



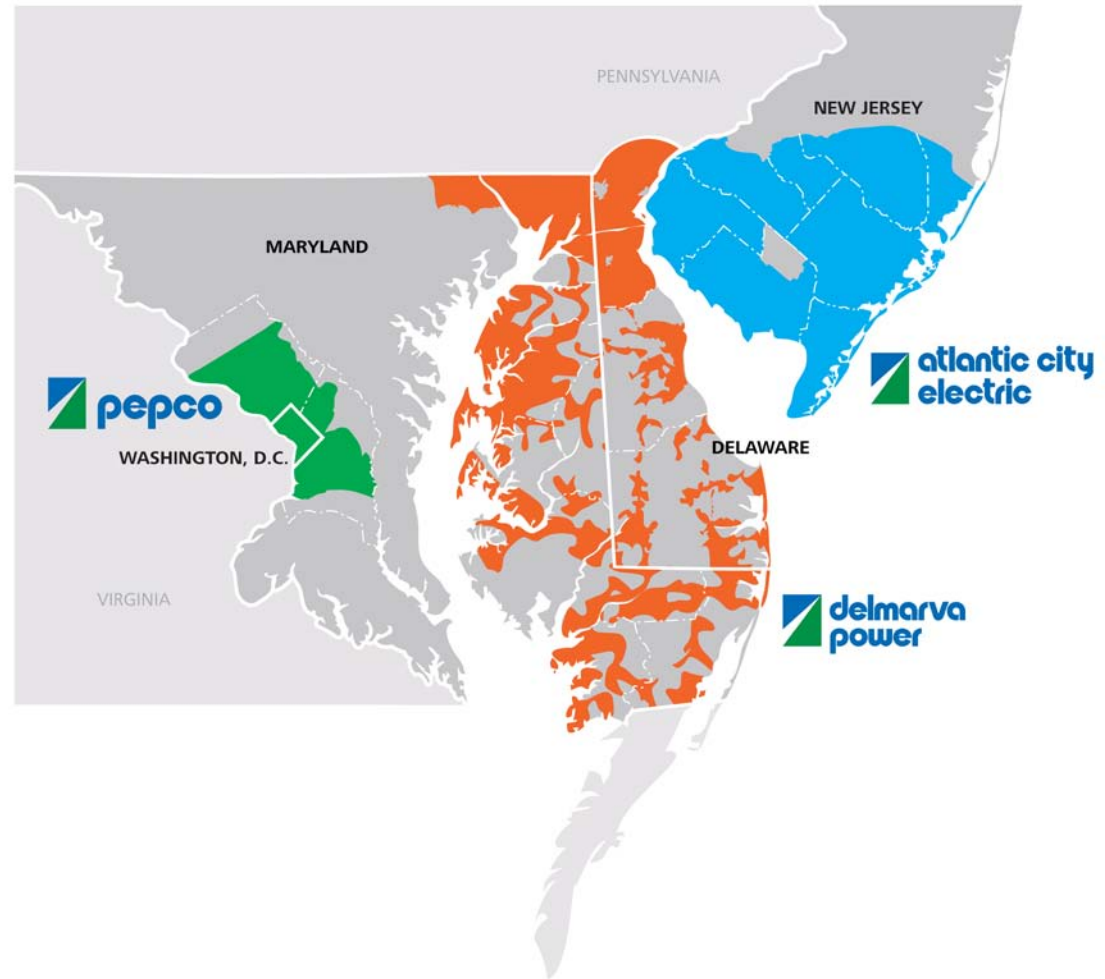
Challenges Impacting Critical Electrical Infrastructure in the Floodplain and Flood Prone Areas due to Storm Events and Sea-level Rise



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Pepco Holdings Quick Facts

- Incorporated in 2002
- Service territory:
8,340 square miles
- Customers served
 - Atlantic City Electric:
 - 545,000 – electric
 - Delmarva Power:
 - 503,000 – electric
 - 125,000 – natural gas
 - Pepco:
 - 793,000 – electric
- Total population served:
5.6 million



In general, what are the issues with sea-level rise?

