NYSEG RG&E

Part of the AVANGRID Family

# Climate Change Vulnerability Study and Resilience Plan

## Working Group Meeting 2

April 17th 2023

# Welcome & Introductions

Project Update

Climate Data & Asset Exposure Analysis

Sensitivity, Consequence & Potential Impact

Priority Vulnerabilities

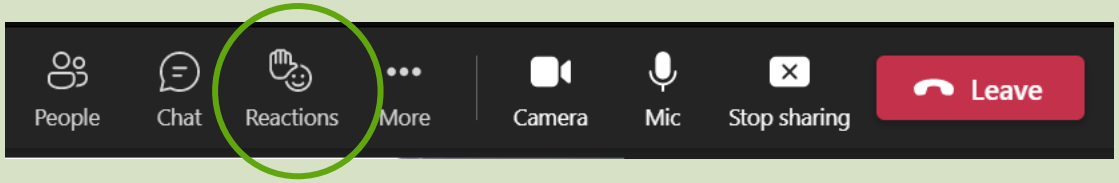
Discussion

Next Steps

# Welcome & Introductions

- 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
- The presentation was provided to everyone in advance of today's working group session.
- If you have technical difficulties or need assistance with the Microsoft Teams please message jeffrey.meek@icf.com

**Example of Toolbar**



# Team

- **Project Lead:** Dave Bradt, Senior Director – Strategic Planning
- **Technical Lead:** Ed Roedel, Principal Engineer – Strategic Planning
- **Stakeholder Engagement:** Dave Gridley, Director – Government & Community Relations
- **Regulatory Lead:** Lori Cole, Manager – Regulatory & Tariffs

- **Study Support:** ICF Consulting
  - Judsen Bruzgul – Project Lead
  - Dan Bishop, PhD – Climate Scientist
  - Jeffrey Meek – Stakeholder Lead

# Registered Working Group Participants

| Name | Organization or Affiliation |
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| Avni Pravin | AGREE |
| Ziang Zhang | Binghamton Unviersity |
| Erika Pierce | Board of Legislators |
| Aimee Dailey | Broome County Planning |
| Beth Lucas | Broome County Planning |
| Owlen Huxley | C&S Companies |
| Brian Eden | Campaign for Renewable Energy |
| Barry Carr | Clean Communities of CNY |
| Abigail McHugh-Grifa | Climate Solutions Accelerator of the Genesee-Finger Lakes Region |
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| Molly Ryan | Clinton County IDA |
| Kelly Donoghue | Clinton County Office of Emergency Services |
| Patrice Perry | Columbia County Planning Department |
| Guillermo Metz | Cornell Cooperative Extension Tompkins County |
| Karim Beers | Cornell Cooperative Extension Tompkins County |
| Robert Corpora | Cortland County |
| Michael Mager | Couch White, LLP for Multiple Intervenors |
| Rick Mancini | Customized Energy Solutions |
| Bonnie Lawrence | Erie County Department of Environment and Planning |
| Romy M Fain, PhD | Heat Inverse |
| Michael Jagielski | Koffman Southern Tier Incubator |
| Andrew Brodell | Livingston County OEM |
| Will Gall | Livingston County OEM |
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| Jack Wheeler | Steuben County |
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| Jennifer de Souza | The Raymond Corporation |
| Mike Straight | Tier Energy Network |
| Jeff Smith | Tier Energy Network, Rotary |
| Hailley Delisle | Tompkins County |
| Peter Bardaglio | Tompkins County Climate Protection Initiative |
| Katie Borgella | Tompkins County Dept of Planning and Sustainability |
| Fion MacCrea | Town of Alfred |
| Jason Keding | Town of Boston |
| Dr. Mitch Tucker | Town of Boston |
| Brendan Ryan | Town of Brighton |
| Evert Garcia | Town of Brighton |
| C.J. Randall | Town of Ithaca |
| Nick Goldsmith | Town of Ithaca |
| Katherine Daniels | Town of North Salem |
| Norma J Burris | Town of Orange |
| Josheph Wilson | Village of Dryden |
| James Basile | Village of Fair Haven |
| Dave McDowell | Village of Sodus Point |
| Thomas Lyon | Wayne County Economic Development & Planning |
| Ryan Dwyer | Westchester County |
| Brian Meyers | Wyoming County |

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**Project Update**

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# Overview of PSC Order

- March 2022, PSC law became effective (Case 22-E-0222) to NY electric utilities
- Conduct a **Climate Change Vulnerability Study (Study)** and develop a **Climate Change Resilience Plan (Plan)**
- The Study must include an evaluation of the electric grid's vulnerability to climate-driven risks
- The Plan must address the findings of the Study for the next ten- and twenty-year periods
- Engage and collaborate with stakeholders
- The Study and Plan must be filed in the fall of 2023, with updates at least every five years

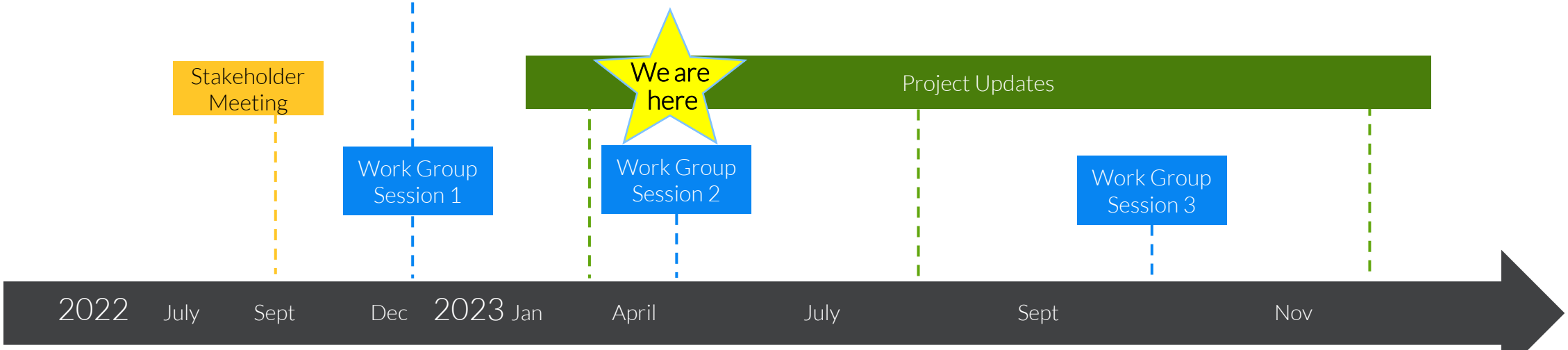
# Reminder: Working Group Overview

- Provide a platform for open and constructive discussion of key issues affecting NYSEG and RG&E's climate resilience planning
  - Gather input and insights from external stakeholders and subject matter experts on strengths and gaps
  - Learn about parallel efforts and connection points
- This is the second Working Group meeting, with the third meeting to be scheduled in early fall of 2023

# Reminder: Efforts to Date

**WG Session 1:**

- Project Background (PSC Order, WG goals)
- Climate science summary & sample asset exposure findings
- Process for determining physical impacts of climate change on infrastructure
- Next steps



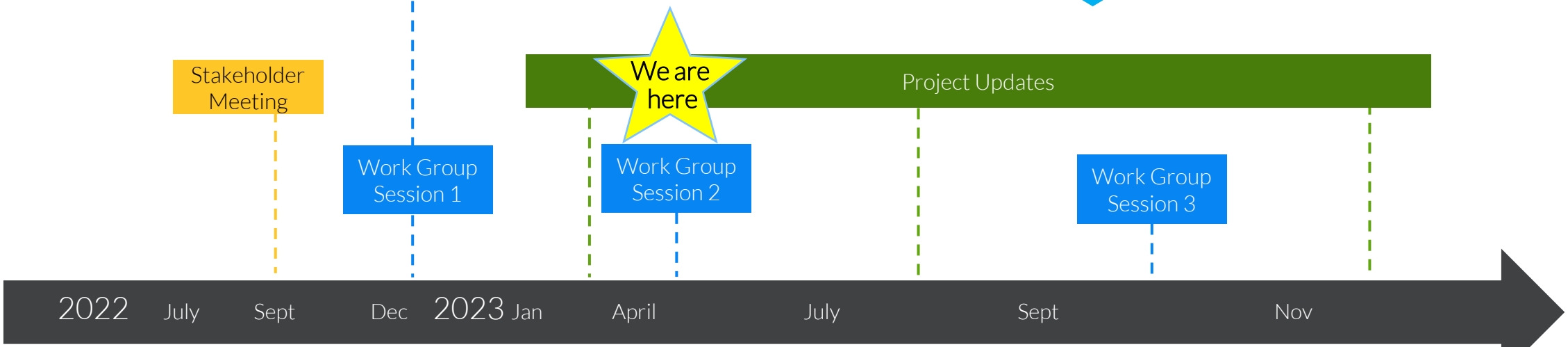

Project process:

# Reminder: Efforts to Date

**WG Session 1:**

- Project Background (PSC Order, WG goals)
- Climate science summary & sample asset exposure findings
- Process for determining physical impacts of climate change on infrastructure
- Next steps

What was helpful to you in the first session?




