Citizen Microgrid

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Microgrid vs Traditional Supplier Roles

Criteria	MEA/Shell	IIT/Exelon	Calpine[8]	NextEra[9]	US Avg.
Source Energy Intensity (mmBTU/MWh)	3.8	6.6	7.3	8.0	9.1
CO_2 Intensity (lbs/MWh)	610	0	870	650	1330
SO_2 Intensity (lbs/MWh)	0.3	0	0.0044	0.44	3.0
NOx Intensity (lbs/MWh)	0.3	0	0.12	0.33	1.4
Water Consumption (gallons/MWh)	>400*	240*	100	230	>400*
Solid Waste Recycled (waste recycled/total waste)	16%*	60%	0%*	28%*	65%
Renewable Energy Credits (bonus points)	6	0	0	0	N/A
PPI Rating Score (max 100)	**91**	**79**	**68**	**64**	**41**
Percent Renewable	**60%**	**40%**	**6%**	**13%**	**9%**

**Numbers estimated from available data*

Notes: Results adjusted for average system losses. MEA is the Marin Energy Authority contracting with Shell Energy. IIT is the Illinois Institute of Technology contracting with Exelon.

Table 3, Assessing Power Supply: Environment and Energy Efficiency, Perfect Power Institute, July 2012

[8] Calpine (2010). *Annual Report: A Generation Ahead, Today*. www.calpine.com/docs/CPN_Annual_Report.pdf

[9] NextEra Energy (2011). *Sustainability Report 2011*. http://www.nexteraenergy.com/pdf/sustain-report.pdf

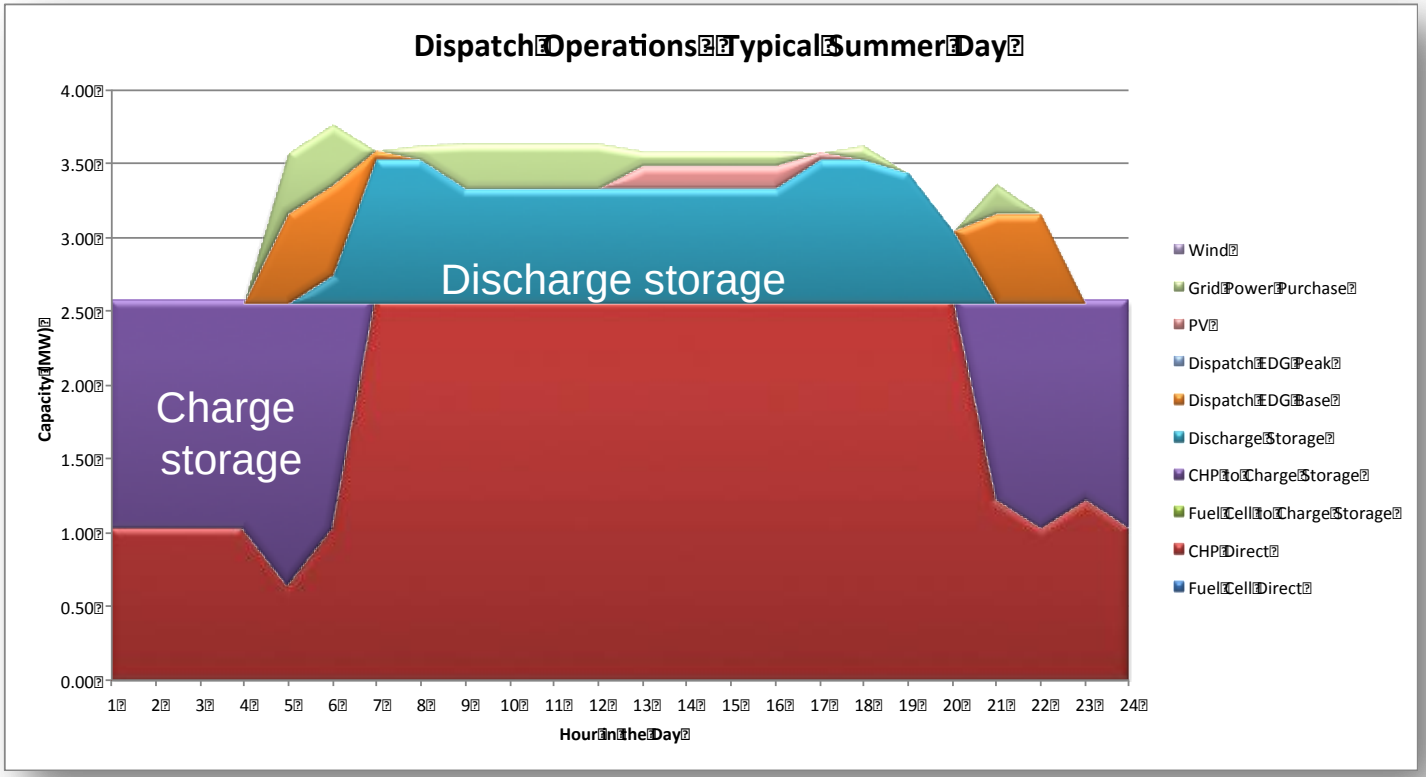
Case Study: What if ConEd?