- Higher and more frequent flooding of wetlands and adjacent shores
- Expanded flooding during severe storms and high tides



In general, what are the issues with sea-level rise?

- Increased wave energy in the near-shore area
- Upward and land-ward migration of beaches
- Accelerated coastal retreat and erosion



In general, what are the issues with sea-level rise?

- Damage to coastal infrastructure
- Overall impacts on the coastal economy



What Challenges do Utilities face due to sea-level rise?

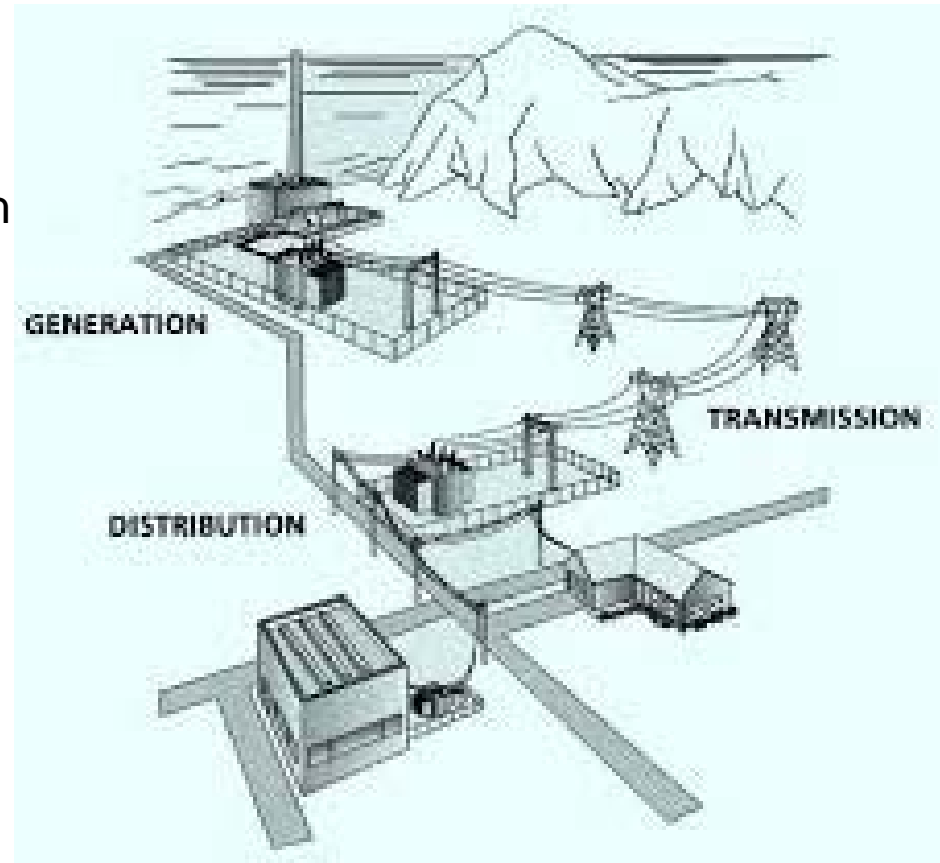
- Limited access for routine maintenance and storm restoration
- Vulnerability of our utility infrastructure to flood damage
- Changing drainage patterns affecting infrastructure stability
- Maintaining reliable service due to the affects of sea-level rise



What are we doing to address sea-level rise?

We are focusing on two critical parts of our infrastructure....

- Transmission Circuits
 - Transmission circuits are the power lines that transport high voltage electricity from the generating stations to the substations.
- Substations
 - Substation are fed by transmission circuits and transform the high voltage energy to low voltage energy that energize communities.



Proposed Transmission Circuit Hardening

Possible Actions:

- 1.) hardening pole line infrastructure to a steel and concrete solution to accommodate extreme wind conditions,
- 2.) correcting foundation stability problems in tidal wetlands and flood plains for pole lines, and,
- 3.) placing entire circuits or portions thereof underground in especially sensitive areas. It will better position these assets to withstand extreme wind forces and storm surges by replacing vulnerable wood poles with steel, installing steel caisson foundations (as necessary), installing storm guying, and / or by using submarine cable or underground cable in conduit as conditions require.