Project process:

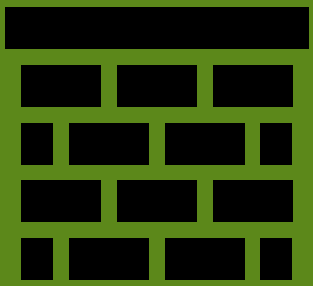
- Vulnerability Analyses (Exposure, Potential Impacts)
- Develop Resilience Plan
- Final Vulnerability Study and Resilience Plan

# Today's Focus

- Update on the study progress since the last WG meeting
- Provide information on the climate science, assets, and exposure for the Climate Change Vulnerability Study and Resilience Plan
- Review study process for determining **sensitivity, consequence, and potential impact** of climate change on electric utility infrastructure
- Summarize the priority vulnerability findings and how they will drive the focus of the Resilience Plan
- Discuss study details and process, and share next steps

**Reminder:**

Adaptation



Actions to increase resilience to climate change (e.g., hardening, undergrounding, new storm barriers, changes to design standards, etc.)

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**Climate Data & Asset Exposure Analysis**

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# Project Process Diagram

(Vulnerability Assessment → Resilience Plan)

## Today's focus

### Potential Impact
The potential for negative outcomes in the event of climate hazard exposure

- Sensitivity
- Consequence

### Exposure
The degree to which assets, operations, or systems could face climate hazards, based on their physical locations and projected hazards.

### Vulnerability
Potential of assets or operations to be affected by hazards, and significance of potential consequences

### Risk Assessment
- Quantification of asset specific impacts
- Quantification of risk-reduction potential of mitigation measures

### Resilience Plan
Comprehensive framework to address gradual climate change and extreme events that can guide investment planning

# Process Diagram: Vulnerability Assessment Overview

**Potential impact** scores are assessed alongside **exposure** (climate data for AVANGRID service territory) to identify **vulnerabilities.**

## Potential Impact

### Sensitivity

Sensitivity is the degree to which assets could be negatively affected by climate hazard exposures

Examples:

- Overheads transformers **are not** sensitive to flooding
- Pad mount transformers **are** sensitive to flooding

### Consequence

Consequence is the potential for impacts to sensitive assets to result in negative outcomes for Avangrid's system, customers, or staff

Examples:

- Overhead transformer failure impacts 5-15 customers
- Substation transformer failure impacts 1,000+ customers

## Exposure

**Exposure** is the overlap between probabilistic climate hazards and equipment locations

## Vulnerabilities

**Vulnerabilities** serve as a starting point to identify and prioritize adaptation investments that will be further explored in the resilience plan.

## Priority Vulnerabilities

**Priority vulnerabilities** are asset types with the highest potential impact from each hazard, in the most exposed regions. These variables will drive the **resilience plan** focus.

# Overview of Preliminary Exposure Findings

## High-Level

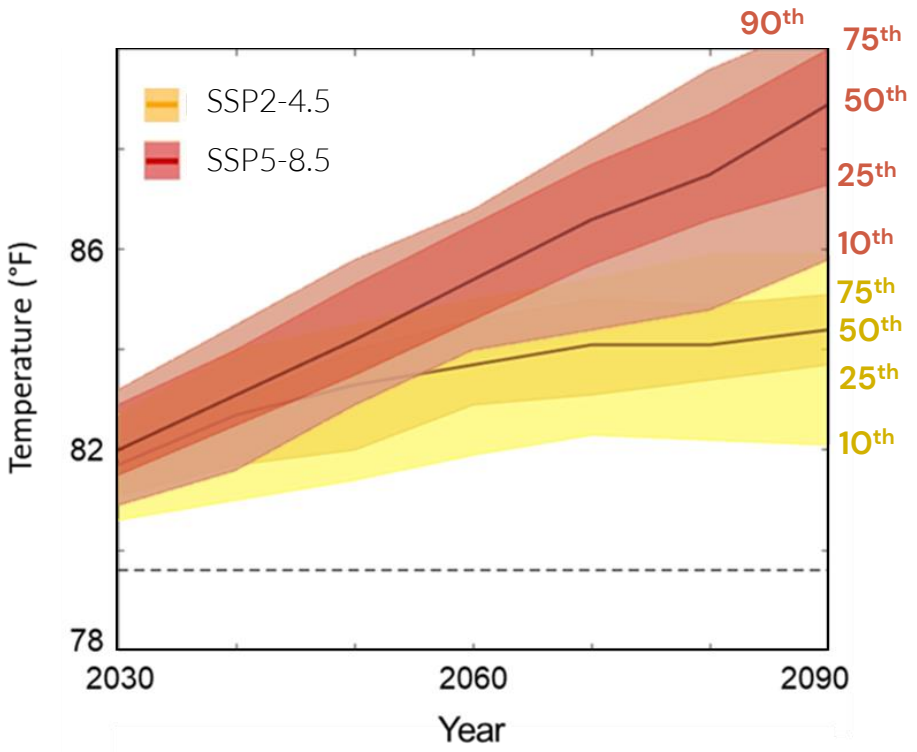
- Climate change will lead a warmer and wetter future
- Extreme events are expected to occur more frequently and of a greater intensity, but determining quantifiable changes to justify projects is difficult/uncertain

## Specific

- By 2050, more than half of NYSEG and 100% of RG&E facilities are projected to go from 0 to more than 2 days per year with average temperatures over 86˚F [Affects transformers and ratings]
- By 2050, 100% of NYSEG and RG&E facilities are projected to see 1-in-10-year temperatures ranging from 100˚F to 105˚F compared to just 22% currently [Affects most temperature sensitive equipment; 104˚F max]
- By 2050, NYSEG and RG&E territories are projected to see increases of 9%-12% in the maximum 5-day precipitation event. [Not expected to be limiting]
- Average wind speeds are not expected to increase significantly. Windspeeds of ~70+ mph have already been measured across the territories
- There are already significant numbers of assets in flood zones for present-day 100- and 500-year events; by 2050, 100- and 500-year flood events are projected to cause deeper and more extensive flooding

# Climate Pathways

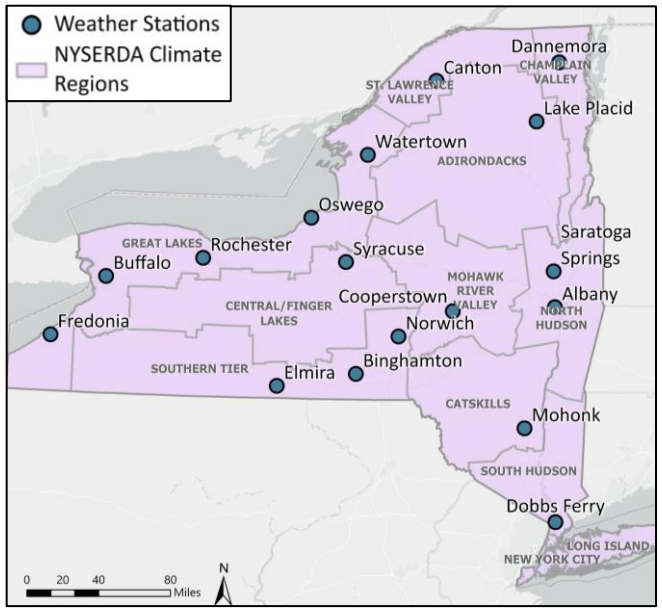
- **Climate change projections:** a range of possible outcomes in terms of future temperatures, rainfall, or sea level rise
- **Vulnerability assessment scenarios:** a subset of climate projections that consider potential climate futures to characterize future climate risks
- Each scenario consists of:
  1. Shared Socioeconomic Pathway (SSP)
  2. Representative Concentration Pathway (RCP)
     - **SSP2-RCP4.5:** trends do not shift from historical patterns
     - **SSP5-RCP8.5:** rapidly growing global economy heavily dependent on fossil fuels
  3. Percentile from the range of model outcomes for a given emissions trajectory (e.g., 25th, 50th, 90th percentiles)
- We used three pathways representing the plausible lower and upper bounds of climate model projections:
  - **SSP2-4.5 50th percentile** as lower bound
  - **SSP5-8.5 50th percentile** as high bound ← NYSEG/RG&E's Selected Planning Level
  - **SSP5-8.5 90th percentile** as a high-end "stress test"



