Resilient Sustainable Power

Energy Storage Project

www.GridEnergy.direct

Overview

- GRID MODERNIZATION
- GEORGETOWN UNIVERSITY VOLTAGE FLUCTUATIONS: CHALLENGE & OPPORTUNITY
- QUESTIONS & OPTIONS
- ENERGY STORAGE AS AN INDUSTRY
- RESILIENCE
- SUSTAINABILTY

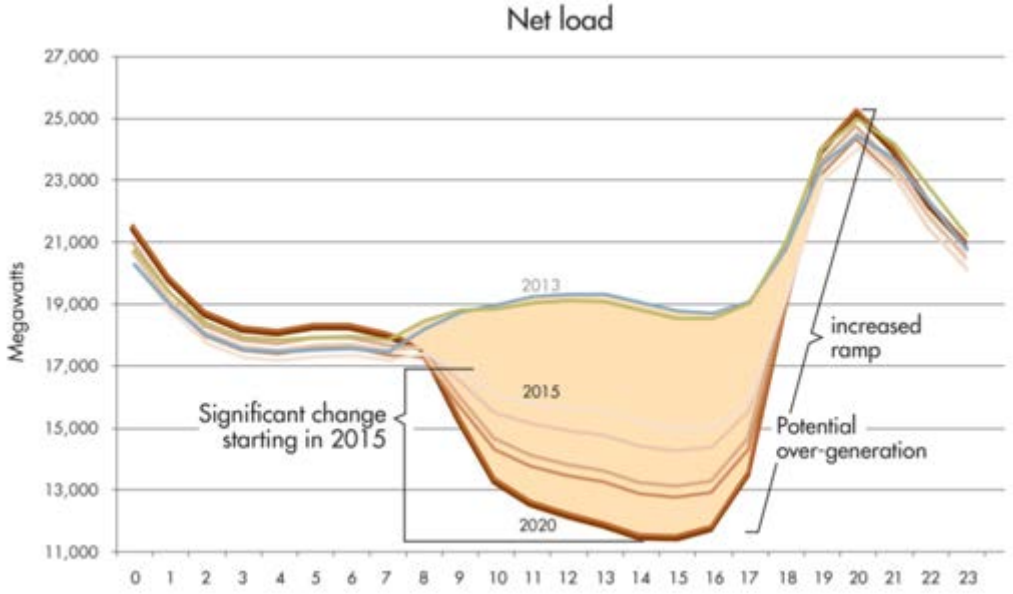
Grid Modernization

Distributed Energy Generation and Storage

- Facilitate two way voltage flows
- Utility scale & Behind the Meter
- Aggregation and dispatch
- Reduce transmission losses
- Reduce peak generation
- Reduce congestion, increase resilience

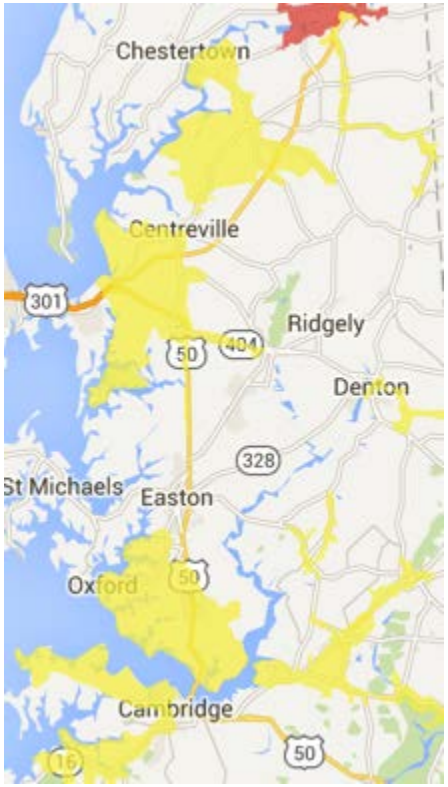
Limits on Renewable Energy Penetration:

The California "Duck Curve"



Limits on Renewable Energy Penetration:

PHI Restricted Circuits



Grid Modernization

DC Public Services Commission

- 1130 Proceeding on Grid Modernization

"to identify technologies and policies that can modernize our energy delivery system for increased sustainability and will make our system more reliable, efficient, cost-effective and interactive."