Justification: During Hurricane Sandy, 23 transmission circuit interruptions caused wide spread outages due to downed poles and downed conductors. This included circuits that serve the Barrier Islands (including for example, Long Beach Island and Ocean City)

Potential Benefits:

- Improved customer reliability due to reduced transmission line outages resulting from storm wind and surge impacted transmission poles and lines.
- Improved restoration times due to reduced exposure of transmission line assets to storm wind and surge.
- Improved aesthetics from fewer poles with more compact construction.
- Lessened environmental impact due to improved placement of transmission assets.

Note That:

- 5 Coastal Circuits and 11 circuits feeding Barrier Islands were out during Hurricane Sandy

Transmission Circuit Hardening



Transmission Circuit Hardening



Substation Storm Surge Prevention

Possible Actions: Upgrade substations to mitigate those with reported flooding and those in the FEMA – ABFE 1% (Advisory Base Flood Elevation – 1% annual chance of being equaled) flood plain and coastal impact areas. The upgrades include (a) installing new equipment at a higher elevation and in more secure buildings (b) elevating switchgear, transformers and control houses, (c) installing GIS (Gas Insulated Substation) equipment to replace air insulated equipment (d) installing protective walls and (e) weather proofed enclosure/buildings for substation switchgear and controls.

Resiliency Justification: There were 16 substations that had reported some degree of flooding in the ACE region during the last two major hurricanes (Irene and Sandy). ACE has 13 substations within the Federal Emergency Management Agency's Advisory Based Flood Elevation (ABFE) 1% flood zone.

Potential Benefits:

- Prevention of water damage to the critical substation buildings and equipment that occurs due to storm surges
- Elimination of potential catastrophic equipment failure
- Reduced equipment failures and outages due to flying debris by enclosing equipment in buildings or steel enclosures
- Reduced customer outages due to less substation asset damage resulting from storm surges
- Lessened environmental impact due to improved critical infrastructure protection
- Extended life of substations with new equipment replacements and increased capacity

Notes:

- Substations are on coastal and river surge areas
- GIS site buildings
- Switchgear replacement
- Control Building replacement
- Raise Transformers

Substation Storm Surge Prevention (Photos)



Existing Peermont Substation



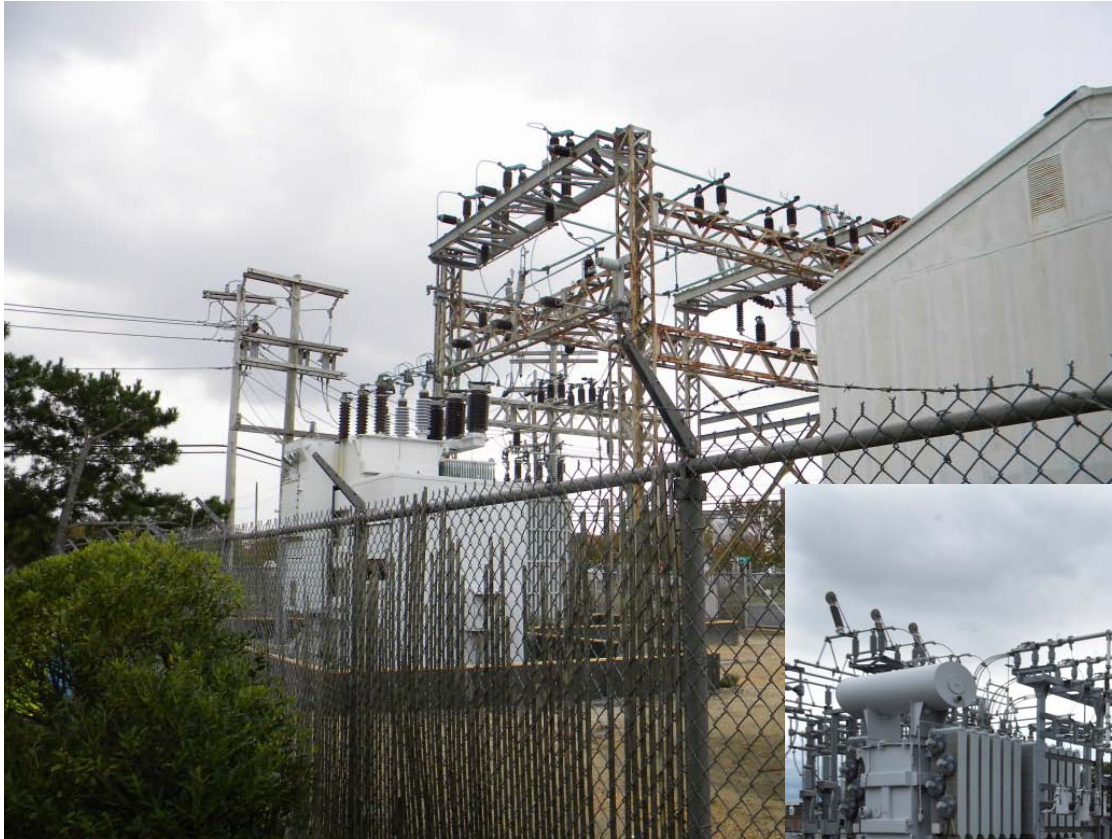
Substation Storm Surge Prevention (Photos)



