PHI Plans for Grid Modernization

Pepco Holdings
An Exelon Company

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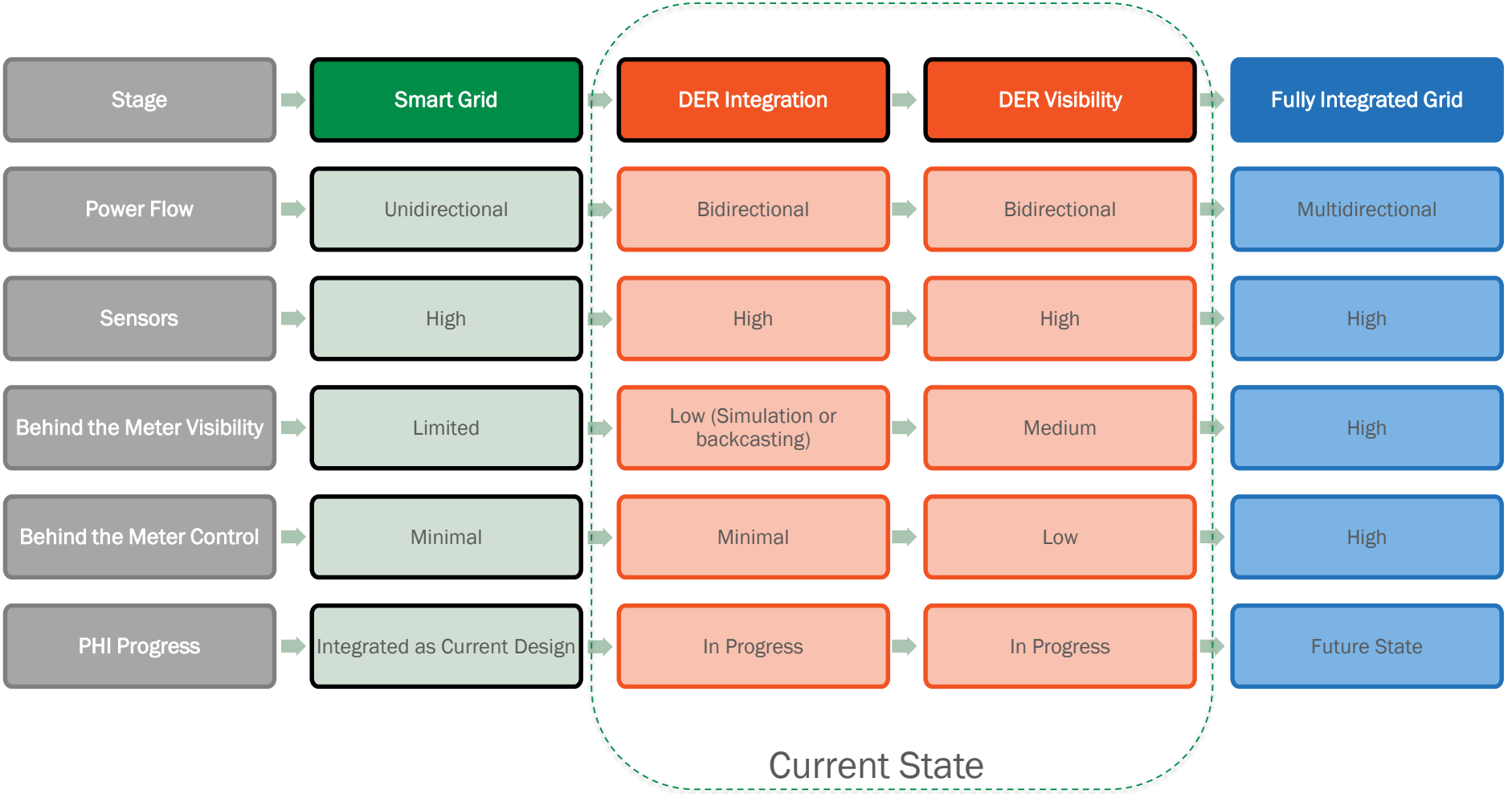
Stages of Grid Modernization



