Hybrid Distributed Energy Resources
What Works and Why

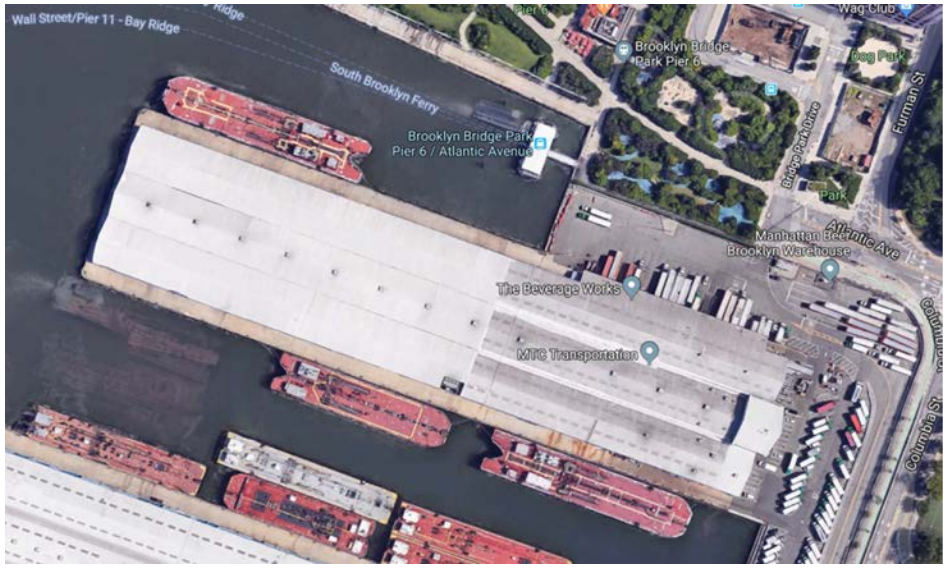
Phoenix Beverage – Industrial CHP Application
Manhattan Beer Distributer

Specific Site Info.

Highlights:

- Cost to run new lines was prohibitive.
- 100% off–grid (independently resilient)
- Avoid 250 diesel trucks on streets; Now the entire fleet runs on CNG (2500+ deliveries per day)
- Pay NGrid Gas 100% (Nothing to ConEd – all self-generating)
- Large roof that can potentially integrate future PV
- $600,000. + and 3,100 tons of CO2 saved annually
- Electricity provides to facility lighting and large forklift recharging station
- Operational 1 day post-Sandy

Thank Goodness!



Tecogen

Discussion Points/Market Trends:

- Many states(and some countries) pushing electrification as “Beneficial Electrification”
  - California & Several Provinces in Canada
- Important to understand the balance
- Better term is “Efficient Electrification” and includes several technologies to maximize efficiency. (CHP, Solar, Fuel Cells, Battery Storage, Etc. in a well controlled system.)
- Identify resource constraints and design a balanced solution that meets load requirements.
  - Multiple efficient technologies can be utilized by recognizing the capacity and practical constraints on each technology and integrating them together into one solution.
- Renewable Only *vs.* Hybrid Approaches.
  - Idealistic or realistic?
- What is the Utilities role?
  - Advocate for customers.
  - Provide market acceleration measures
  - Education and Outreach
- What trends are driving policy/customer behavior?
  - TOU rates, Demand Charges, Departing Load Charges, Incentives, Policy and Utility Tariffs, Etc.
- What is the role of the microgrid?