New Peermont Substation



Substation Storm Surge Prevention (Photos)



Substation Firming

Possible Actions: Upgrade existing and build new substations as required to serve all customers from substations having 100% redundant transformer capacity.

Resiliency Justification: Substation Firming eliminates the need to transport a mobile transformer to the site of a failed substation transformer to restore customers out due to the failure of that substation transformer.

Potential Benefits:

- Improved customer reliability due to the minimization of sustained outages related to substation transformer and/or transmission supply failures.
- When paired with “Create Additional Tie Points”, provides additional substation capacity for use in restoring feeders from adjacent substations.

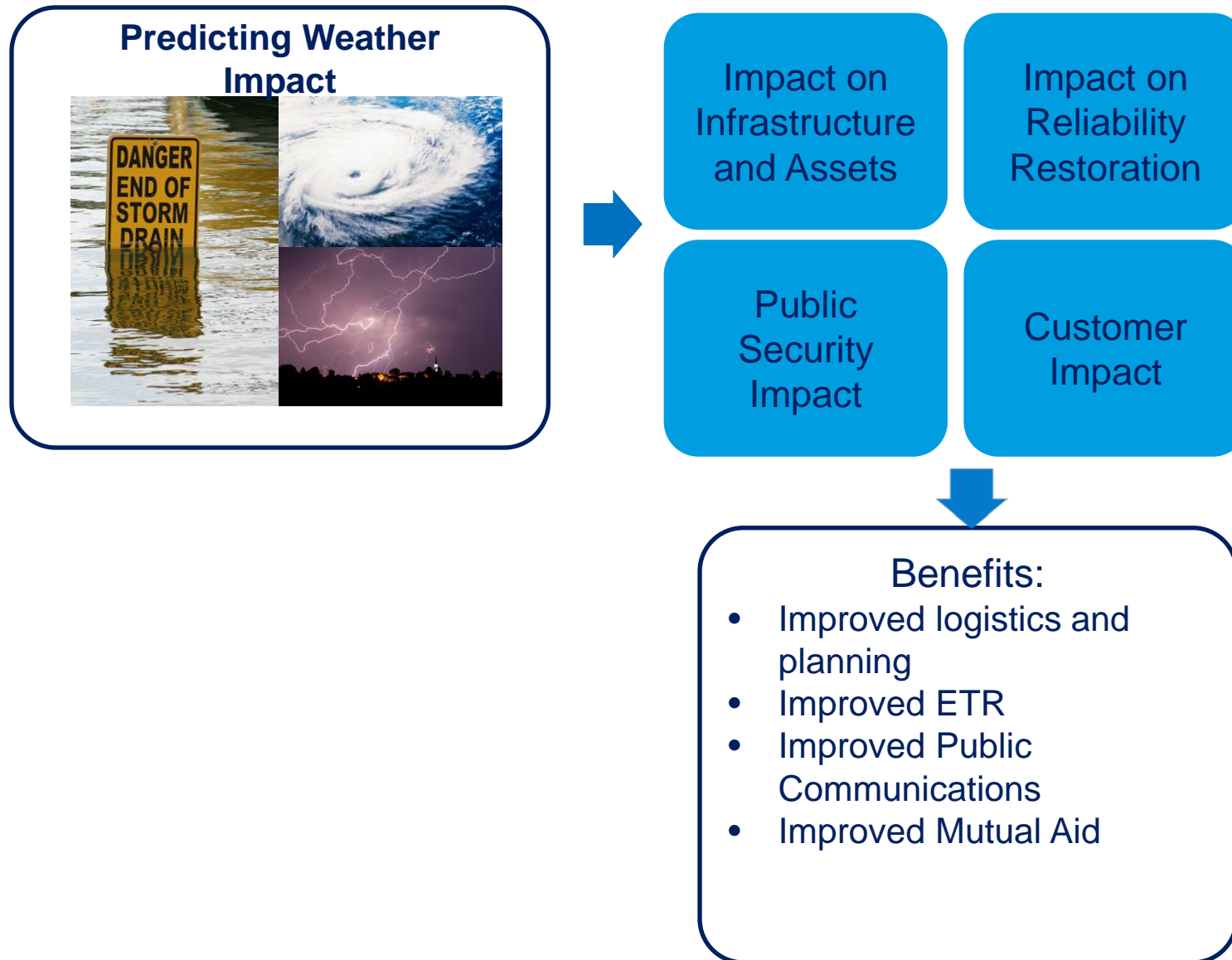