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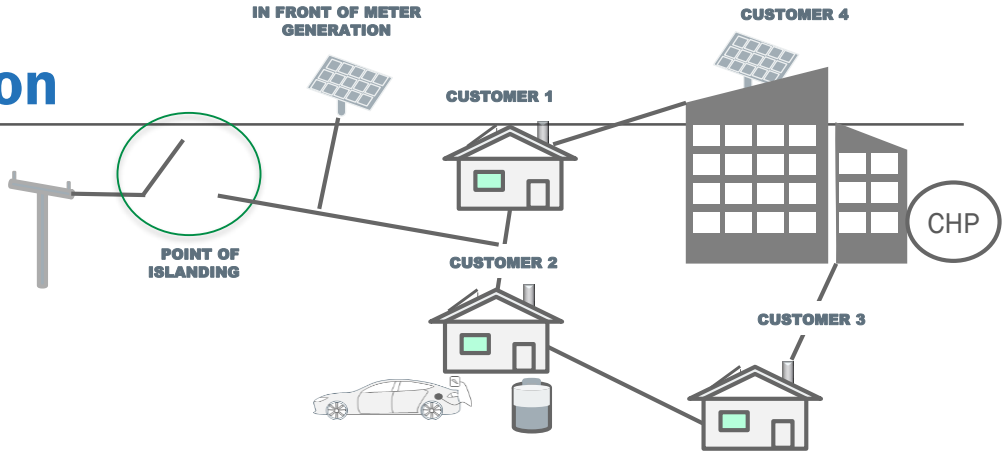
Technologies Under Evaluation



Storage

Design Considerations

- Connection Point
- Inverter Type & Functionality
- PJM Market Interaction
- Discharge rules for NEM net-exporter

Challenges

- Variable battery technical and operating characteristics
- Degradation
- Customer usage protocols

Electric Vehicles Infrastructure

Grid Investment Required for Large-Scale EV Adoption

- At-Home Charging
- Public and semi-public EV supply equipment

Utility's Role

- Maintaining Reliability
- Existing Smart Grid investments and equipment
- System knowledge and customer fairness
- Customer interface experience and education

Microgrids

Campus Microgrids

- Owned and operated by a single customer.
- Owner has complete responsibility for the operation, maintenance and performance of the system.

Public-Sited Microgrids

- Serve multiple customers.
- Owner of the generation will likely be different than the customers served by the microgrid.

Merger Commitments

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Pepco Proposals across the regions

District of Columbia - $1.7M (Filed April 2017 currently in MEDSIS)

Infrastructure Program			Rates
Residential	Non-Residential	Utility Owned	
• 100 customers with existing EVSE get 2nd meter for EV only rate • Up to 50 Smart Chargers for Residential Customers	• 10 Smart Chargers for Multi-Dwelling Unit (MDU) facilities	• 4 DC Fast Charging Stations in the District	• Whole House ToU for 500 customers • EV only ToU • Green Rider

Maryland - $44.2M (Filed January 2018, Currently in PC44)

Opco	Infrastructure Program			Rates	Other Programs
	Residential	Non-Residential	Utility Owned		
Pepco MD	• 100 units L2 smart charger and installation rebate up to 50% of cost • 750 units $500 rebates for L2 Smart Chargers; utility collects data • 100 utility provided FleetCarma devices;	• 50% discount for 667 L2 Workplace Stations • 200 L2 Stations at Multi-Unit Dwellings	• 414 L2 Neighborhood Public Stations • 33 Public DC FC Stations	Whole House ToU with Green Rider option	• Innovation Fund - Develop projects that serve underserved / low income areas (car share, buses, etc.) • Technology Demo (C3, frequency response, integrate storage, etc.)
DPL MD	• 37 units – L2 smart charger and installation rebate up to 50% of cost; • 250 units $500 rebates for L2 Smart Chargers; utility collects data. • 37 utility provided FleetCarma devices;	• 50% discount 239 L2 Workplace Stations • 50 L2 Stations for Multi-Unit Dwellings	• 149 L2 Neighborhood Public Stations • 12 Public DC FC Stations	Whole House ToU with Green Rider option	• Innovation Fund - Develop projects that serve underserved / low income areas (car share, buses, etc.) • Technology Demo (C3, frequency response, integrate storage, etc.)