State	Product	Incentive Name	Valuation
New York	Chiller	ConEd Demand Management Program (DMP)	$550/ton nameplate
	Cogen	ConEd Demand Management Program (DMP)	$650/kW nameplate
	Cogen	NYSERDA PON 2568	roughly $1,430/kW
	Cogen	BQDM Program	matches NYSERDA
	Cogen	ConEd Rider H Gas (DG Rate)	~$0.30/therm decrease on gas
New Jersey	Chiller	Custom Electric Incentive	$0.16/kWh saved in first 12 mo.
	Cogen	NJ Clean Energy SmartStart Incentive	$2,000/kW nameplate
	Cogen	NJ Natural Gas Rate	~$0.25/therm decrease on gas
Maryland	Chiller	Custom Electric Incentive	~$935/ton nameplate
	Cogen	MEA CHP Grant Program	~$550/kW nameplate
	Cogen	BG&E SmartEnergy CHP Incentive	~$350/kW nameplate + $0.07/kWh first 18 mo
	Cogen	PECO / Delmarva Energy CHP Program	$1,200/kW nameplate
Massachusetts	Chiller	Custom Electric Incentive	$0.20-$0.30/kWh offset
	Cogen	MASSSAVE CHP Program	~$0.105/kWh offset first 12 mo
	Cogen	MA APS/REC Credits for CHP Technology	~0.02/kWh offset - paid every year
Connecticut	Chiller	CT Electric Custom Incentive	$300/ton nameplate
	Cogen	Microgrid Grant & Load Programs	Custom
	Cogen	DPUC Connecticut Natural Gas Rates	$0.06/therm delivery on gas
	Cogen	CT-based RECs	~$0.01-$0.025/kWh
D.C.	Cogen	Property Tax Exeption for Solar/CHP	CHP property tax value