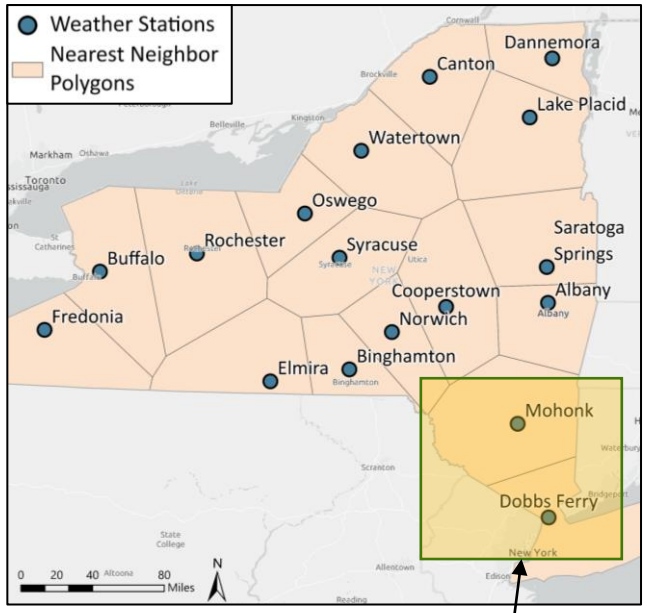
# Exposure Methods

- **Exposure:** degree to which assets could face climate hazards, based on their physical locations and projected hazards
- **Climate data** is from Columbia weather stations
- **Nearest neighbor approach** created polygons for each weather station in the NYSERDA climate region
- **Assets were assigned climate data** of the polygon they're located in

NYSERDA Climate Regions and Weather Stations




Polygons created using nearest neighbor approach




Changes in this region expected to be significant

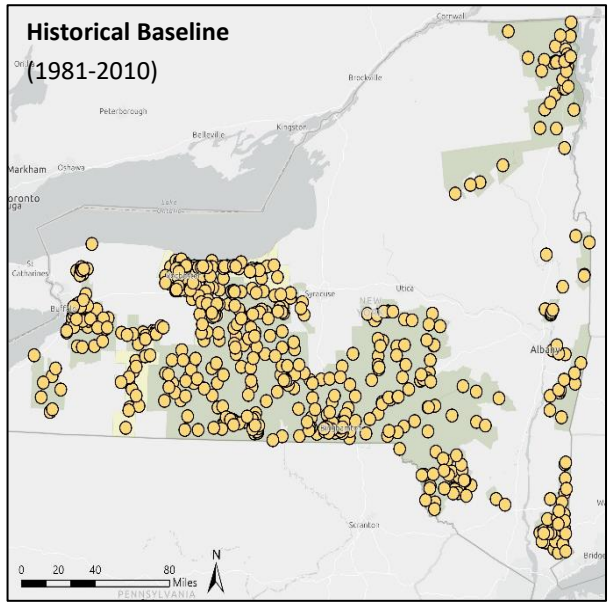
| Quantifiable Climate Variables Assessed | |
|---|---|
| Annual Average Maximum Temperature | 1-in-10-year Maximum Temperature |
| Days Per Year with Daily Avg. Temperatures > 86°F (30°C) | Days Per Year with Max. Temperatures > 95°F (35°C) |
| Days Per Year with Average Max. Temperatures > 104°F (40°C) | Avg. Annual Max. 5-day Precipitation |
| Highest Daily Peak Wind Gusts | First Street Flooding Data (100-year / 500-year) |

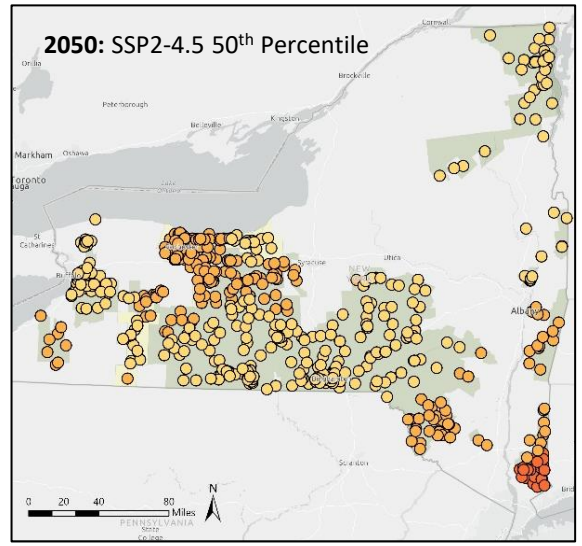
# Exposure: Temperature Findings

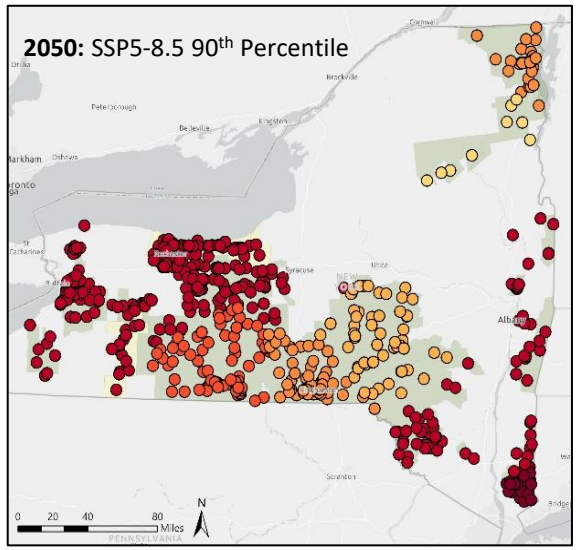
**Key Takeaway:**

All assets are projected to see more frequent days with average temperatures >86°F

- Historically, assets have seen < 2 days each year with average temperatures above 86°F
- Increases projected to be highest in the southeastern region, at assets near the Mohonk and Dobbs Ferry weather stations
- Assets near the Rochester, Oswego, Buffalo, and Fredonia weather stations are also projected to see higher increases, relative to the rest of the service area, under both future scenarios




Substations

NYSEG Divisions

RGE Divisions

Days each year with average temperatures over 86 °F (30 °C)

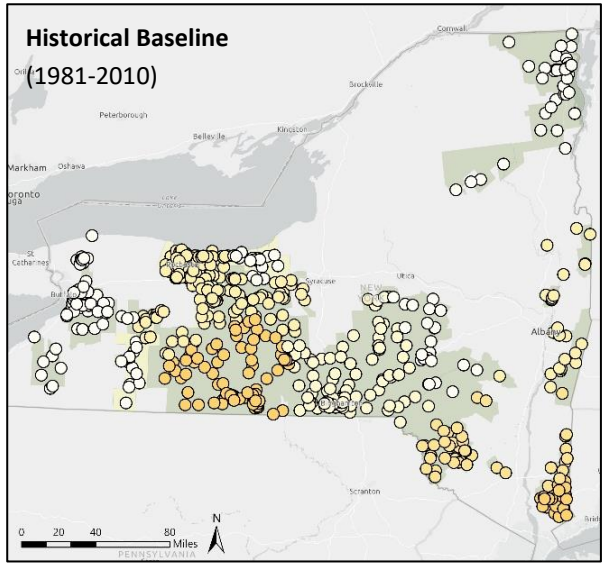
- 0 - 2
- 2- 4
- 4 - 6
- 6 - 8
- 8 - 10
- 10 - 15
- > 15 (max 23)

