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Tapping into the Power of Utility-Scale and Onsite Solar

Wednesday, April 12, 2023
4:00 – 5:00pm

U.S. DEPARTMENT OF ENERGY

Shannon Zaret

DOE

U.S. DEPARTMENT OF ENERGY

Today's Presenters

- **Catie Snyder, Deputy Director of Leading by Example Division**
  - Commonwealth of Massachusetts
- **Erik Schmidt, Director of Sustainability**
  - Chattanooga, TN
- **Zach Lammers, Energy Conservation Program Manager**
  - Anne Arundel County Public Schools

Catie Snyder

Commonwealth of Massachusetts: Deputy Director of Leading by Example Division

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MASSACHUSETTS LEADING BY EXAMPLE PROGRAM
PUBLIC LEADERSHIP, STEWARDSHIP, COMMITMENT

Strategic Deployment of Onsite Solar

Catie Dimas Snyder, MA DOER
April 12, 2023

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MA Department of Energy Resources Leading by Example

LBE works collaboratively with state agencies, quasi-public authorities, and public colleges and universities to advance clean energy and sustainable practices that reduce the environmental impacts of state government operations

Higher education campuses, correctional centers, courthouses, office buildings, hospitals, etc.

Annual electricity consumption: ~1 billion kWh

80 million square feet of buildings

795,000 metric tons CO_2 emissions

MASSACHUSETTS LEADING BY EXAMPLE PROGRAM
PUBLIC LEADERSHIP, STEWARDSHIP, COMMITMENT

MWRA Deer Island solar PV and wind turbines

DFW HQ solar rooftop sized to equate the building's energy use

Roxbury Community College parking lot solar canopy with EV charging stations

Massachusetts Department of Energy Resources

Focus on Solar Generation at State-Owned Sites

- Growing number of onsite installations serving distributed energy resource integration role
  - E.g., pairing solar with battery storage and EV charging
- Results in electricity cost and demand charge savings for state government operations
- Direct contributions to the declining emissions of the regional electricity grid

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Context: Regional "Greening of the Grid" and Solar

- Massachusetts Decarbonization Roadmap outlines pathways to meet statewide 2050 net zero emissions requirement cost-effectively and equitably

Projected lowest cost electricity systems for the Northeast →

- Solar comprised 25-30% of electricity generation across most pathways
- Strategically placed solar could help avoid utility equipment upgrades

1. Wind
2. Solar
3. Hydro

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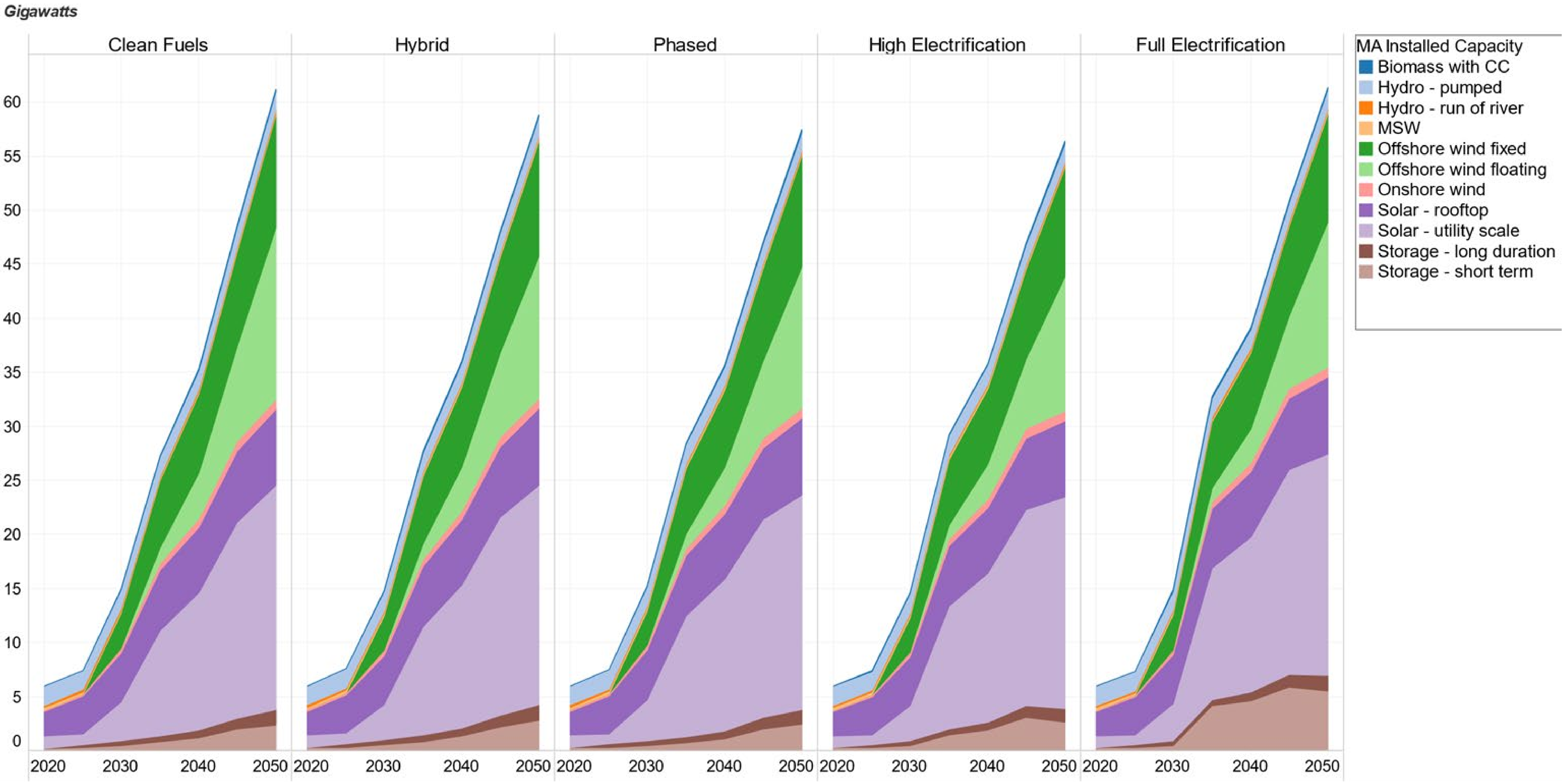
Massachusetts Electricity Capacity by Year and Decarbonization Pathway



Context: Key Statewide Policies and Programs

Stretch and Specialized Opt-in Building Codes

225 CMR 23: MASSACHUSETTS COMMERCIAL STRETCH ENERGY CODE AND MUNICIPAL OPT-IN SPECIALIZED CODE 2023

Massachusetts Stretch Code and Specialized Code for Commercial buildings

(Note: please see 225 CMR 22.00 for low-rise Residential construction)

The Massachusetts Stretch energy code (Stretch Code) first became available for municipal adoption in 2009 as Appendix 110.aa and then 115.aa as part of the building code in 780 CMR. In 2021 the Massachusetts legislature passed new legislation moving authority for updates to the Stretch Code to the Department of Energy Resources and 225 CMR.

This code takes effect on July 1, 2023 and is designed to align with the forthcoming MA 10th edition building code promulgated under 780 CMR. Building permit applications for projects received on or after July 1, 2023 in Stretch Code communities shall comply with this code.

As with the 10th edition building code, this energy code is based on modified versions of the 2021 code books as published by the International Code Council (ICC). Specifically, the 2021 International Energy Conservation Code (IECC 2021) as amended.

This section (225 CMR 23) covers all buildings except for low-rise residential buildings which are covered by 225 CMR 22. 225 CMR 22 and 23 in combination form the Stretch Code – and must be adopted together and not in part.

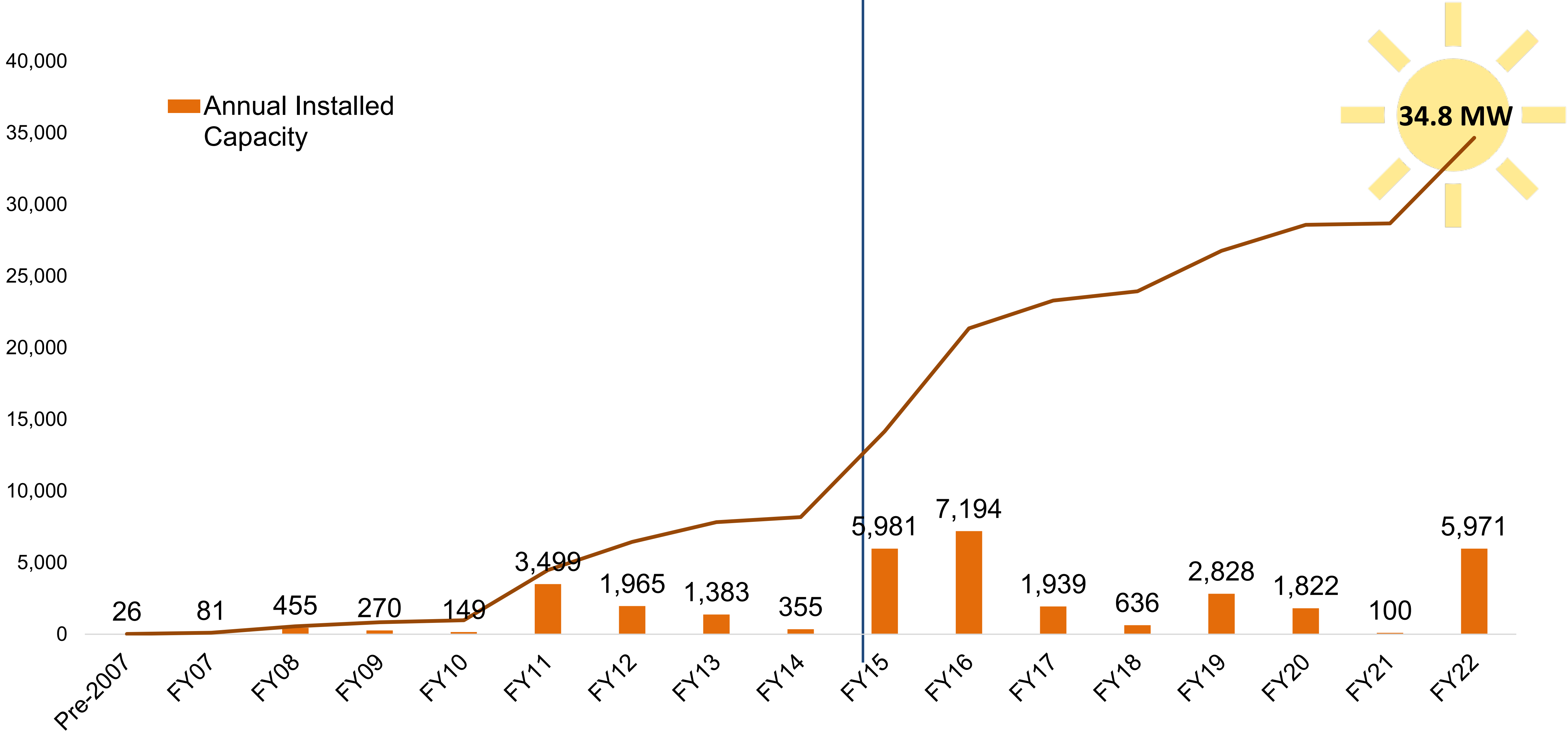
Municipalities may also elect to adopt the combination of Appendix RC of 225 CMR 22 (Low rise residential) and Appendix CC of 225 CMR 23 (all other buildings) which together form the Municipal Opt-in Specialized code (Specialized Code).