Compare 500 MW over 20 years	ConEd BAU	ConEd Microgrid
Amount of microgrids	--	500 MW
Reliability (avg customer outage minutes/year)	118	12
Power Plant Capacity Factor	45.3%	83.2%
Emissions (NO_X, SO_X, CO_2)	--	532,727 Tons less
Consumer Savings	--	$2,091 M higher
Distribution Marginal Cost	$600/kW-year	<$250/kW-year

Case Study based data from an 11 MW industrial microgrid design in CT.

Microgrid Dispatch Operations

System can provide certain ancillary services to grid at certain times of the day.



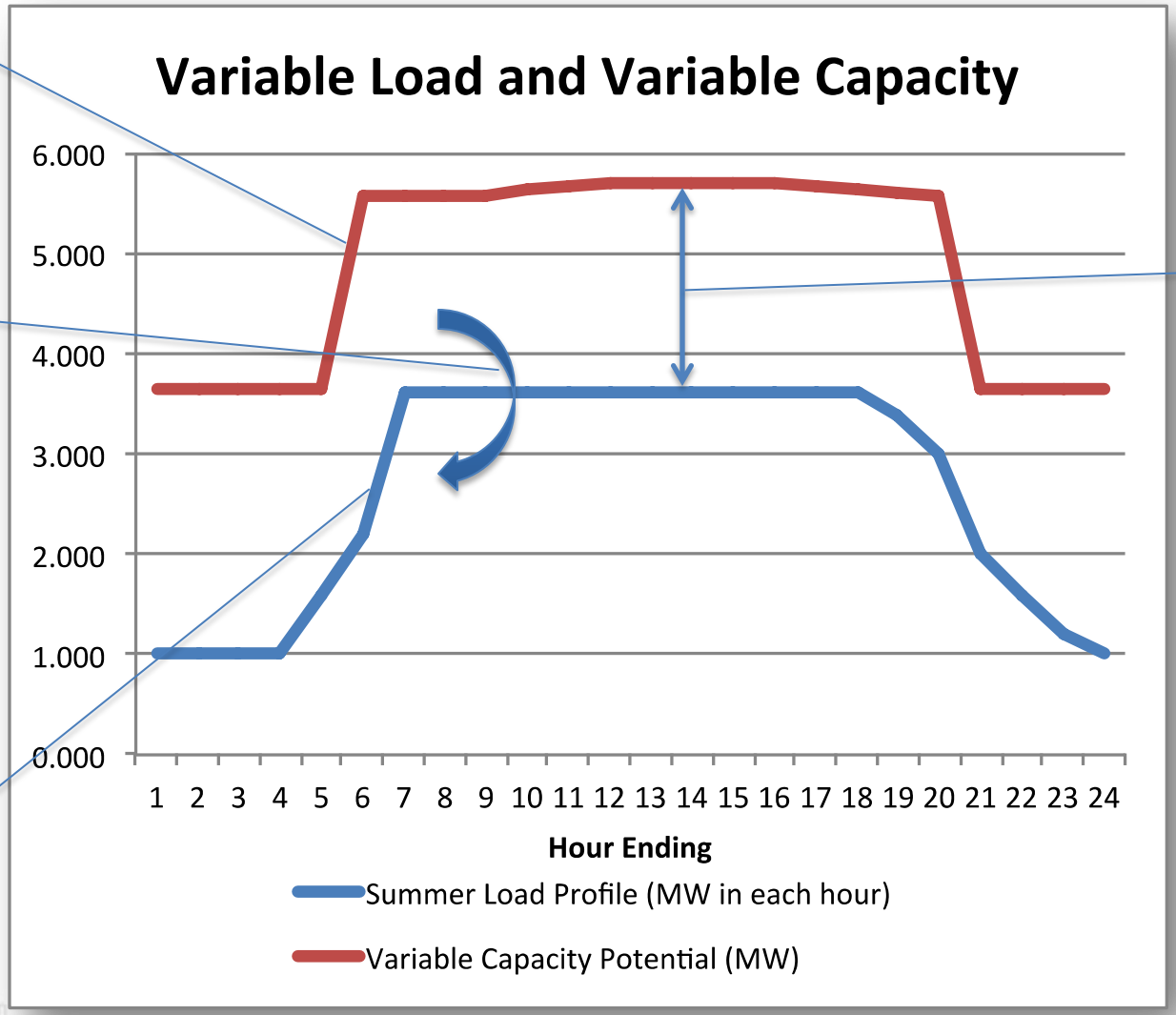
750,000 s.f. 6 tower Engineering Center, 3,200 engineers,
3.5 MW summer day peak, 2.7 MW winter day peak