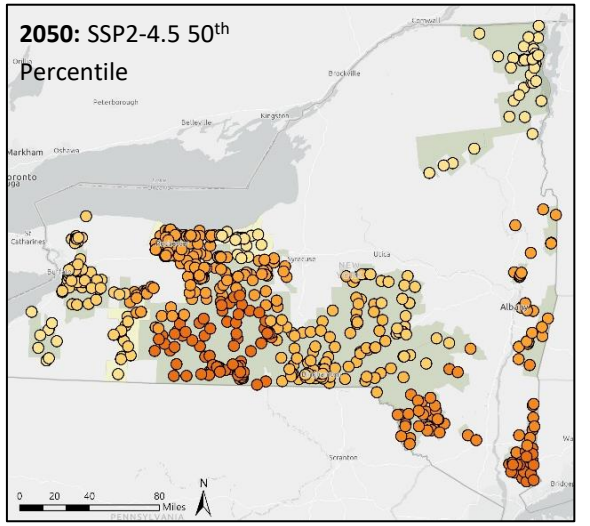
# Exposure: Temperature Findings

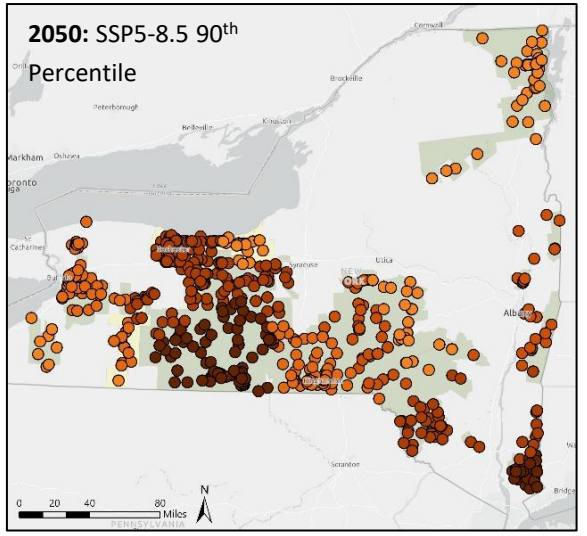
**Key Takeaway:**

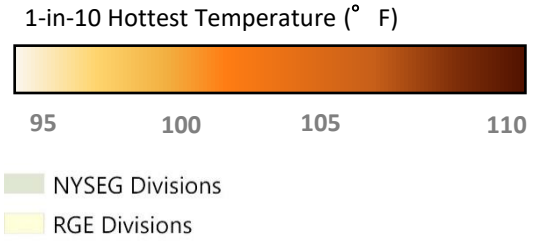
Assets across the service area are projected to experience higher extreme temperatures in coming decades

- Historically, RG&E and NYSEG assets have experienced 1-in-10-year temperatures ranging from 94 - 100°F
- Assets closest to the **Elmira, Dobbs Ferry, and Mohonk** weather stations are projected to experience the greatest increases in extreme temperatures
  - SSP2-4.5 50th percentile projections: 103-107°F, at these stations in 2050
  - SSP5-8.5 90th percentile projections: 108-112°F, at these stations in 2050



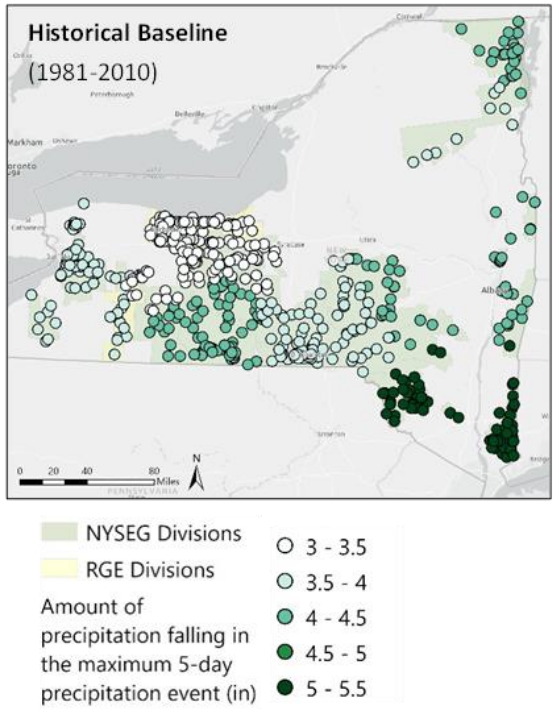
# Exposure: Precipitation Findings

**Key Takeaway:**

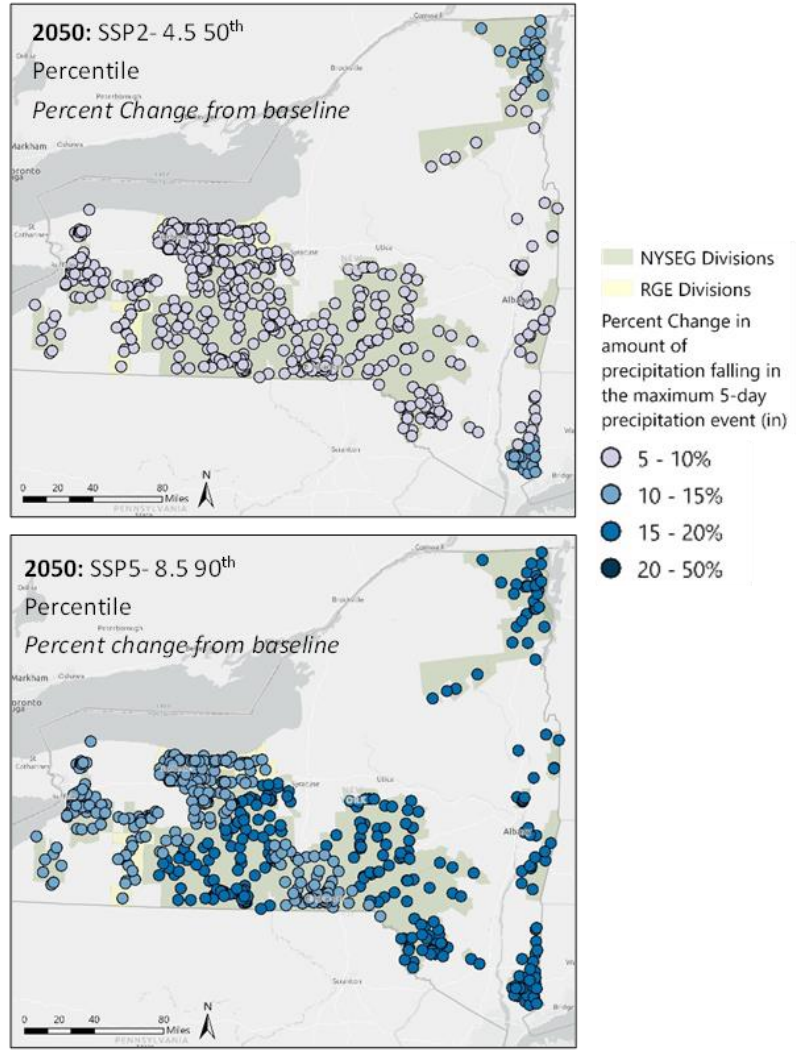
Maximum 5-day precipitation totals are projected to increase across the service area

- Historically, assets around the **Mohonk, Dobbs Ferry, and Saratoga** weather stations have experienced the most precipitation falling during the maximum 5-day event
- Highest totals are projected to continue to occur at these **Mohonk, Dobbs Ferry, and Saratoga** weather stations