BRIGHT POWER

Hybrid DER

Building Energy NYC Conference Panel

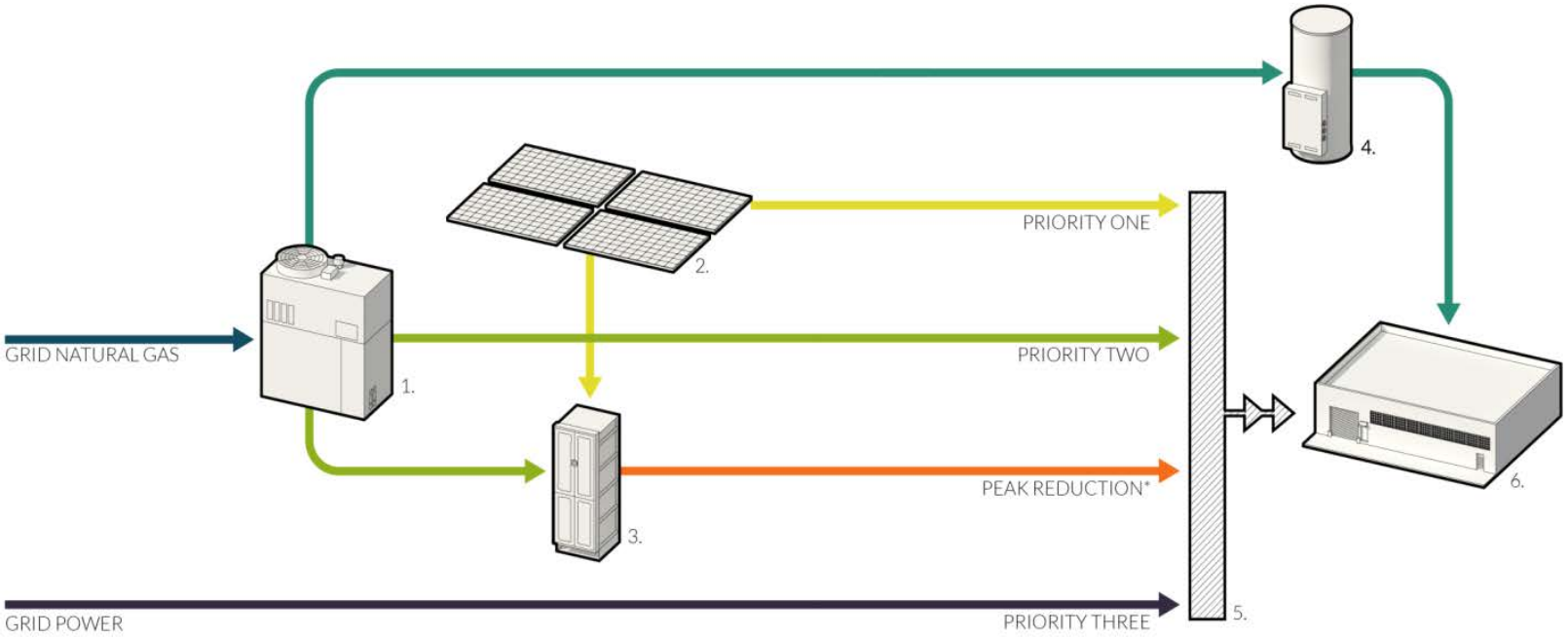
October 3, 2018

Bright Power's Resilient Power Hub

THE RESILIENT POWER HUB SYSTEM

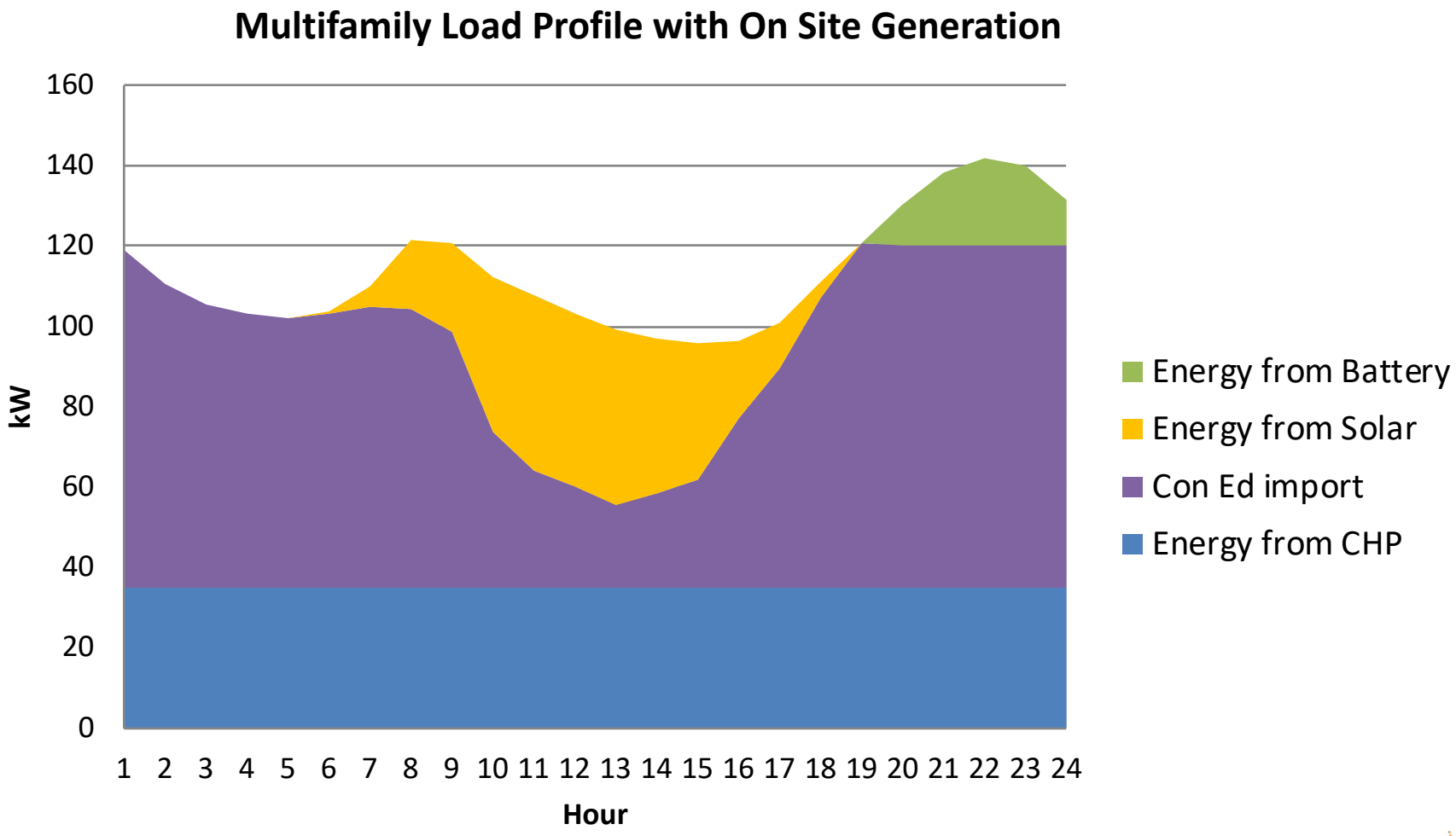
Architectural solutions by thread collective llc.
Product/systems development by Bright Power Inc.

