.90	27.13
5	28.06	28.19	28.07	27.83	28.17	27.97	27.89	27.81	26.98
6	32.97	33.10	32.98	32.67	33.11	33.09	32.86	32.82	31.77
7	37.33	37.46	37.49	37.03	37.51	37.24	37.44	37.29	36.38
8	40.87	40.99	41.07	40.62	41.05	40.90	41.01	40.86	39.96
9	35.01	35.09	35.25	36.10	35.06	41.63	35.25	34.96	34.33
10	45.85	45.99	46.13	46.51	46.09	50.20	46.07	45.92	44.34
11	73.81	74.12	74.15	73.39	74.69	73.55	74.11	74.15	71.31
12	89.80	90.11	90.35	89.45	93.48	89.51	90.14	89.86	86.67
13	185.70	186.25	187.11	185.44	190.47	185.53	186.15	184.95	178.01
14	554.71	555.62	560.77	555.12	558.00	555.55	555.69	551.95	530.00
15	206.54	206.72	209.37	207.47	308.93	207.60	206.72	205.66	196.51
16	70.45	70.57	71.51	70.86	158.68	70.91	70.15	70.67	65.38
17	86.23	86.34	87.48	86.72	168.94	86.71	85.96	86.14	80.60
18	133.90	134.22	135.05	134.18	174.45	134.14	133.38	133.73	126.21
19	72.92	73.14	73.35	72.90	107.74	72.81	72.65	73.38	68.10
20	75.16	75.35	75.60	75.14	82.61	75.08	75.14	75.41	71.28
21	74.36	74.62	74.61	74.20	75.75	73.96	74.14	74.76	70.18
22	55.07	55.27	55.32	54.86	55.76	54.56	54.81	54.91	52.16
23	38.60	38.75	38.82	38.36	39.02	38.21	38.48	38.42	36.99
24	54.55	54.76	54.98	54.15	55.00	54.01	54.41	54.12	52.48
AVG	88.98	89.20	89.73	88.98	104.53	89.45	88.95	88.74	84.85
On Peak AVG	114.94	115.20	116.00	115.08	138.17	115.68	114.99	114.73	109.50
Off Peak AVG	37.06	37.20	37.19	36.78	37.24	37.00	36.86	36.75	35.53

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Project Case Study

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Project Case Study

1. Small Tech Corporate Campus; 150,000 sq. ft.
2. Southern Vermont; GMP Service Territory
3. Power outages/year; 4 to 8.
4. Outages up to 2 hours.
5. Load ranges from 1,200 kW to 1,950 kW.
6. Land available for solar; 6 acres.

