Energy Storage: Is it Right for Your Building?

Better Buildings Summit

Wednesday, May 11, 2016

Introduction and Agenda

- Session Objectives:
  - Provide update on the Better Buildings Alliance's Renewables Integration Team
  - Discuss energy storage and hear case implementation case studies
- Agenda
  - Introduction – Jay Paidipati, Navigant Consulting
  - Stephen Kelly, Green Charge Networks
  - Greg Farley, Chesapeake College
  - Q&A Discussion

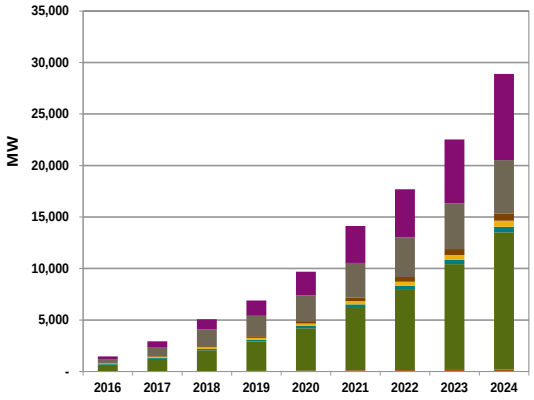
Why Energy Storage Now?

Industry changes are driving demand for energy storage, while policy, technology, and cost advances are making it a more attractive option.

Strong Demand for Energy Storage

- Increasing Intermittent Renewable Generation
- Increased Customer Expectations and Engagement
- Aging Infrastructure
- Utility Transformation from Centralized to Networked Grid

Increased Energy Storage Adoption



Increased Performance at a Decreased Price

- Policy Initiatives
- Technology Performance Advancements
- Technology Demonstration Validations
- Cost Reductions

What Can Energy Storage Do for You?

Energy storage has many applications, but only a few are relevant to commercial and institutional buildings.

Electricity Cost Optimization

- **Peak/Off-Peak Price Management**
- **Demand and Power Factor Charge Management**
- **Renewable Energy Shifting**

Capacity

- Generation Resource Adequacy (e.g., capacity markets, capacity contracts, operating reserves, demand response programs)
- T&D Infrastructure Adequacy

Routine Grid Operations

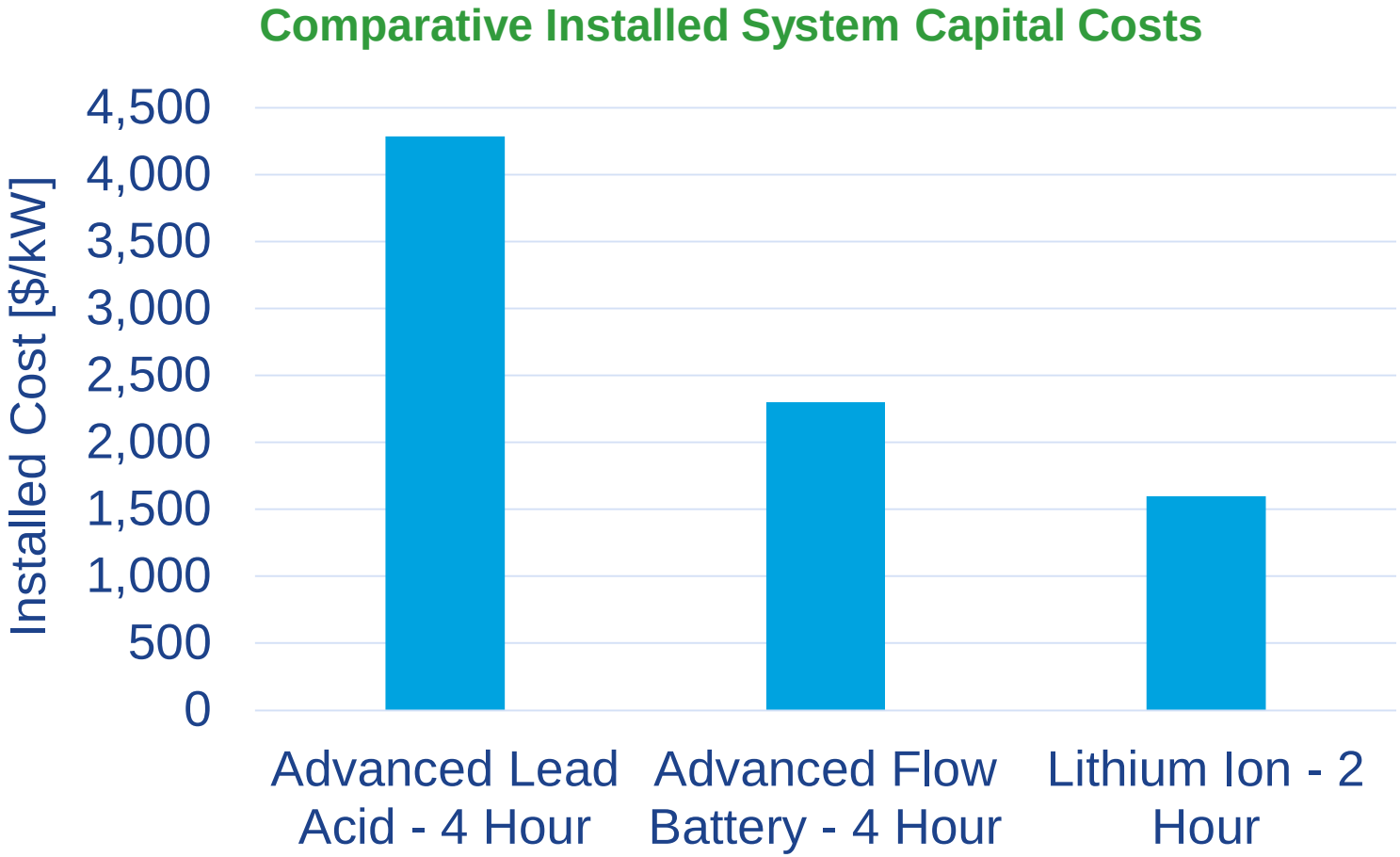
- Frequency Regulation
- Voltage/VAR Support
- Renewable Energy Ramping
- Renewable Energy Smoothing

Contingency Situations

- Black Start
- **Sustained Outages**
- **Momentary Outages**

Costs

There is significant variability in installed cost by technology and by application.



Source: Navigant Research, Q1 2016

Technology Options

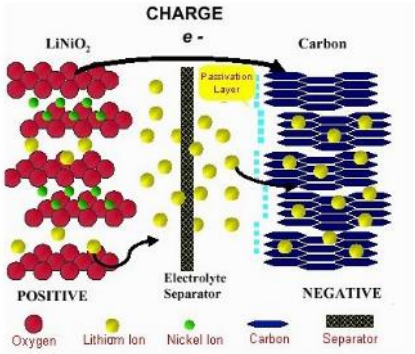
Electrical energy storage comes in many forms and only some of them are practical for commercial and institutional buildings.

Mechanical

Source: Beacon Power

- Pumped Hydro Storage (PHS)
- Compressed Air Energy Storage (CAES)
- Flywheel

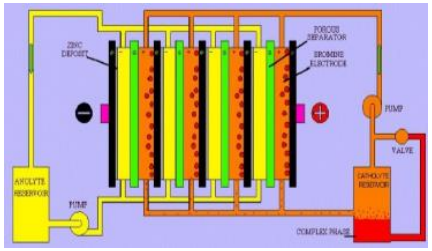
Batteries



Source: SAFT

- Lead Acid
- Advanced Lead Acid
- Zinc Air
- Sodium Sulfur
- Sodium Metal Halide
- Sodium Ion
- Lithium - Ion

Flow Batteries



Source: www.ZBBenergy.com

- Zinc Bromine
- Vanadium Redox
- Iron Chromium
- Other

Other

Source: www.smartgrid.gov

Thermal
- Ice Based
- Thermal Molten Salt

Power To Gas
- Hydrogen
- Synthetic Natural Gas

Capacitors
- electric double-layer capacitors, or "supercapacitors" or "ultracapacitors"

Business Model Options

Business models are still evolving, with the most typical options shown below.

Storage Developer - Offers	System Ownership
Shared Savings Model	Third-Party Owner (TPO)
Sale/Lease + Host Control	Host Owned
Utility Procurements	Third-Party Owner (TPO) Utility-controlled
Sale/Lease + Utility Tariff Rate	Host Owned Utility-controlled

- Due to differences in tax treatment for owned assets vs. leased assets, some businesses may prefer an operational lease instead of a capital lease.
- Many customers prefer TPO owned systems for other reasons, including ease of financing, and operation and maintenance services.
- Utilities are willing to offer special tariffs and pay for systems if they are allowed to control them and able to use them for investment deferrals and during emergencies.

