Climate Change Vulnerability Study and Resilience Plan

Third Climate Resilience Working Group (CRWG) Meeting

October 18, 2023

nationalgrid

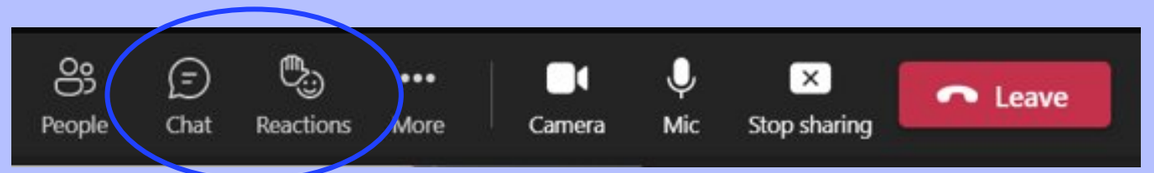
Today's Agenda

- Welcome and Introduction
- Project Context
- Climate Change Vulnerability Study Recap
- Resilience Journey
- Climate Change Resilience Plan Framework
- Proposed Resilience Measures and Justification
  - Detailed Project Examples
- Questions & Discussion
- Next Steps

Meeting Logistics

- Please use the **raise hand function** at any point during the presentation to ask a question or **add it to the chat**.
- The meeting will be **recorded**.
- If you have technical difficulties or need assistance, please **message Marina Mateski in Teams**, or email at Marina.Mateski@icf.com.

Example of Toolbar



Introductions: National Grid Team

Natasha Deschene

VP Electric Asset Management & Engineering

Casey Kirkpatrick

Director, Reliability and Research & Development

Matthew LaFlair

Director, Integrated Planning & Solutions

Peter Haswell

Project Manager

Peter.haswell@nationalgrid.com

Katie Meyer

Technical Lead

Kaitlyn.Meyer@nationalgrid.com

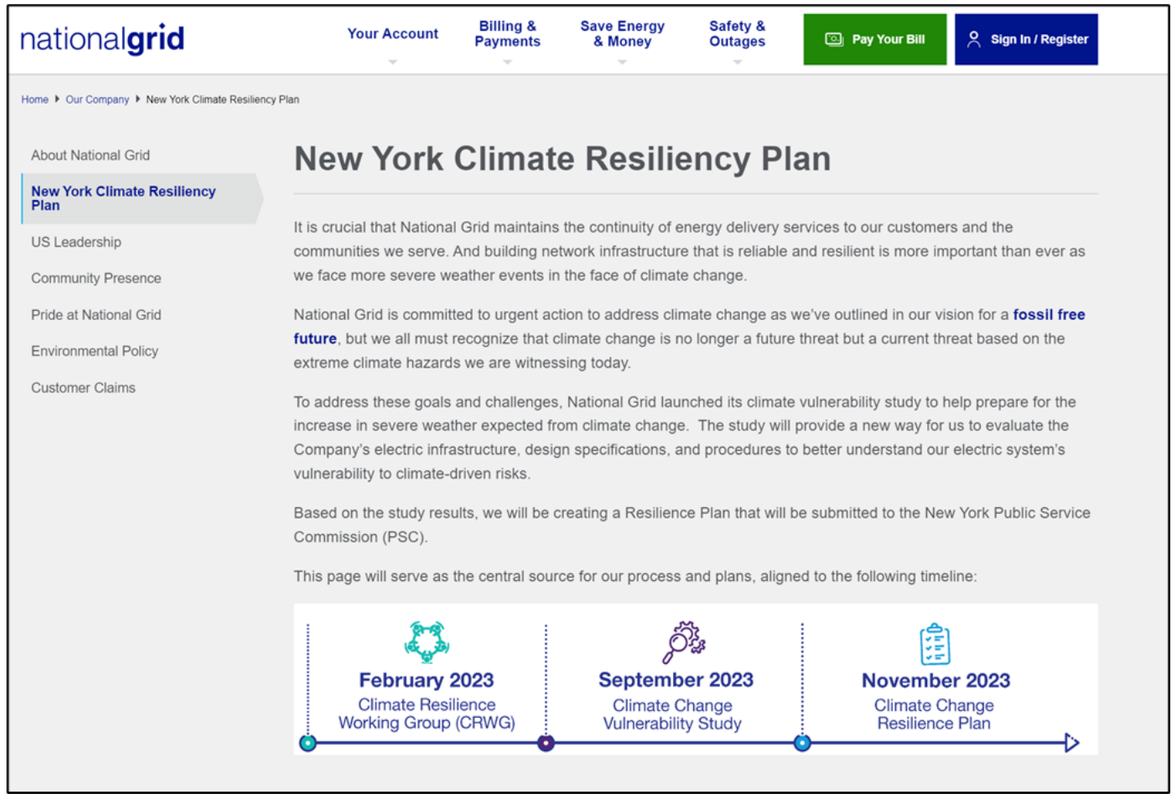
Rachel Stowell

Stakeholder Lead

Rachel.stowell@nationalgrid.com

Visit our website

https://www.nationalgridus.com/Our-Company/New-York-Climate-Resiliency-Plan



National Grid Working Group Participants

Organization
Office of Environment, Onondaga County
AARP New York
AARP
Alliance for a Green Economy (AGREE)
Barclay Damon, LLP
Central NY Regional Planning & Development Board
ChargePoint, Inc.
Citizen Action of New York, Inc.
City of Albany
City of Glens Falls
City of Niagara Falls
City of Syracuse
Columbia County Planning Department
Columbia Economic Development Corporation
Direct Energy Services LLC
Division of Consumer Protection
Environmental Defense Fund
Erie County DHSES
Family Energy, Inc.
Franklin County Government
Greenlots
HOCCPP
Marathon Power LLC
Mission:data Coalition, Inc.
Natural Resources Defense Council
New York Geothermal Energy Org
New York Power Authority

Organization
New York State Department of Public Service (DPS)
New York State Office of General Services
Niagara County
NYGEO
NYSDOT
NYSERDA
Office of Environment, Onondaga County
Onondaga County DOT
Onondaga County
Oswego County
Other Intervenors
Pace Energy And Climate Center
People United for Sustainable Housing, Buffalo
DPS Staff
Public Utility Law Project of New York, Inc.
PULP
Schenectady County
Schenectady Fire Department
Sierra Club
St Lawrence County Emergency Services
Stop NY Fracked Gas Pipeline
Town of Amherst
Town of DeWitt
Utility Intervention Unit, Division of Consumer Protection,
Wyoming County Office of Emergency Services
Wyoming County Planning Department

Please provide your name, title, and affiliation in the chat

Project Context

nationalgrid

Overview of Public Service Commission Requirements

Aims to bolster electric utility planning and resilience by incorporating climate change considerations

Vulnerability Study

- Evaluate infrastructure, design specifications, and procedures to identify vulnerabilities
- Identify priorities for adaptation measures that will feed into Resilience Plan
- Study to be performed with supporting climate data from NYSERDA and Columbia University

Resilience Plan

- Propose storm hardening measures for next 10 and 20 years
- Detail how climate change is reflected in planning, design, operations, & emergency response
- Address impacts on costs, outage times, potential for undergrounding lines, etc.
- Utility to establish “Climate Resilience Working Group” by 3/2023 to advise on Resilience Plan to include municipalities, customer advocacy groups, and energy/environmental advocates

CRWG Role and Engagement Roadmap

Outreach, Engagement & Initial Feedback | **Study & Plan Development** | **Ongoing Engagement & Reporting**

2022 | 2023 | 2024

August 2022: Conducted initial local community outreach to create awareness and seek input

January 2023: Engaged advocacy groups to identify priorities; reviewed survey input

Feb 2023: WG Meeting 1 Initiate CRWG and Introduction to the Project

June 2023: WG Meeting 2 Discuss findings from the Vulnerability Study till date.

September 2023: File the Vulnerability Study

October 2023: WG Meeting 3 Preview Resilience Plan

WE ARE HERE

November 2023 File the Resilience Plan

Fall 2024 and Beyond: Report to stakeholders on Plan updates

Today's CRWG Focus

- Summarize findings on **priority vulnerabilities** for National Grid
- Discuss the **resilience framework** to achieve a multi-pronged strategy
- Discuss the **business case justification framework** and results
  - System Reliability, Criticality, Community Resilience
  - Consideration of Equity
- Review the **resilience measures** being proposed as part of the CCRP
- 5-, 10-, 20-yr **investment plan**

Stakeholder Input

National Grid sees CRWG input as **critical** and appreciates thoughts and questions shared in this meeting

Project Process & Timeline

nationalgrid

Climate Change Vulnerability Study and Resilience Plan – Approach Overview

Climate Data

Columbia/NYSERDA; MIT Study, National Grid's Climate Change Risk Tool

Exposure Analysis

Identify relevant design thresholds for assets and operations and conduct exposure analysis for different asset-hazard combinations.

Potential Impact Analysis

Evaluate assets and operations for climate **sensitivities** and identify potential **consequences** of exposure to understand vulnerability.

Identify Priority Vulnerabilities

Assets and operations with highest vulnerability will be prioritized for inclusion in National Grid's Resilience Plan.

Climate Change Vulnerability Study (CCVS)

Identify Resilience Measures

For priority assets & operations identify resilience measures for next 5, 10 and 20 years.

Prioritize Resilience Measures

Based on quantification of risk mitigation **benefits** and risk mitigation **costs** of resilience measures.

Develop Resilience Plan

Develop portfolio of prioritized resilience measures with implementation timeframes, rate impact estimates etc.

Climate Change Resilience Plan (CCRP)

Stakeholder Engagement

Climate Change Vulnerability Study and Resilience Plan – Approach Overview

Climate Data

Columbia/NYSERDA; MIT Study, National Grid's Climate Change Risk Tool

Exposure Analysis

Identify relevant design thresholds for assets and operations and conduct exposure analysis for different asset-hazard combinations.