1. **NATURAL GAS CO-GENERATOR**
   10kW m-CHP unit
2. **SOLAR PHOTOVOLTAIC ARRAY**
   58 panels (4 shown) totalling 20kW
3. **ENERGY STORAGE**
   40kWh battery tower stack
4. **HOT WATER TANK**
   stores waste heat from m-CHP unit
5. **SMART CONTROL SYSTEM**
   monitors and maintains system performance
6. **CORE BUILDING SYSTEMS**
   kept online during grid failure



*In grid-connected scenarios the battery is discharged during times of peak demand on the energy grid, reducing energy costs for the building.

Solar PV + Cogen + Storage: How it Works



172nd Street Resilient Power Hub

LOGICAL BUILDINGS

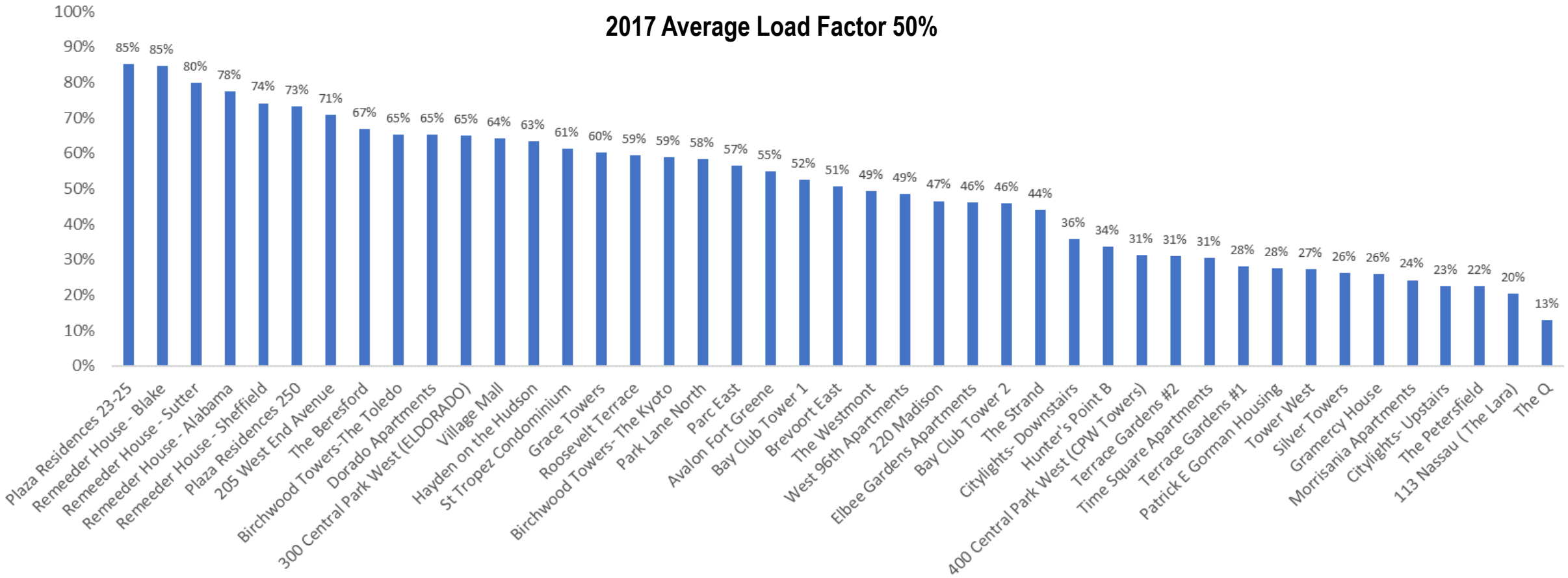
Building Energy NYC Hybrid DER

DER Dispatch Monetization Opportunities
Increasing Sustainability and Resiliency

October 4, 2018

Solving CHP Load Factor Limitations

Many factors can contribute to low load factor such as utility export buffer limits, thermal load limits, prioritization of resiliency or redundancy