Stephen Kelley, Green Charge Networks

U.S. DEPARTMENT OF ENERGY

Energy Storage

Energy Storage and Commercial Buildings

Steve Kelley
SVP Sales
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www.greencharge.net

greencharge networks

- Largest provider of commercial energy storage (50+ MWh of contracted/operational projects)
- Proven track record of savings
- Founded in 2009
- Non-recourse project financing for equipment & construction
- Headquartered in Santa Clara, CA with offices in New York & San Diego

ENVIRONMENTAL LEADER PRODUCT OF THE YEAR 2015

ENERGY STORAGE NORTH AMERICA GOLD AWARD 2014 & 2015

GREENTECH MEDIA'S GRID EDGE 20 2015

STEVIE'S AMERICAN BUSINESS AWARDS FINALIST 2015

PLATTS GLOBAL ENERGY AWARDS FINALIST 2015

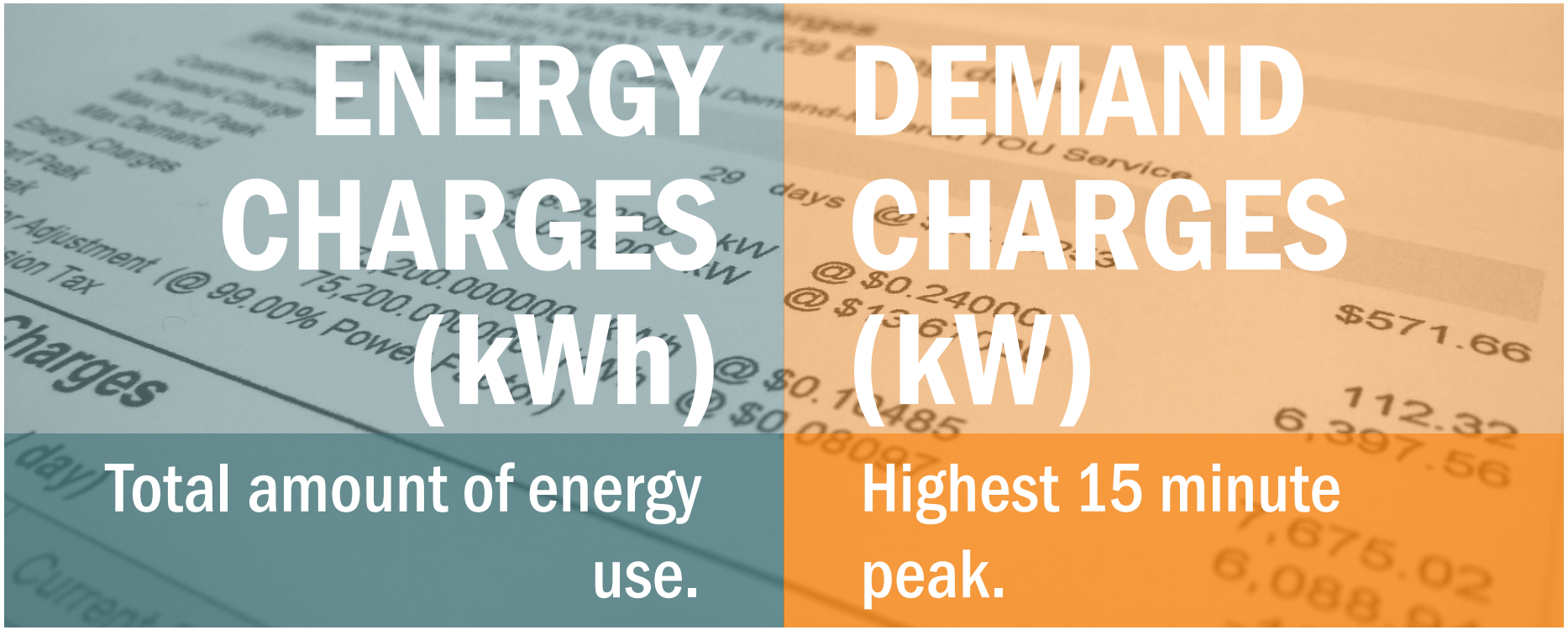
FIERCE INNOVATION AWARD WINNER 2015

SMART GRID NEWS TOP 15 COMPANIES FINALIST 2015

GLOBAL CLEANTECH TOP 100 COMPANY 2015

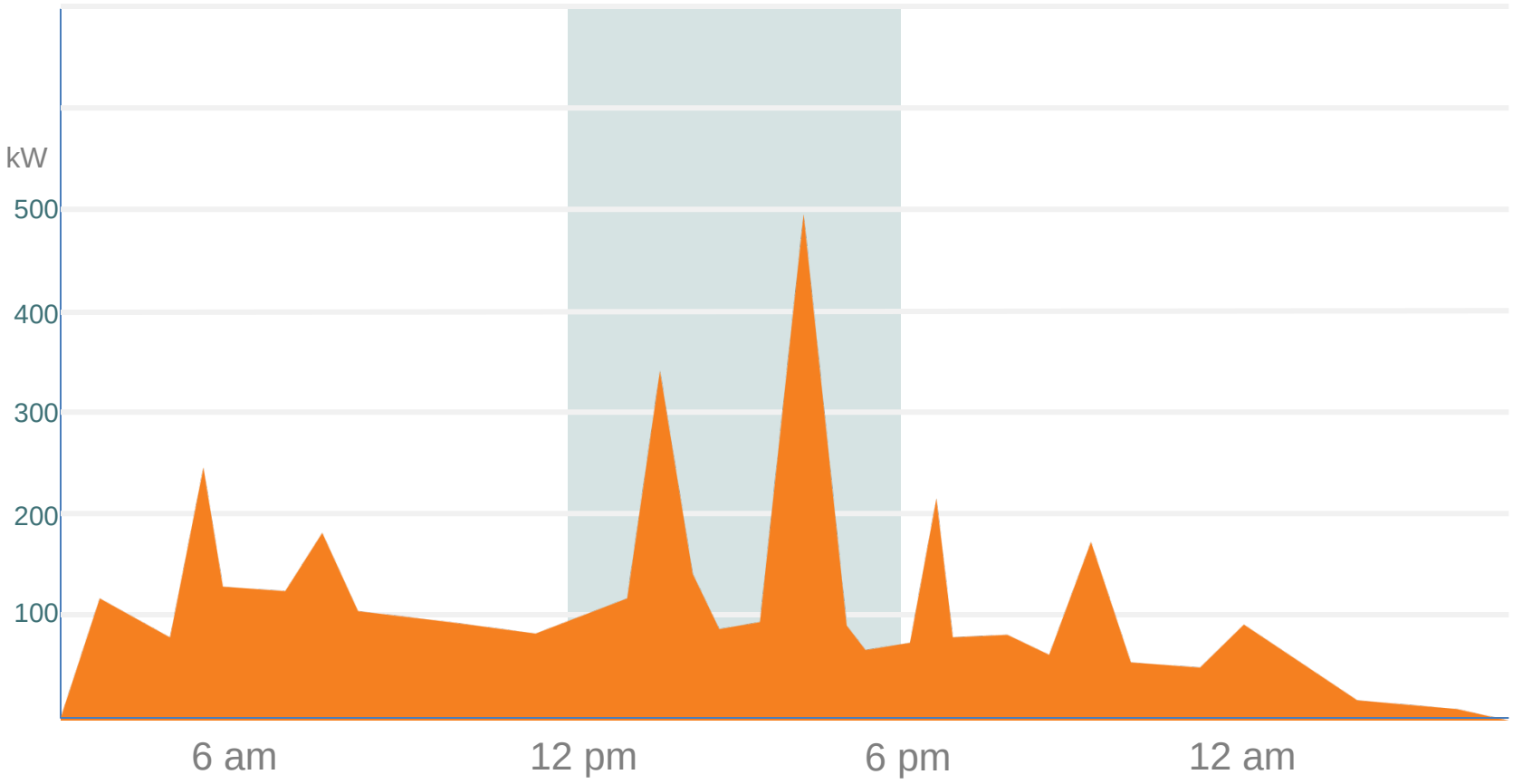
Sample Customers & Partners

Two Components of Commercial Utility Bills

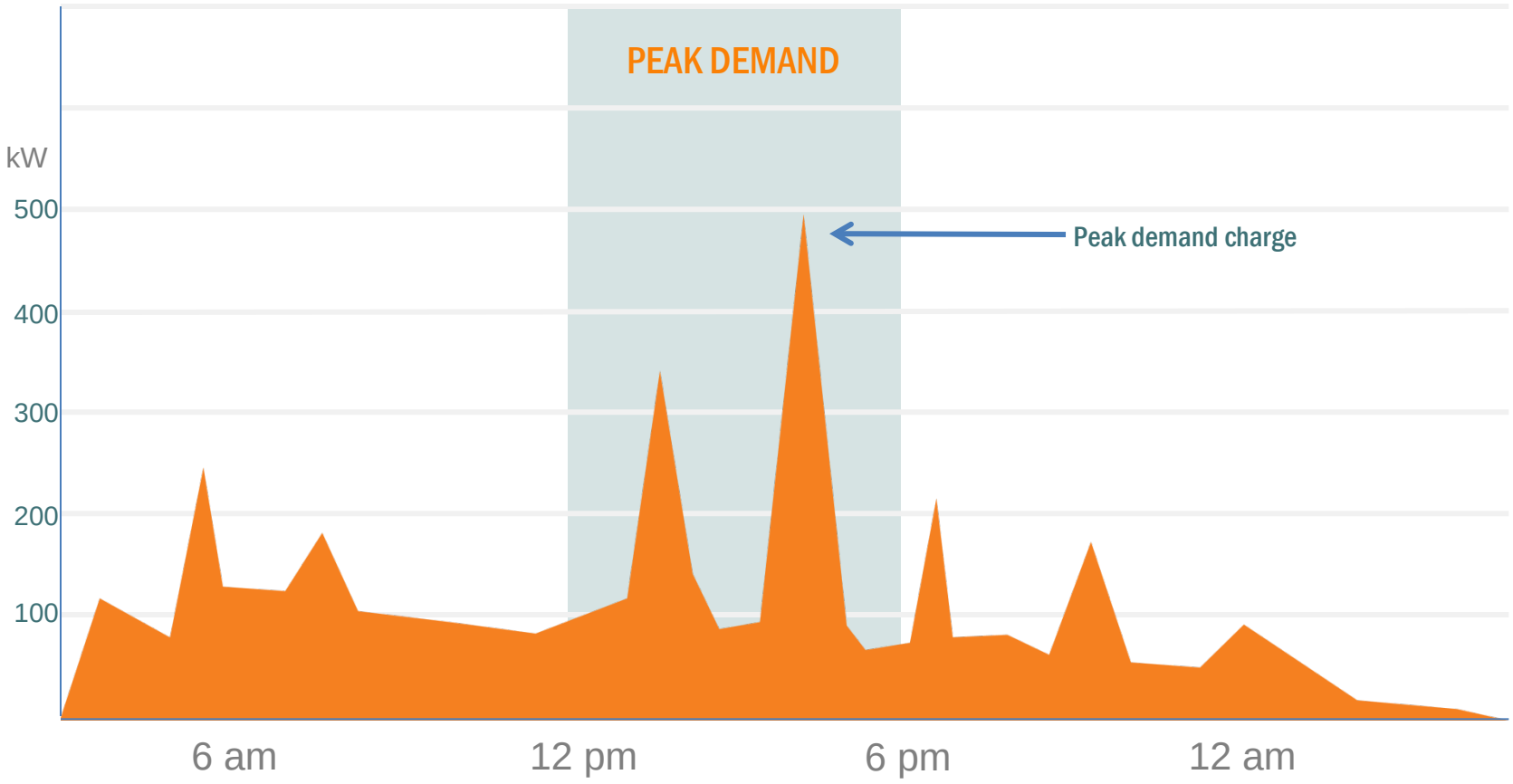


Demand Charges can account for over 50% of an electric bill.