Potential Impact Analysis

Evaluate assets and operations for climate **sensitivities** and identify potential **consequences** of exposure to understand vulnerability.

Identify Priority Vulnerabilities

Assets and operations with highest vulnerability will be prioritized for inclusion in National Grid's Resilience Plan.

Climate Change Vulnerability Study (CCVS)

In focus today

Identify Resilience Measures

For priority assets & operations identify resilience measures for next 5, 10 and 20 years.

Prioritize Resilience Measures

Based on quantification of risk mitigation **benefits** and risk mitigation **costs** of resilience measures.

Develop Resilience Plan

Develop portfolio of prioritized resilience measures with implementation timeframes, rate impact estimates etc.

Climate Change Resilience Plan (CCRP)

Stakeholder Engagement

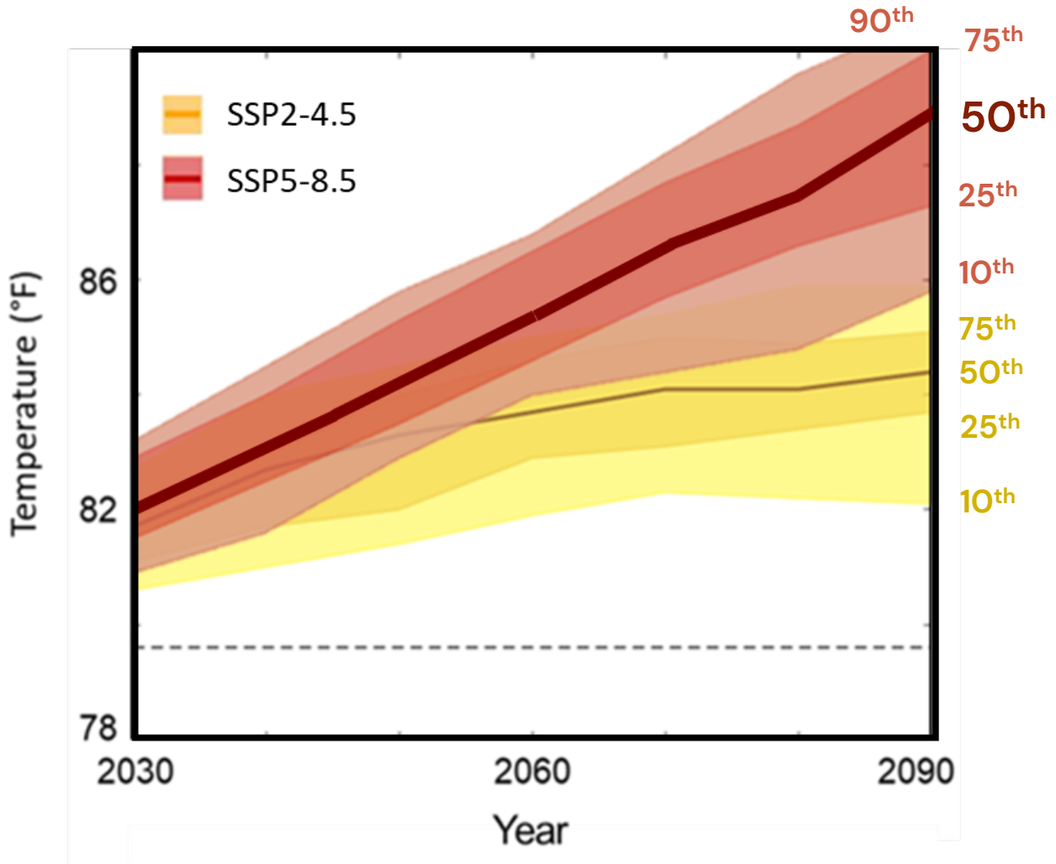
Climate Change Planning Pathway

Climate change projections provide a range of plausible climate futures reflecting uncertainty around both future emissions trajectories and climate sensitivity.

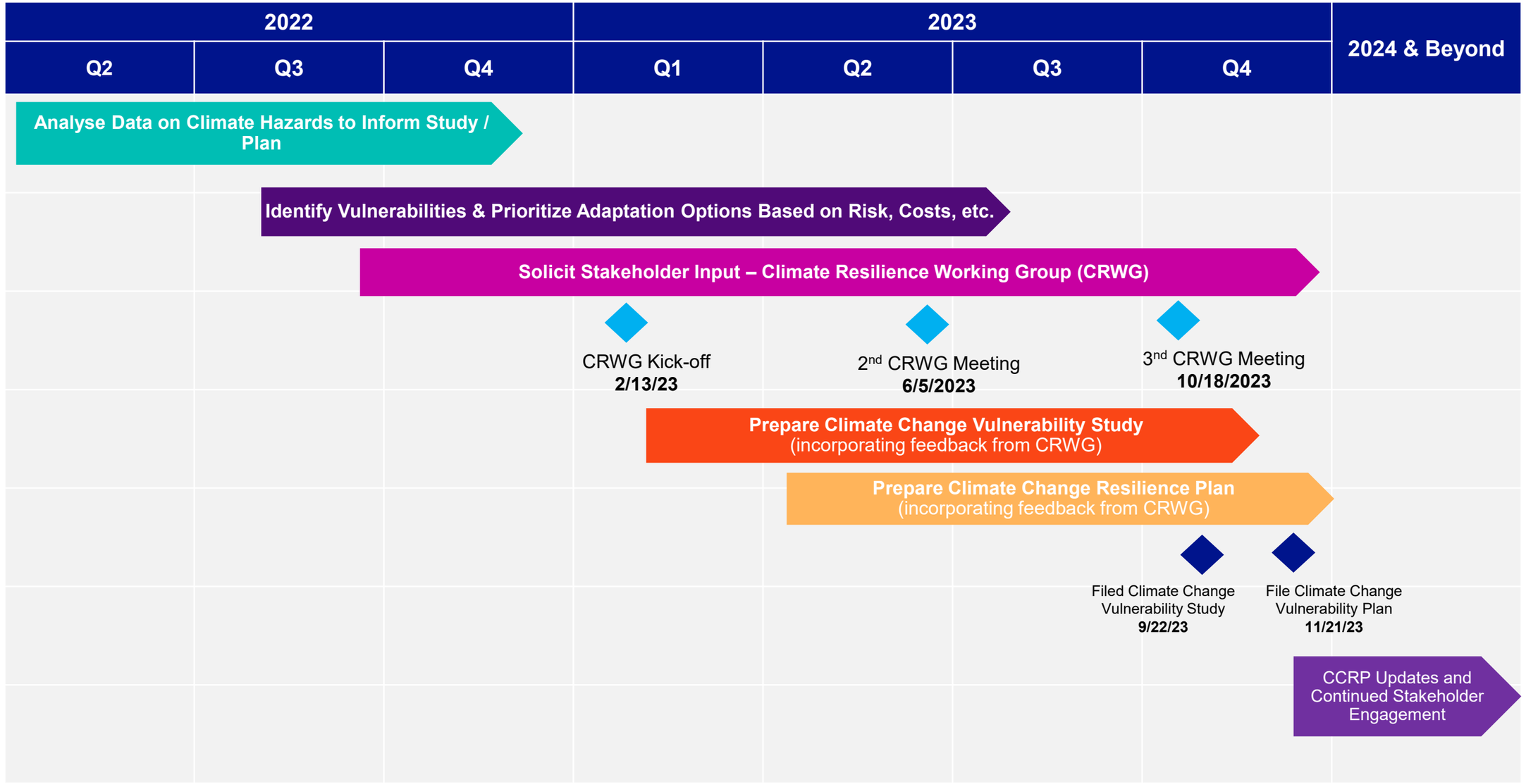
Pathways provide **standardized climate projections and assumed climate conditions in the service area** to which the utility would **plan in order to strengthen resilience** to potential climate change risks.

National Grid's Selected Planning Scenario - **SSP5-8.5 50th percentile**

- Utilizing the worst-case climate planning scenario (pathway) and using the 50th percentile
- Very high GHG emissions



Timeline Overview

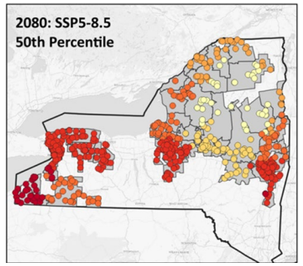


Vulnerability Study: Recap

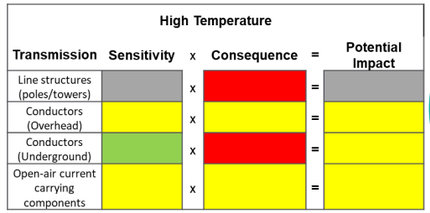
nationalgrid

Priority Asset Vulnerabilities for National Grid

- Potential Impact ratings were considered alongside findings from the Exposure analysis to understand priority vulnerabilities for National Grid.



Exposure to climate hazards



Potential Impacts from exposure

Vulnerability

- **Priority vulnerabilities** represent the asset groups with the highest potential impact from each hazard.

- These priority vulnerabilities will feed into National Grid's Resilience Plan and will be addressed further in the identification of resilience measures.

ASSET GROUP	High Temperature	Inland Flooding	Wind Gusts	Ice
Transmission Line	✓		✓	✓
Distribution Line[10]	✓		✓	✓
Substation	✓	✓		

Potential Impacts on Operational and Planning functions

- Potential impacts on key operational and planning functions were also qualitatively reviewed.
- Climate hazards of most concern were identified for each function.