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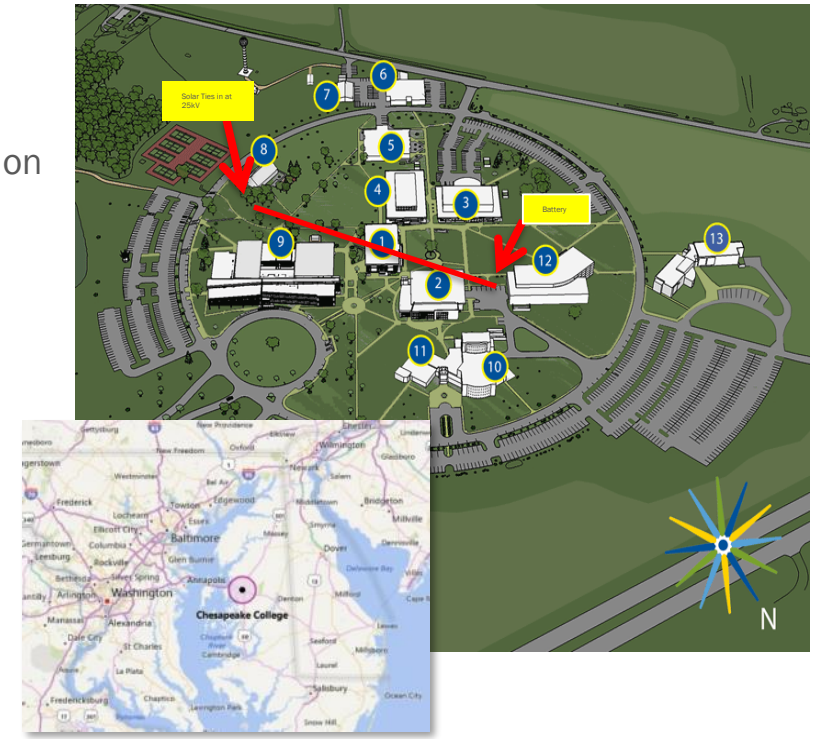
PHI Current Storage Projects – Chesapeake College

Started as a solar DER system on a high penetrations feeder

Delmarva applied for, and received, $250K grant from MEA for installing batteries to help mitigate the effects on the Distribution System

College is identifying critical loads to create microgrid



Building Loads to Back Up:

2 – Caroline Center

12 – Learning Resource Center

The College has a 25kV system for the campus with switchgear connecting to DPL in Bldg 12

Distance from Solar Tie in at 25kV to where Battery System will be located (shown as red line) is about 2,000'

PV System

- Size: 2.18 MW DC, 1.76 MW AC
- Installer/Owner: Solar City
- Inverters: Solectria (with smart inverter functions)
- Output from inverter will be 480V then tied to 480/25kV transformer to step up to 25kV
- System is split into a 1,464 kW ground mount array and 300 kW carport with EV charging capability
- In-service date: May 2016

Battery System

- Proposed size is 1MW, 500kWh (half hour battery)
- Installer/Owner: AF Mensah
- Battery and PV system will have separate inverters for independent operation
- Electrical interconnection design to be proposed by AF Mensah

Next Steps

- Work with Solar City, AF Mensah, and Chesapeake College to enable final design into permanent operation
- Finalize central and local control strategy after selecting Central Control vendor
- Collect data and submit report to MEA.