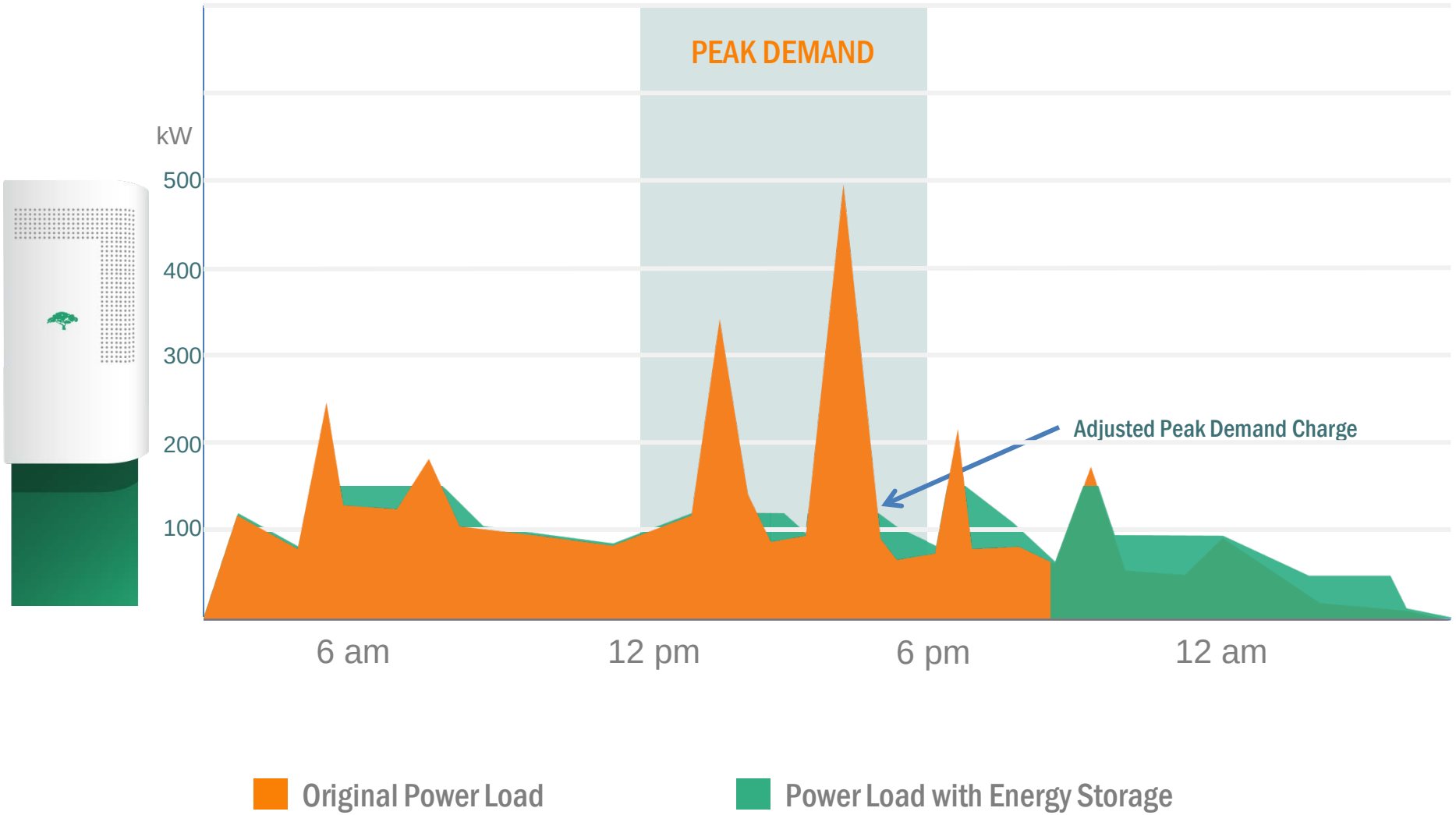
Energy – Measured in KWh



Peak Demand Charges - KW



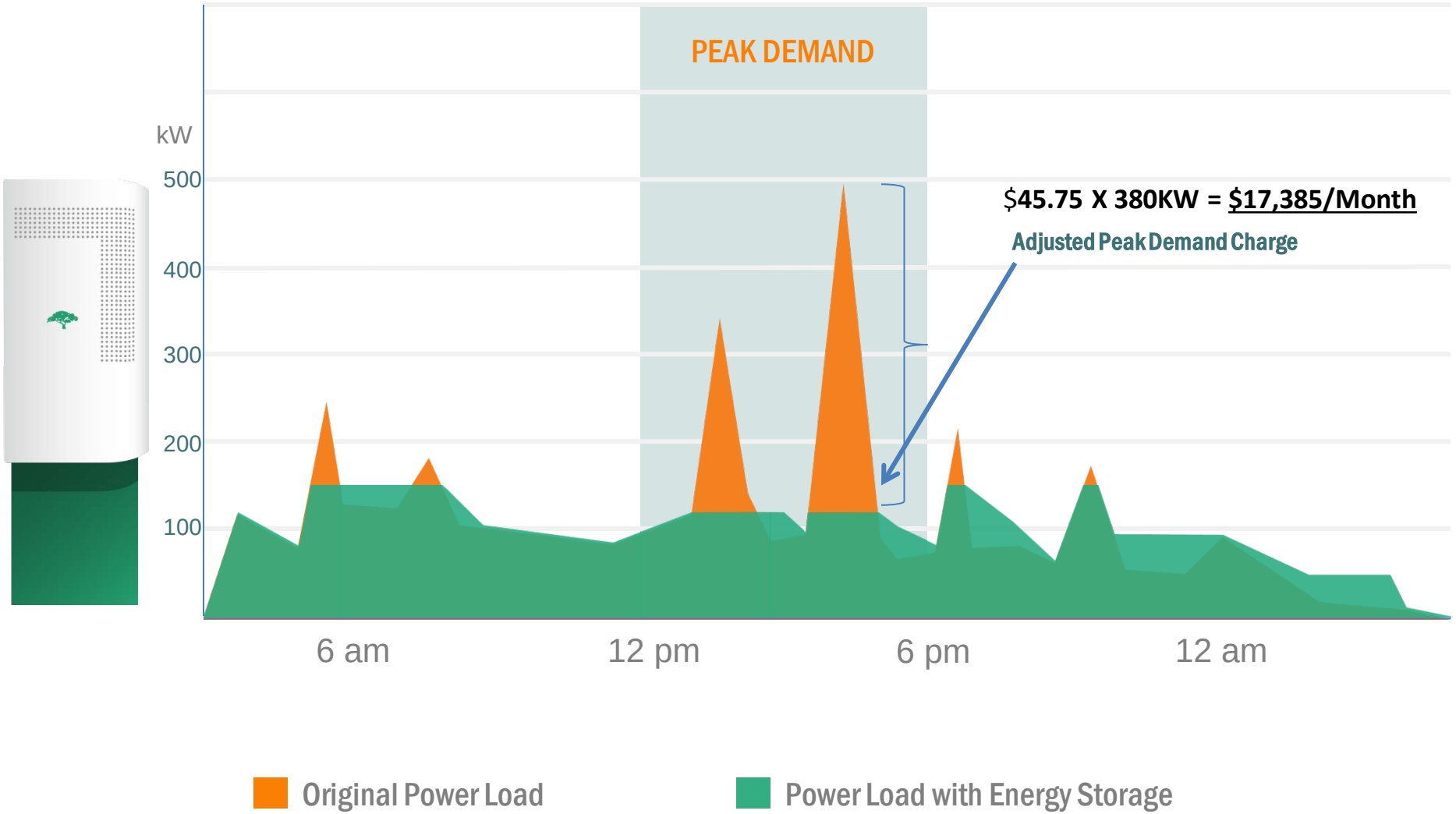
Save On Demand Charges



Year	Southern California Edison	PG&E	SDG&E	
2005	$23.30	$16.10	$16.19	Cost Per kW
2006	$26.62	$22.07	$18.65	
2007	$25.43	$22.13	$15.42	
2008	$26.11	$18.28	$21.31	
2009	$28.16	$21.13	$25.38	
2010	$29.22	$21.43	$24.75	
2011	$27.40	$21.31	$28.02	
2012	$28.10	$26.19	$30.68	
2013	$33.14	$28.40	$35.68	
2014	$38.14	$30.96	$41.87	
2015	$43.14	$36.46	$45.75	
Avg. Year Over Year Increase '05 – '15	7.7%	11.5%	16.6%	

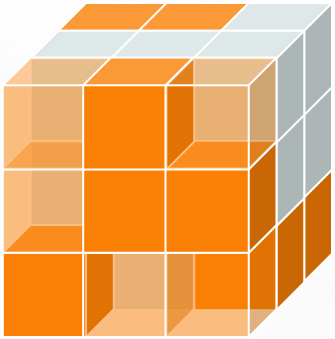
SDG&E demand charges have gone up 180% over the past decade and 49% over just the last three years!