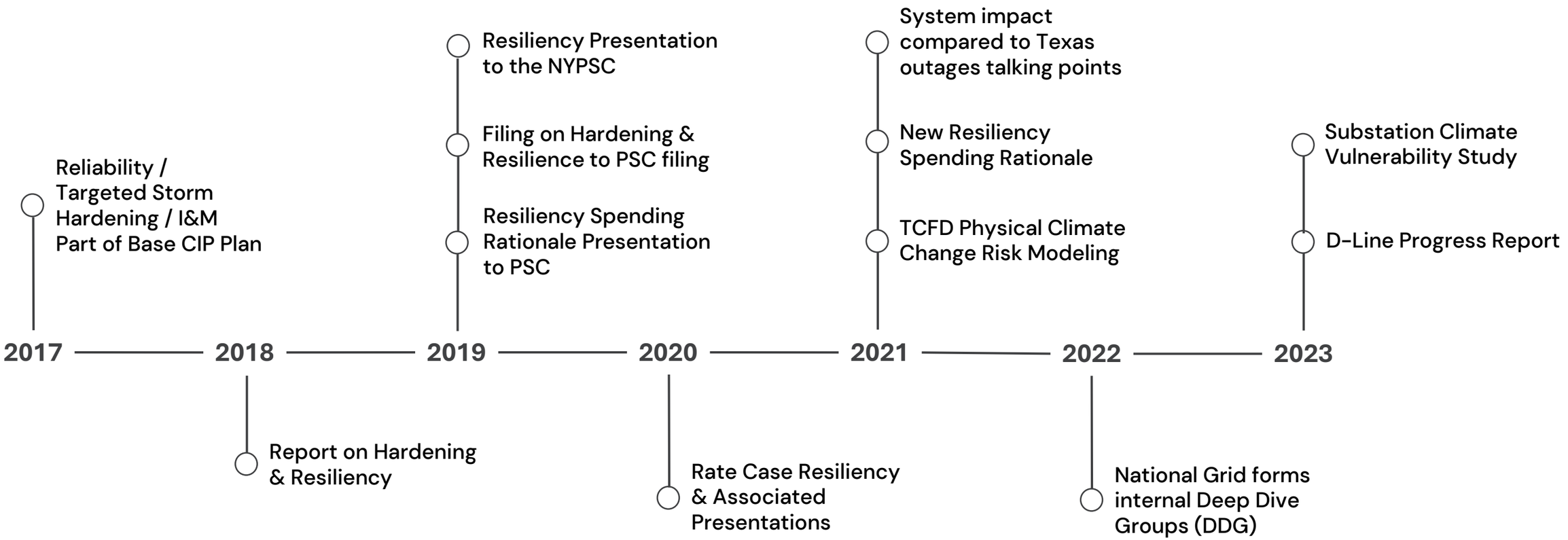
OPERATIONS AND PLANNING FUNCTION	High Temperature	Inland Flooding	High Winds	Ice
Emergency Response	✓	✓	✓	✓
Vegetation Management		✓	✓	✓
Workforce Safety and Methods	✓	✓	✓	✓
Reliability Planning	✓	✓	✓	✓
Load Forecasting	✓			
Capacity Planning	✓			

Any questions?

Climate Change Resilience Plan Overview and Strategies

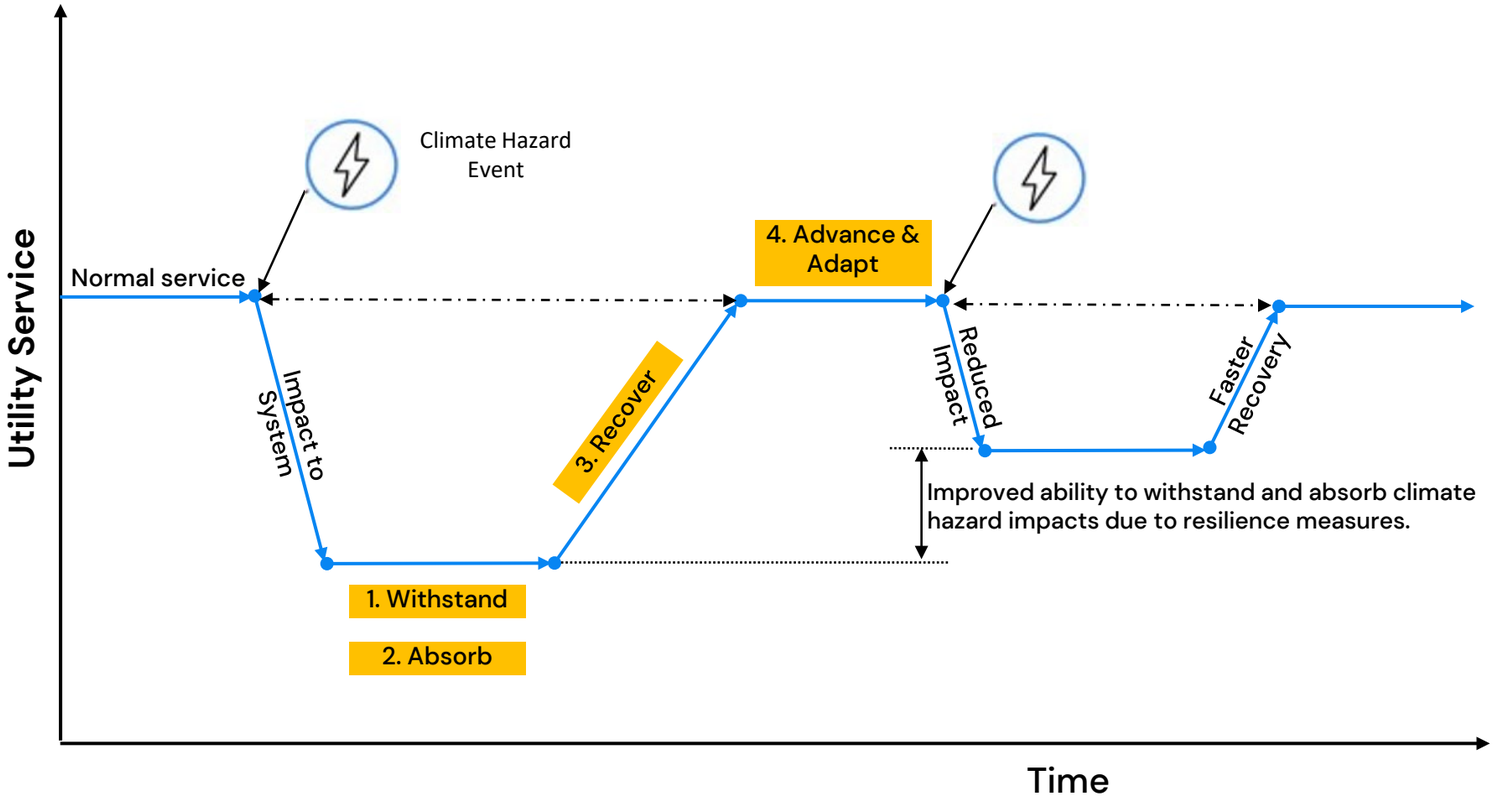
nationalgrid

CCRP Resilience Journey



Resilience Framework

Pursue a multi-pronged resilience strategy with four dimensions: Withstand, Absorb, Recover, and Advance and Adapt.



1. Strengthen assets and operations to withstand the adverse impacts of a climate hazard event.

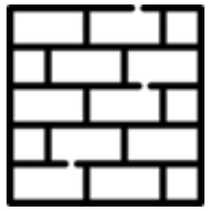
2. Increase the system's ability to anticipate when a climate hazard event may occur and absorb its effects.

3. Bolster the system's ability to quickly respond and recover in the aftermath of a climate hazard event.

4. Advance and adapt the system to address a continuously changing threat landscape and perpetually improve resilience.

Physical and Operational Resiliency Measures

Strengthen & Withstand



Physical Measures

- Distribution and Transmission Substation flood risk mitigation
- Updating design standards for transformers
- Distribution line structure upgrades
- Sub-transmission structure upgrades
- Transmission structure upgrades
- Sub-transmission upgrades
- Distribution line upgrades

Advance & Adapt

Physical Measures

- Distribution and sub-transmission targeted undergrounding
- Increase T&D structure standards

Operational Measures

- Substation Transformer Specification changes
- Increase distribution structure standards
- Increase transmission structure standards

Respond & Recover

Physical Measures

- Additional high strength spare structures

Operational Measures

- Strategic Spares Program

Anticipate & Absorb

Operational Measures

- Electric load forecasting

Business Case Justification

nationalgrid

Business Case Justification (BCJ) Overview

The BCJ process helps National Grid characterize the benefits, to the company and community, of the selected resilience projects and programs. The BCJ is scored by three considerations: System Reliability, Criticality, and Community Resilience.

System Reliability (scored from 1 to 5)

- Provides insight on whether a resilience measure being proposed is in an area with historically lower reliability relative to others in the service territory.

Criticality (scored from 1 to 5)

- Based on the count of critical facilities that provide health- and safety-related services to the community (e.g., hospitals, police stations, water treatment plants, shelters) associated to each substation.

Community Resilience (scored from 1 to 5)

- Provides insight into the extent of the economic impact on the region due to an electrical outage. It is based on the count of critical facilities and the population they serve, and the number of customers served.