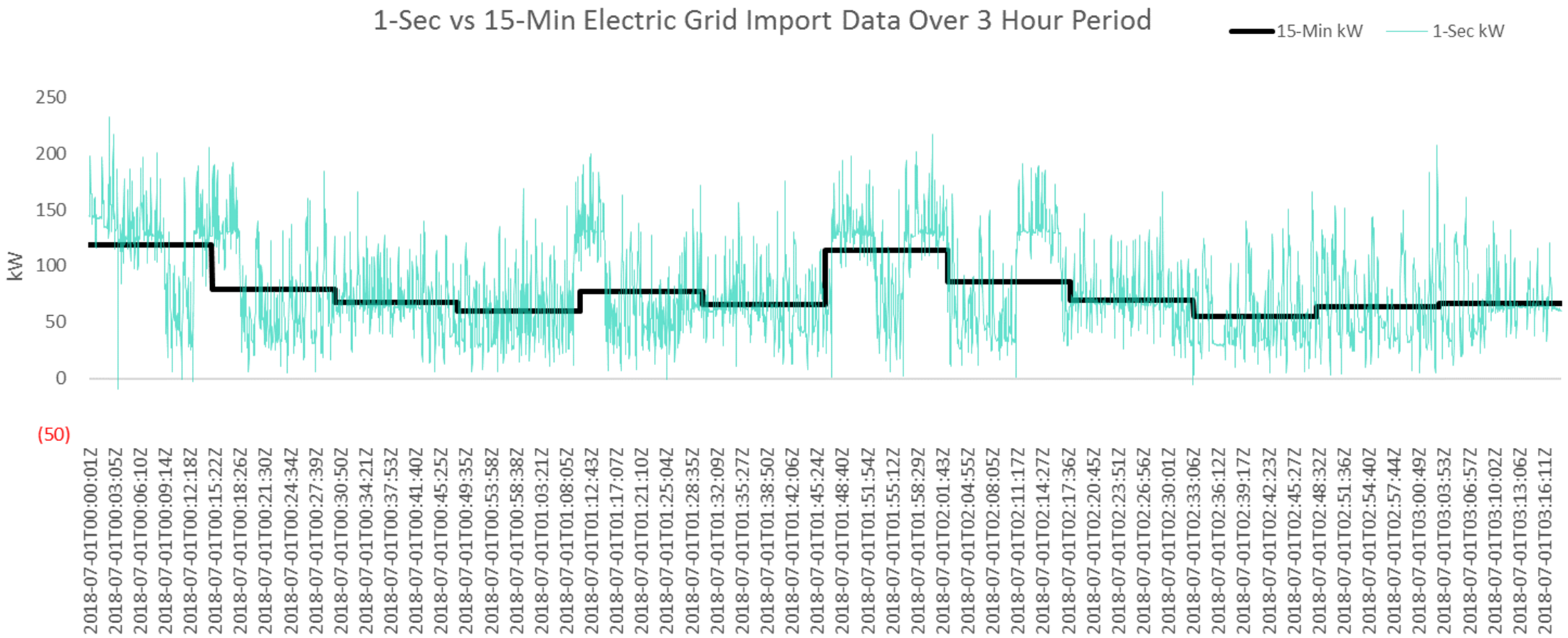


2017 Load Factor of CHP Systems in Multifamily Properties (NYSERDA DG Integrated Data System)

Utilizing the available CHP kW output data for 72 Multifamily + Hotel properties (CHP capacity below 1 MW)