Save On Demand Charges

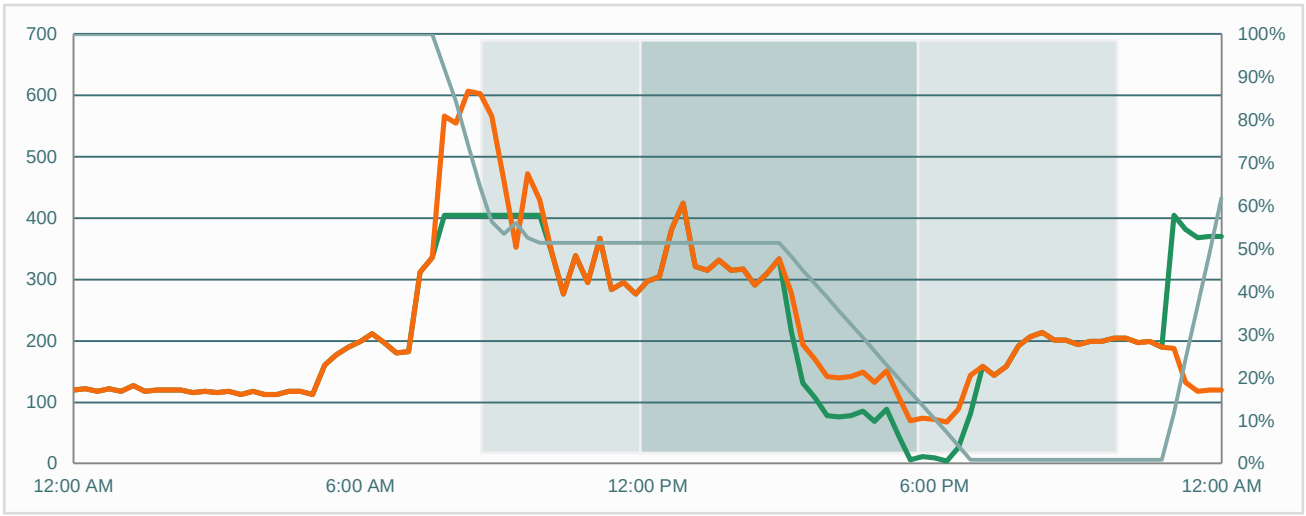


VALUE STREAMS

- Demand Savings
- Tariff Optimization
- Energy Arbitrage
- Demand Response
- Wholesale Market*



*Future Upside

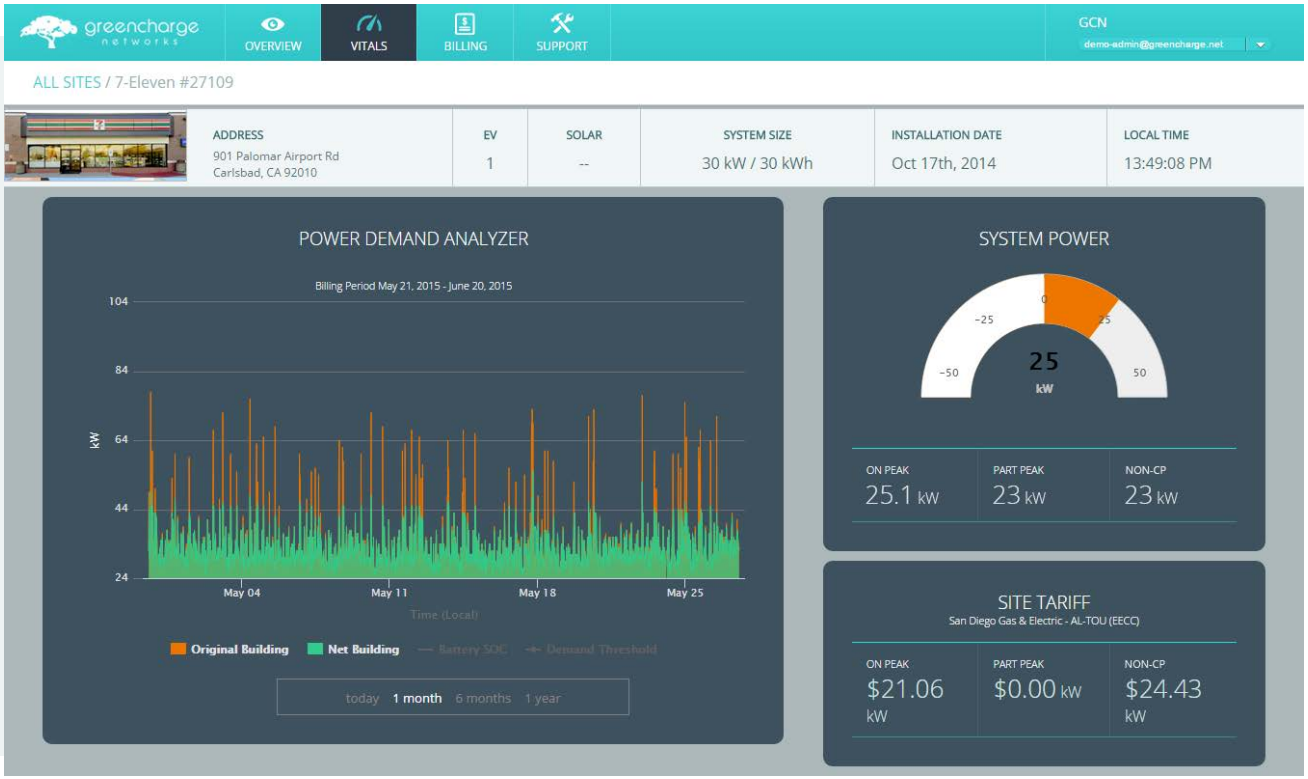


The GridSynergy Software Platform Optimizes Across Multiple Revenue Streams to Maximize Benefits

(2.7MW / 5.4MWh across 17 sites in the school district)

Demand	Tariff	Energy	Demand Response	Annual Total Benefit
$207,908	$144,997	$81,355	$42,660	**$476,920**
44%	31%	17%	9%	-

Intelligent software automatically responds to peaks in demand by learning a facility's energy use patterns.



- 200,000+ operational hours
- 5 years of proven savings
- Scalable software platform
- Easily measure and communicate energy performance and savings

- Leverage data to identify additional energy savings
  - Transit schedules, usage patterns
- Additional Utility service revenue
  - Demand response
  - Utility services

Energy Storage Solution – Hardware

Flexible and proven hardware options designed to perform optimally in various environments.

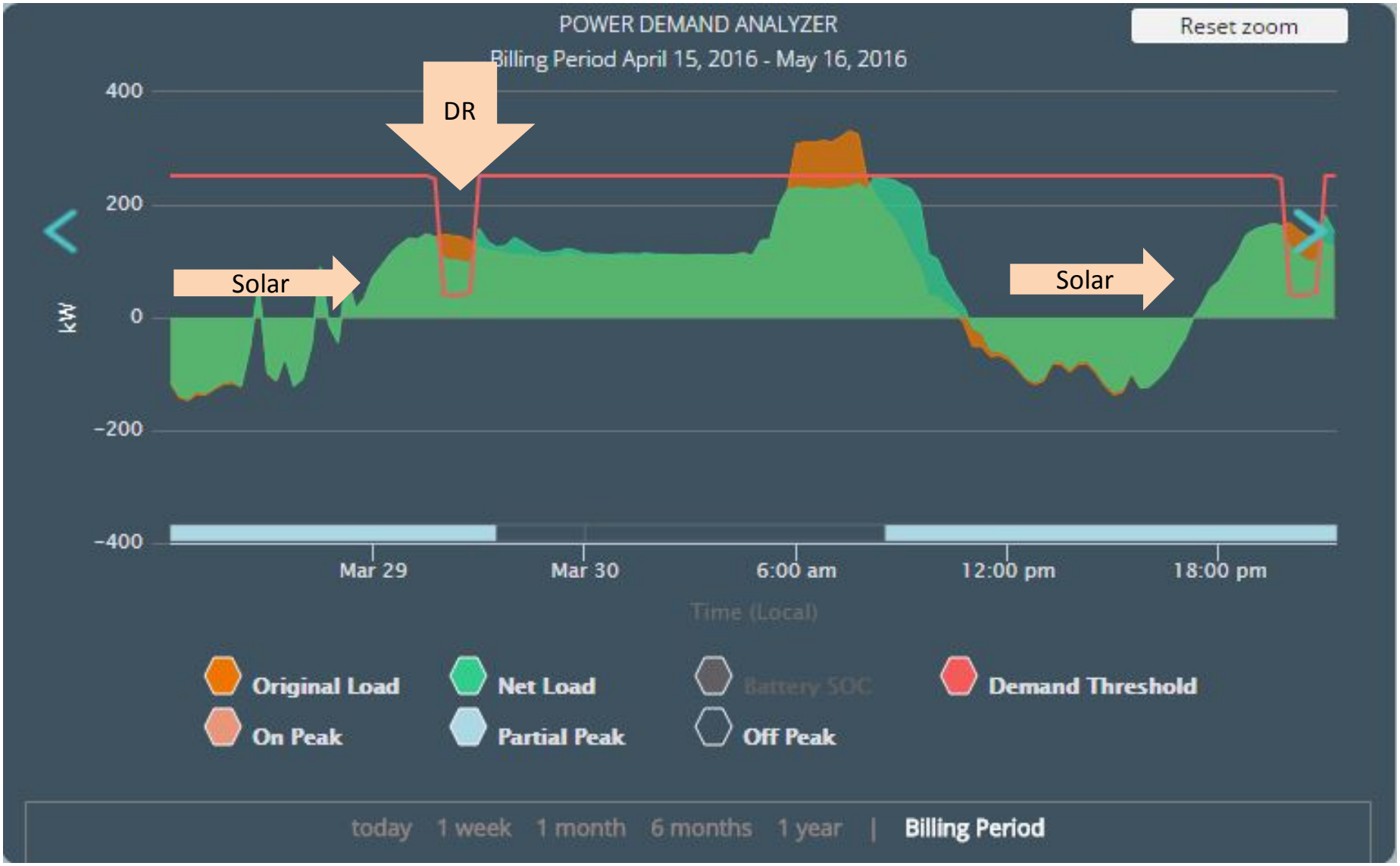
- Industry leading lithium-ion batteries
- Modular and expandable
- 10-year warranty
- Indoor/outdoor
- HVAC cooling
- Perfect Safety Record
- 30kW/30kWh
  - 2' x 2.5' footprint
- 250kW/500kWh & Up