Average amount of precipitation




Change in average amount of precipitation



# Exposure: Flooding Findings

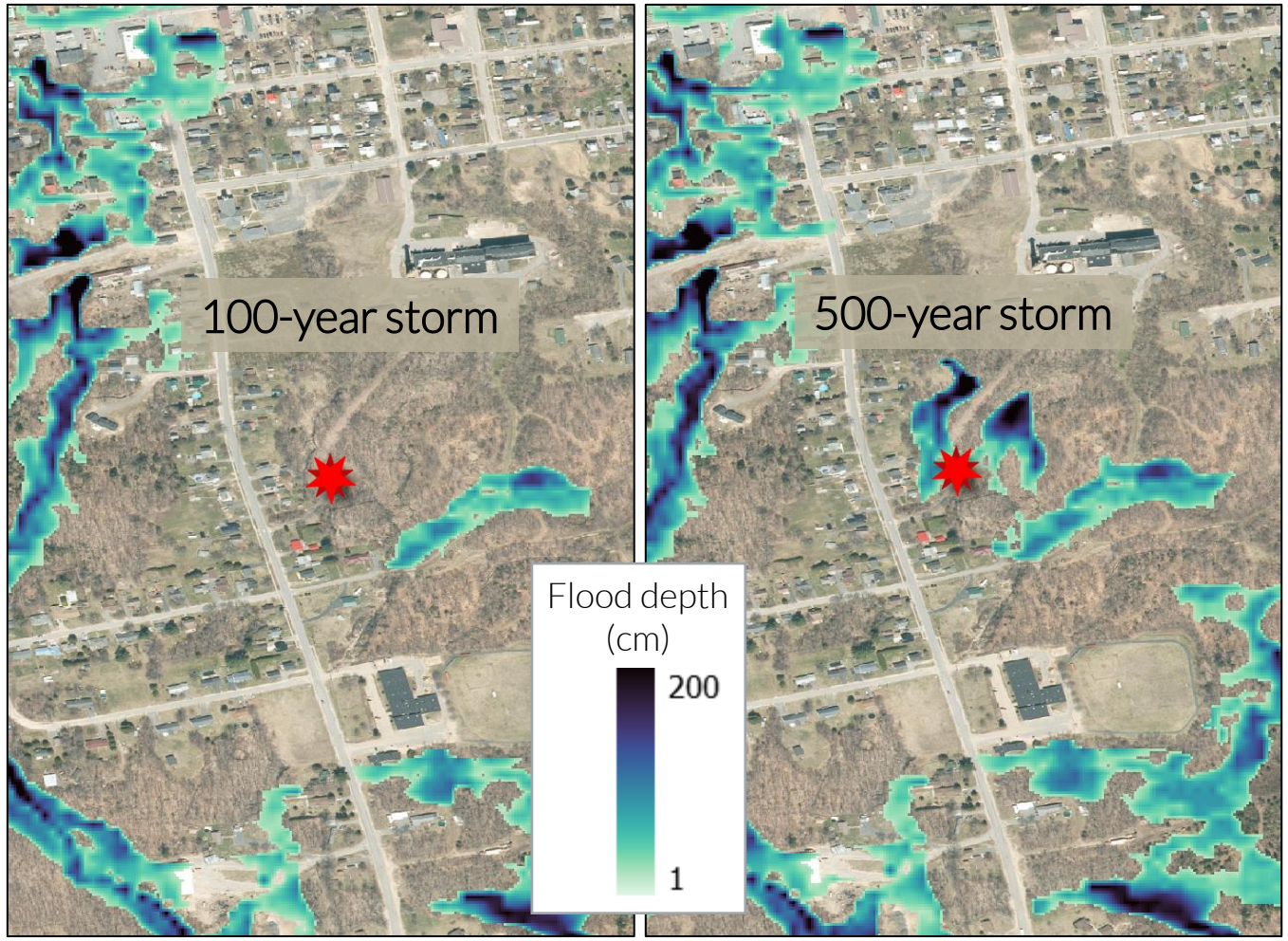
**Key Takeaways**

There are already significant numbers of assets in flood inundation zones for present-day 100- and 500-year events; by 2050, 100- and 500-year flood events are projected to cause deeper and more extensive flooding.

Flooding was evaluated on an asset-by-asset basis, instead of a regional basis

- Currently, approximately **16%** of substations are inundated by at least ~0.5 in. of water under the 100-year storm, and **22%** are inundated under the 500-year storm
- By 2050, on average, substations are projected to see a **~2.5 in.** increase in flood depth under the 100-year storm scenario, and an **~3 in.** increase under the 500-year storm scenario

Example asset & flood data (Dannemora Distribution Station)



# Exposure: Wind Findings

Quantifying the effect of climate change potential for high-winds that are the result of unique weather events is difficult to do with a high degree of confidence. Our analysis relies on:

## Extreme Wind Analysis

### Quantifiable

(Quantitatively Modeled Simulations)

- Average near-surface wind-speeds
- Reproduction of events experienced at regional airports via "gust-factor"
- Utilizes 16 Global Climate Models as part of NASA simulation efforts
- Does not include most extreme windspeeds, e.g., tropical cyclones

Limited "prediction" capability of maximum possible future wind-speeds

### Qualified

(High Uncertainty/Dynamic Events)

- Tropical/Extra-Tropical Cyclone
  - Intensity
  - Trajectory/Path
  - Frequency
- Uses literature review of studies specific to the analyzed phenomenon

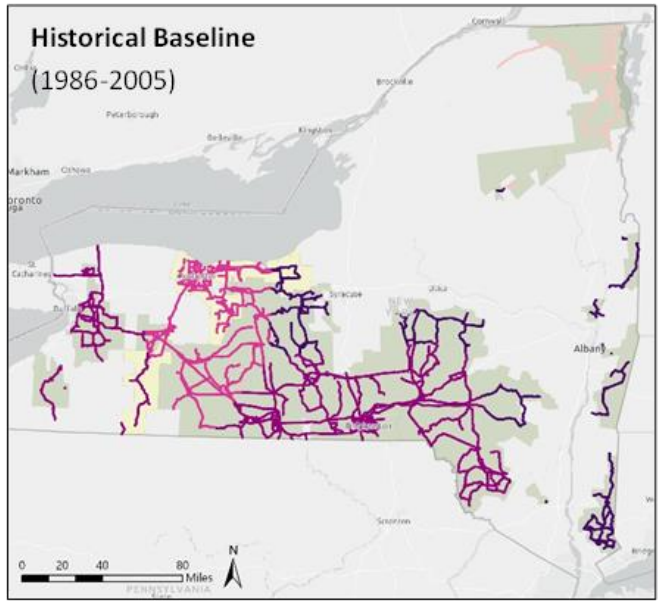
Limited to analysis from literature; cannot determine specific probabilities of storm occurrence/intensity; hard to ask "what-if" questions quantitatively

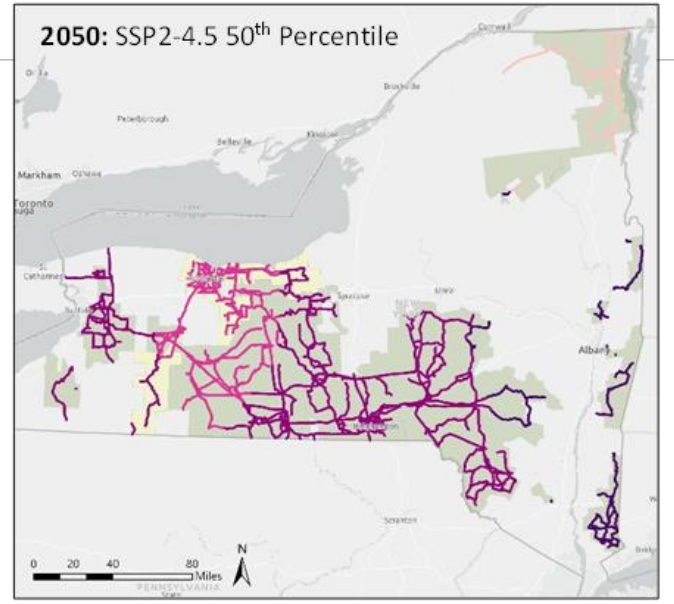
# Exposure: Wind Findings

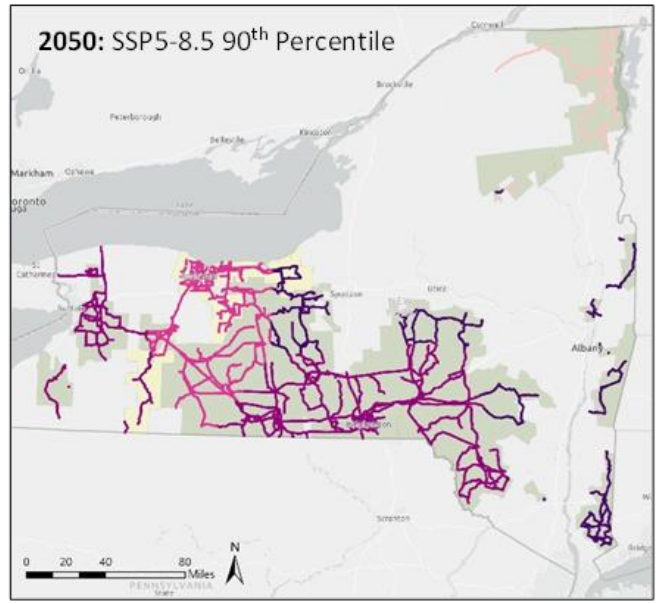
**Key Takeaways:**

Wind projections do not indicate large increases in average wind gust speeds in future decades; however, high impact, low likelihood storm events *are* projected to intensify, which may drive higher extreme wind speeds