SMART
MASSACHUSETTS SOLAR PROGRAM

MASSACHUSETTS LEADING BY EXAMPLE PROGRAM
PUBLIC LEADERSHIP, STEWARDSHIP, COMMITMENT

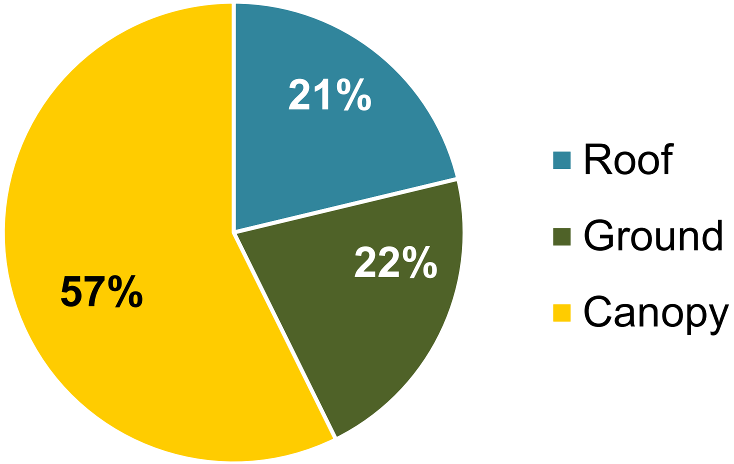
Executive Order 594: Decarbonizing and Minimizing Environmental Impacts of State Government

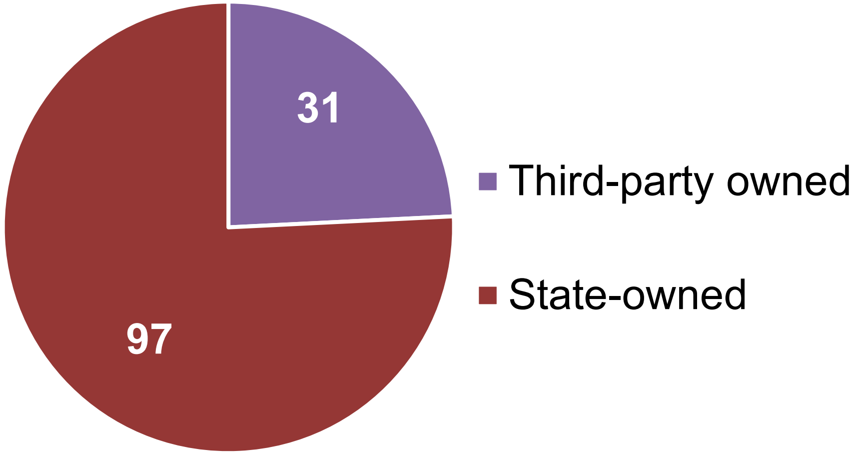
State Facility Solar Progress: Installed Capacity



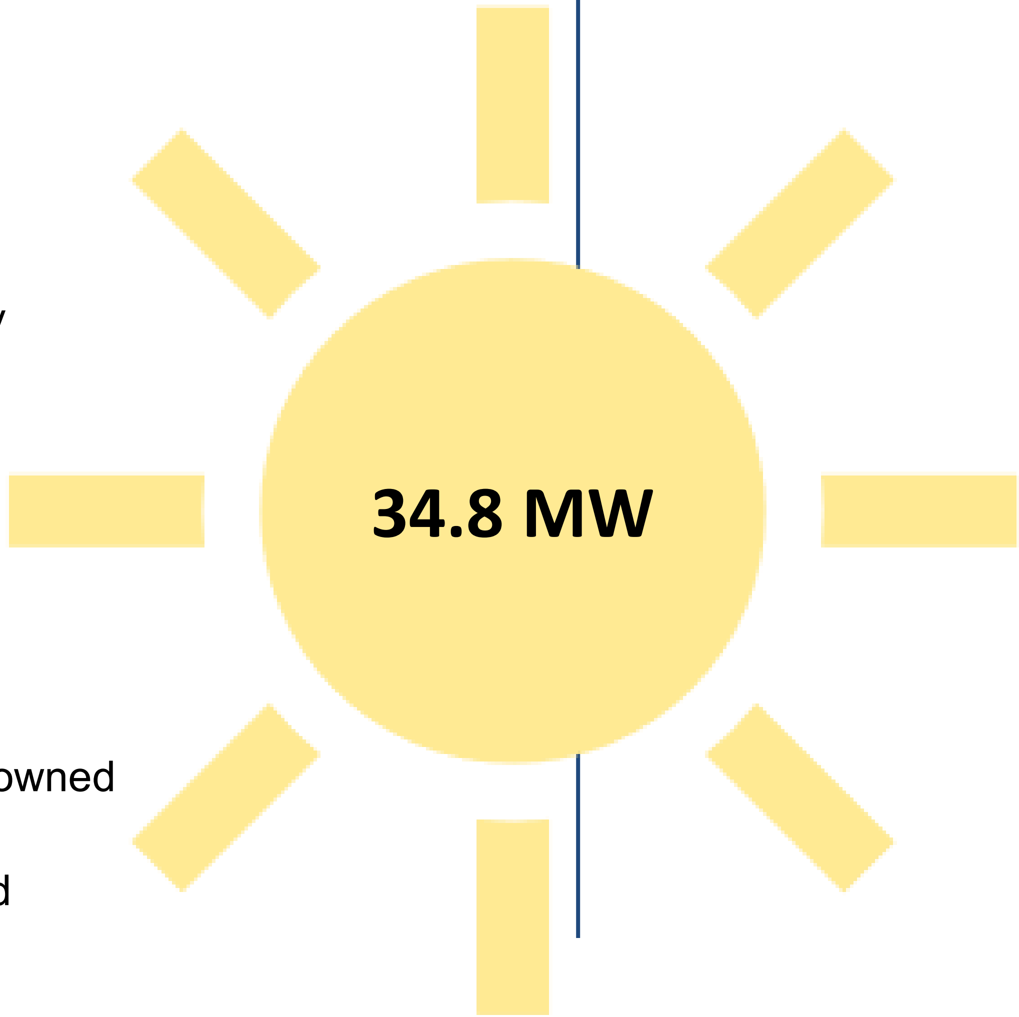
State Facility Solar Progress: Diverse Portfolio

↓ Array types





↑Number of projects by ownership model



Solar capacity by site type ↘

Campuses: 58%

Agencies: 31%

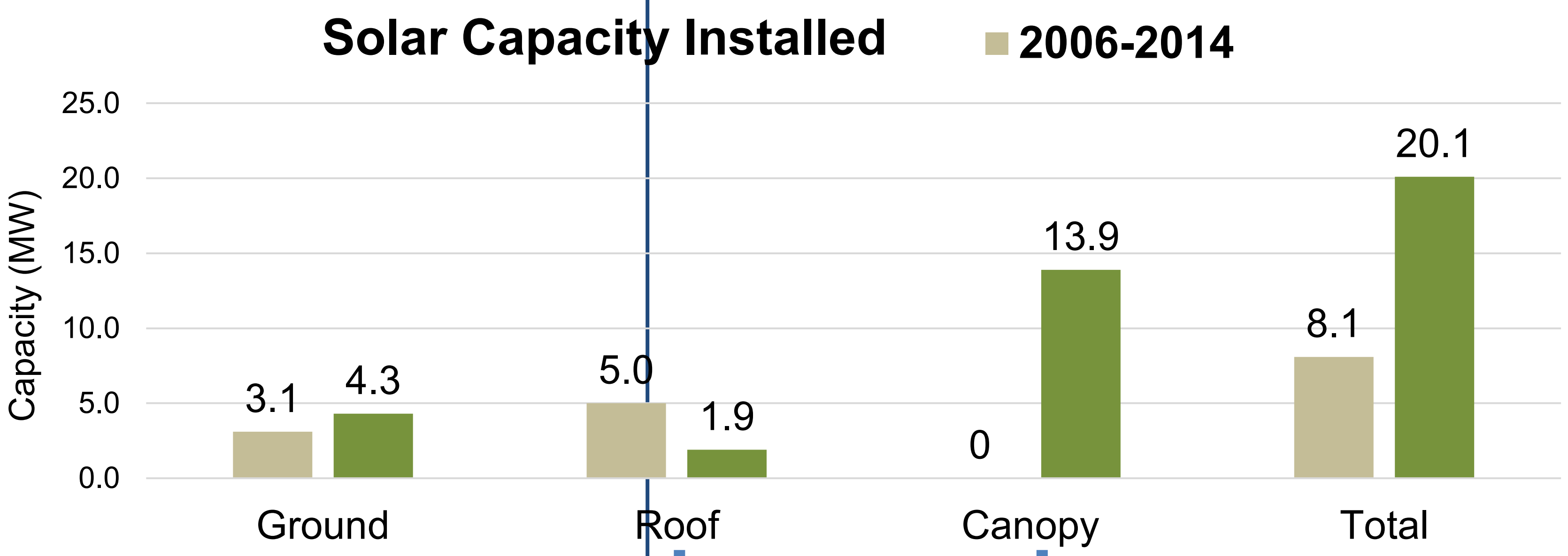
Public Authorities: 12%

State Facility Solar Progress: Scope and Scale

Rooftop

Solar Canopies

2016 LBE Solar Canopy Feasibility Study



Average project size	86 kW	945 kW
Average cost per watt	$2.70	$5.00

+ Supplemental canopy benefits, e.g., land use efficiency, mitigating urban heat island effect, weather protection, car cooling, and closed-loop EV charging

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Strategic Partnerships

solectenergy

PowerOptions

Solar + storage PPAs

DIVISION OF CAPITAL ASSET MANAGEMENT & MAINTENANCE

New construction; large efficiency projects and renewable installations; decarbonization planning

Dedicated agency and campus partners (facility contacts and leadership)

MASSACHUSETTS LEADING BY EXAMPLE PROGRAM

PUBLIC LEADERSHIP, STEWARDSHIP, COMMITMENT

Technical assistance direct to state entities; resources (e.g., solar pro forma); grant funding

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Financing Mechanisms for Upfront and Ongoing Costs

Build-to-own	
Overview	• Standalone installation or part of a broader energy project • Host site pays for project costs through upfront capital budgets or self-financing • Fewer state-owned projects in recent years given capital constraints
Pros	• Site can reap the full long-term fiscal benefits • No leasing issues
Cons	• Significant capital for upfront project cost • Host site responsible for specification development, procurement process, award, and construction project management • Maintenance responsibility • Budgeting for ongoing repair and maintenance (no incentives available) • May need to procure battery management and optimization services • Could take longer than PPA model and lead to lower SMART incentives

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Financing Mechanisms for Upfront and Ongoing Costs