MVLA
HIGH SCHOOL DISTRICT

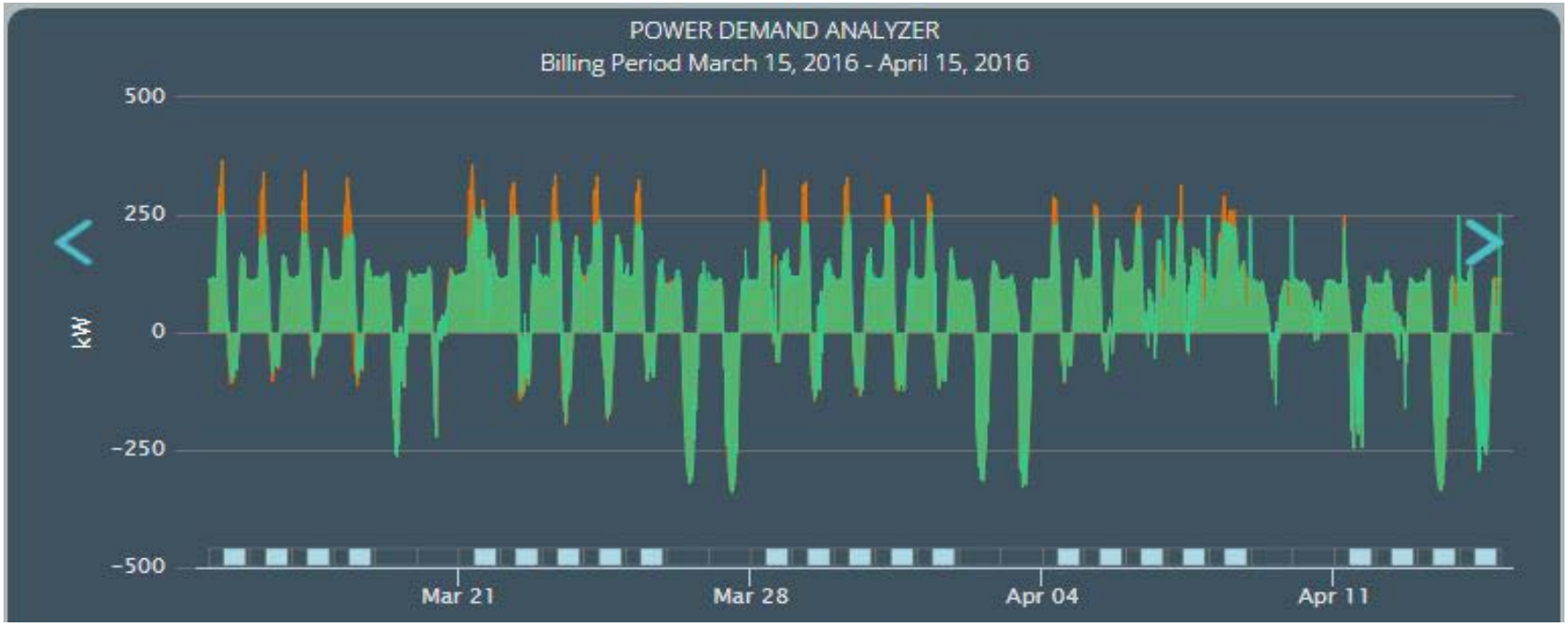
- Serving the communities of Mountain View, Los Altos & Los Altos Hills
- Looking for ways to reduce total electric bill
- Wanted EV charging
- Volatility of solar was not reducing demand charges

Green Charge Networks solution

- No cost to the district
- 540KW/1080KWh system at 2 schools
- Combined EV charging, Solar and Storage
- $86,000 in annual demand charge savings
- Service offerings
  - Peak Demand Savings
  - Arbitrage
  - Demand Response
- Performing at 127 % of expected savings


POWER DEMAND ANALYZER
Billing Period April 15, 2016 - May 16, 2016
Reset zoom
DR
Solar
Solar
400
200
0
-200
-400
kW
Mar 29
Mar 30
6:00 am
12:00 pm
18:00 pm
Time (Local)
Original Load
Net Load
Battery SOC
Demand Threshold
On Peak
Partial Peak
Off Peak
today
1 week
1 month
6 months
1 year
Billing Period

Los Altos HS Performance – Solar, EV, DR



	Feb-16	Mar-16	Apr-16	Totals
Initial Saving Projections	$1,853.32	$2,121.67	$1,541.15	$5,516.14
Actual Demand Savings	$1,319.22	$1,223.68	$1,156.59	$3,699.49
Energy Market (DR) Revenue	$1,100.00	$1,100	$1,100	$3,300
Delta	$565.90	$202.01	$715.44	$1,483.35
Performance	131%	110%	146%	127%

Case Study: Redwood City

Municipality: Redwood City

Size: 84,000 Residents

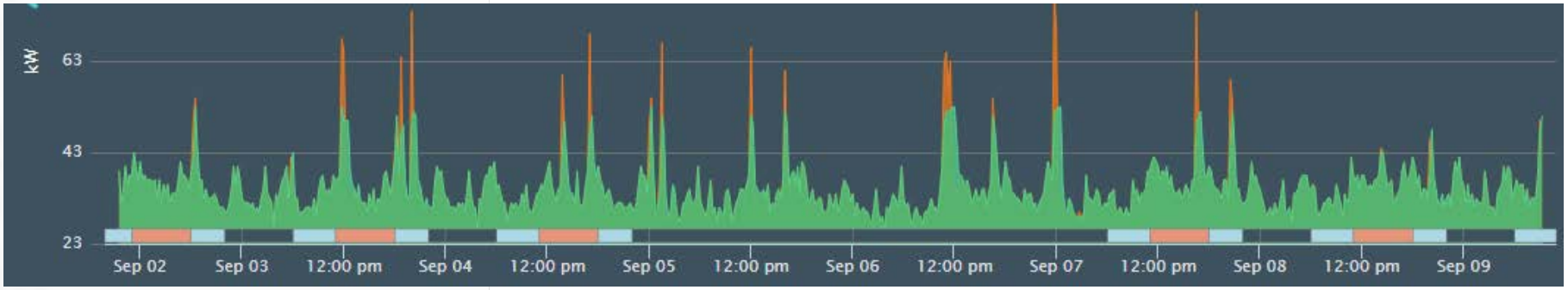
Locations: 2

- High-traffic downtown parking garage
- Redwood City Public Library

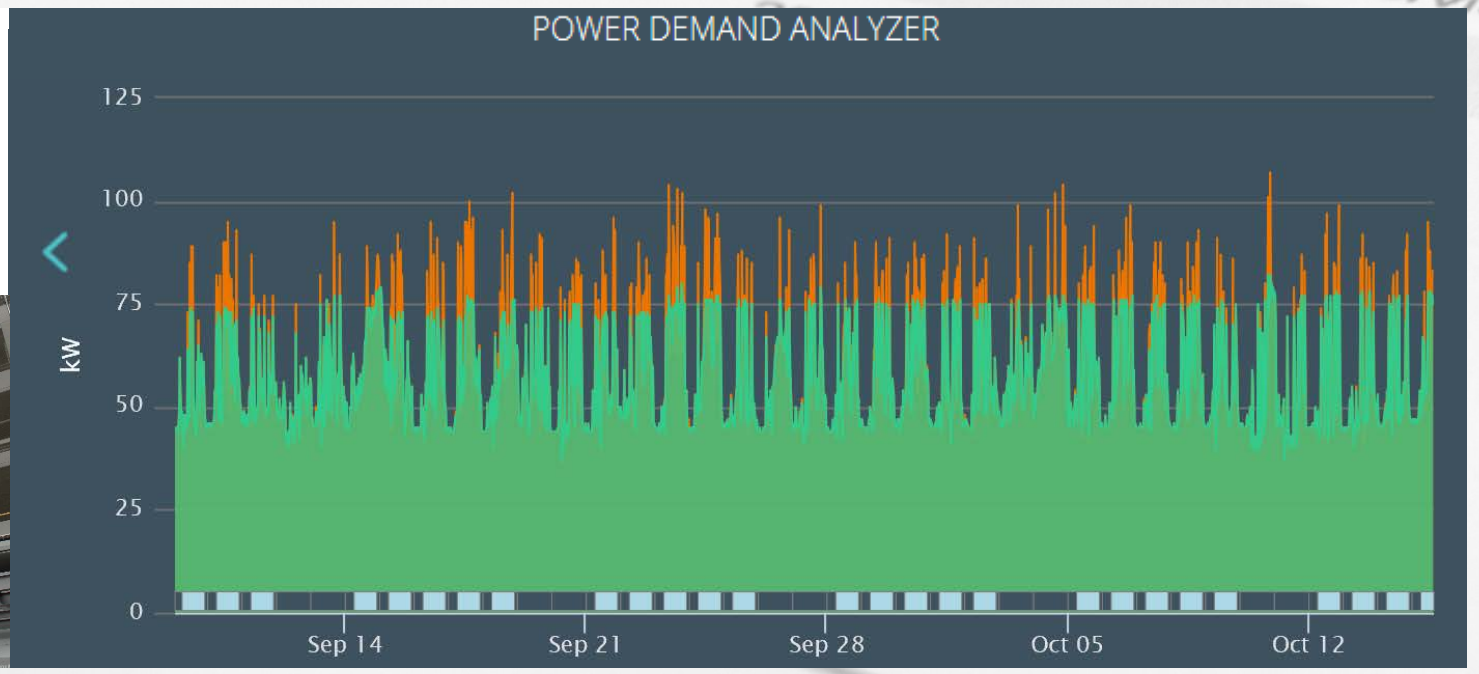
Annual Savings: $7,000 per site in demand charges