Business Case Justification Example

System Reliability Scoring – worst performing

Substation Name	Number of Events*	SAIFI*	SAIDI*	Feeder Rank*	Reliability Score
North Creek	45	0.71	2.75	7035	5
Belmont	17	2.74	6	7848	5
Buffalo Station 56	3	.38	.84	4685	3

*worst performing feeder associated with substation

Criticality Scoring – critical facilities

Substation Name	Tier 1 Critical Facilities Count	Tier 2 Critical Facilities Count	Safety Score
North Creek	5	8	5
Belmont	2	2	4
Buffalo Station 56	2	1	4

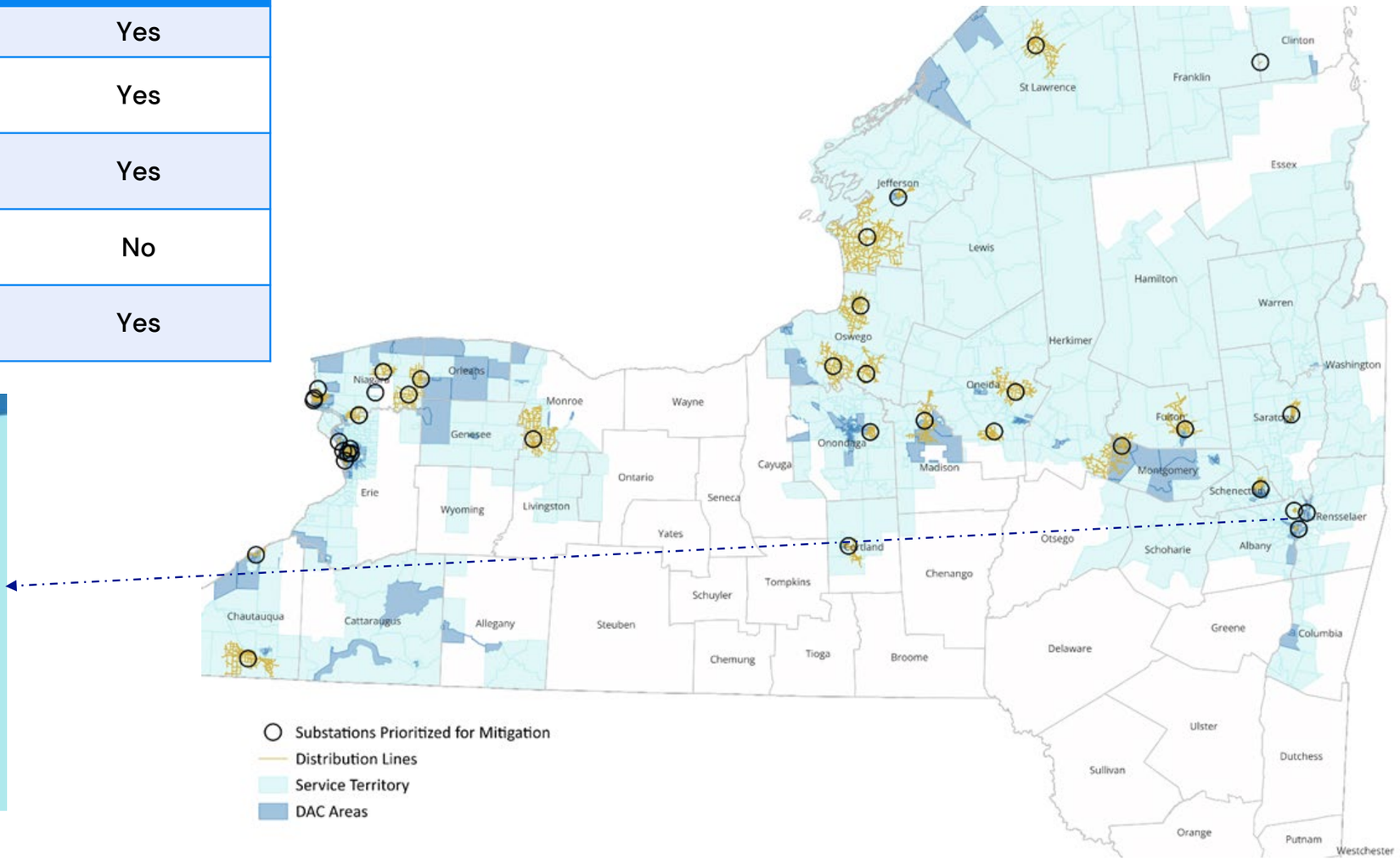
Community Resilience Scoring – most regional impact

Substation Name	Outage Duration (days)	Total Critical Facilities (Tier 1, 2, 3)	Population by Region	Resilience Score
North Creek	2.42	29	383,692	5
Belmont	1.91	6	1,603,241	5
Buffalo Station 56	2.30	2	580,596	4

Substation Name	BCJ Score
North Creek	100%
Belmont	93%
Buffalo Station 56	73%

Equity Considerations

Substation Name	BCJ Score	Serving DAC?
Front St Station 360	100%	Yes
Gloversville Station 72	100%	Yes
Riverside Station 288	93%	Yes
West Monroe Station 274	93%	No
Peterboro Station 514	87%	Yes



Any questions or suggestions?

Proposed Resilience Investments

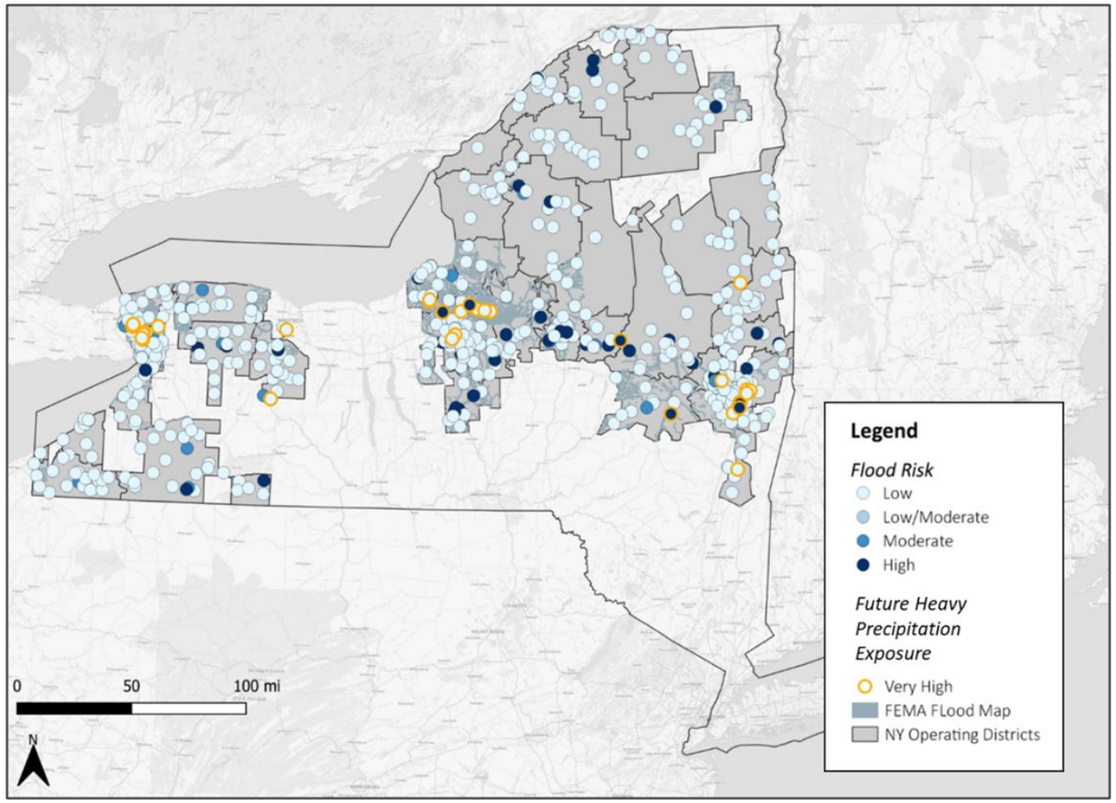
Project	Mitigated Climate Hazard	Description
1. Overhead Distribution and Sub-transmission Line Design Upgrades*	Wind Gusts and Ice	Update distribution line standards to move from type class 3 poles to class 1 for main lines and poles that carry heavy equipment (8,000 poles/year) and update sub-transmission line standards to use class 1 poles for single circuit structures, class H1 for double circuit structures, and class H2 for double circuit with distribution underbuilds (900 poles/year).
2. Overhead Transmission Line Design Upgrades*	Wind Gusts and Ice	Build T-Lines to withstand 120 MPH wind gusts in high wind areas (46 total) by using more steel and larger foundations. Projects include 44 – 115kV lines and 2 – 230KV lines (1,300 circuit miles covered).
3. Distribution and Sub-transmission Targeted Undergrounding	Wind Gusts and Ice	Targeted undergrounding of 1-2 miles per year of 3-phase main line in highest wind and icing areas.
4. Spare Transmission Line Structures	Wind Gusts and Ice	Purchase 10 T-Line spare structures per division designed for 120 MPH gusts to speed restoration.
5. Substation Flood Walls	Flooding	Install flood walls at 18 substations in high -risk areas (17,000 linear feet of flood walls total).
6. Distribution and Transmission Substation Transformer Specification Upgrades*	Extreme Heat	Update transformer spec from 32°C (90°F) to 35°C (95°F). There will be 35 distribution projects (81 transformers) and 24 transmission projects (37 transformers) with installs and replacements.

* Additional to existing projects

Substation Floodwalls

- A Comprehensive evaluation was performed by SMEs using **FEMA** and climate change risk tool (**CCRT**) information to identify substations at high risk for flooding
- **18 substations (8 distribution, 10 transmission)** were recommended for flood mitigation
- **Flood walls determined to be most cost-effective solution**, although other options such as relocating or raising substation equipment were evaluated
- Substation flooding can damage critical substation equipment such as transformers, breakers, and protection & control systems and **interrupt service to 10's of thousands of customers for long durations**
- Resilience Plan (CCRP) Proposal:
  - **Over the next 10 years**, install flood walls at 18 Substations in high-risk areas
    - Install **17,000 linear feet** of flood walls, total