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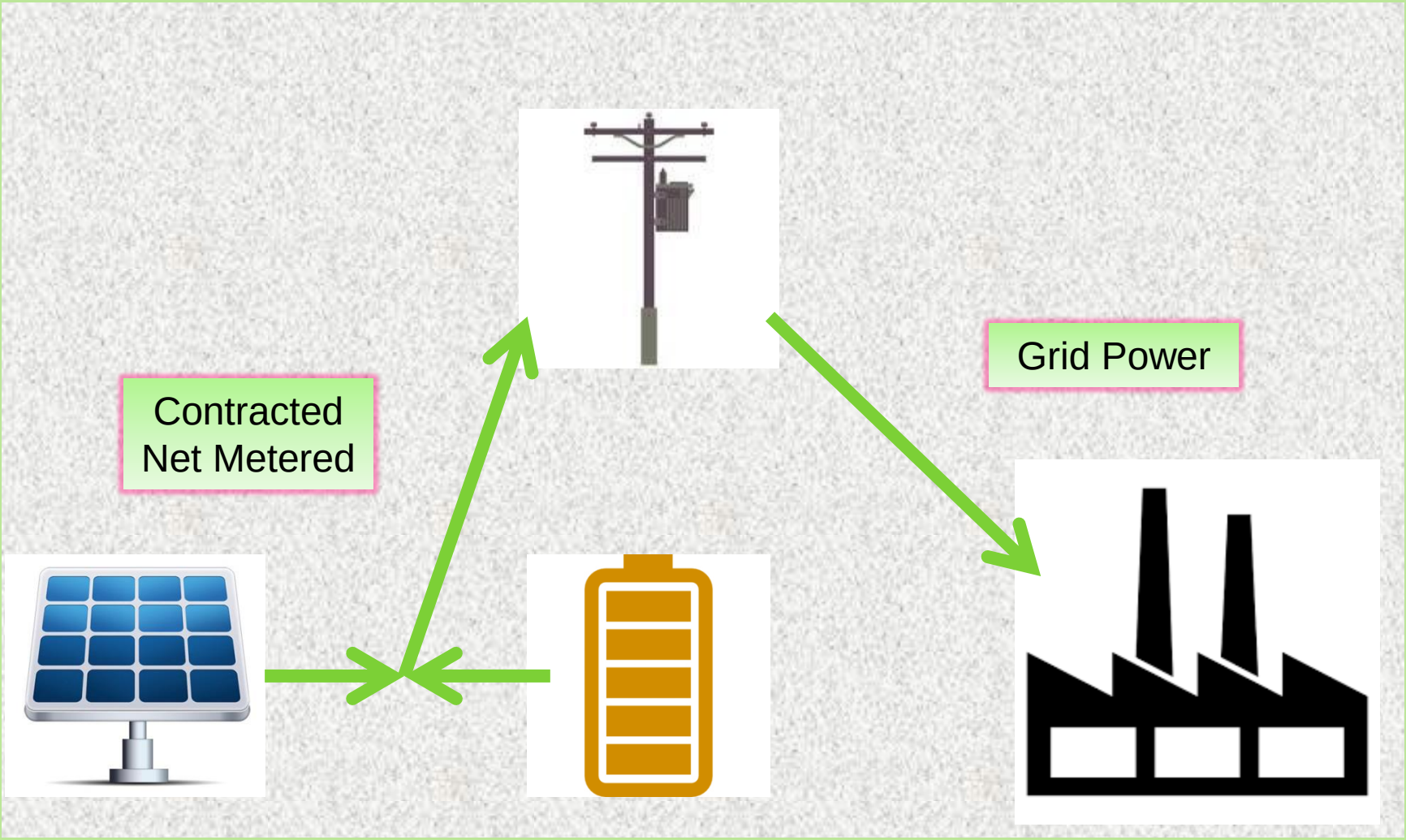
Early Morning



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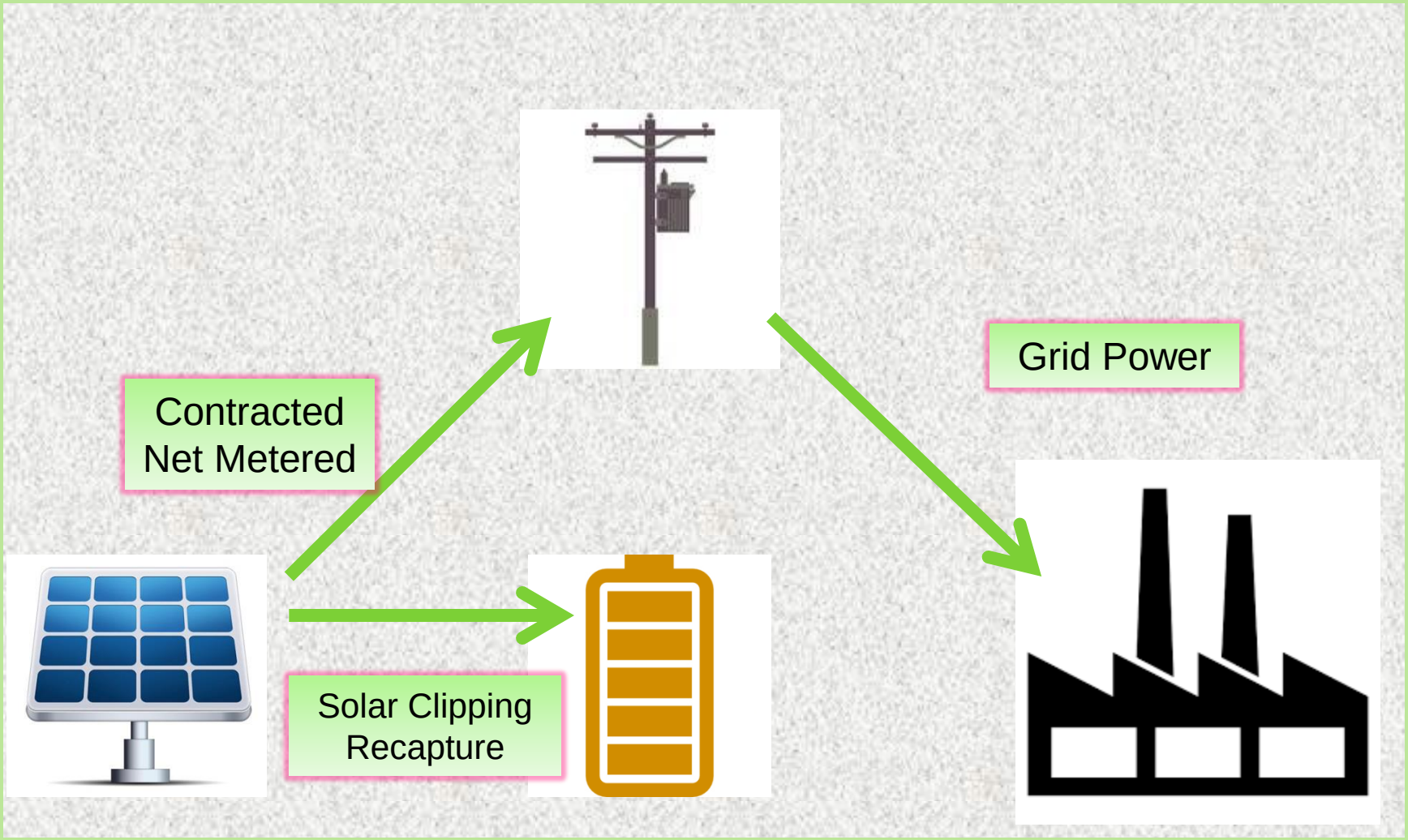
Mid-Day