- Wind gust speeds in 2050 are projected to be between **3% lower and 1% higher than historical speeds**
- Wind gusts are highest at assets around Syracuse and Albany and lowest in Plattsburgh
- Even so, future tropical/extra tropical cyclone events and other low likelihood events are projected to intensify in the future; these high intensity low likelihood events may drive higher extreme wind speeds



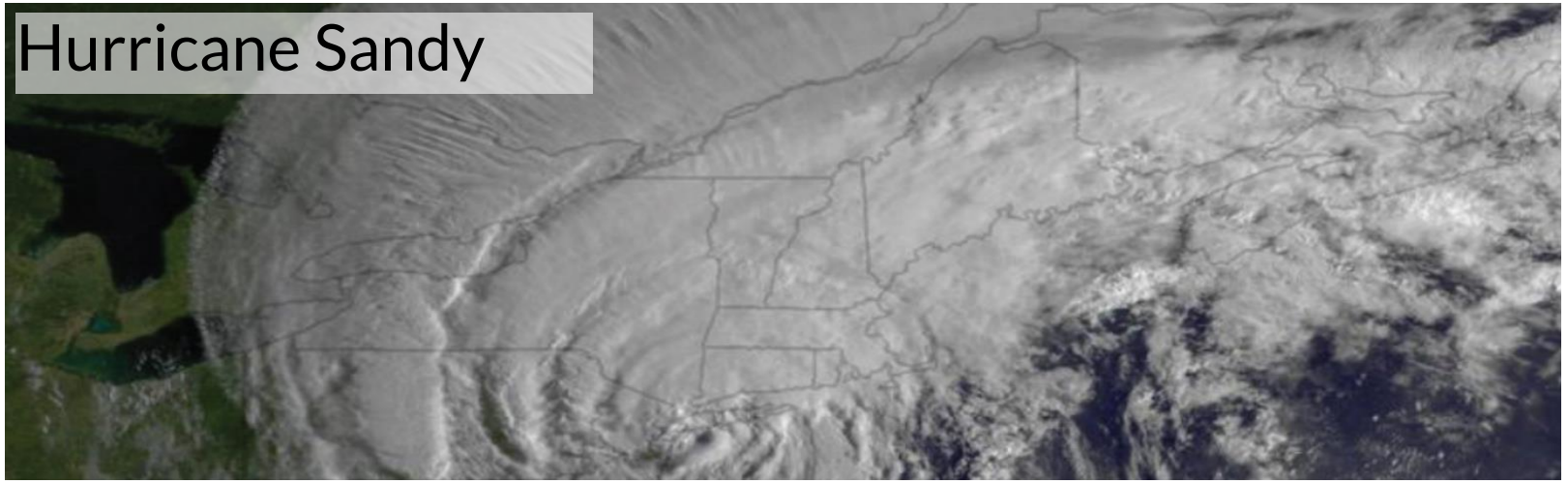




NYSEG Divisions
RGE Divisions

Highest Daily Peak Wind Gusts (mph)
60 - 62
62 - 65
65 - 70
70 - 75
> 75

# High Impact Low Likelihood (HILL) Extreme Event Scenarios

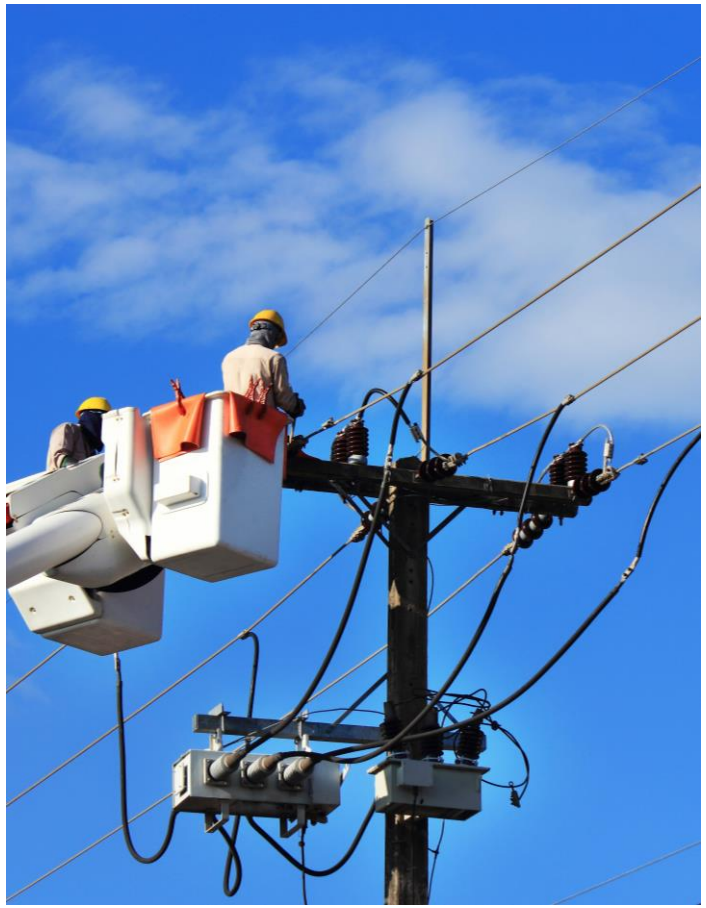
- **Opportunity to explore "stress test" extreme weather and climate events**—*including consecutive or compounding events*—that are not well resolved by standard downscaled climate models but drive potentially outsized impacts.
- **Unlocks an expanded set and potential "worst-case" vulnerabilities** to consider in the Vulnerability Assessment, including impacts to the system that may already be operating in a degraded state and complex restoration scenarios.
- **NYSEG & RG&E are evaluating:**
  1. Hurricane with tropical storm force winds and inland flooding
  2. Ice storm followed by cold snap



# Check-in: Climate Data & Asset Exposure Analysis

Key takeaways from the climate data & exposure analysis?

Any questions?



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# Sensitivity: Methods

***Sensitivity:*** *the degree to which assets could be negatively affected by exposure to a climate hazard*

Each asset in scope was given a sensitivity rating for each hazard, from 0 (None) to 3 (high)

These ratings were determined using ICF in-house expertise in consultation with Avangrid Project Leads

| Sensitivity | |
|---|---|
| None | • Not sensitive to this hazard |
| Low | • Asset, operation, or system faces minimal potential adverse impact from this hazard. |
| Moderate | • Asset, operation, or system may be adversely affected by this hazard.<br>• Impacts are medium by one or more factors:<br>  ◦ Impacts are only likely at a very high threshold of exposure (i.e., very high temperature, or water level.<br>  ◦ Impacts are more likely to be chronic/controlled than sudden/acute (i.e., accelerated degradation rather than catastrophic failure). |
| High | • Asset, operation, or system may be subject to increased risk of major and/or sudden failure in the event of hazard exposure.<br>• Asset has limited existing tolerance for exposure to this hazard (i.e., substation without existing flood protection; non-submersible padmount transformer |

# Example

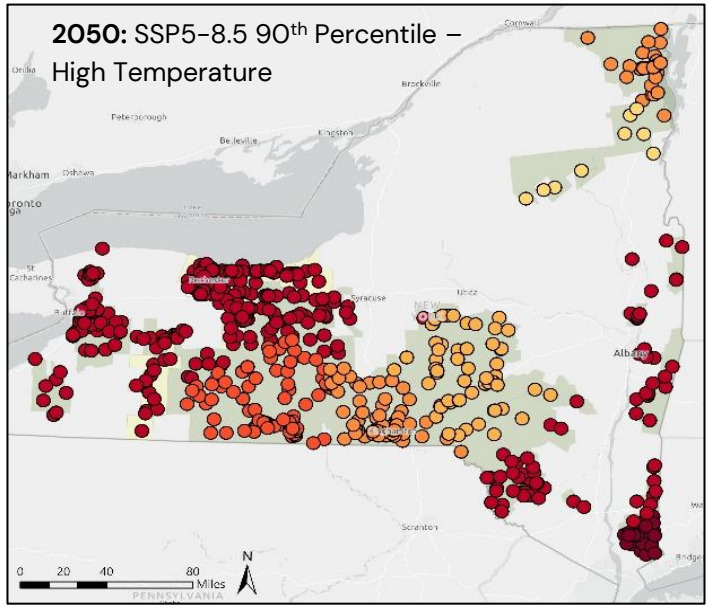
Sensitivity **X** Consequence **=** Potential Impact **X** Exposure → Priority Vulnerabilities