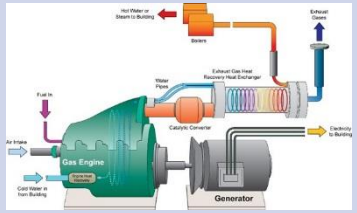
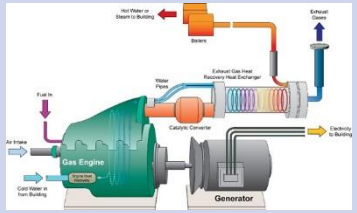
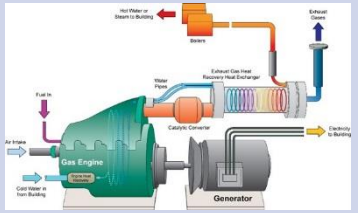
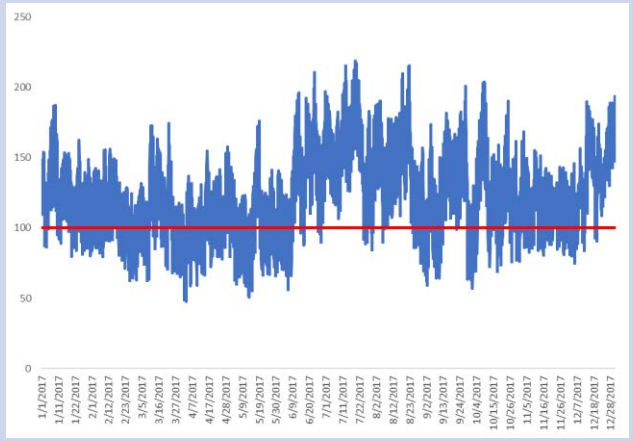
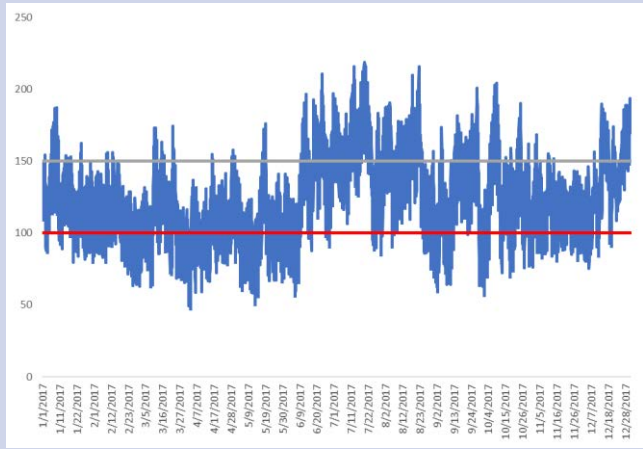
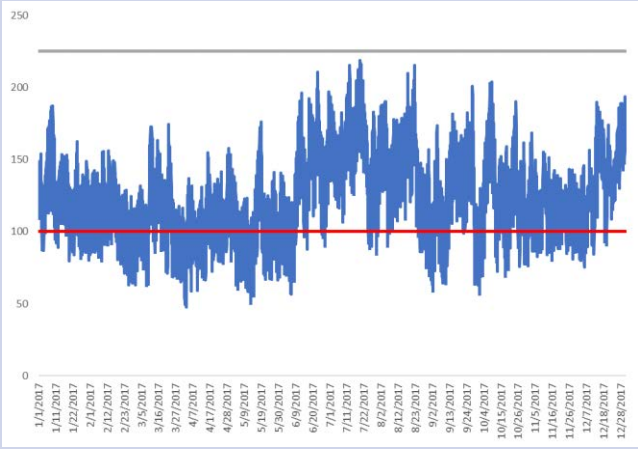
The Grid Edge Hybrid DER Value Opportunities:

Data transparency generates opportunities to integrate/optimize Hybrid DER resources to balance building's unique load profile - lowering costs, generating revenue, increasing resiliency.