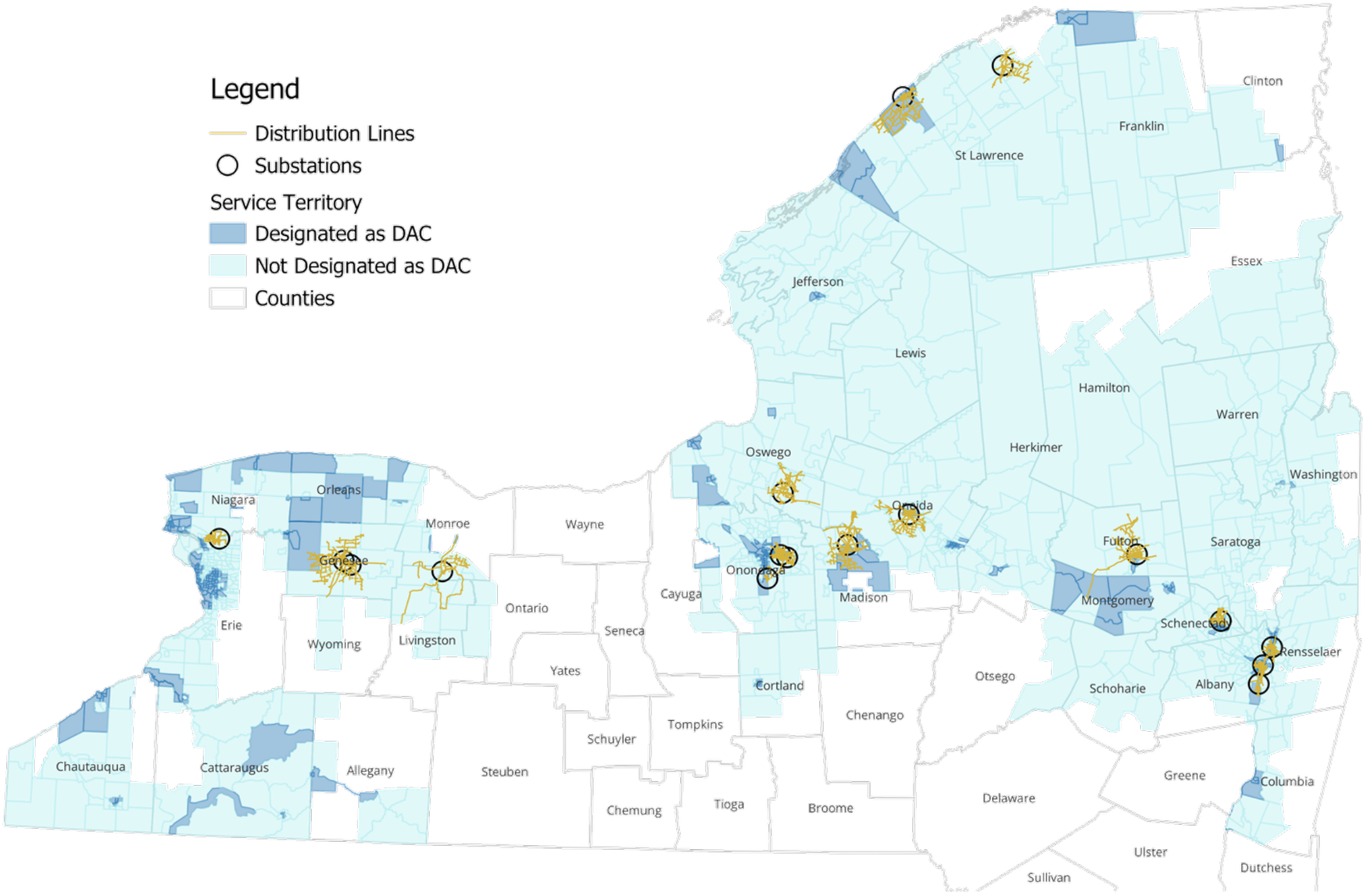
Substation Flood Risk



Project Costs (Capex - $M)	Rate Case FY26-29	5 Year FY26-30	BP23 FY24-33	10 Year FY26-35	20 Year FY26-45
Distribution Substations	5	7	11	12	12
Transmission Substations	10	12	16	16	16
TOTAL	15	19	27	28	28

*Added scope to existing projects

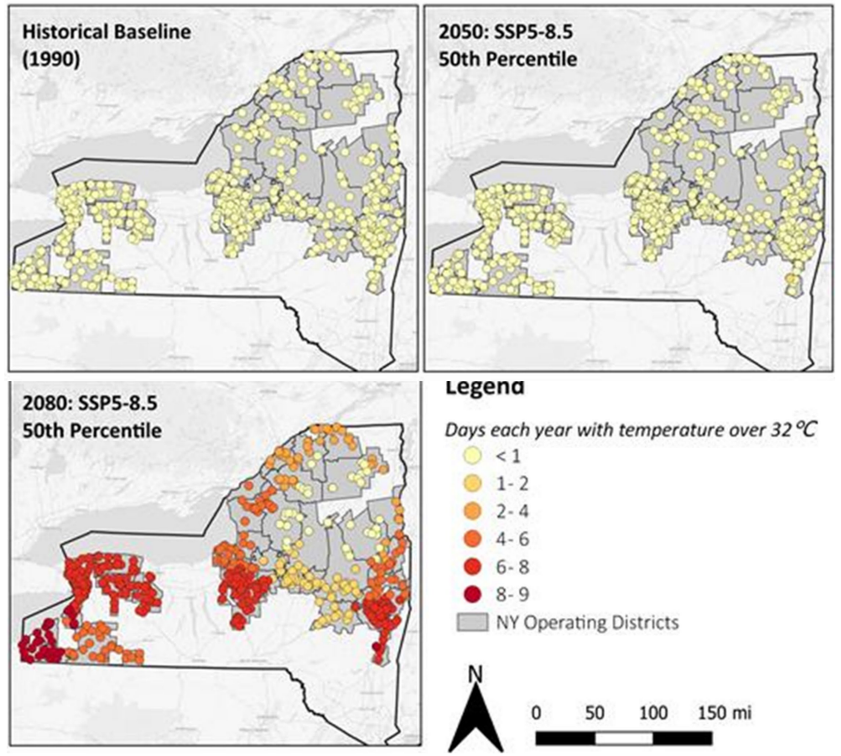
Substation Flood Mitigation Projects



Substation Transformers Upgrades

- Substation transformers presently specified for maximum daily average of 32˚ C (90˚ F)
- Temperatures projected to increase, with some areas reaching 35˚ C (95˚ F) by the 2050s
- Temperatures above specified levels will **reduce capacity, equipment lifespan** or cause **damage** up to and including a **transformer failure** and resulting **customer outages**.
- Resilience Plan (CCRP) Proposal:
  - **Update transformer spec from 32˚ C (90˚ F) to 35˚ C (95˚ F).**
  - This will result in a **3-5% cost increase** for most transformers
  - Projects in 5-year plan w/ transformer installs & replacements
    - **Distribution: 35 projects, 81 transformers**
    - **Transmission: 24 projects, 37 transformers**

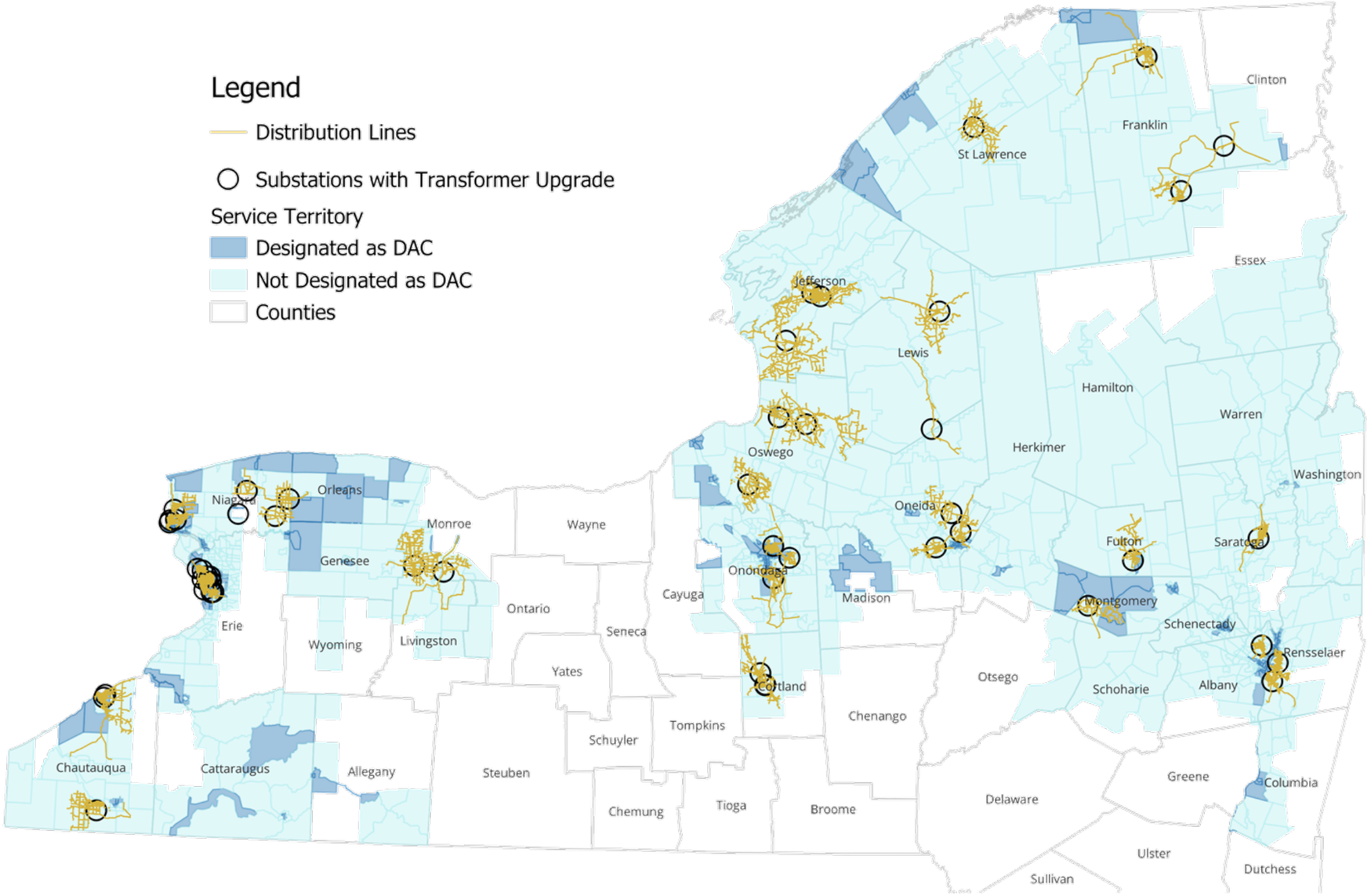
Substation Average Ambient Temperatures Above 32˚ C