High Temperature

| Transmission | Sensitivity | x | Consequence | = | Potential Impact |
|---|---|---|---|---|---|
| Line structures (poles/towers) | | x | | = | |
| Conductors (Overhead) | | x | | = | |
| Conductors (Underground) | | x | | = | |
| Open-air current carrying components | | x | | = | |

| N/A | Low | Medium | High |
|---|---|---|---|

**X**




**Potential impact** scores are assessed alongside **exposure** (climate data for AVANGRID service territory) to identify **priority vulnerabilities.**

These priority vulnerabilities serve as a starting point to identify and prioritize adaptation investments that will be further explored in the resilience plan.

# Sensitivity: Findings

| None | Low | Medium | High |
|---|---|---|---|

| Transmission | Temperature | Wind | Inland & Riverine Flooding | Precipitation | Wind + Ice |
|---|---|---|---|---|---|
| Line structures (poles/towers) | | | | | |
| Conductors (Overhead) | | | | | |
| Conductors (Underground) | | | | | |
| Open-air current carrying components (i.e., switches, jumpers…) | | | | | |

| Distribution | Temperature | Wind | Inland & Riverine Flooding | Precipitation | Wind + Ice |
|---|---|---|---|---|---|
| Structures (overhead) [includes poles] | | | | | |
| Conductors (underground) | | | | | |
| Conductors (overhead) | | | | | |
| Transformers (overhead) | | | | | |
| Transformers (pad mount) | | | | | |
| Regulators (pole mount) | | | | | |
| Capacitors (pole mount) | | | | | |
| Open-air current carrying components (i.e., switches, jumpers…) | | | | | |
| Surge Arresters | | | | | |

| Substations | Temperature | Wind | Inland & Riverine Flooding | Precipitation | Wind + Ice |
|---|---|---|---|---|---|
| Substation transformers | | | | | |
| Substation regulators | | | | | |
| Circuit breakers (open air) | | | | | |
| Protection and control devices | | | | | |
| Instrument Transformers (CT's and PT's) | | | | | |
| Control room/ Control house | | | | | |
| Substation Reactor | | | | | |
| Support Structures | | | | | |

**Sensitivity** is the degree to which assets could be negatively affected by climate hazard exposures.

# Consequence: Findings

| None | Low | Medium | High |
|---|---|---|---|

| Transmission | Consequences |
|---|---|
| Line structures (poles/towers) | |
| Conductors (Overhead) | |
| Conductors (Underground) | |
| Open-air current carrying components (i.e., switches, jumpers…) | |

| Distribution | |
|---|---|
| Structures (overhead) [includes poles] | |
| Conductors (underground) | |
| Conductors (overhead) | |
| Transformers (overhead) | |
| Transformers (pad mount) | |
| Regulators (pole mount) | |
| Capacitors (pole mount) | |
| Open-air current carrying components (i.e., switches, jumpers…) | |
| Surge Arresters | |

| Substations | |
|---|---|
| Substation transformers | |
| Substation regulators | |
| Circuit breakers | |
| Protection and control devices | |
| Instrument Transformers (CT's and PT's) | |
| Control room/ Control house | |
| Substation Reactor | |
| Support Structures | |

**Consequence** is the estimated magnitude of negative outcomes associated with impacts.

# Potential Impact Ratings (sensitivity x consequence)

| None | Low | Medium | High |
|---|---|---|---|

| Transmission | Temperature | Wind | Inland & Riverine Flooding | Precipitation | Wind + Ice |
|---|---|---|---|---|---|
| Line structures (poles/towers) | | | | | |
| Conductors (Overhead) | | | | | |
| Conductors (Underground) | | | | | |
| Open-air current carrying components (i.e., switches, jumpers…) | | | | | |

| Distribution | Temperature | Wind | Inland & Riverine Flooding | Precipitation | Wind + Ice |
|---|---|---|---|---|---|
| Structures (overhead) [includes poles] | | | | | |
| Conductors (underground) | | | | | |
| Conductors (overhead) | | | | | |
| Transformers (overhead) | | | | | |
| Transformers (pad mount) | | | | | |
| Regulators (pole mount) | | | | | |
| Capacitors (pole mount) | | | | | |
| Open-air current carrying components (i.e., switches, jumpers…) | | | | | |
| Surge Arresters | | | | | |

| Substations | Temperature | Wind | Inland & Riverine Flooding | Precipitation | Wind + Ice |
|---|---|---|---|---|---|
| Substation transformers | | | | | |
| Substation regulators | | | | | |
| Circuit breakers | | | | | |
| Protection and control devices | | | | | |
| Instrument Transformers (CT's and PT's) | | | | | |
| Control room/ Control house | | | | | |
| Substation Reactor | | | | | |
| Support Structures | | | | | |

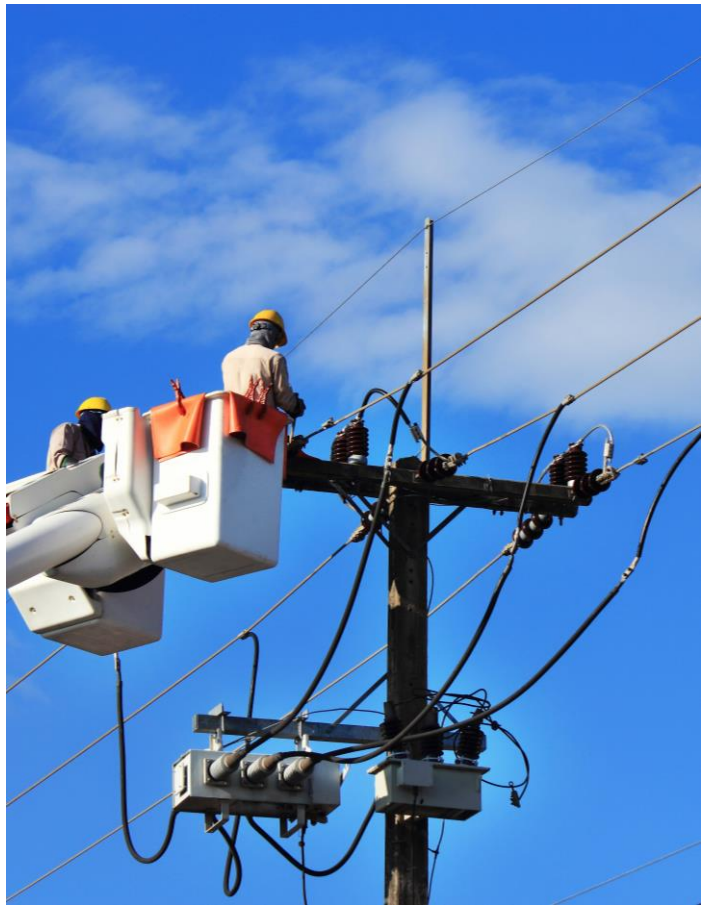


**Potential impact** is the potential for negative outcomes in the event of climate hazard exposure.

# Check-in: Sensitivity, Consequence, & Potential Impacts

Major takeaways from this analysis?

Which concerns are most important to you?



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Sensitivity, Consequence & Potential Impact

**Priority Vulnerabilities**

Discussion

Next Steps

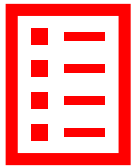
# Vulnerabilities

The potential of assets, operations or customers to be affected by projected hazards, and the significance of the potential consequences.

Each asset was given a **sensitivity** rating for each hazard, from 0 (N/A) to 3 (high), and a **consequence** rating.

Sensitivity and consequence ratings were considered in tandem to generate a **potential impact** score from low (green) to high (red).