-DC PSC 1130

Opportunity to present Georgetown University energy storage project as pilot under 1130 for accelerated rule making, compensation model innovation with PEPCO.

PUBLIC SERVICE COMMISSION of the District of Columbia

Grid Modernization

Energy Storage

- New compensation models
- Declining price points (50% in last 5 years
- Mature chemistries
- More diversity in power and energy ratios

Voltage Fluctuations

Challenge

- Feeder switches
- Total power loss during 5-8 second switching sequence
- Bridge to Black Start

Georgetown University Voltage Fluctuations

Opportunity: Energy Storage

- Alleviate University voltage fluctuations
- Create new revenue source
- Make University a ‘net exporter’ of resilience in the DC grid, contributing to the health and competitiveness of the city’s infrastructure
- Enable further penetration of renewable energy in the PJM grid territory

Solution

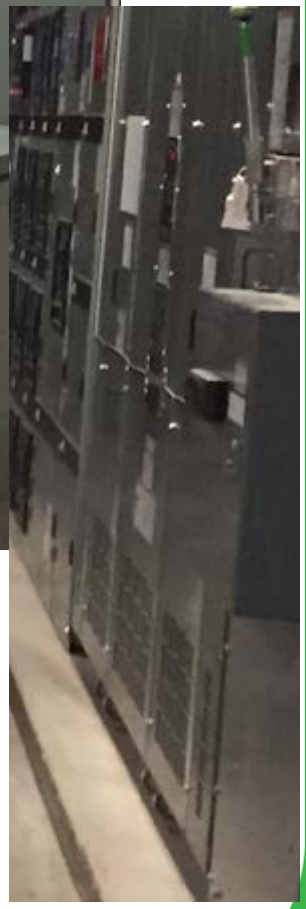
Overview

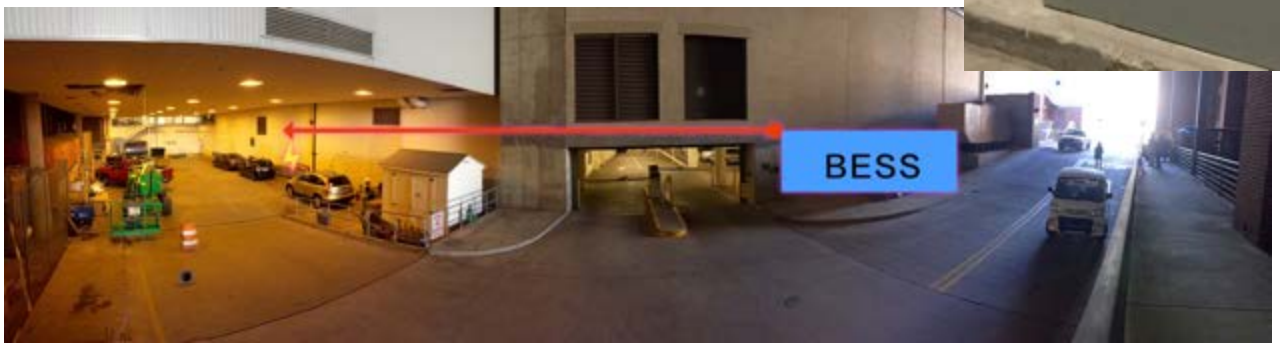
- Lithium Ion energy storage system
- Frequency regulation and voltage support
- Inverters that rapidly switch between use cases
- Energy storage system controlled/monitored/dispatched by remote software platform, integrated to PJM REG D market
- 20-30 millisecond response time. 30 minute discharge.
- Support for:
  - Bridge to Black Start
  - 30 minute back up power
  - Contribution to PLC Management
  - Contribution to Economic Capacity Market
  - Contribution to Synchronized Reserves Market
  - Contribution to Emergency Capacity Market participation
- Energy storage system as foundation for larger microgrid capability.