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Prince George's County MD Location - Largo

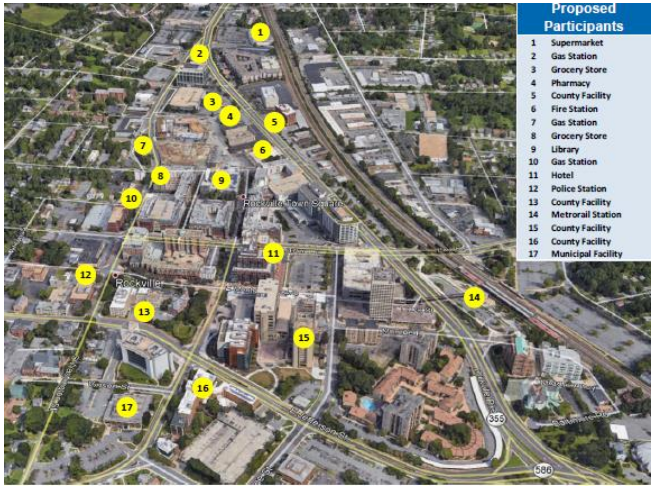
- The area adjacent to the Largo Town Center was selected by the County as an ideal location that could serve the community during periods of prolonged outages
- Identified participants include a hospital, county services building, medical facility, gas station, pharmacy, and grocery store
- Potential generation mix:

Proposed Participants	
1	County Admin. Bldg.
2	Medical Facility
3	Pharmacy/drugstore
4	Gas Station
5	Grocery Store
6	Hospital

Generation			Energy Storage	
Type	PV Array	Natural-Gas-Fired Generation	Type	Battery
Fuel	Solar	Natural Gas	Output	1.6 MW
Capacity	1.225 MW	5.6 MW	Capacity	3.2MWh
Sq. Footage (approx.)	130,000	5,000	Sq. Footage (approx.)	1,000
Location	Rooftop, Parking Lot/Garage (Canopy)	Indoor	Location	Parking Lot, Electric Room
Total	**6.8 MW**		**Total**	**1.6MW**

Montgomery County, MD Location – Rockville

- Montgomery County selected the area near and around the Rockville Town Center as an ideal location to serve the community in an emergency situation
- Identified participants include emergency response services, government (county and city) services, multiple grocery stores and gas stations, a hotel a pharmacy and a WMATA passenger station



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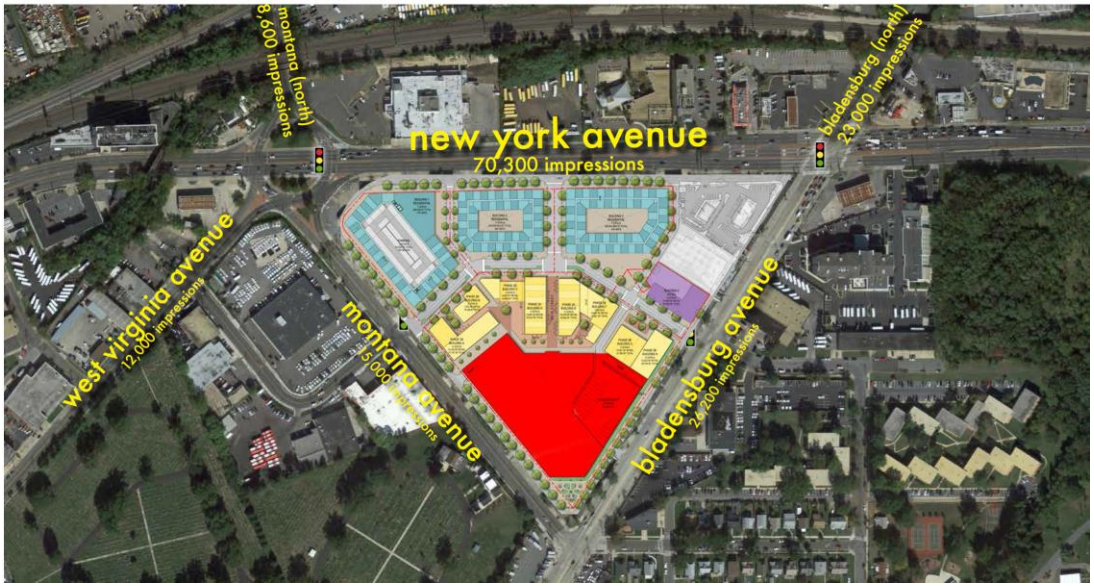
Generation			Energy Storage	
Type	Rooftop & Canopy PV Array	Gas-Fired	**Type**	Battery
Fuel	Solar	Natural Gas	**Output**	0.25 MWh
Size	0.86 MW	6.60 MW	**Capacity**	0.5 MWh
Space (Sq. Ft.)	80,000	6,000	**Space (Sq. Ft.)**	200
Location	Rooftop, Canopy (Parking Lot)	Indoor or Outdoor	**Location**	Indoor or Outdoor
Total	**7.46 MW**		**Total**	**0.25 MW**