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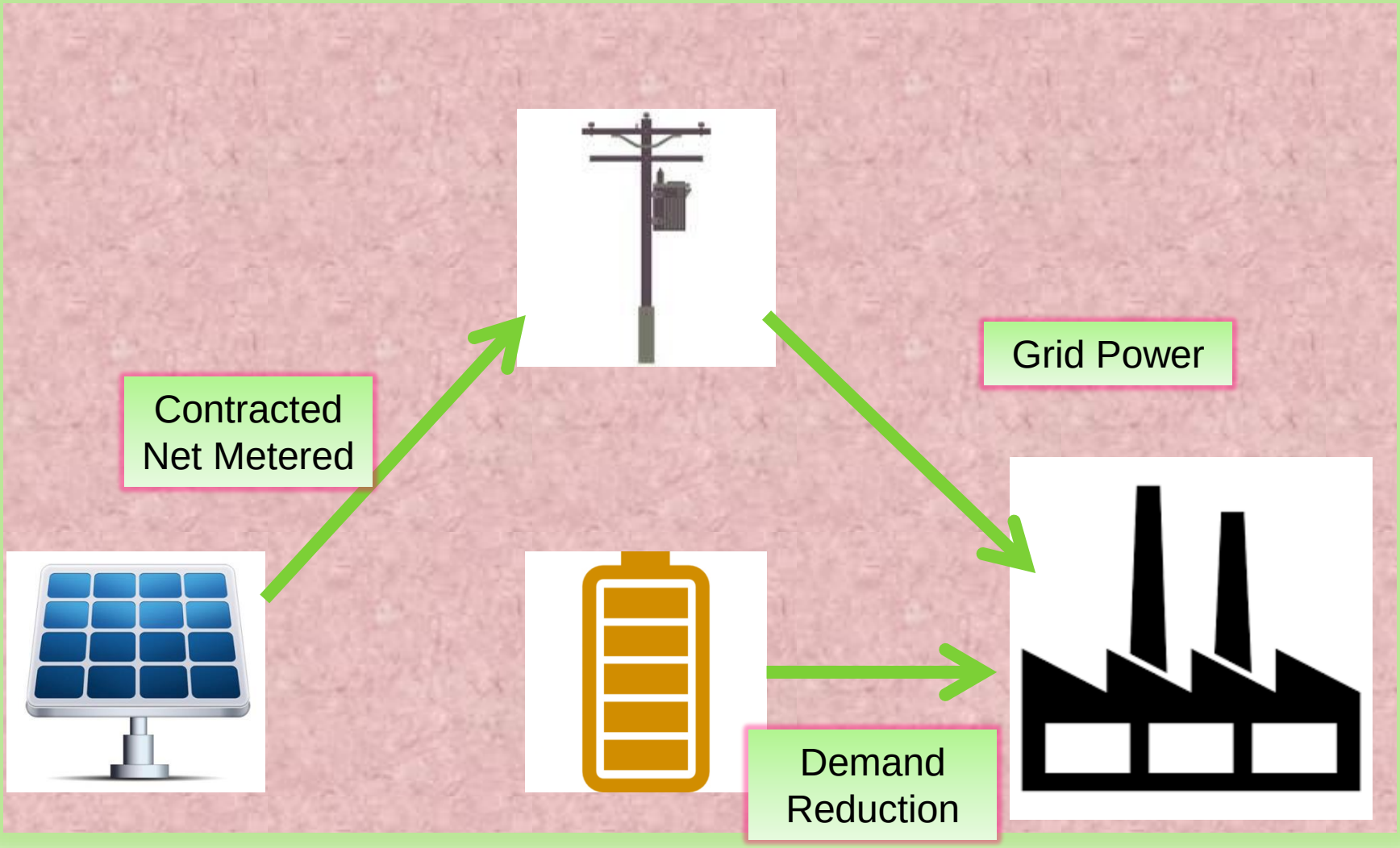
Peak Demand