Solution

Technical

- SAFT 1.6 MW BESS (950 kwh)
  - With IM+20M container
  - 17 racks
- ABB 1.6 MVA PCS100 inverter and 480V AC output.
- Viridity software platform/PJM
- External container, pad mounted, wall surface cabling, with full monitoring, security, fire suppression.



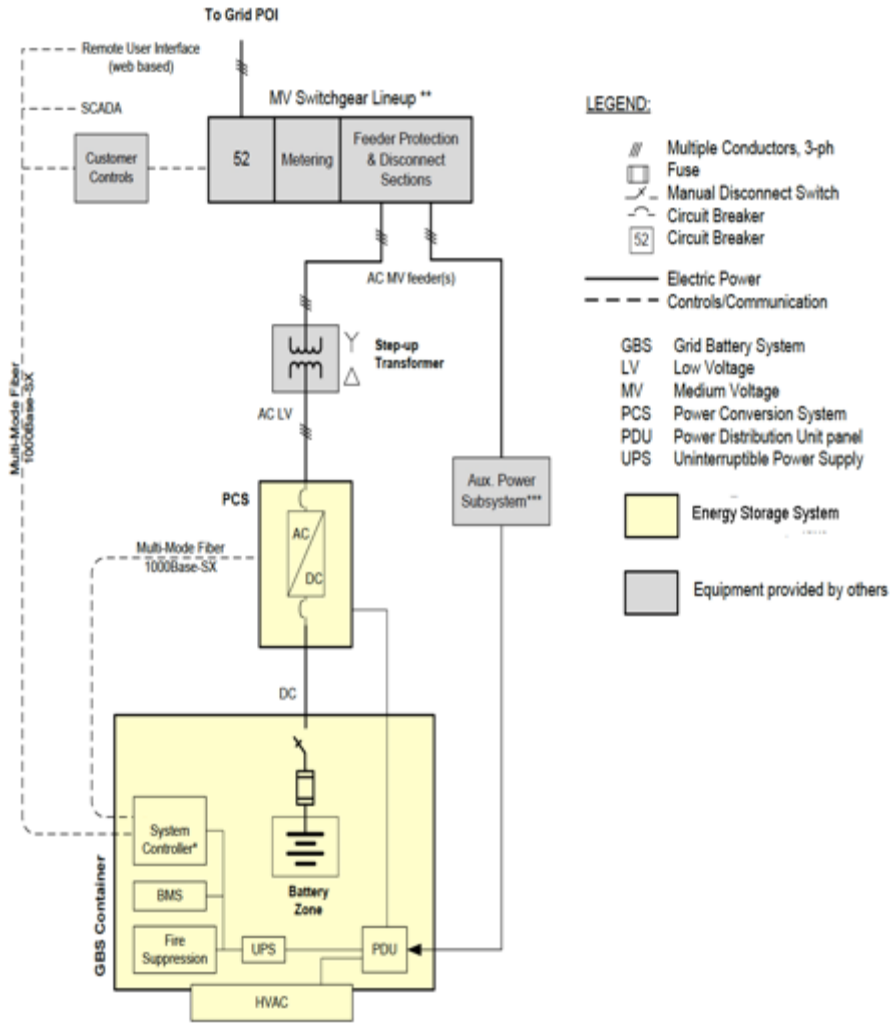


Solution
Containerized Battery

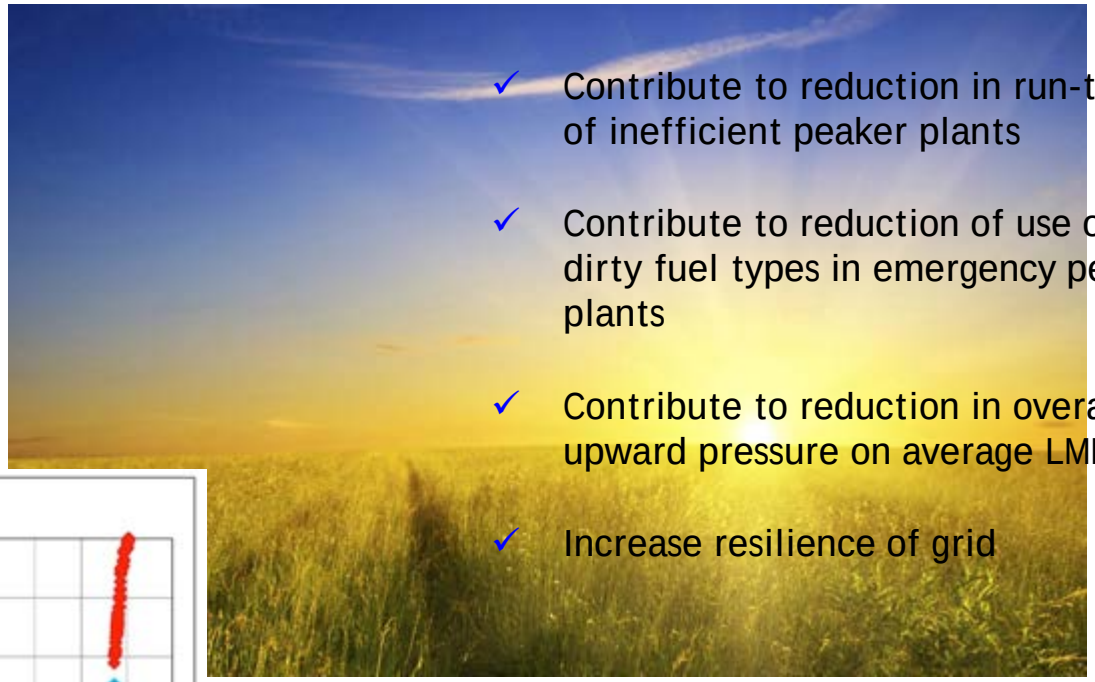
- Standard shipping container, retrofitted with battery stacks, distribution cabinet, inverters.
- Independent security, monitoring, fire suppression.