Third-party Owned (PPAs)	
Overview	• Developer owns, operates, and maintains array for 20-25 years • Host site receives electricity at fixed rate, typically lower than grid electricity rate • Greater uptake by state sites in last 5 years
Pros	• No upfront cost to host site – particularly effective for solar canopies • Vendor responsible for site investigation and design • Accelerated contracting process • Fixed electricity rate for duration of agreement for kWh generated by system • May include benefit-share for energy storage systems • Developer can absorb incentives, including tax credits not currently available to public entities • Typically includes a production guarantee, protecting the savings stream for the agency • Vendor implements ongoing monitoring and maintenance
Cons	• Potentially lower fiscal benefit over project lifetime

Example PPA Process Flow

(LBE provides assistance throughout the process)

- Host site expresses interest, identifies location(s)
- Provides usage data/utility bills

→

- Run site through capital planning assessment
- Preliminary green light to explore further

→

Initial discussion with various entities involved

→

Initial solar design and PPA rate modeling based on certain assumptions (e.g., ITC, SMART incentives)

→

- Discussion about proposal(s)
- Site visit

→

- More detailed proposal and design
- If agreeable, host site signs LOI

→

- Submission of utility ISA and incentive application
- Sign agreements with not-to-exceed PPA rate

→

- Project development initiated (incl. impact study, if required)
- Civil/structural engineering

→

- State incentive approval
- Utility ISA approval or cost of impact study finalized

→

- Finalize PPA rate based on outcome of development activities (ISA, site engineering, incentives)

→

- Pre-construction plan + schedule
- Permitting

→

- Construction, inspections complete
- Interconnection
- System(s) online
- PPA payments begin
- Monitoring and maintenance

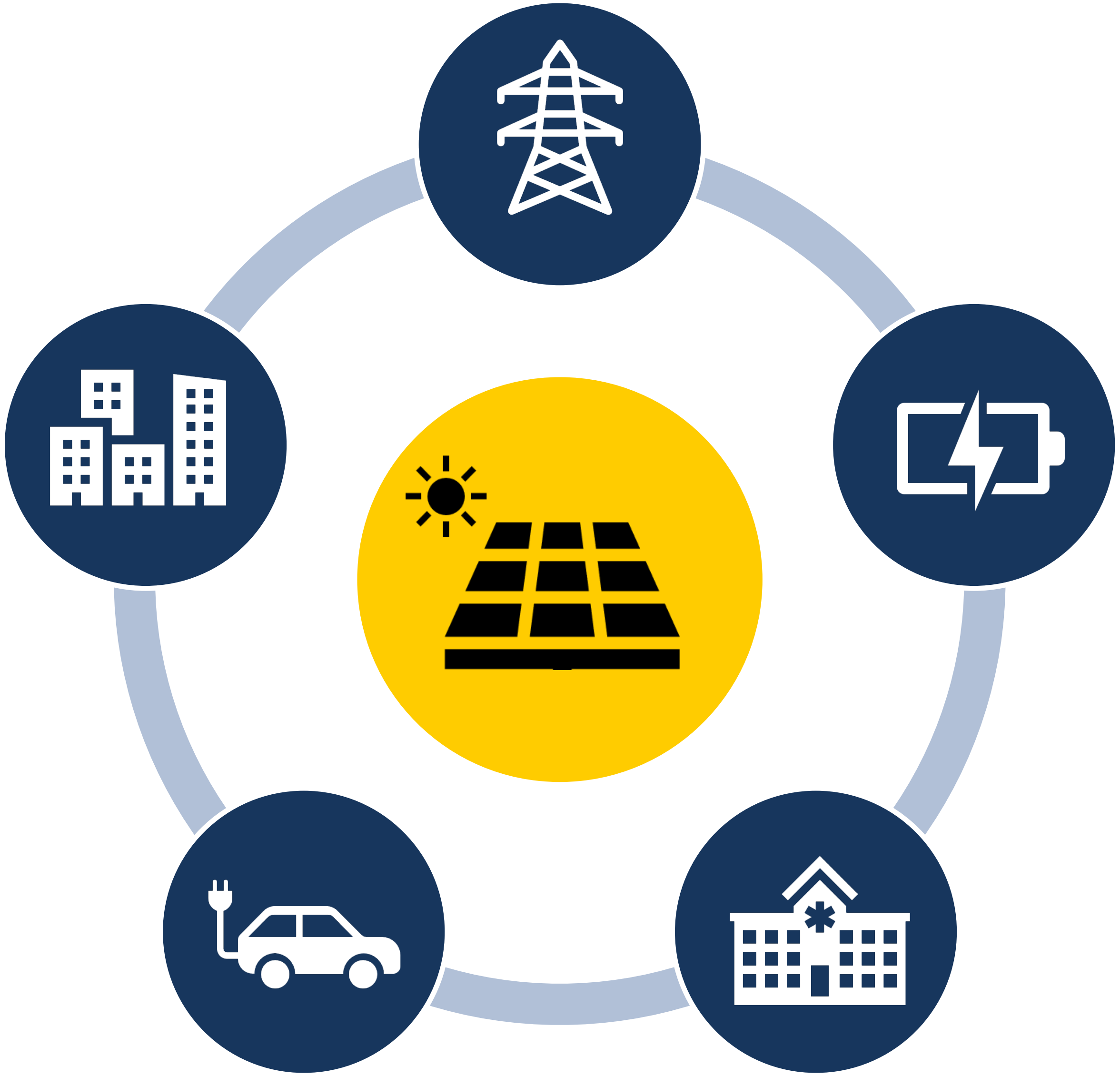
Challenges with Solar + Facility Electrification

New construction and major renovations: MA LEED Plus 2.0 Standard (optimized solar area)

Existing state facilities: Decarbonization and energy master planning (demand reduction and cost containment)

- Relatively high capital costs for canopies, regardless of ownership model
- Incorporating solar into efficiency or capital projects and budgets
- Reduced state incentives
- Awaiting federal guidance and regulations on Direct Pay for public entities
- Navigating energy storage management
- Significant utility interconnection delays

Future Opportunities with BTM Integrated Solar



- Electrification support
  - Demand charge mitigation
  - Suitability for BESS
- Short-term energy resilience, renewable backup alternative, additional redundancy
  - Key infrastructure
  - Nonstop operations
  - Sensitive populations
- EV charging

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Thank you!

Erik Schmidt

Chattanooga, TN: Director of Sustainability

U.S. Department of Energy Better Buildings: Tapping Into the Power of Utility-Scale Solar

Erik Schmidt, Director of Sustainability
City of Chattanooga
City Planning Department

January 31, 2023

Climate Action Plan

Chattanooga's Path Toward Resilience

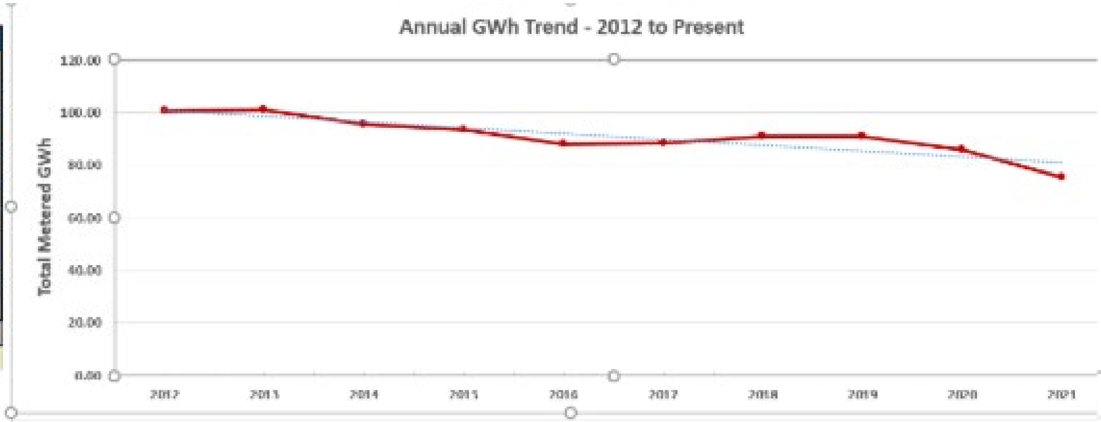
- USDOE Better Buildings Challenge
  - 2016: 20% EUI, 2 million square feet
  - 2019: Goal Achieved, 30% EUI Reduction
  - 2021: 36% EUI Reduction; 25% annual
- Municipal Performance (2012-2021)
  - 25% electricity reduction; 25 gigawatt hours / year
  - $2.2 Million Annual Savings
- 2023: Going Forward
  - Better Climate Challenge
    - 50% GHG reduction by 2033
  - Climate Action Plan
    - Net-Zero Carbon by 2040 (Municipal)

Step 1: Right sizing with energy-efficiency

Annual Changes In Usage

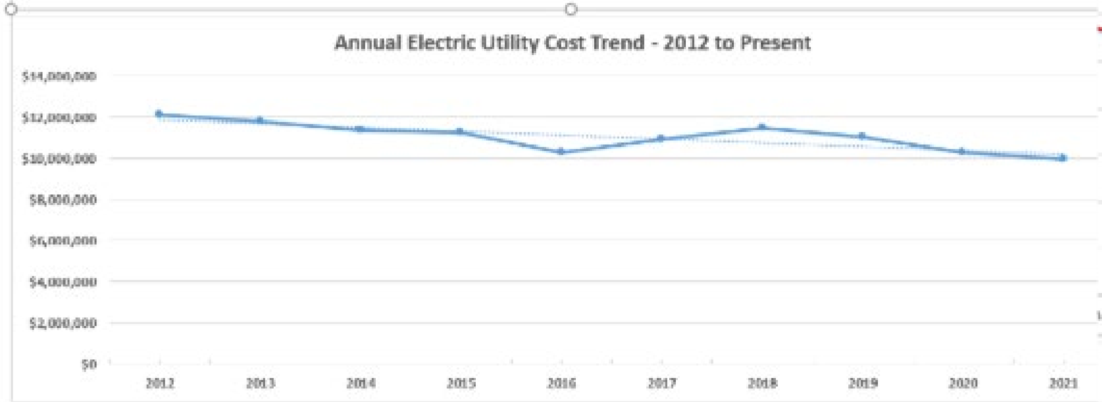
YEAR	Total Metered GWh	Year Prior Delta (GWh)
2012	100.66	
2013	101.09	0.43
2014	95.31	-5.78
2015	93.26	-2.05
2016	87.68	-5.58
2017	88.34	0.66
2018	90.77	2.43
2019	90.69	-0.07
2020	85.81	-4.88
2021	75.36	-10.45
Grand Total	**908.96**	
	%Reduction 2012 vs 2021	25.13%