Vulnerability Assessment



Vulnerability Assessment

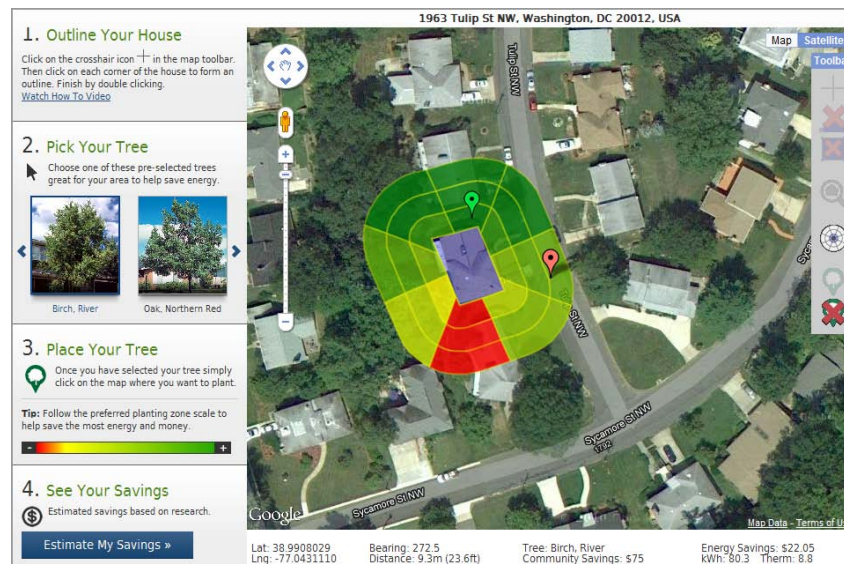


Integrated Damage Prediction Model





- Two free trees per customer for energy saving benefits
- Partnership with Arbor Day Foundation since 2011
- Online mapping tool indicating best place to plant for most energy savings
- Also improves air quality, storm water, carbon sequestration
- To date, 3,900 trees in DPL (20,300 across territory)



Habitat Restoration Addressing Sea Level Rise Impacts: Nanticoke River Wetland Restoration, Vienna, MD

- 260+ PHI-owned acres targeted for restoration of native wetland vegetation
- Reintroduce structural diversity – improved habitat and wetland health
- MD DNR, USFWS, multiple adjacent landowners
- Landscape scale effort
- Photo: 1 yr after 1st treatment