- French company, manufactured in Jacksonville, Florida at factory established with collaborative funding from US Department of Energy

Solution

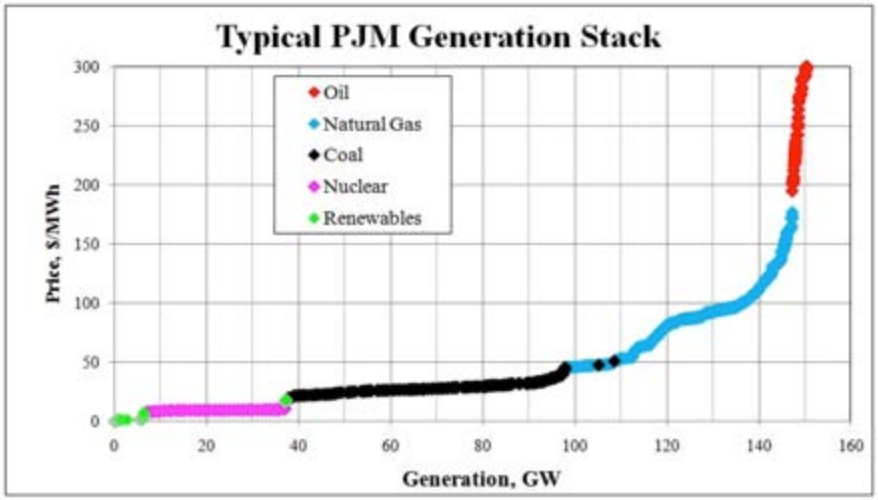
Schematic



Sustainability



- ✓ Contribute to reduction in run-times of inefficient peaker plants
- ✓ Contribute to reduction of use of dirty fuel types in emergency peaker plants
- ✓ Contribute to reduction in overall upward pressure on average LMP
- ✓ Increase resilience of grid



Phase I/Regent Hall Energy Storage Solution would reduce GHG & other airborne pollutants by 1.2 million pounds.