Does not include non-metered accounts or streetlights

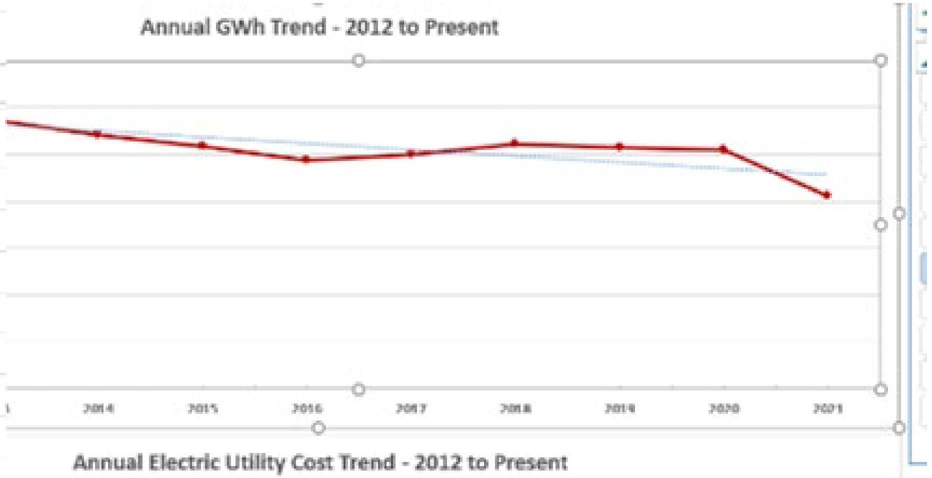


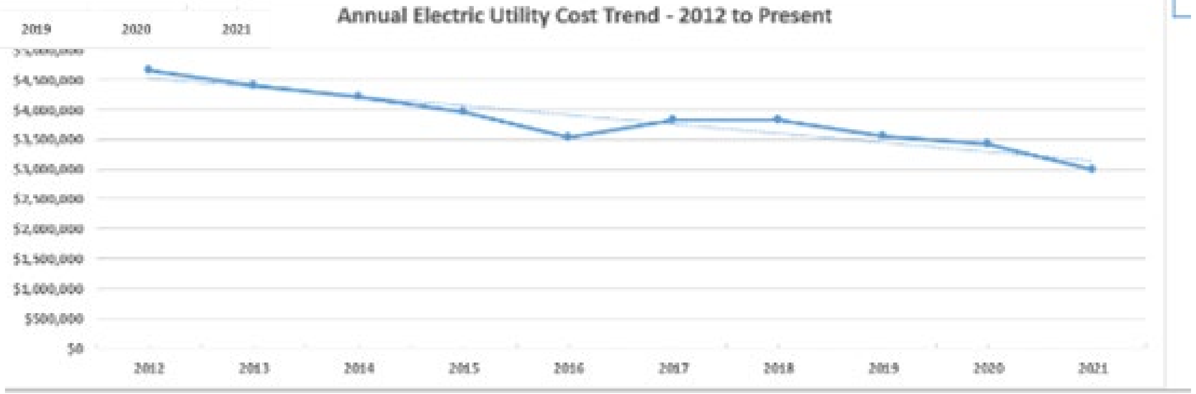
Delta GWh - Pivot Chart

YEAR	Total Metered GWh
2012	100.66
2013	101.09
2014	95.31
2015	93.26
2016	87.68
2017	88.34
2018	90.77
2019	90.69
2020	85.81
2021	75.36
Grand Total	**908.96**



MBEC
2012: 59.32 GWh
2020: 50.90 GWh
2021: 41.16 GWh





Total Municipal Electricity Use
2012: 100.66 GWh
2020: 85.81 GWh
2021: 75.36 GWh

Moccasin Bend Environmental Campus (Regional Wastewater Treatment Facility)

- Over 400K residents in 6 counties
- Largest municipal energy consumer
  - 55%; 41/75 GWh (not including street lights)
- Size: 10 acres / 9,300+ panels
- Generation: 4 MW / 10+% total MBEC
- Annual Savings (behind the meter):
- $400,000+ / 5.45 GWh (2021)
- Total Cost: $5.25M / ROI: 12-13 years, then cash+
- Increases operational continuity and resilience
- Panel efficiency increased 23% (orig. 3.25MW) from bid to contract
- Complexity, cost and scale (i.e., land availability)

Due to scale, the MBEC solar array serves a critical role in helping Chattanooga achieve its carbon-neutral goal by 2040 while maintaining water quality standards in the Tennessee River

MBEC Solar Performance

	Solar Array Energy Output (kWh)	Insolation kWh/m2	No. days	Savings	Cumulative Savings
Oct-20	32,221	14.02	2	$ 2,417	$ 2,417
Nov-20	397,131	121.59	30	$ 29,785	$ 32,201
Dec-20	326,124	102.22	31	$ 24,459	$ 56,661
Jan-21	317,904	96.09	31	$ 23,843	$ 80,504
Feb-21	352,966	102.73	28	$ 26,472	$ 106,976
Mar-21	458,484	138.93	31	$ 34,386	$ 141,362
Apr-21	532,993	167.60	30	$ 39,974	$ 181,337
May-21	605,031	191.47	31	$ 45,377	$ 226,714
Jun-21	559,741	182.74	30	$ 41,981	$ 268,695
Jul-21	555,943	179.82	31	$ 41,696	$ 310,390
Aug-21	522,442	171.13	31	$ 39,183	$ 349,574
Sep-21	501,304	165.9	30	$ 37,598	$ 387,171
Oct-21	391,006	132.56	31	$ 29,325	$ 416,497
Nov-21	421,412	136.79	30	$ 31,606	$ 448,103
Dec-21	243,763	81.82	31	$ 18,282	$ 466,385

Moccasin Bend WWTP - Monthly Production **12-2021**

Production vs Irradiance

Daily Values

Time	Energy (kWh)	Insolation (kWh/m2)	PR (%)
12-01-2021	10,246.00	3.48	72
12-02-2021	14,738.00	5.07	72
12-03-2021	14,817.00	5.07	72
12-04-2021	5,889.00	1.90	76
12-05-2021	1,239.00	0.38	81
12-06-2021	1,548.00	0.46	82
12-07-2021	8,727.00	2.84	76
12-08-2021	14,668.00	4.82	75
12-09-2021	8,846.00	2.81	78
12-10-2021	1,286.00	0.39	82
12-11-2021	1,424.00	0.41	86
12-12-2021	16,144.00	5.47	73
12-13-2021	15,399.00	5.29	72

Meteorology

Metrics	Value
Average Irradiance	255.35 W/m2
Wind (Average)	17.70 m/s

Cumulative Production

Metrics	Accumulated Month	Accumulated Year
Production	243,763.00 kWh	5,452,929.10 kWh
Insolation	81.82 kWh/m2	1,747.57 kWh/m2
Peak Power	4,064.00 kWp	4,064.00 kWp
PR	73 %	77 %
Equivalent Hours (*)	59.98 eh	1,341.76 eh

Public Safety Campus (Police, Fire, Radio)

- Electric Microgrid in partnership with municipal utility, EPB
- Police and Fire Dept Headquarters
- Fire Station 11
- TVRCS Radio Shop
- Auxiliary Police buildings
- City Assets:
  - 144kW solar array (behind the meter)
  - 200kW diesel generator (only emergency)
- EPB Assets:
  - 500kW/1100kW battery storage
  - Microgrid Controller (island-mode capable)

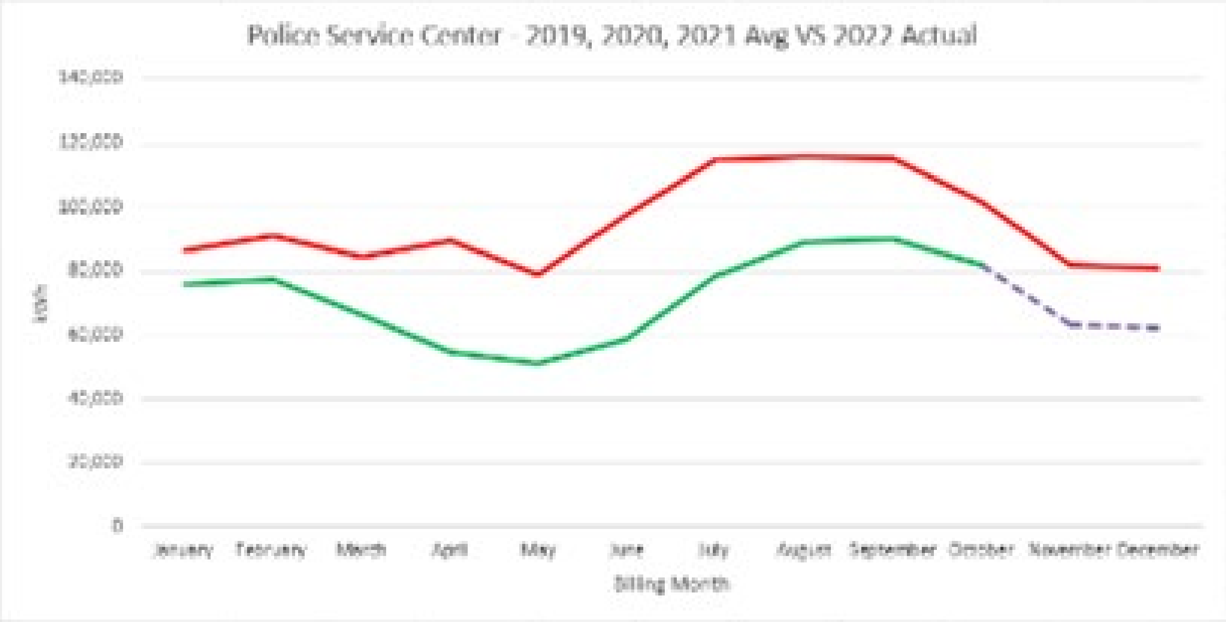
- Increases resilience of critical electric infrastructure for public safety
- Ensures 24/7/365 operational continuity
- 25-30% reduction in retail power purchase (City)
- Peak shaving, grid support, wholesale reduction (EPB)
- Reduces demand / contributes to carbon-neutral goal
- Established replicable partnership model
- Increases technical competence/capacity of LPC
- Midstream cost increases / supply chain delays
- Lower economies of scale

Public Safety Microgrid Performance

1		EPB Billing Data					
2	Billing Month	2019 kWh	2020 kWh	2021 kWh	2022 kWh		
3	January	82200	81600	95100	75900		
4	February	87900	93600	92100	77400		
5	March	85800	81300	86400	66300		
6	April	88800	83400	96300	54900		
7	May	83700	66900	86100	51300		
8	June	107700	96300	88200	58800		
9	July	117600	104400	121500	78600		
10	August	107400	122400	117300	89100		
11	September	112200	114300	118500	90000		20% Savings
12	October	110100	92100	102600	82080	Estimated	20520
13	November	86400	80100	78900	63120	Estimated	15780
14	December	84900	76800	62100	62100	Estimated	

19			EPB Billing Data		Calculated Value	EPB Billing Data	
20	**Billing Month**	**2019 kWh**	**2020 kWh**	**2021 kWh**	**Hist 3yr Avg**	**2022 kWh**	**% Usage Savings**
21	**January**	82200	81000	95100	86300	75900	12%
22	**February**	87900	93600	92100	91200	77400	15%
23	**March**	85800	81300	86400	84500	66300	22%
24	**April**	88800	83400	96300	89500	54900	39%
25	**May**	83700	66900	86100	78900	51300	35%
26	**June**	107700	96300	88200	97400	58800	40%
27	**July**	117000	104400	121500	114500	78000	31%
28	**August**	107400	122400	117300	115700	89100	22%
29	**September**	112200	114300	118500	115000	90000	22%
30	**October**	110100	92100	102600	101000	82080	19%
31	**November**	85400	80100	78900	81800	63120	22%
32	**December**	84900	76800	62100	80850	62100	23%
33	Total	1154700	1093200	1145100	1137250	840600	25%