Project Costs (Capex - $M)	Rate Case FY26-29	5 Year FY26-30	BP23 FY24-33	10 Year FY26-35	20 Year FY26-45
Distribution Transformers*	4	5	8	10	18
Transmission Transformers*	2	2	3	4	7
TOTAL	6	7	11	14	25

*Added scope to existing projects

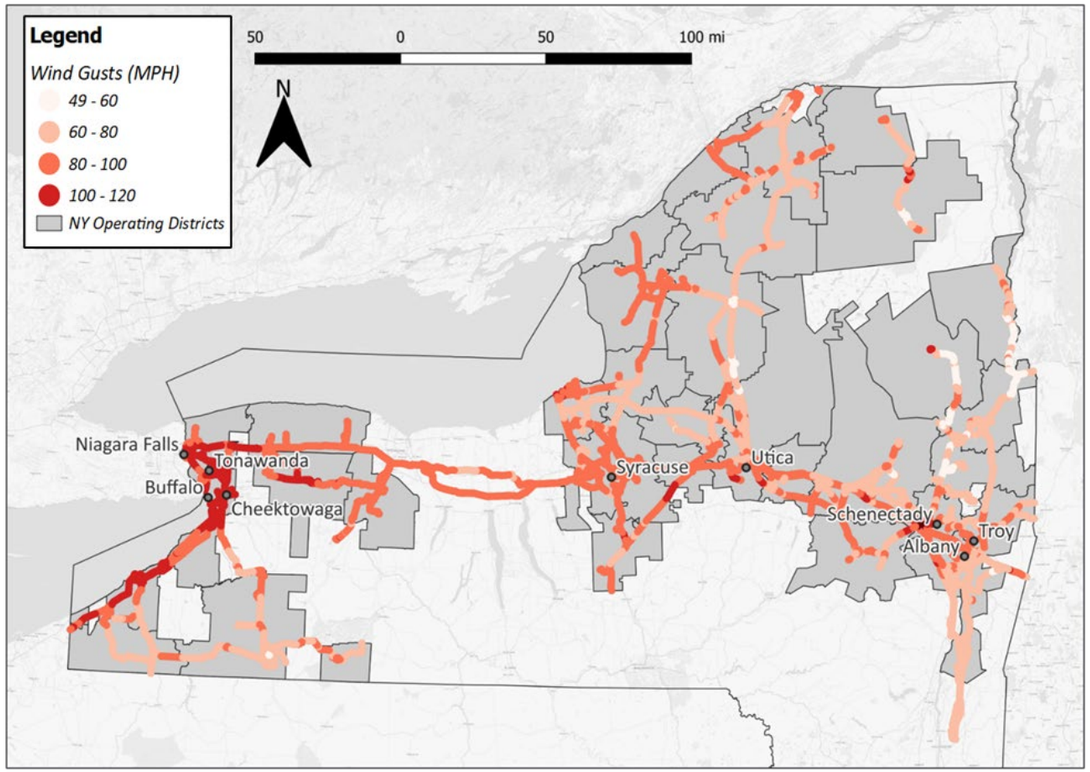
Substation Transformer Upgrade



Overhead transmission line structure upgrades

- Transmission lines are **presently** designed to withstand **95 MPH** gusts (per NESC standard)
- MIT Study **projects** winds may reach up to **120 MPH** gusts in some areas
- T-Line outages due to structure failures can result in outages to entire substations, potentially impacting 10's of thousands of customers for long durations.
- Resilience Plan (CCRP) Proposal:
  - Build T-Lines to withstand 120 MPH wind gusts in high wind areas
    - **43 T-Line projects** presently in our 5 & 15 year plans fall in high wind areas
    - Projects include **44 – 115kV lines** and **2 – 230KV lines** covering about 1,300 circuit miles
    - More steel, larger foundations
  - Purchase **10 T-Line spare structures** per division (East, Central, West) designed for 120 MPH gusts to speed restoration

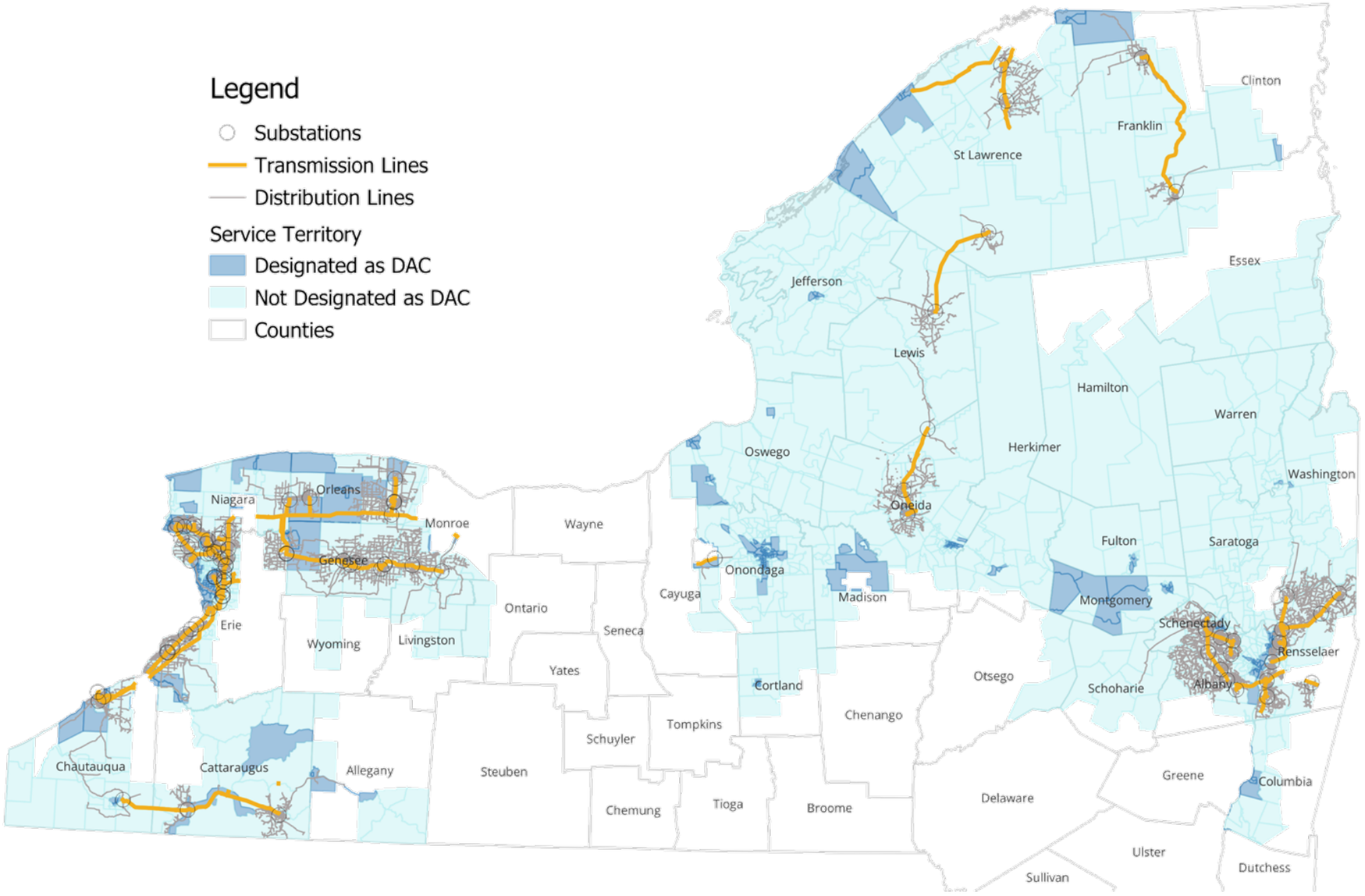
Wind Gust Projections for T-Lines



Project Costs (Capex - $M)	Rate Case FY26-29	5 Year FY26-30	BP23 FY24-33	10 Year FY26-35	20 Year FY26-45
T-Line Upgrades*	27	33	55	63	115
Spare T-Line Structures	2	2	2	2	2
TOTAL	29	35	57	65	117

*Added scope to existing projects

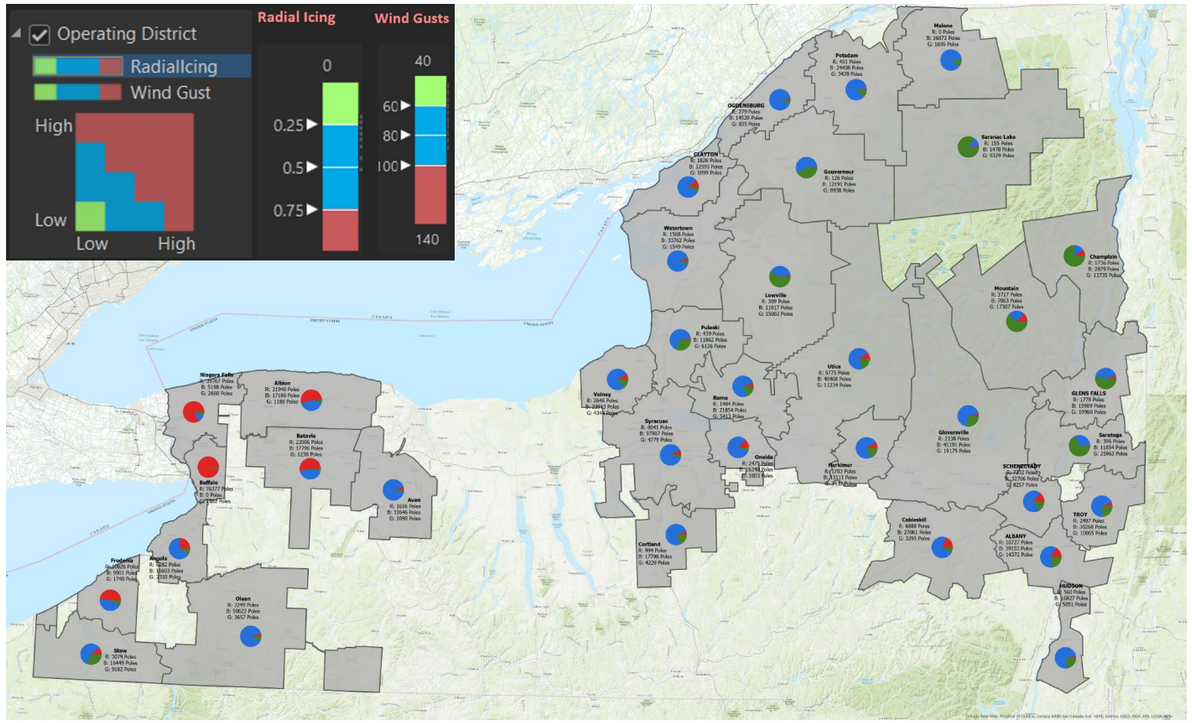
Transmission lines for structure class upgrade