Sustainability

Emission Reduction

Environmental Impact (per EPA)											
lbs of CO2/MWH	1,800.00	1,800.00	1,800.00	1,800.00	1,800.00	1,800.00	1,800.00	1,800.00	1,800.00	1,800.00	
lbs of Nox/MWH	49.62	49.62	49.62	49.62	49.62	49.62	49.62	49.62	49.62	49.62	
lbs of SOx/MWH	10,848.87	10,848.87	10,848.87	10,848.87	10,848.87	10,848.87	10,848.87	10,848.87	10,848.87	10,848.87	
lbs/benzene/MWH	26.48	26.48	26.48	26.48	26.48	26.48	26.48	26.48	26.48	26.48	
lbs/Toluene/MWH	9.59	9.59	9.59	9.59	9.59	9.59	9.59	9.59	9.59	9.59	
lbs/Xylenes/MWH	6.59	6.59	6.59	6.59	6.59	6.59	6.59	6.59	6.59	6.59	
lbs/Propylene/MWH	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	9.52	
lbs/Formaldehyde/MWH	26.92	26.92	26.92	26.92	26.92	26.92	26.92	26.92	26.92	26.92	
lbs/Acetaldehyde/MWH	8.60	8.60	8.60	8.60	8.60	8.60	8.60	8.60	8.60	8.60	
lbs/Acrolein/MWH	26.89	26.89	26.89	26.89	26.89	26.89	26.89	26.89	26.89	26.89	
Avoided MWH from Peak Shaving	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	*10*	
NET IMPACT	***128,131***	***128,131***	***128,131***	***128,131***	***128,131***	***128,131***	***128,131***	***128,131***	***128,131***	***128,131***	**1,281,307**

(Total lbs Avoided GHG & Other Airborne Pollutants)

http://www.epa.gov/ttnchie1/ap42/ch03/final/c03s04.pdf

REFERENCE

Questions & Options

- Stability of Frequency Regulation Market
- Providing voltage support for full voltage loss inside of two cycles of electricity (30 MS) requires modeling Feeder switching sequence
- Providing voltage support to both AC buses, each fed by separate feeder, requires:

Energy Storage

Economics

- Multiple Use cases
- New compensation models
- Declining price points (50% in last 5 years)

Ancillary Services

Enhance ability to participate in new revenue generating activities: economic capacity, synchronized reserves, frequency regulation.

Demand Charges

Manage RTO and utility demand charges by reducing peak use at forecast times.