Estimates



Next Steps in Scaling Up Municipal Solar

- GHG Inventory (recurring moving forward)
- Portfolio-Wide Energy-Efficiency and Host-Site Suitability Feasibility Study
- Explore Available Funding Opportunities
  - Capital Budget
  - 3rd Party Financing
  - Federal Funding Opportunities
- Explore partnership opportunities with EPB and TVA
- Measure, Manage, Report

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Zach Lammers

Anne Arundel County Public Schools: Energy Conservation Program Manager

U.S. Department of Energy Better Buildings Summit

Tapping Into the Power of Utility-Scale Solar

Zach Lammers, CEM

Energy Manager

Anne Arundel County Public Schools

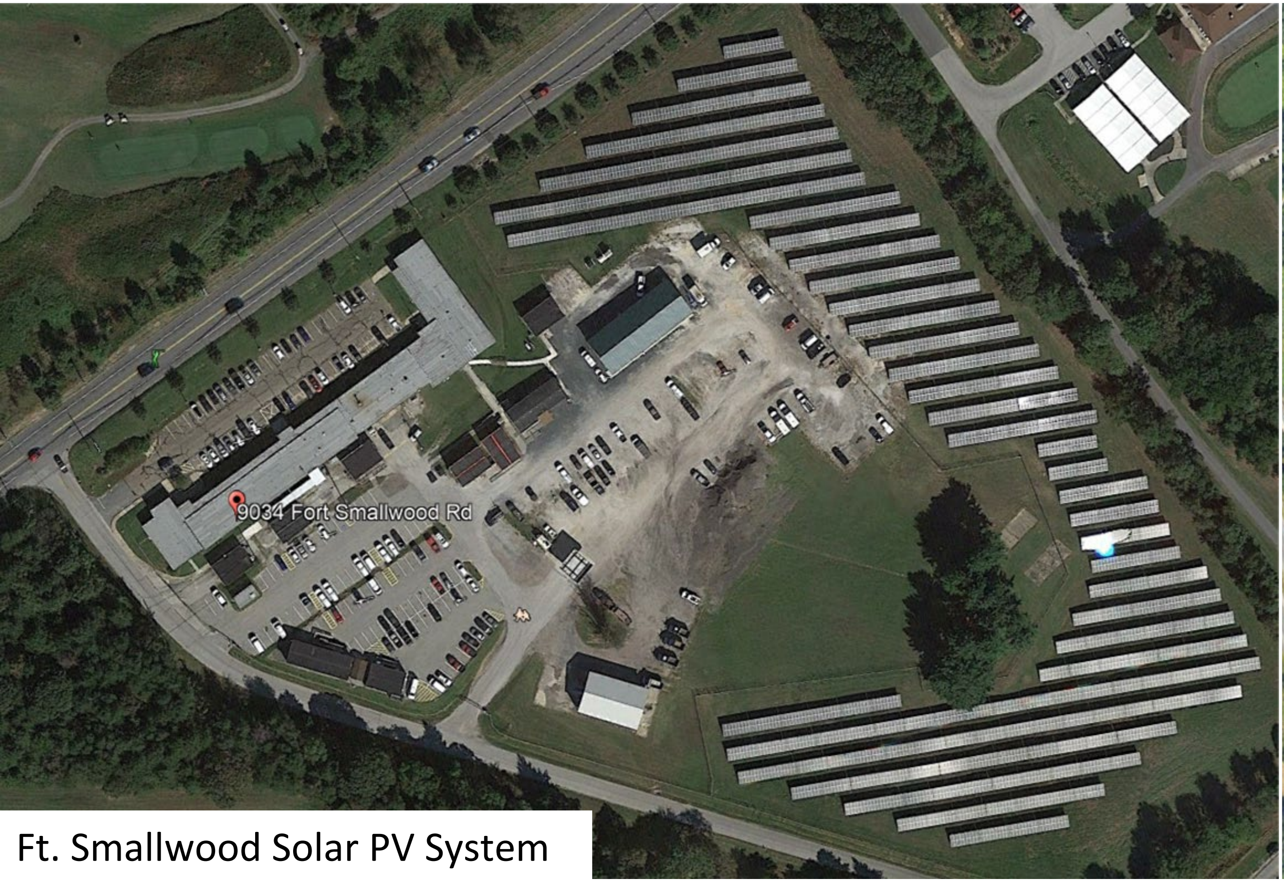
ANNE ARUNDEL COUNTY PUBLIC SCHOOLS

- 80,000+ Student Population
- 3,200 Acres of Property
- 130 Buildings
- 14M+ SQFT of Floor Space
- 100% Air Conditioned
- 99% Integrated to BAS
- Over 1,000 HVAC Schedules
- $18M+/- Utility Budget
  - Over 600 Meters tracked
  - Electric, Natural Gas, Fuel Oil, Water, Propane

**Electricity typically accounts for up 75% of our utility costs*

- 2019 Better Buildings Goal Achiever
- $1M in Energy Intelligence recurring savings since 2018
- Over 200 Strategic Lighting Projects generating $790k in annual savings since 2013
- $532k in Utility Billing errors identified and credited since 2018
- $3.6M in BGE Rebates paid all time with another $2.1M in pursuit
- $3.4M in Demand Response Capacity Payments all time; Net $2.2M Earnings
- 73 MAEOE Green Schools
- 2016 US Dep. Of Education Green Ribbon School District
- 4.4MWdc / 3MWac of aggregate net meter Solar

Ft. Smallwood & City of Annapolis Solar Farms



Ft. Smallwood Solar PV System

Annapolis Solar PV System

4.4 MWdc
3.2 MWac
of Solar Energy

Offset of up to
50 BGE accounts
for the next 20 years

Projected to deliver
$4M in savings
over the life of the agreements

Equivalent Carbon Emission Reduction as removing
730 passenger cars
from the road, each year

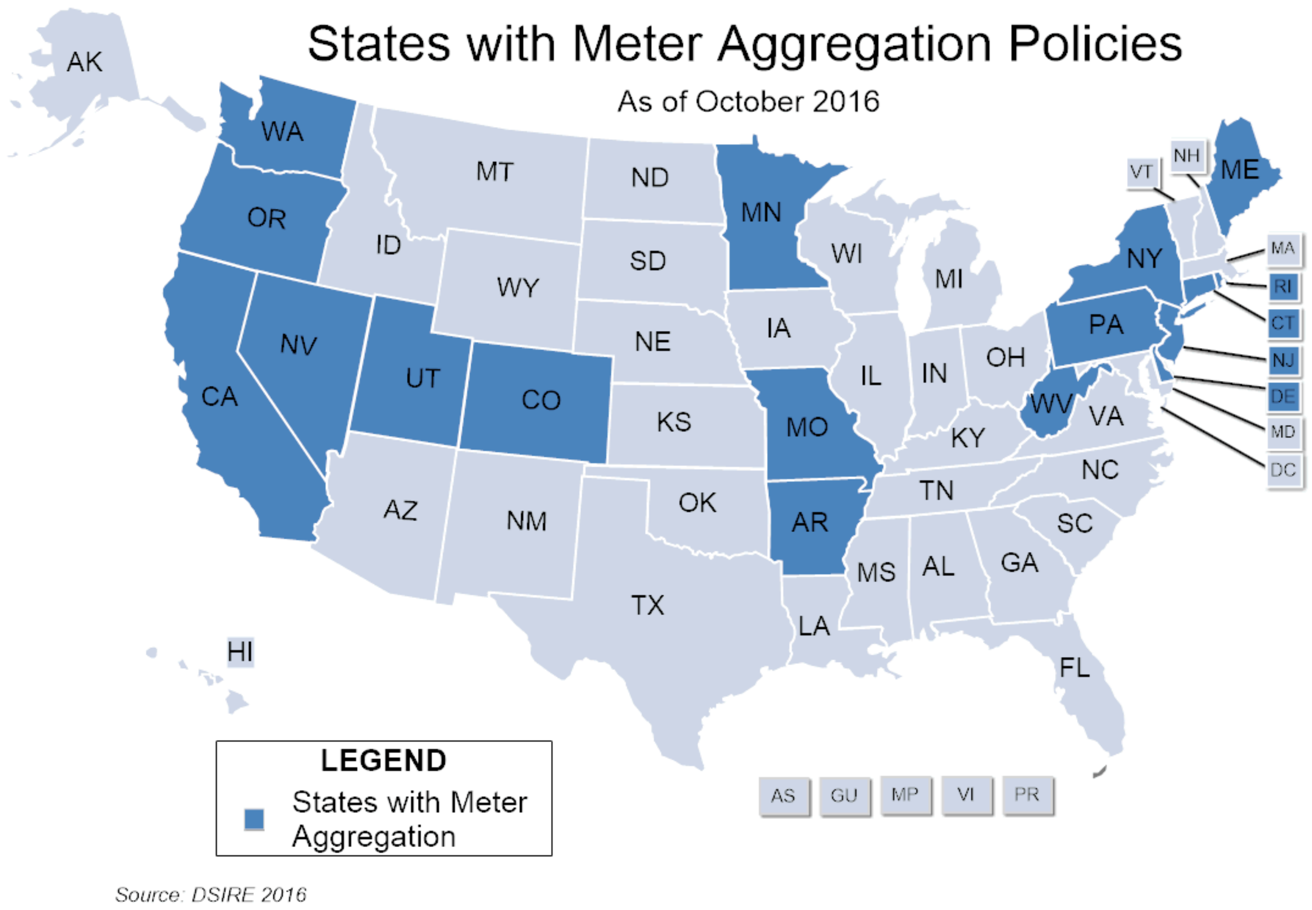
Maryland Aggregate Net Metering (ANM)

Aggregate Net Metering (ANM): is a net metering arrangement that allows for a single generating system to be used to offset electricity use on multiple meters, without necessarily requiring a physical connection between the system and those meters.

ANM enables customers with multiple meters and associated utility accounts, to receive the benefits of a single renewable energy system.

In Maryland: Meter aggregation is allowed for agricultural, non-profit <u>and municipal or county government customers</u>. Customers must provide details on how to distribute excess generation credits when they request meter aggregation.