Financing Model: Green Charge PEA Shared Savings

Sample GridSynergy Control Software View



Santa Clara Tasman Garage – Levi's Stadium



greencharge networks

www.greencharge.net

Thank you

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PLACE HOLDER

- Stephen Kelley, Green Charge Networks

Greg Farley, Chesapeake College

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Your time.Your place.
Chesapeake College at 50

The Art of the Possible: Energy Savings and more at a Small, Rural Community College

or,

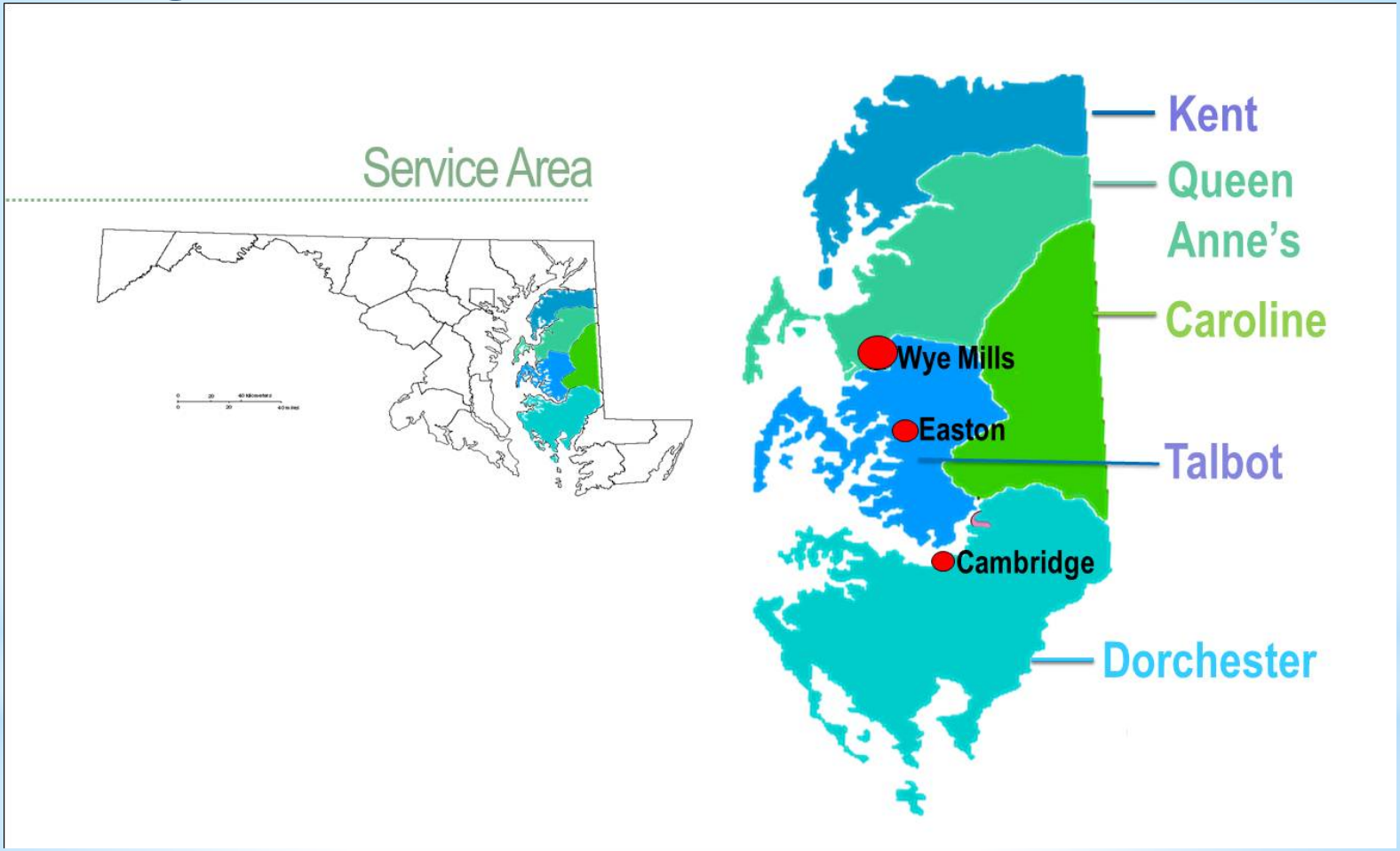
"It's Good to Have Friends"

Gregory S. Farley
Director, Center for Leadership in Environmental Education
Professor of Biological Science
Chesapeake College
Wye Mills, MD

May 10, 2016

Your time.Your place.
Chesapeake College at 50

Some Background



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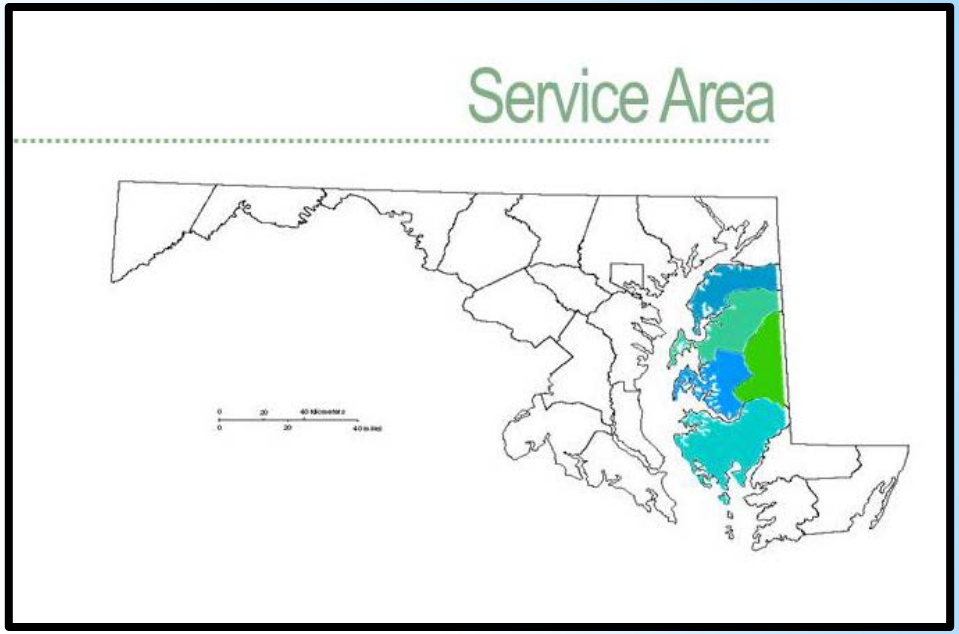


- Established 1965
- **Rural, regional**
  - **18% of land area of MD**
  - **3% of population**

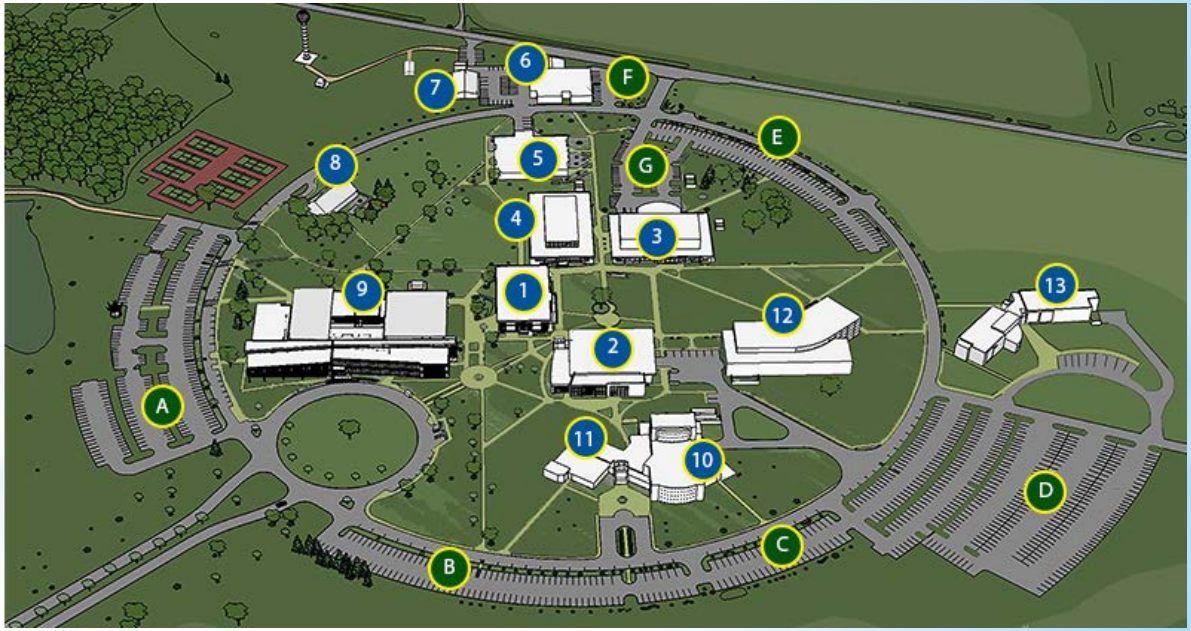
- **3000 students in credit classes**
- **6300 students in continuing-education/workforce training**

Two locations: Wye Mills, Cambridge

Your time. Your place.
Chesapeake College at 50

- 12 (+1) buildings
- Newest building 2003
- Renovations since 2003: 5 buildings

- All on a single electric meter!
- No on-campus generation
- Energy bills approx. $500-600,000/year (includes both locations)