OH Distribution and Sub-transmission Line Upgrades

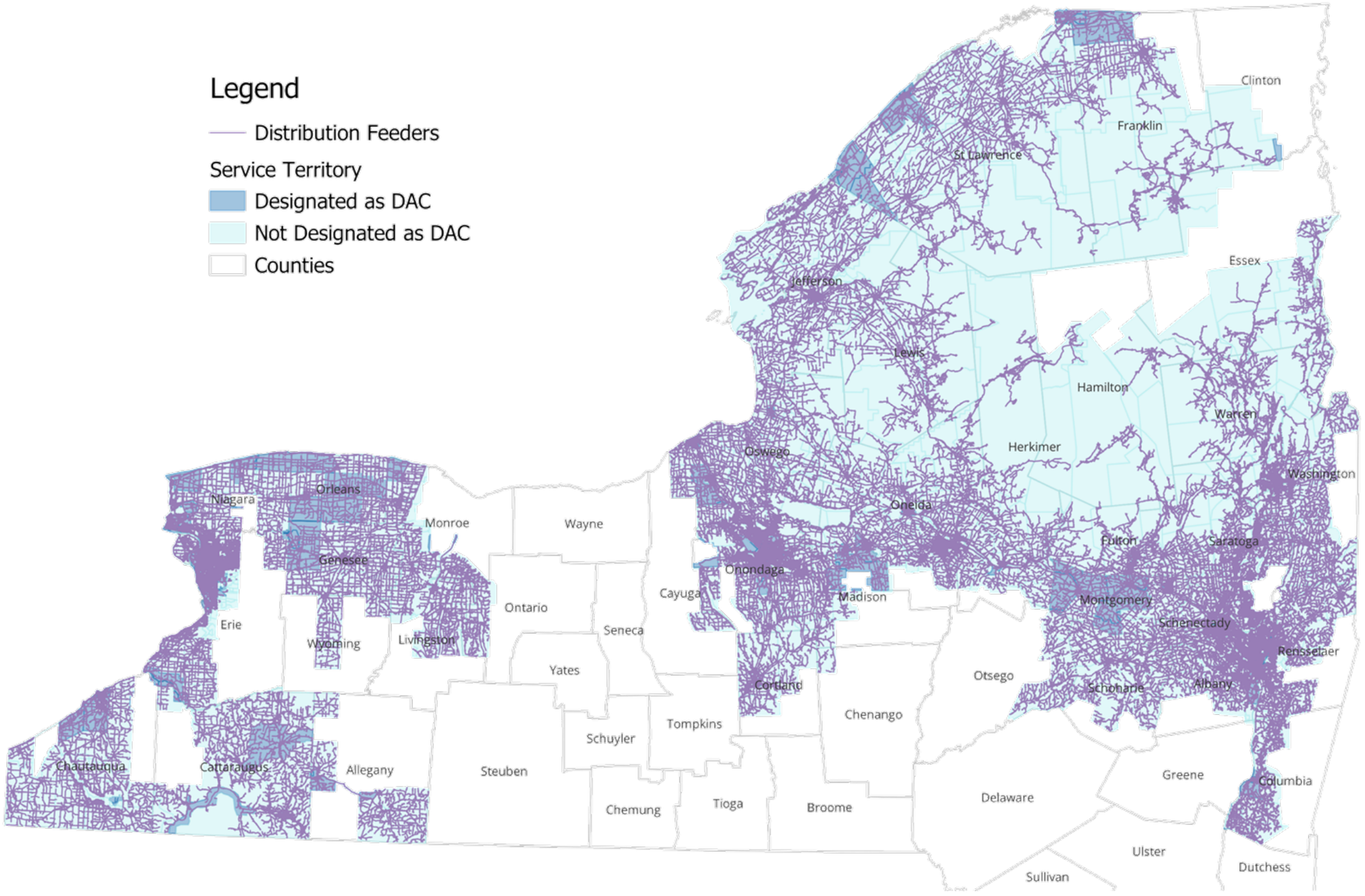
- D & Sub-T lines are **presently** designed to withstand combined **40 MPH wind gusts** and **0.5" Icing** (per NESC standard)
- Only 16% of existing poles are designed to withstand projected wind and ice levels, with some areas **projected** to see over **100 MPH gusts** or over **0.75" of icing**
- Pole failures due to wind & icing can result in outages to thousands of customers for long durations.
- Resilience Plan (CCRP) Proposal:
  - For **D-Line** projects going forward, update standards to move from typical class 3 poles to class 1 for main lines (3 phase backbone) and poles that carry heavy equipment – **8,000 poles** / year on average
  - For **Sub-T** projects going forward, update standard designs to use class 1 poles for single circuit structures, class H1 for double circuit structures, and class H2 for double circuit with distribution underbuilds – **900 poles** / year on average
  - **Targeted undergrounding of 1-2 miles** per year of 3-phase main line in highest wind and icing areas

Combination of Wind & Icing Impact on Poles for D-Line

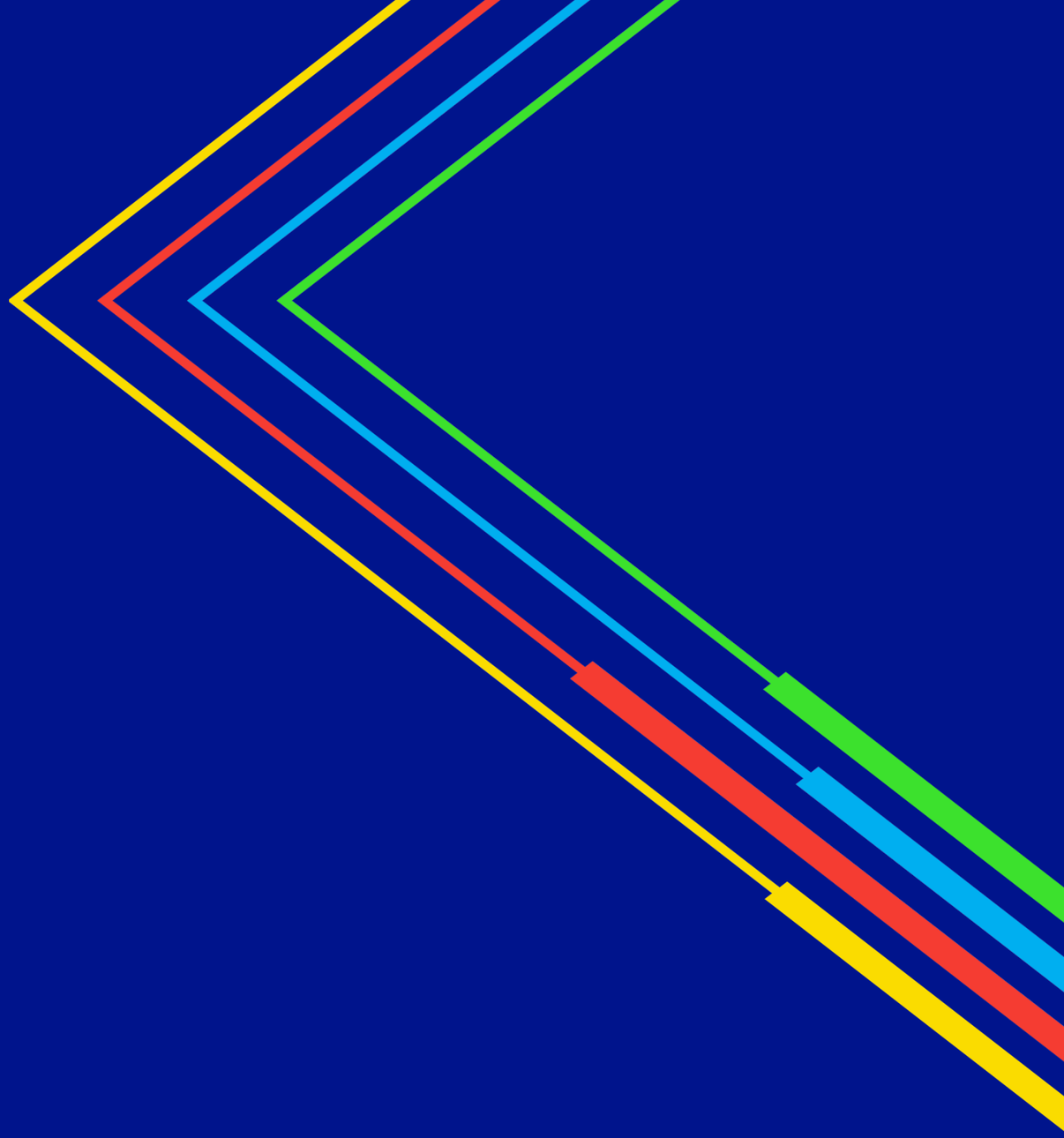


Project Costs (Capex - $M)	Rate Case FY26-29	5 Year FY26-30	BP23 FY24-33	10 Year FY26-35	20 Year FY26-45
D-Line Upgrades*	89	118	207	292	775
Sub-T Line Upgrades*	11	14	23	35	104
Targeted Undergrounding	36	51	96	138	348
TOTAL	136	183	326	465	1,227