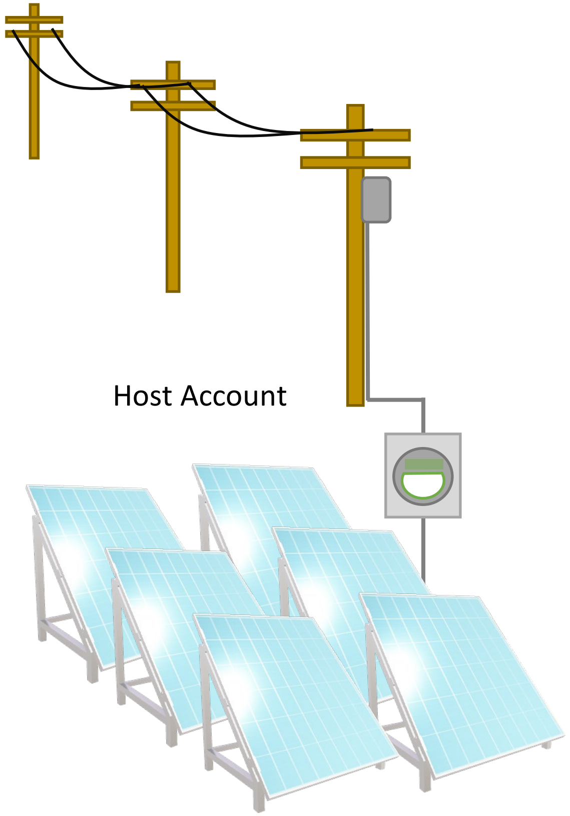
- 2-MWac Max Capacity
- Host Account
- Child Accounts
- AMR required
- Suppliers must match



Front of Meter vs. Behind the Meter

EXAMPLE: GROUND MOUNT vs. ROOF MOUNT

Aggregate Net Meter Arrangement



Utility Assigns kWh Produced by Host Account to Customer Determined Account List each month until all energy produced is accounted for…any remaining kWh are carried over to the next month

- kWh applied to Child Account
- kWh applied to Child Account
- kWh applied to Child Account
- kWh Carryover

vs.

Facility Net Meter Arrangement

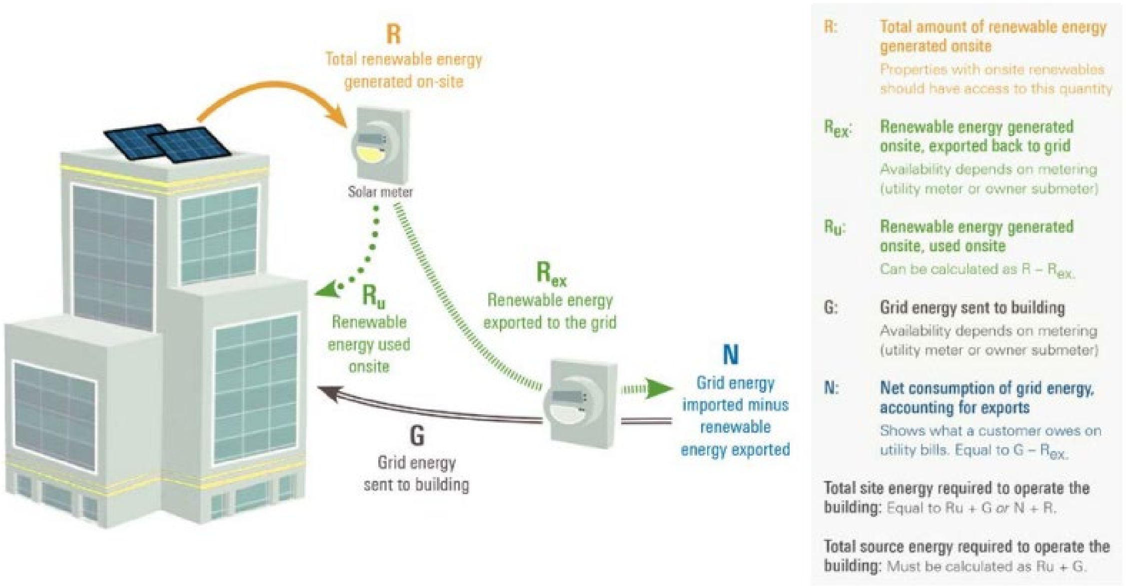
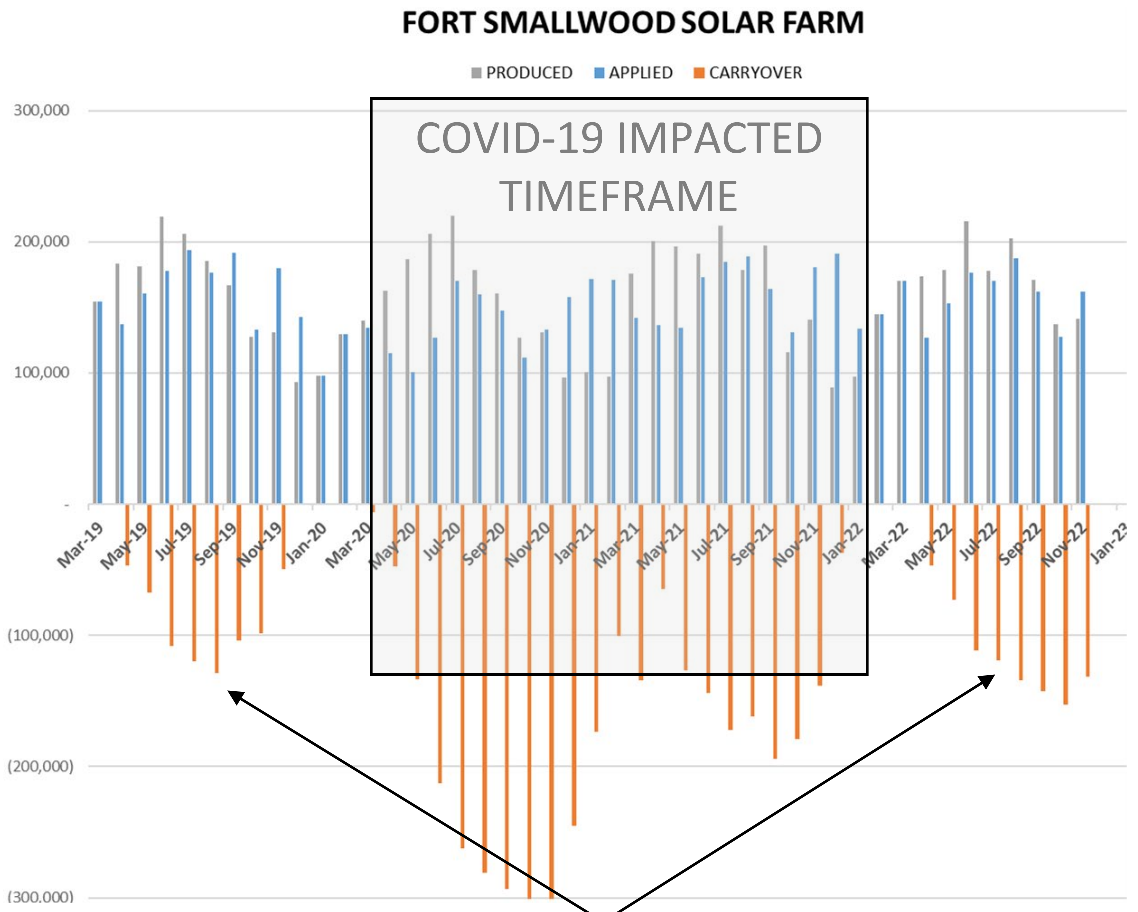


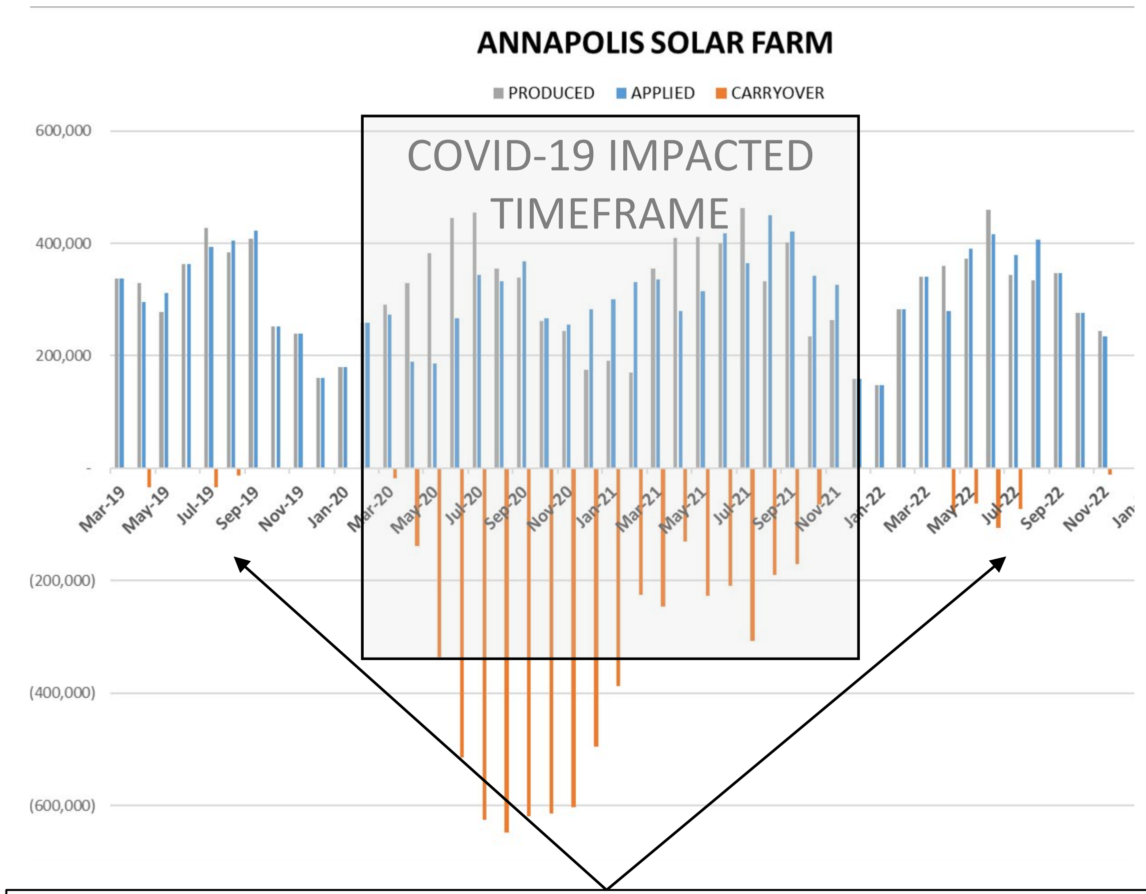
Image Source: EPA Energy Star Portfolio Manager Tech Ref. Green Power

purely kWh driven cost benefit…

kWh & kW driven cost benefits…

Example ANM Monthly Production and Child Account Offset Optimization





Wil assess whether adding (1) small G account in Spring'23 beneficial to reduce carryover and end of year credit based on 2019 and remainder of 2022 performance