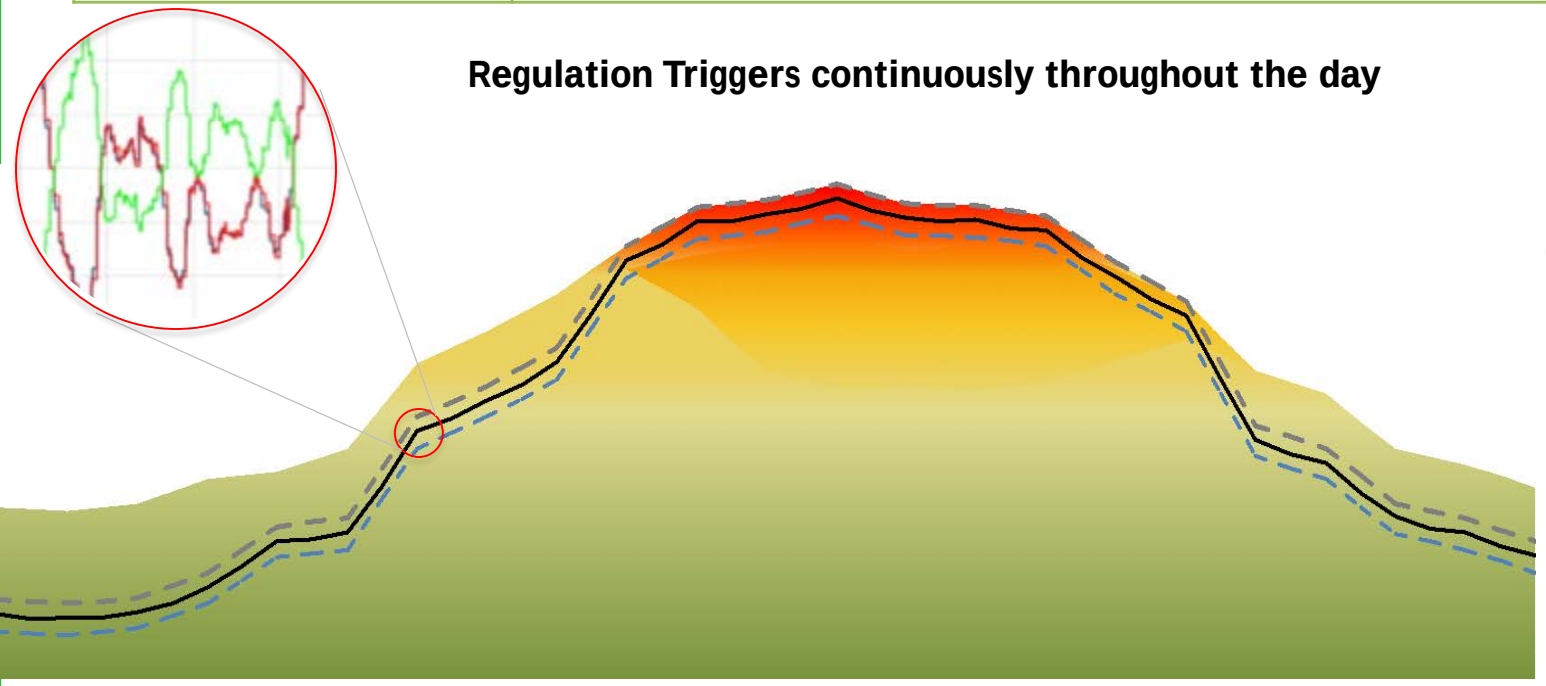
"Batteries that let large users lower their reliance on the most expensive electricity threaten to cripple sales for U.S. independent power producers and utilities…[T]echnological disruption and paradigm shift is precisely why states should avoid mandating capacity purchases by load, particularly on a three-year forward basis, as such government-mandated forward procurements rob customers of the benefits and savings from innovation, and only aid incumbent industry participants. – Bloomberg, September 24, 2015

PJM Frequency Regulation

High Frequency, Fast, Automated, Voluntary Response Program

Successful Customer Type	**Those with qualifying energy load or equipment that are able to reduce or increase power usage with little notification time**
Program Trigger	Grid balance and reliability (continuous response to 2-4 second signal)
Program Frequency	Participation frequency based on voluntary bid. Continuous opportunities 24 hours a day
Payment Structure	Payments based on voluntary bid acceptance (with pay for performance based on speed of response)

Regulation Triggers continuously throughout the day



PJM Frequency Regulation Scoring

Fast Ramping Resource

- Market structure aligns compensation with actual performance for resources that provide regulation service, favoring storage and other fast-ramp technologies
  - ✓ New PJM regulation pricing model: ~$34 / MW / hour
  - ✓ Prior PJM regulation pricing model: ~$15 / MW / hour
- August PJM Members meeting