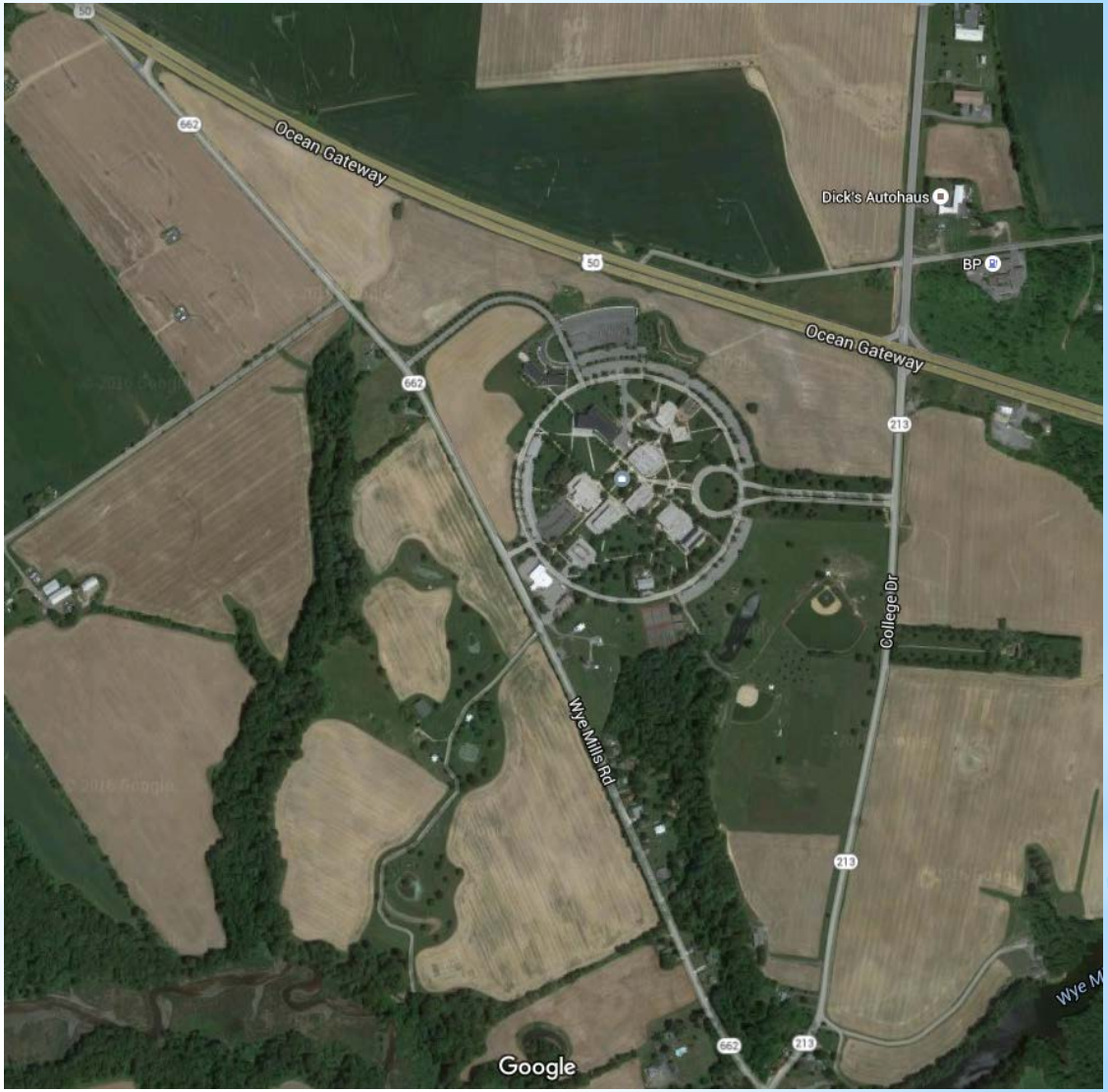


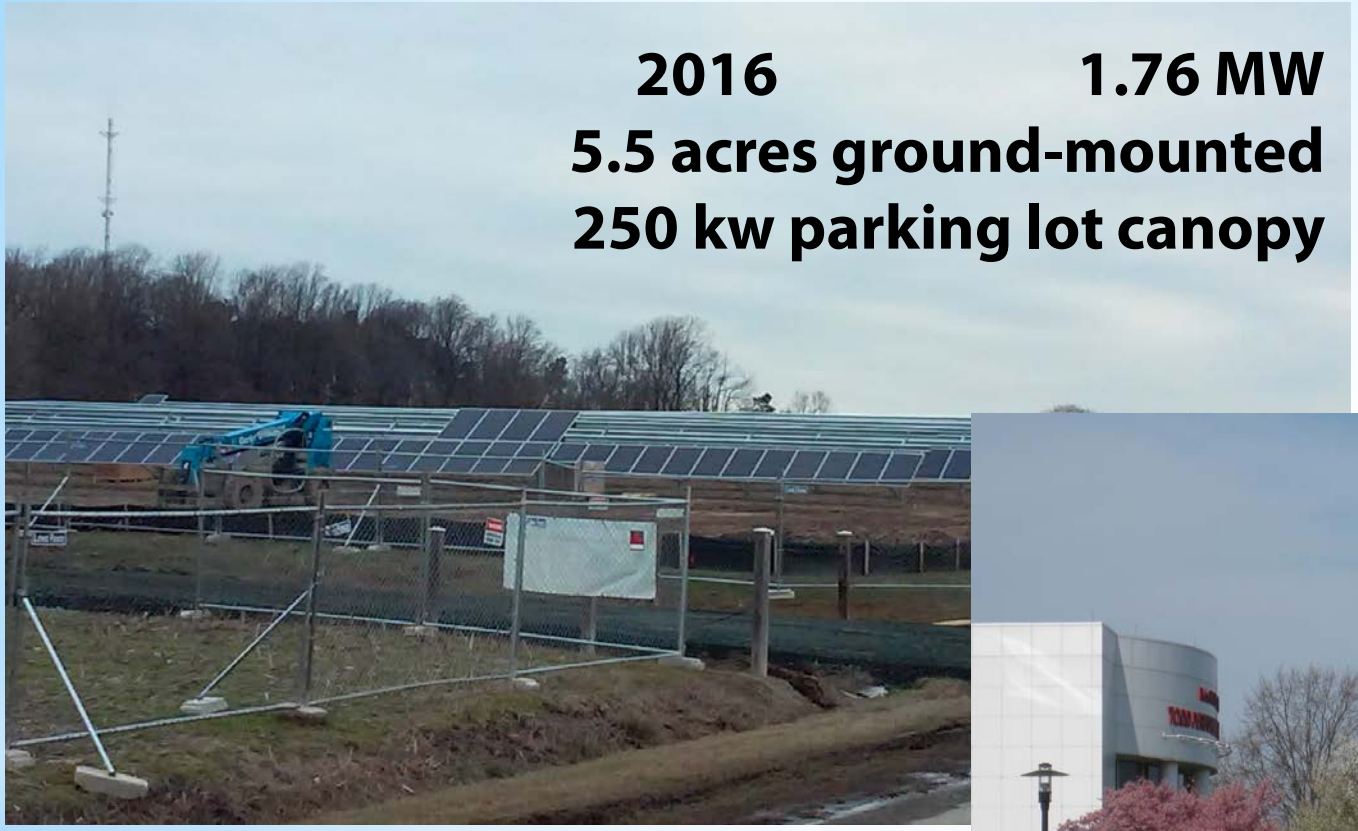
delmarva power
An Exelon Company

Campus is still very rural.

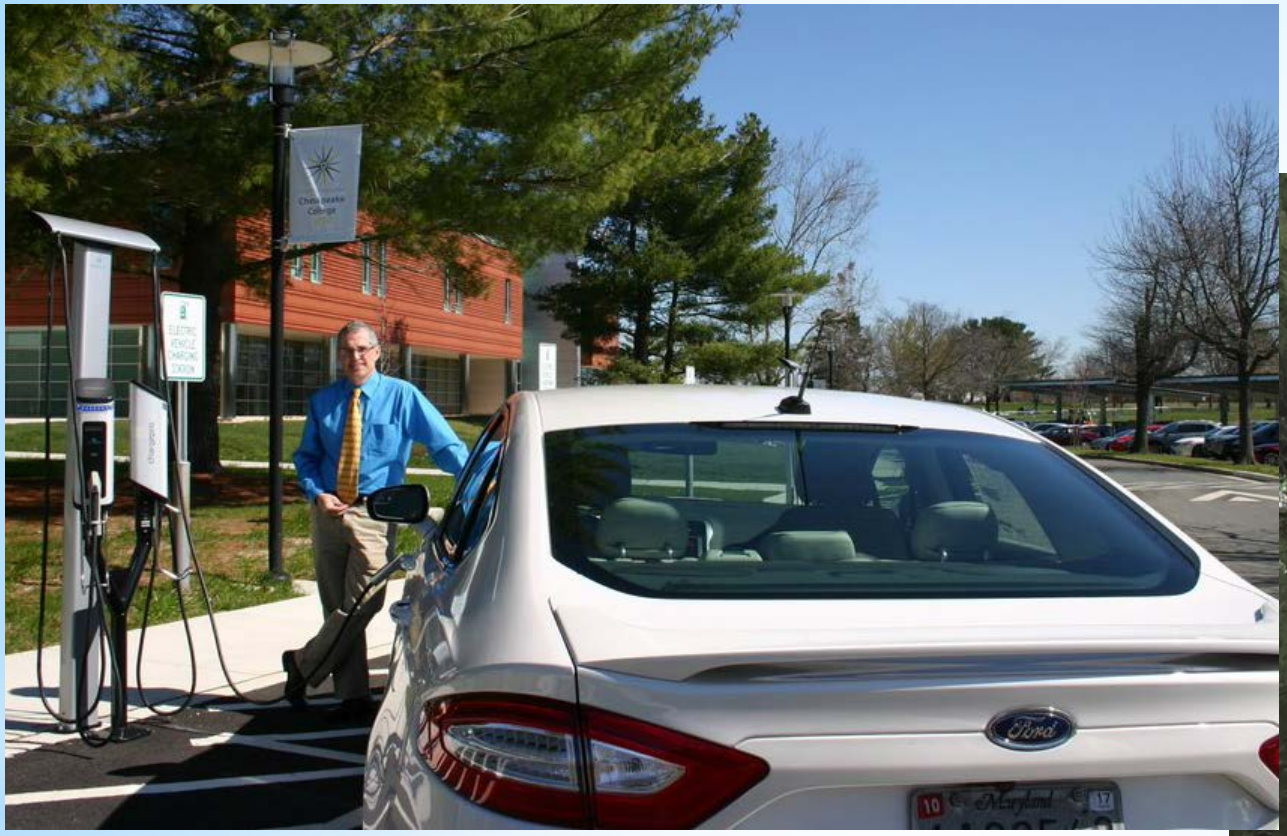
55 acres of agriculture

We are using this asset – space – to lead the rural energy dialogue.