New City Microgrid – Douglas Development

- Proposing a renewable and sustainable microgrid to provide reliable supply for an urban complex development:
  - 10-20% green power production from roof-top solar PV systems on buildings
  - Supplying the customers during power outages
  - Incorporating innovative technologies such as: Energy Storage, EV chargers, energy conservation schemes



Generation Equipment	Size
Natural Gas Turbine	7 MW
Photovoltaic	1.7 MW
Battery[1]	0.5 MW/1 MWH

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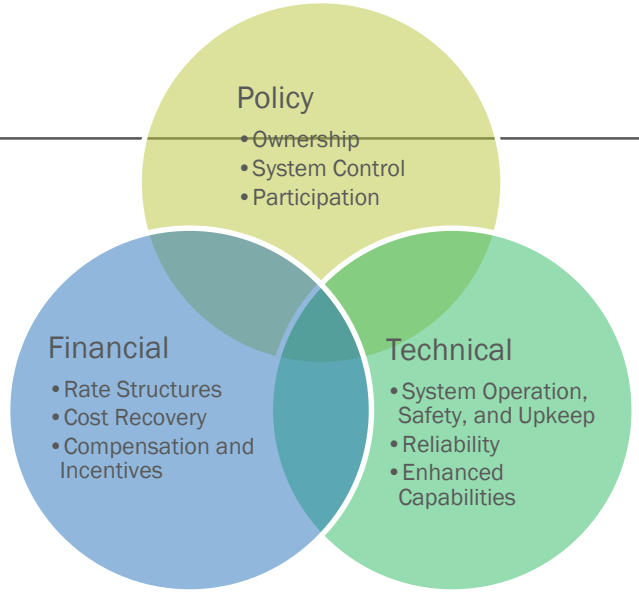
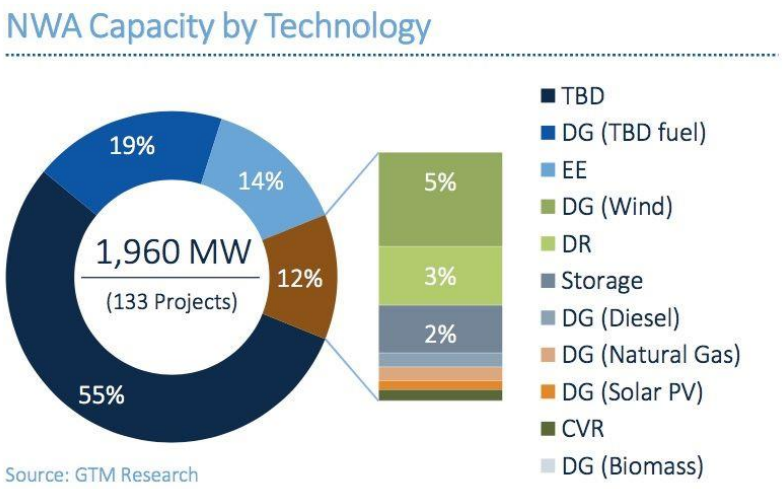
Points to Consider…

- Conventional Planning and Operating the future Distribution Grid will become more complicated
  - Higher penetrations of DER
  - Deployment of storage
  - Microgrids
  - Electric Vehicles / Vehicle to Grid
  - Advanced Demand Response



- Large Capital Capacity Projects will continue to be challenged by commissions with greater frequency
  - Non-Wires Alternatives and Deferral are the new financial model

- In order to maximize the amount of DER connected to the grid, the way systems are operated and dispatched will need to be better designed and managed



Utilities are uniquely positioned to support this initiative with expertise, system knowledge, and technical capability.

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WHO
WHAT
WHERE
WHEN
WHY
HOW
QUESTIONS
ANSWERS