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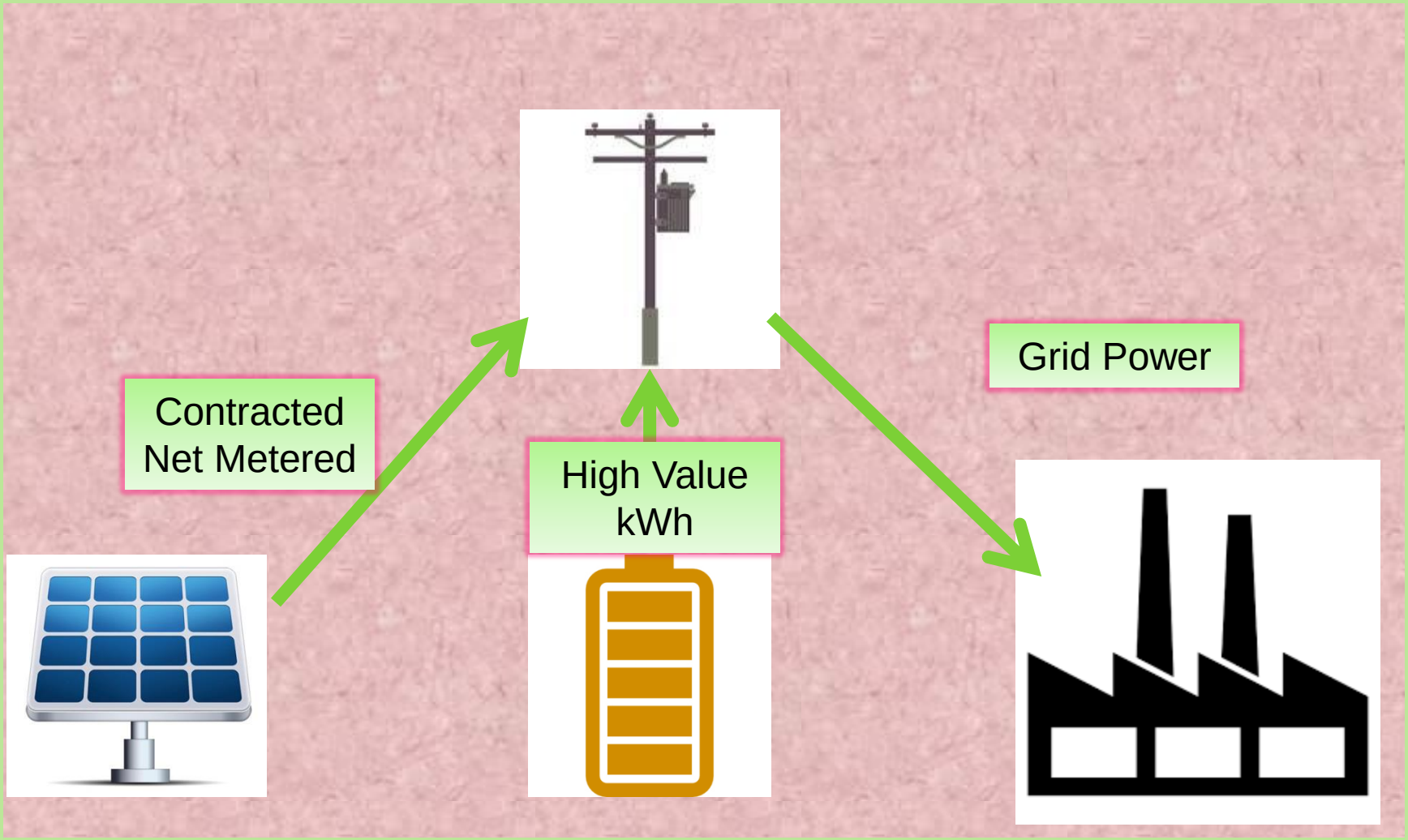
Energy Arbitrage