- **Efficiency up: infrastructure, behavior change; 19% reduction**
- **On-campus generation**


ELECTRIC VEHICLE PARKING STATION
Ford
Maryland

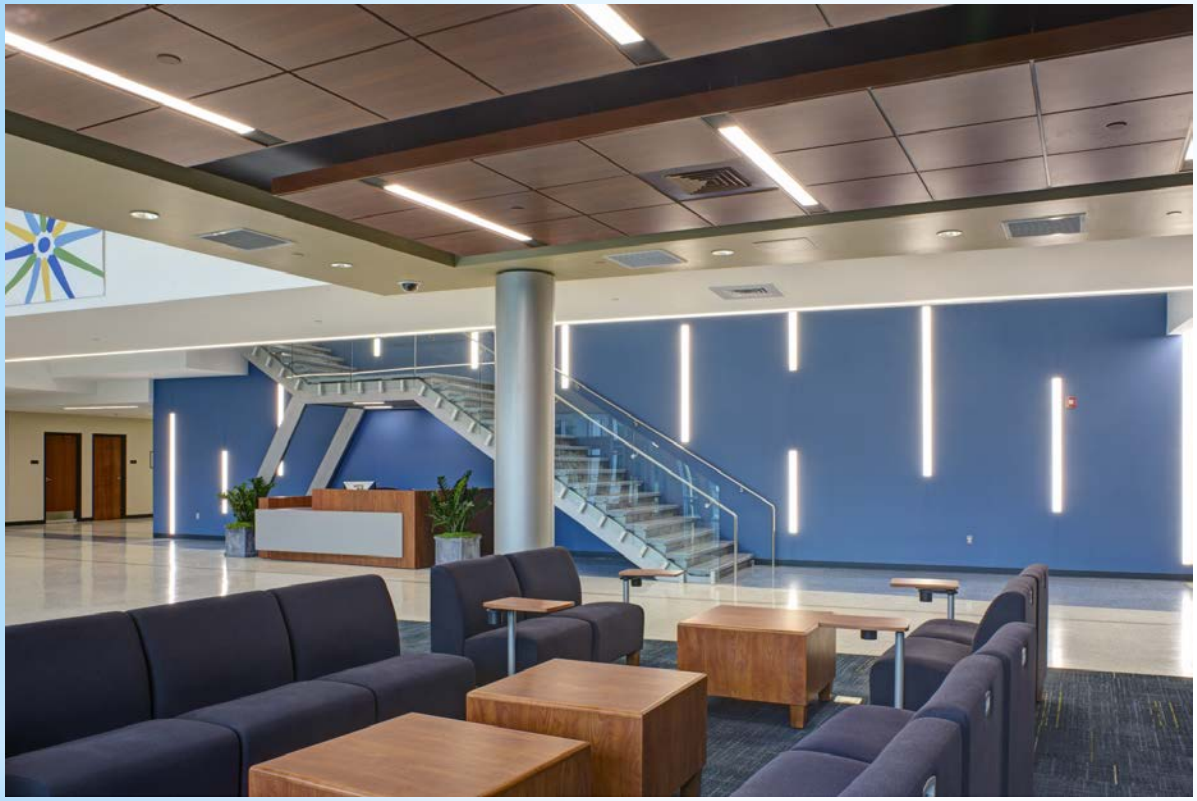

CHESAPEAKE COLLEGE
HEALTH PROFESSIONS
AND ATHLETICS CENTER

Previously: Gymnasium (1965-66) and Pool (1976?)

- 40,000 GSF
- Aging; unsafe
- No energy data

- Pool closed in 2013

- **Pool did have solar thermal loop for heating**
- **Decision to renovate; add space for health sciences**
- **18-month renovation**



New HPAC houses health, athletics, and general classroom space; faculty/staff offices

Energy Features:

- 101,000 GSF
- Thermal massing
- Solar hot water loop (preheat)
- Low-flow sinks & showers
- Geothermal HVAC
- Heat recovery air handlers
- Natural light & LED lighting
- High-efficiency windows
- Daylight harvesting
- Occupancy sensors
- Building controls

- Energy Use Intensity 312.39 kBtu/sq ft/yr
- 31% energy savings relative to ASHRAE standards
- 56% cost savings on energy
- See the whole profile at http://1.usa.gov/1MBjUNu

MARSHALL CRAFT ASSOCIATES

"It's good to have friends…"

- Solar array: 1.76 MW
  - Behind the meter
  - PPA with Solar City < $0.05/kWh
- Too large for regional grid

- Special meeting to discuss connection
  - Grid communication and assessment testing
  - Curtailment testing
  - "Sky-Cam" and cloud cover testing

SolarCity

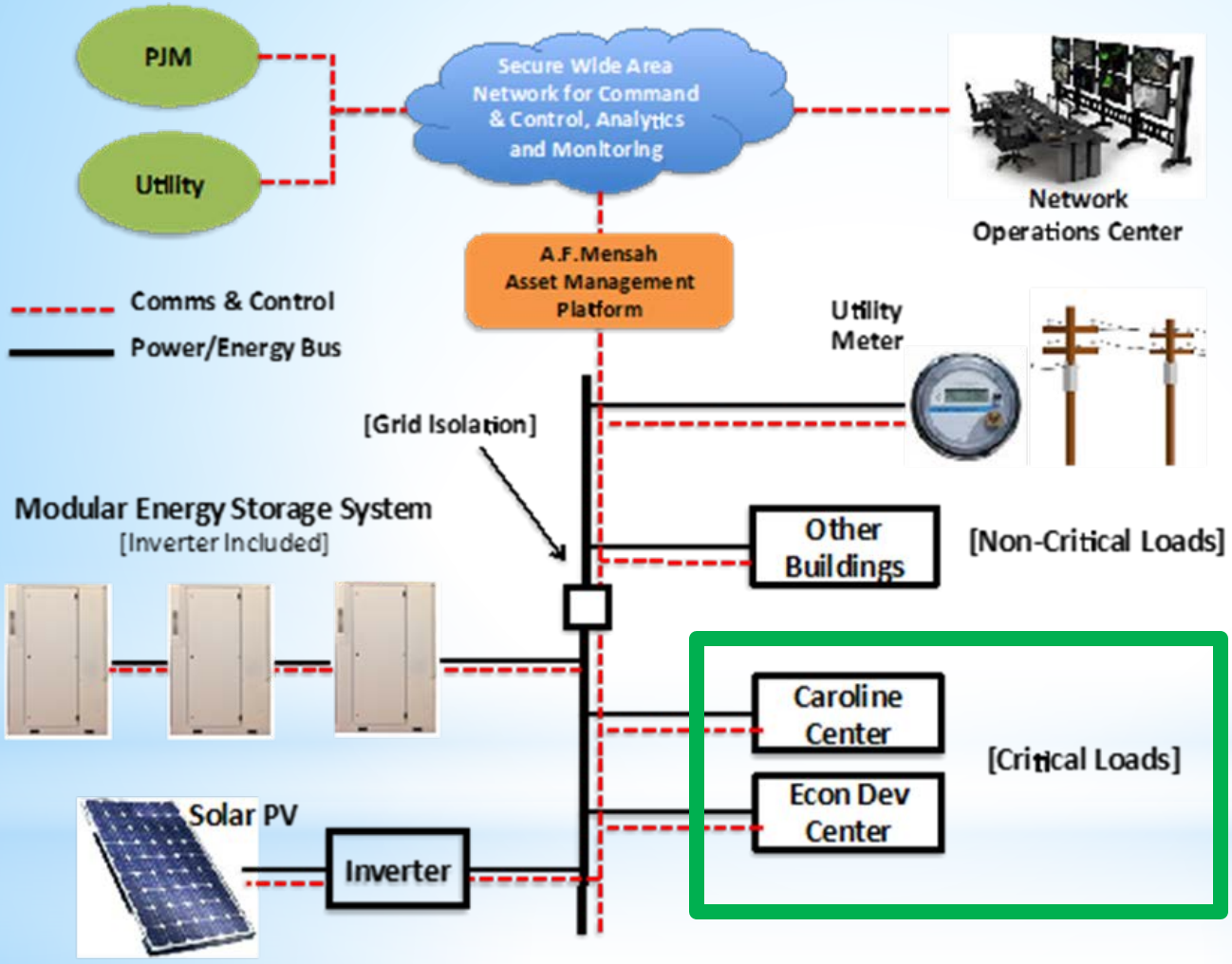
delmarva power
An Exelon Company

Pepco Holdings
An Exelon Company

“It’s good to have friends…”

- Battery-storage technology: up to 2MW
  - Grid integration testing
  - “Islanding” two buildings

A.F.Mensah



NOT the HPAC building; student center and adjacent building; community resiliency needs.

Your time.Your place.
Chesapeake College at 50

Discussion

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Thank you!

Jay Paidipati

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