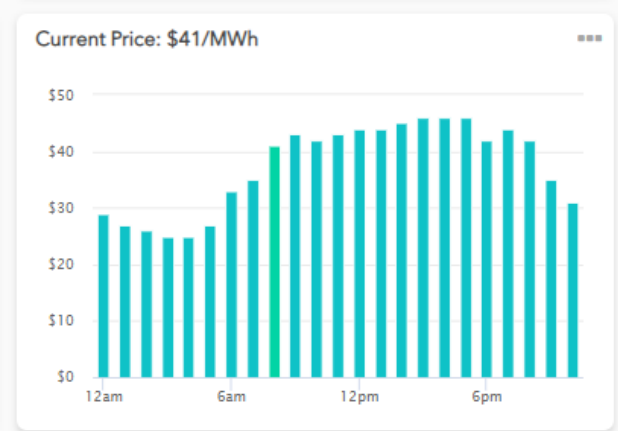
The Grid Edge: Electricity Consumption is Extremely Volatile When View at Second Level Granularity (as opposed to 15-min)

CHP + Battery Scenarios = Hybrid DER Dispatch Monetization Opportunity

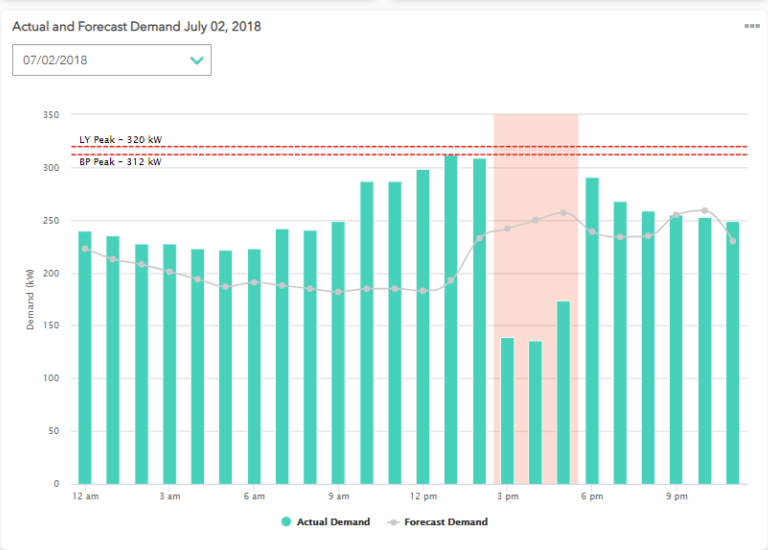
CHP Standalone	CHP + Battery Sized to Increase CHP Utilization Rates	CHP + Battery Sized to Full Stack Value
100kW CHP 	100kW CHP  + 50kW Battery 	100kW CHP  + 125kW Battery 
CHP Utilization 40%-80%	CHP runs closer to 100% as Battery charges from Backfeed	▪ CHP runs closer to 100% as Battery charges from Backfeed ▪ Battery peak shaves daily, discharges during Demand Response, CHP Maintenance, CHP thermally constrained
 100kW CHP	 50kW Battery 100kW CHP	 125kW Battery 100kW CHP

Dispatching Hybrid DER to Achieve "Full Stack" Value – Integrating CHP, Battery Storage, Intelligent Controls, and Predictive Analytics/AI

On/Off Peak Price Spread



Peak Demand Management



Demand Response / ICAP Reduction

Hybrid DER Case Study – Demonstrate CHP + Battery Sized to Full Stack Value

Goal: Integrate a battery storage system Behind the Meter with a 2x100kW CHP system in order to increase CHP utilization

Problem: CHP system utilization is limited because high frequency data reveals incidental exports to grid

Value Stack of a 125 kW / 243 kWh battery installation

- Stabilize load at the building through high frequency charge/discharge cycling in order to increase capacity of existing 200kW CHP system
- Peak Shaving Cost Reduction and Demand Response Revenue
- Resiliency - enhance backup power capacity
- Sustainability - reduce GHG emissions

The optimal size of the battery is dependent on the relationship between the size of the CHP system, base building load and the export buffer

The battery can perform multiple functions by adjusting its charge/discharge algorithm and targeting a certain level of charge.

Current Hybrid DER Dispatch Program: CHP Strategic Load Managment, Intelligent Controls, Predictive Analytics/AI, Con Edison/NYISO Demand Response Participation

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