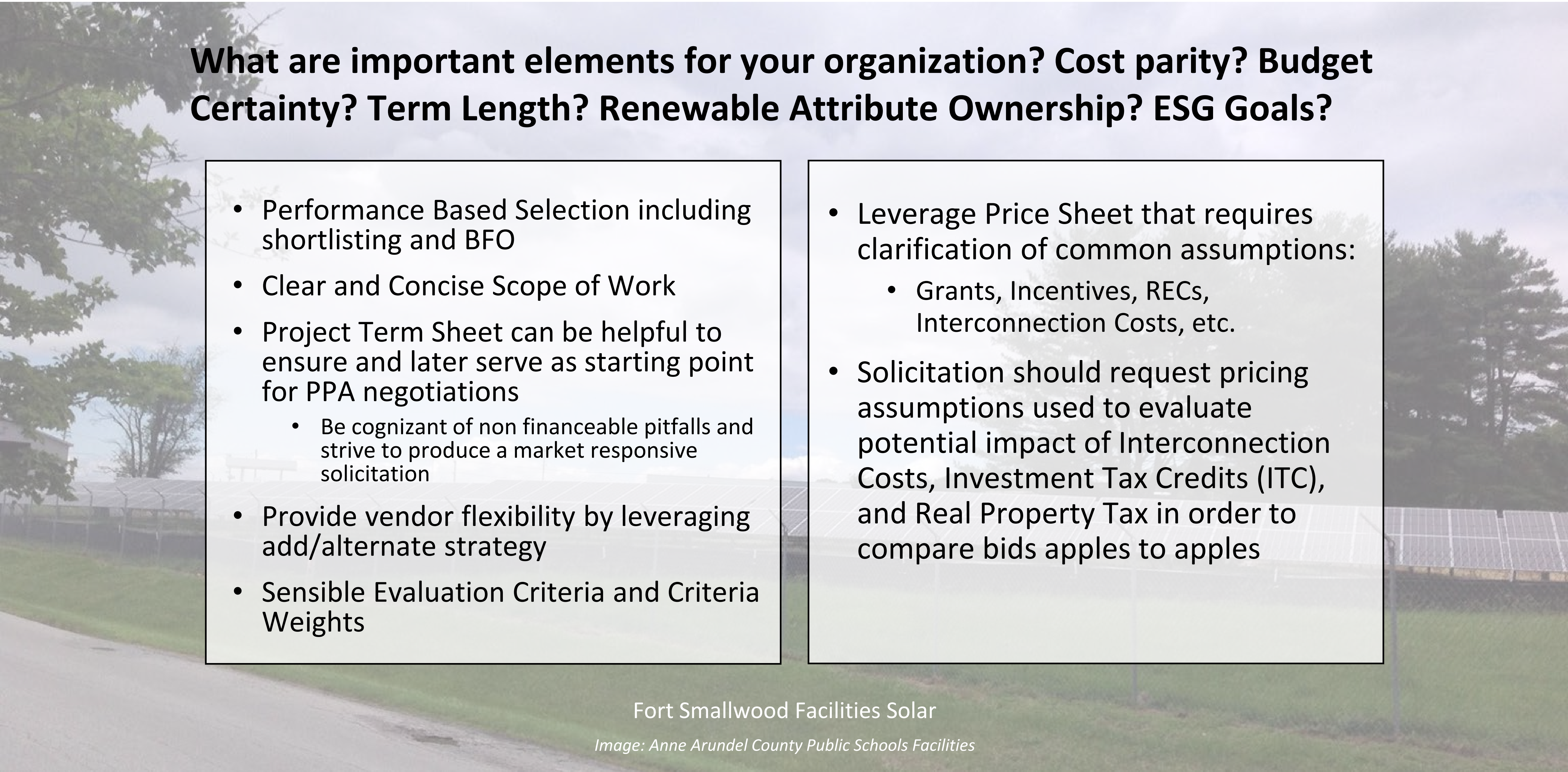
Wil remove last few GL accounts in Spring'23 to eliminate exposure to SOS rates for those accounts based on 2019 and remainder of 2022 performance

RFP Approach, Critical Elements, Lessons Learned

What are important elements for your organization? Cost parity? Budget Certainty? Term Length? Renewable Attribute Ownership? ESG Goals?

- Performance Based Selection including shortlisting and BFO
- Clear and Concise Scope of Work
- Project Term Sheet can be helpful to ensure and later serve as starting point for PPA negotiations
  - Be cognizant of non financeable pitfalls and strive to produce a market responsive solicitation
- Provide vendor flexibility by leveraging add/alternate strategy
- Sensible Evaluation Criteria and Criteria Weights

- Leverage Price Sheet that requires clarification of common assumptions:
  - Grants, Incentives, RECs, Interconnection Costs, etc.
- Solicitation should request pricing assumptions used to evaluate potential impact of Interconnection Costs, Investment Tax Credits (ITC), and Real Property Tax in order to compare bids apples to apples



Fort Smallwood Facilities Solar

Image: Anne Arundel County Public Schools Facilities

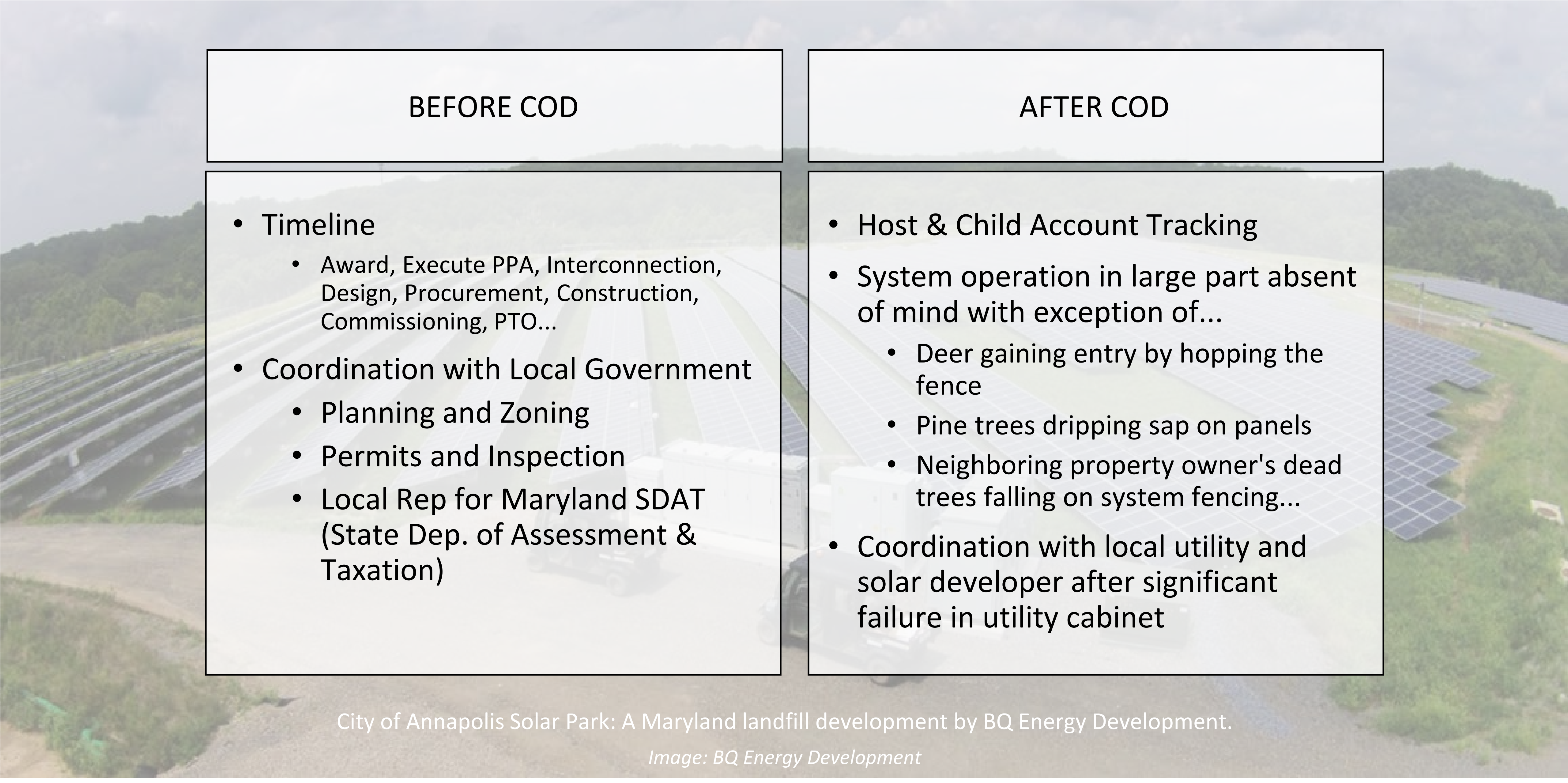
Lessons learned leading up to and after COD

BEFORE COD

- Timeline
  - Award, Execute PPA, Interconnection, Design, Procurement, Construction, Commissioning, PTO...
- Coordination with Local Government
  - Planning and Zoning
  - Permits and Inspection
  - Local Rep for Maryland SDAT (State Dep. of Assessment & Taxation)

AFTER COD

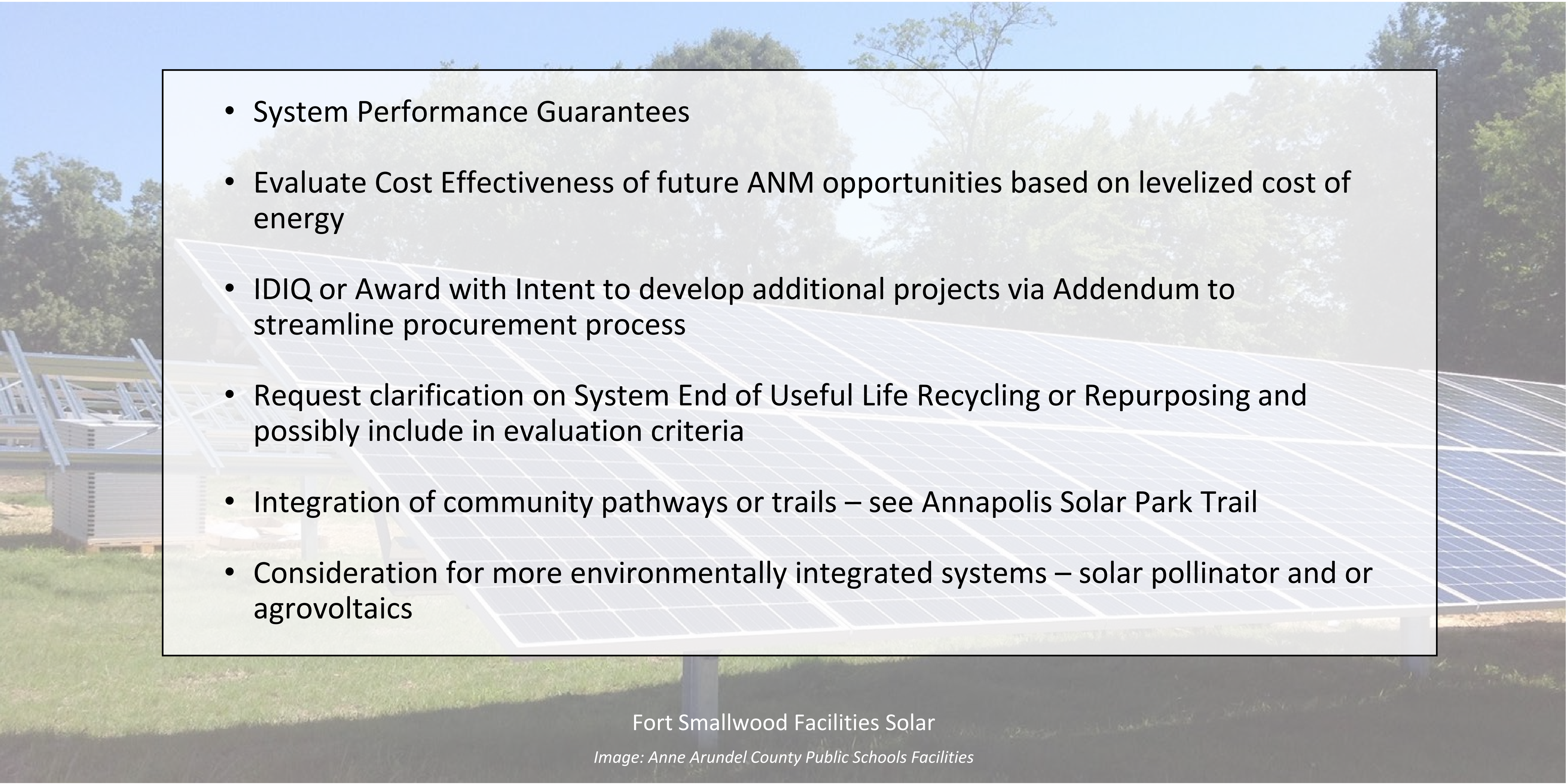
- Host & Child Account Tracking
- System operation in large part absent of mind with exception of...
  - Deer gaining entry by hopping the fence
  - Pine trees dripping sap on panels
  - Neighboring property owner's dead trees falling on system fencing...
- Coordination with local utility and solar developer after significant failure in utility cabinet



City of Annapolis Solar Park: A Maryland landfill development by BQ Energy Development.