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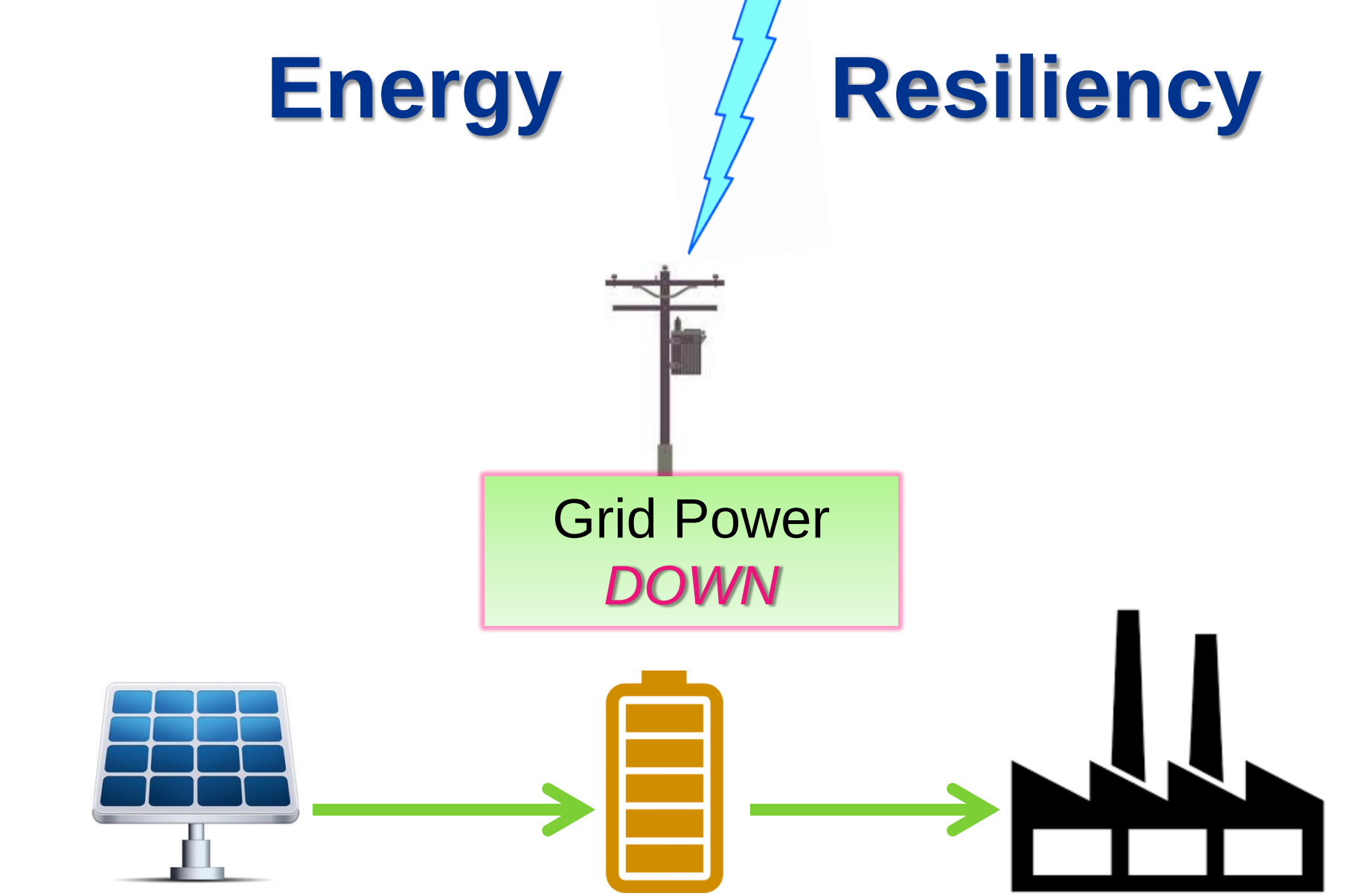
Energy Resiliency