*Added scope to existing projects


Legend
Distribution Feeders
Service Territory
Designated as DAC
Not Designated as DAC
Counties
Clinton
Franklin
St Lawrence
Essex
Jefferson
Lewis
Hamilton
Warren
Herkimer
Oswego
Washington
Oneida
Orleans
Niagara
Monroe
Wayne
Fulton
Saratoga
Genesee
Onondaga
Cayuga
Madison
Montgomery
Schenectady
Ontario
Erie
Seneca
Wyoming
Livingston
Rensselaer
Yates
Otsego
Schoharie
Albany
Cortland
Chenango
Tompkins
Schuyler
Greene
Columbia
Chautauqua
Cattaraugus
Allegany
Steuben
Delaware
Chemung
Tioga
Broome
Ulster
Dutchess
Sullivan

Discussion and Questions?



nationalgrid

Next Steps

nationalgrid

Meeting Follow Up

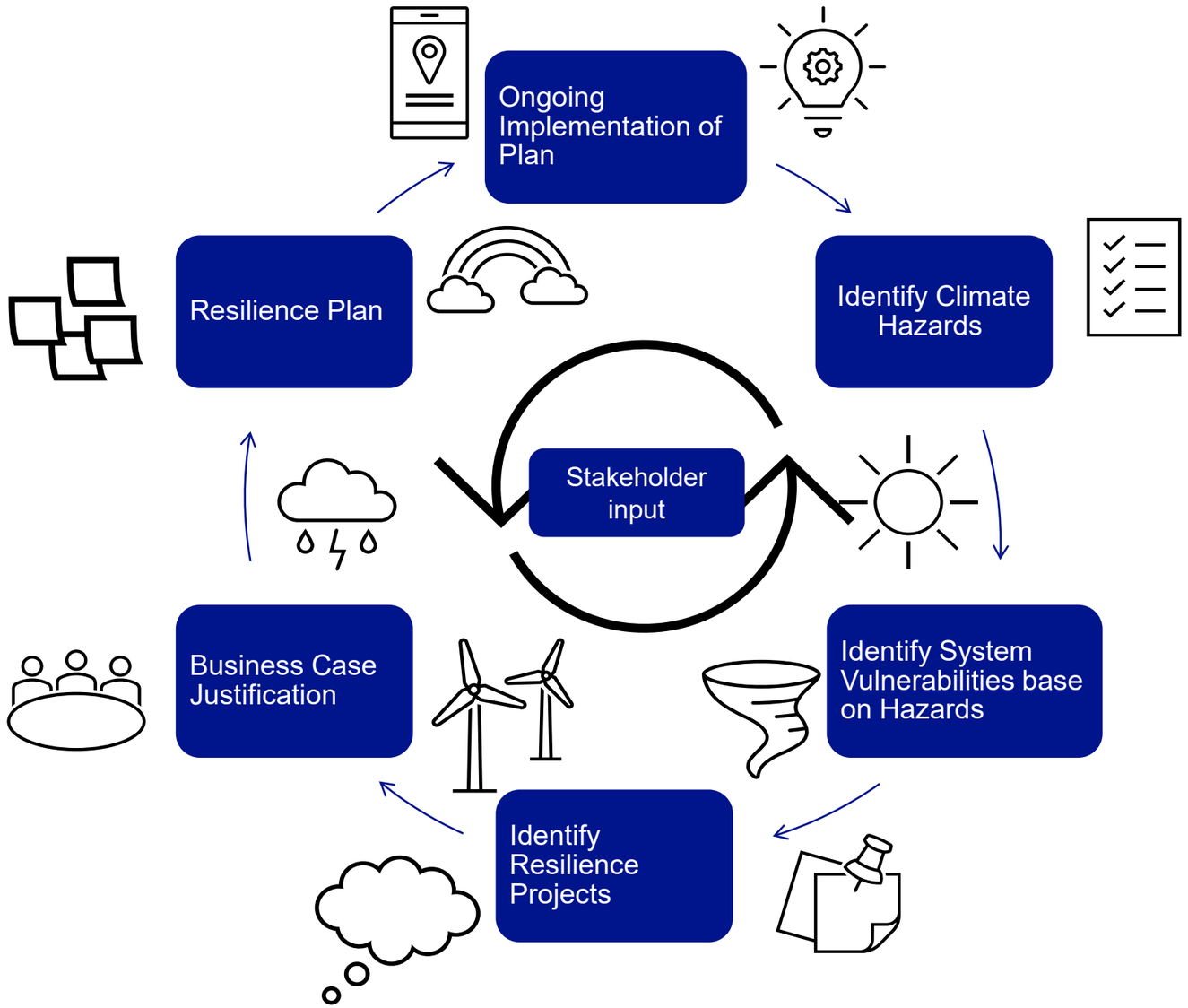
Looking ahead:

- We will share our final version of the CCRP with you
- Please share your comments with us on the filing at the PSC website (Docket 22-E-0222):

  https://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterSeq=67333&MNO=22-E-0222

- Please visit our website for more information:

  https://www.nationalgridus.com/Our-Company/New-York-Climate-Resiliency-Plan



CRWG Engagement Roadmap

Outreach, Engagement & Initial Feedback

Study & Plan Development

Ongoing Engagement & Reporting

2022 | 2023 | 2024

August 2022:
Conducted initial local community outreach to create awareness and seek input

January 2023:
Engaged advocacy groups to identify priorities; reviewed survey input

Feb 2023:
WG Meeting 1

Initiate CRWG and Introduction to the Project

June 2023:
WG Meeting 2

Discuss findings from the Vulnerability Study till date.

September 2023:

File the Vulnerability Study

October 2023:
WG Meeting 3

Preview Resilience Plan

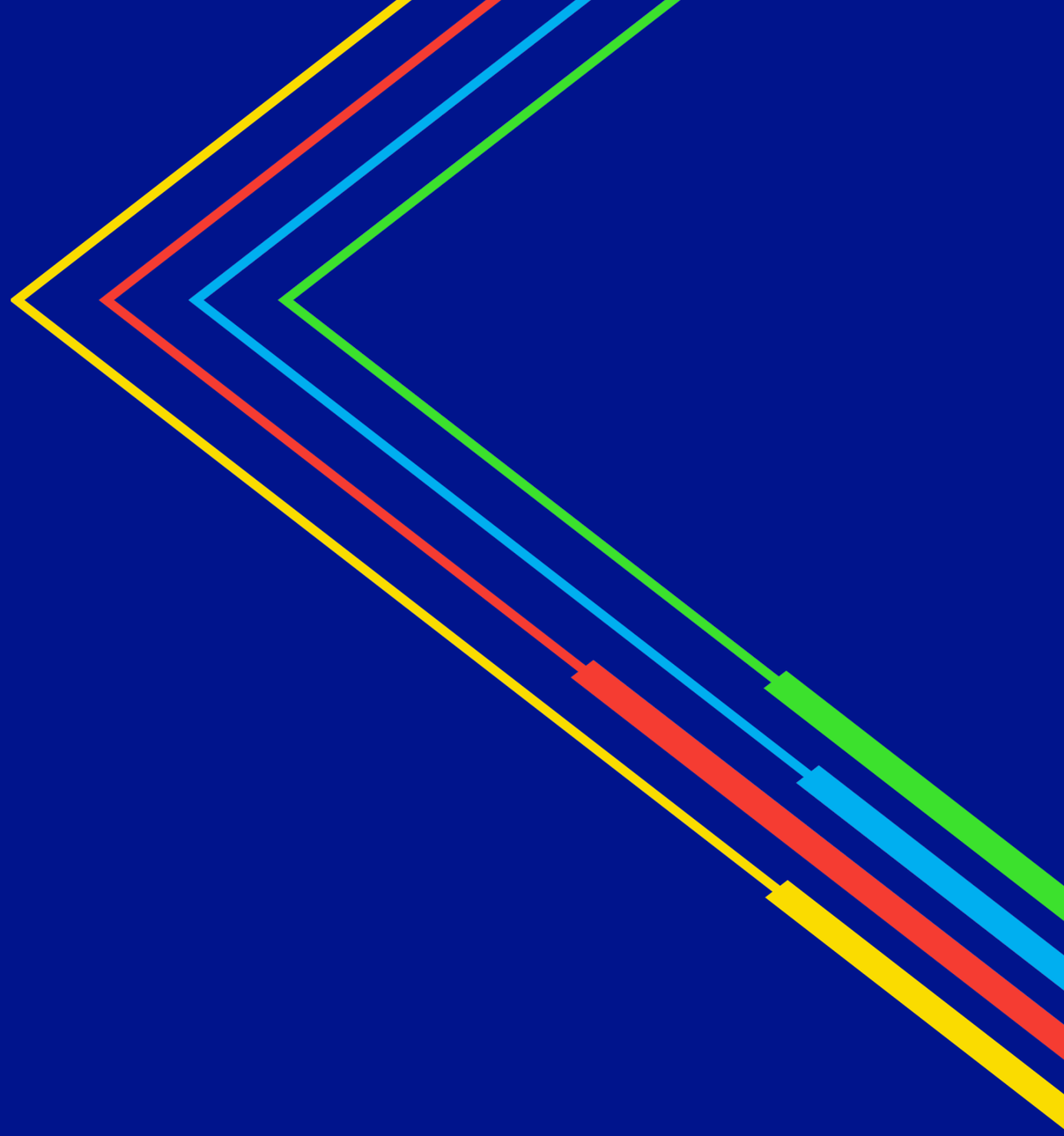
November 2023

File the Resilience Plan

Fall 2024 and Beyond:
Report to stakeholders on Plan updates

NEXT STEP

Thank you!



nationalgrid