Image: BQ Energy Development

Considerations for future Opportunities



- System Performance Guarantees
- Evaluate Cost Effectiveness of future ANM opportunities based on levelized cost of energy
- IDIQ or Award with Intent to develop additional projects via Addendum to streamline procurement process
- Request clarification on System End of Useful Life Recycling or Repurposing and possibly include in evaluation criteria
- Integration of community pathways or trails – see Annapolis Solar Park Trail
- Consideration for more environmentally integrated systems – solar pollinator and or agrovoltaics

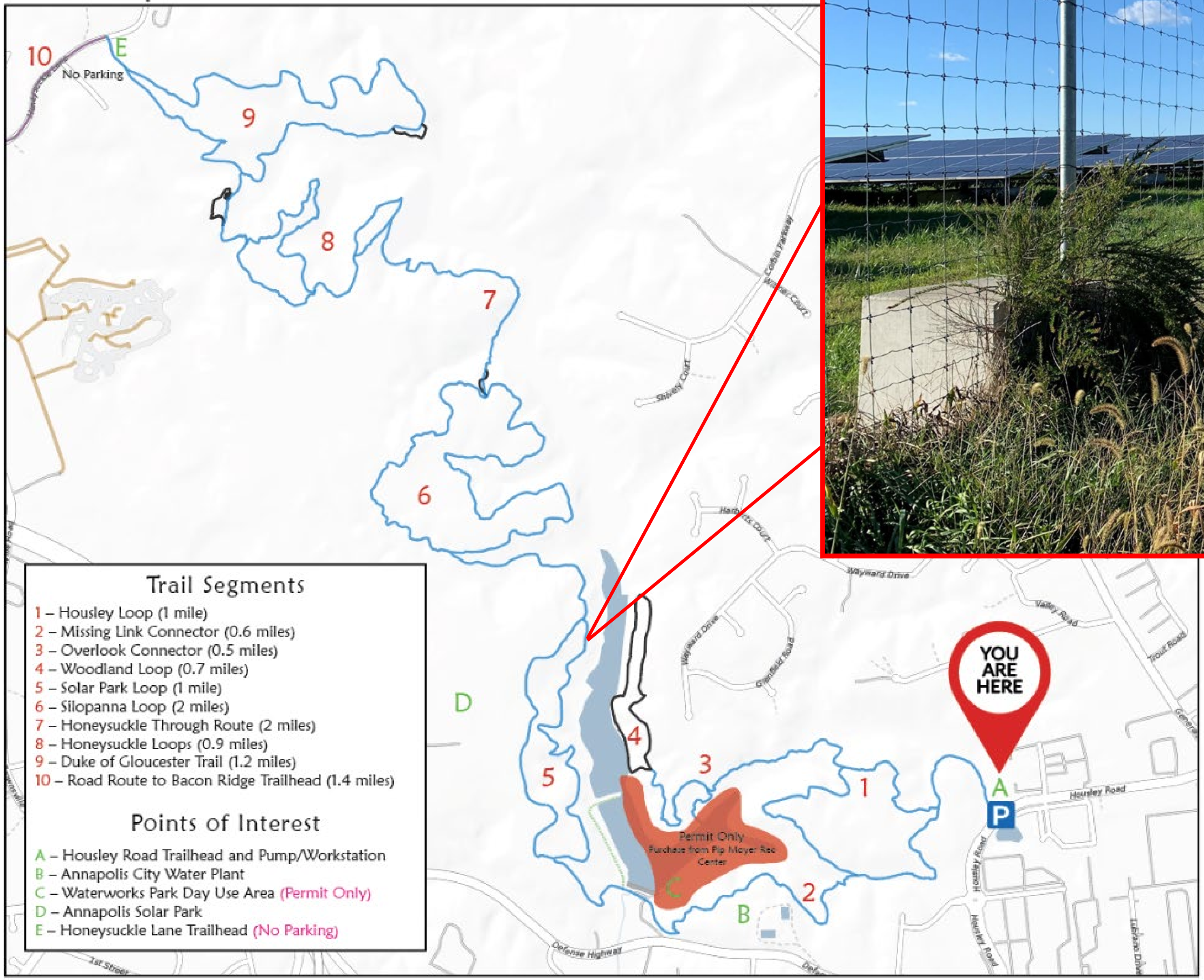
Fort Smallwood Facilities Solar

Image: Anne Arundel County Public Schools Facilities

ANNAPOLIS Waterworks MD TRAIL USA

EST. 2019

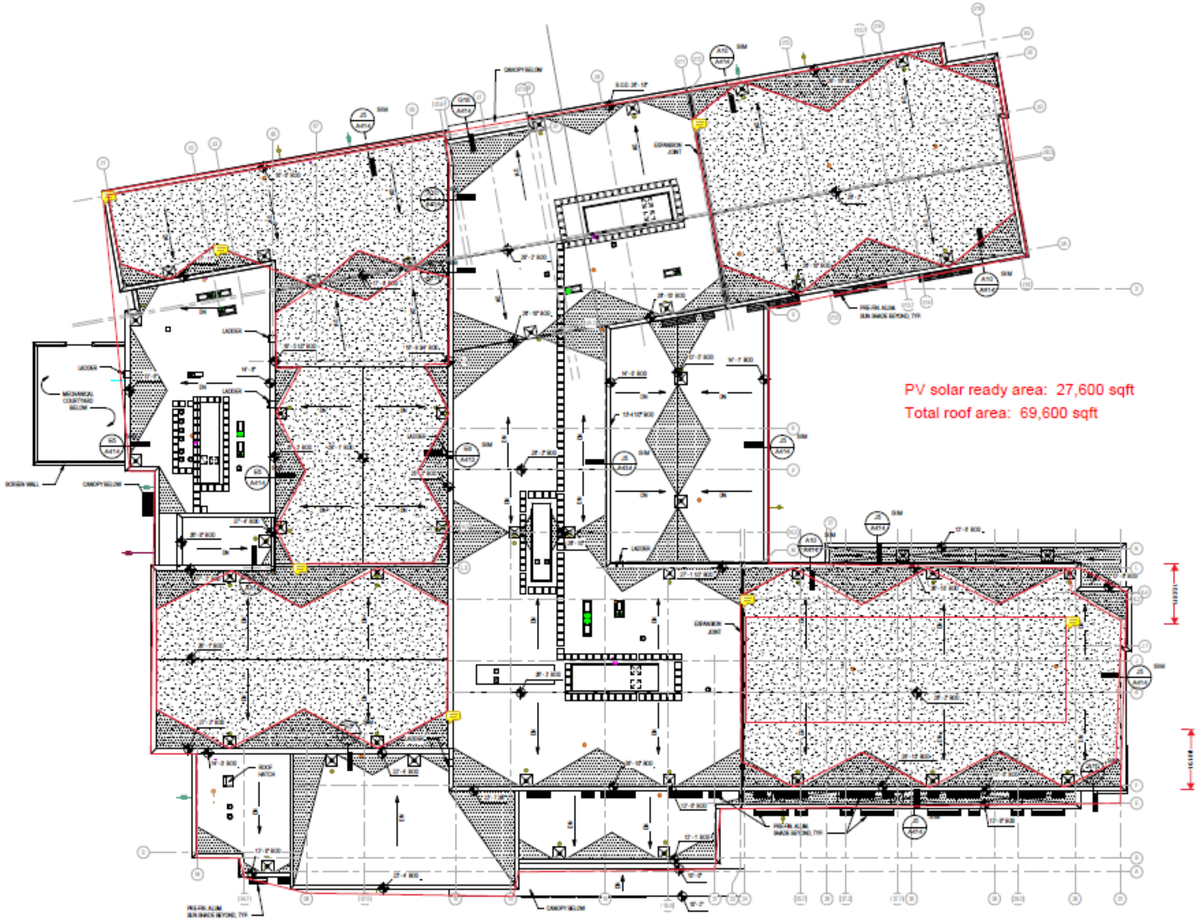
Trail Map



TRAILFORKS

Solar-Ready Project Potential (2018 IECC Appendix CA)

- Old Mill West HS – Roof mount
  - Estimated capacity: **970 kW-DC**
- Rippling Woods ES - Rooftop array
  - Estimated capacity: **420 kW-DC**
- Quarterfield ES - Rooftop array
  - Estimated capacity: **349 kW-DC**
- Hillsmere ES - Rooftop array
  - Estimated capacity: **272 kW-DC**



Total Capacity: **2,012 kW-DC** (calculated by Lightbox Energy)

Baltimore Regional Cooperative Purchasing Committee
Renewable PPA Workgroup

- BRCPC is one of largest buyers of electric in state of MD
  - Energy Advisory Purchasing Strategy has saved the group on average $14M a year compared to SOS rates
  - AACPS has saved in excess of $8M by participating in BRCPC since 2011/2012
- SB 516 – Clean Energy Jobs Act increased RPS standard to 50% renewable by 2030
  - DC, Philadelphia 100% of electric from renewable by 2030
  - California 100% of electric from carbon neutral by 2045
  - Maryland Schools, Howard County Gov, AA Co Gov, Baltimore County Gov, etc. pursuing Solar
- Benefits
  - Improve regional air quality, support transition away from carbon intensive sources
  - Manage long term energy price risk
  - Get ahead of cost of carbon and future SREC price increases
- Challenges
  - BRCPC has no legal authority to enter multi-year PPAs and each entity has their own governing bodies / procurement regulations
  - Renewable PPA likely come at a small premium to conventional energy in the first few years of PPA
- Renewable PPA RFP Experience in 2021
  - Strategy: Request renewable energy proposals for 10% – 15% of BRCPC's annual load
  - Several lessons learned – rigid terms and conditions, challenging timelines, and insufficient market engagement led to insufficient market participation and an inability to award due to a lack of appropriate competition
- Individual members are continuing to develop interagency renewable projects

Closing Thoughts…

Q & A

Thank You!

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