Day in the Life – Engineering Center

Variable capacity is dispatchable (Smart)

Hourly dispatch to serve load

~8% dispatchable w/o impact

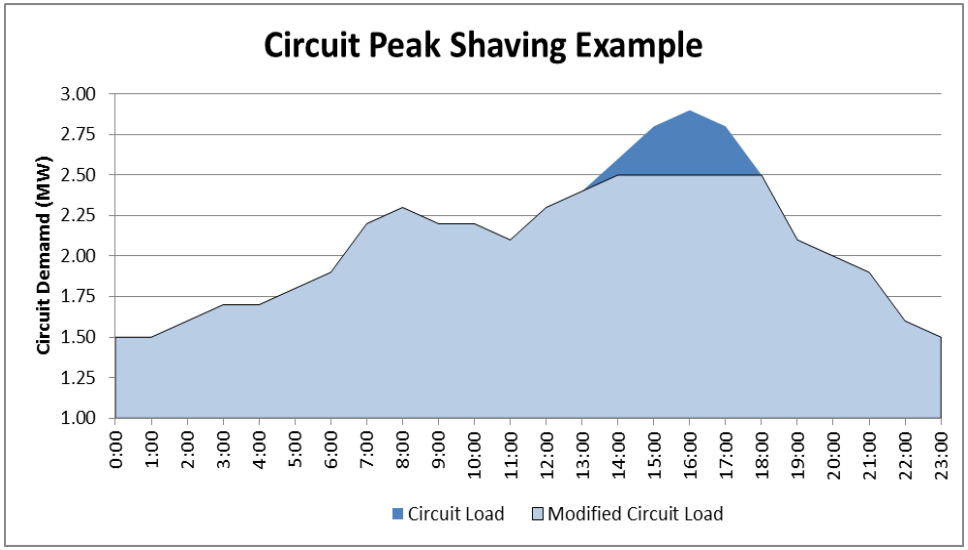


Can hourly dispatch remainder for ancillary services to grid

Some ancillary services do not hinder serving dispatchable load

Microgrid Energy Storage System

- Modes of Operation
  - Constant Charge
  - Constant Discharge
  - Peak Shaving
  - PV Smoothing
  - Load Shifting
  - VAr Control
  - Demand Response
  - Arbitrage



kW	kVAr	kVA
0	500	500
300	400	500
400	300	500
500	0	500
400	-300	500
300	-400	500
0	-500	500
-300	-400	500
-400	-300	500
-500	0	500
-400	300	500
-300	400	500