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Corporate Campus w/ PV & ESS

750 kWDC 500 kWAC Solar PV System

(1.5 ratio)

$ 1,500,000 Gross CapEx

1 MW ESS Capacity with 400 kWh Hourly Discharge Rate

$ 800,000 Gross CapEx

Federal Incentives @ 30% - $ 690,000
Net CapEx @ $ 1,610,000

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Corporate Campus w/ PV & ESS

Contracted solar direct Net Meter Energy:	
860,000 kWh @ $ 0.20/kWh	$ 172,000
Solar clipping recapture:	
52,000 kWh minus 40% reserve	$ 6,240
Low voltage harvesting:	
5,000 kWh @ 0.20/kWh	$ 1,000
Demand Reduction:	$ 54,000
Energy Arbitrage:	$ 15,000
Total	**$ 248,240**

Simple Payback of 6.5 years

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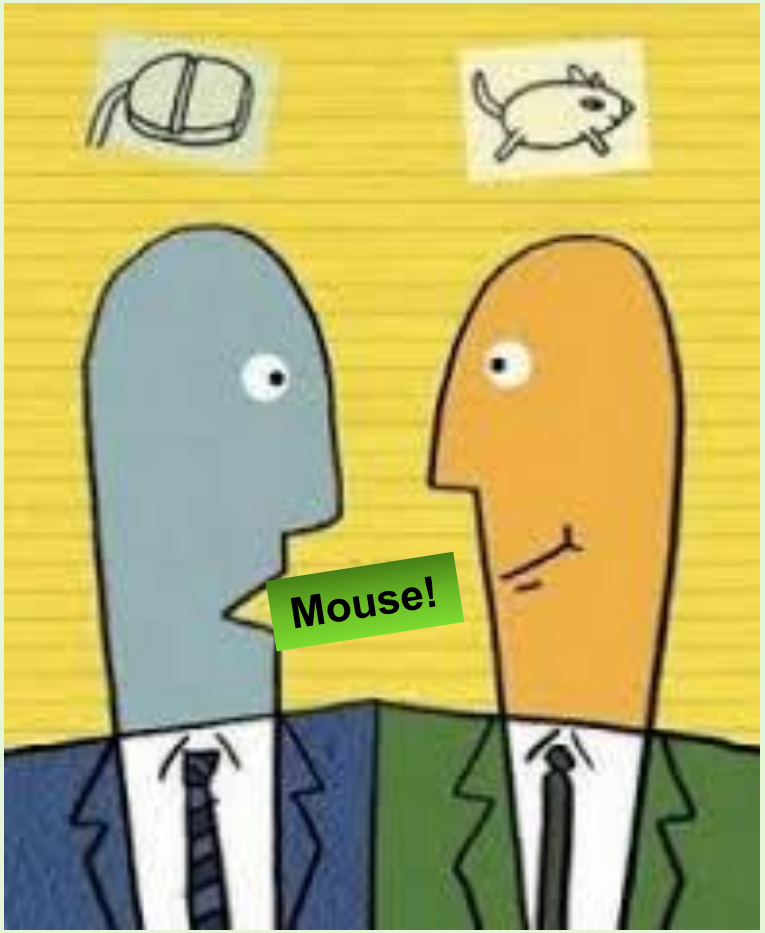
The most important issue:

The developer and the design engineer have to be on the same page!

There can be no disconnect on design intent!



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