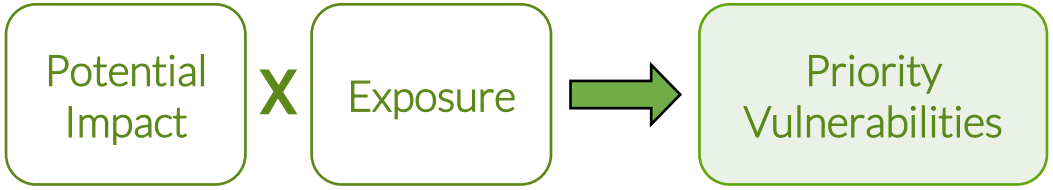
These ratings were determined through Avangrid and ICF experts' knowledge.

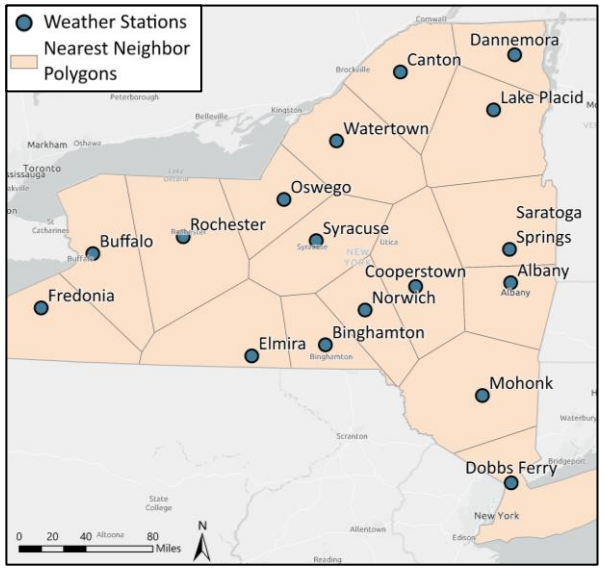


**Potential impact** scores were assessed alongside exposure data to create a list of **priority vulnerabilities.**

# Preliminary Priority Vulnerabilities

Vulnerability is the potential of assets to be affected by projected hazards, and significance of potential consequences.

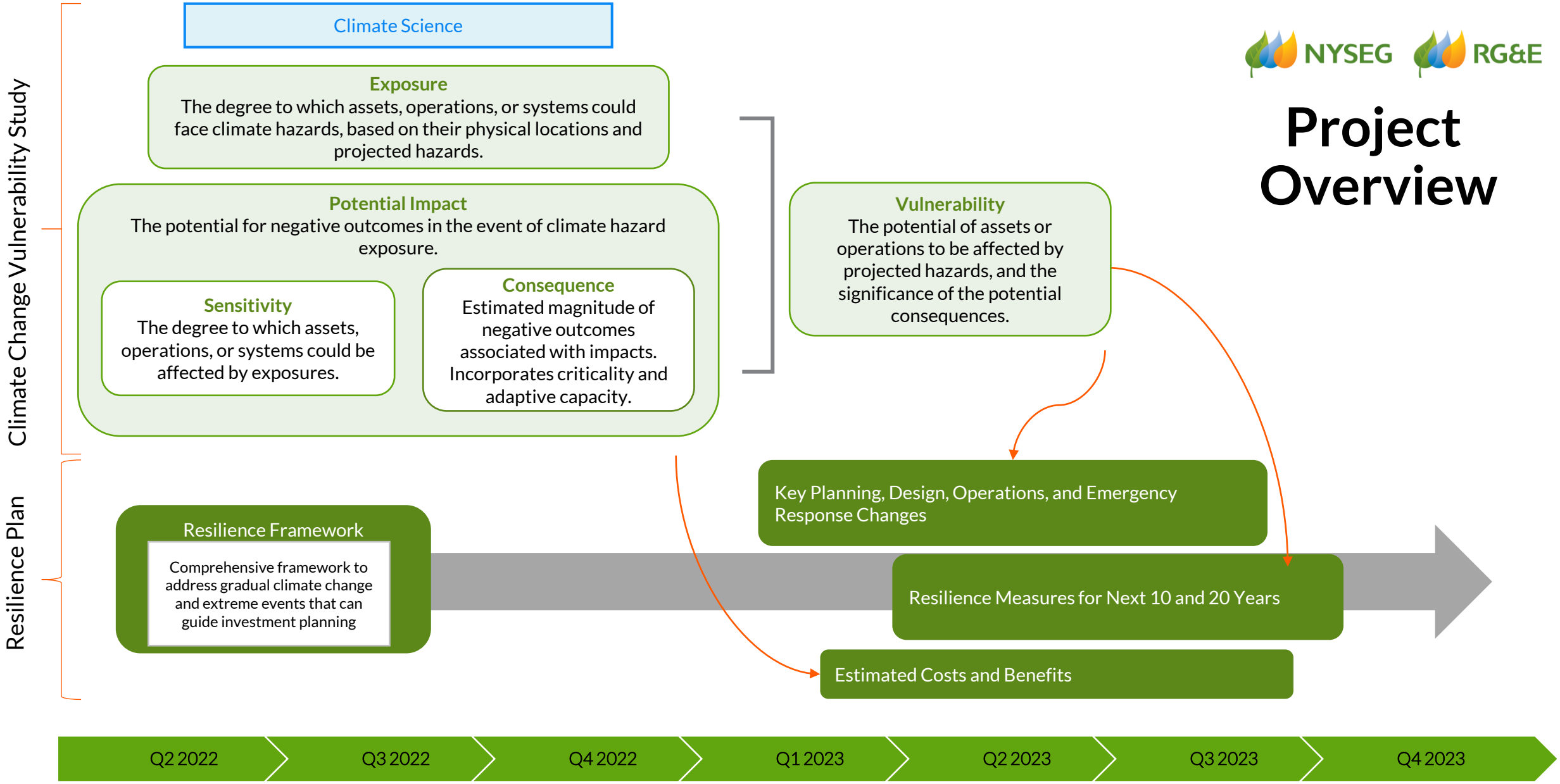



These asset–hazard–region combinations are **priority potential vulnerabilities** for further investigation in the resilience plan:

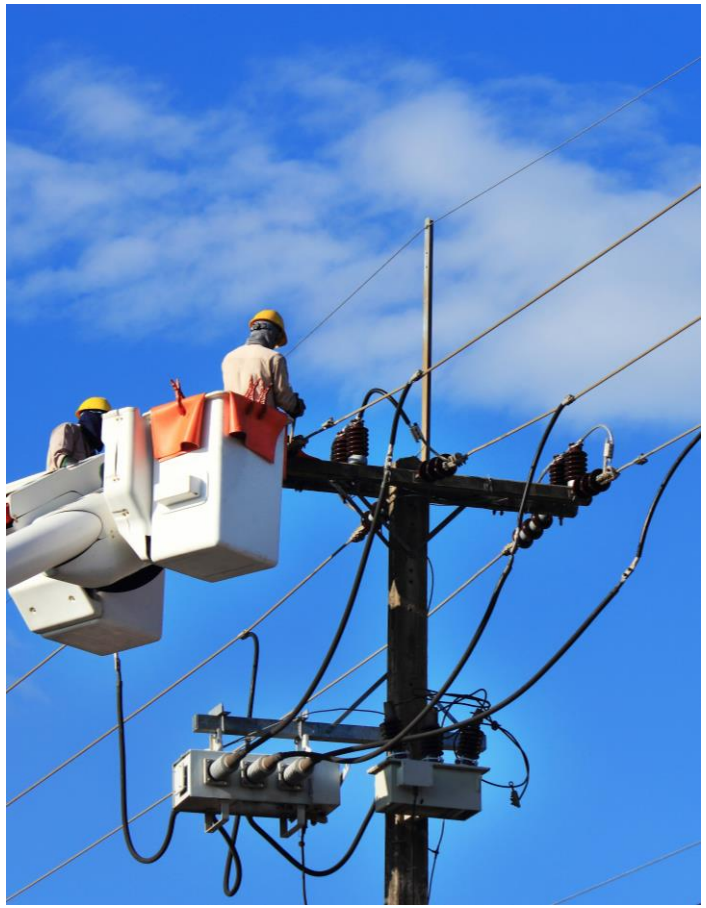
| | Temperature | Wind | Inland & Riverine Flooding | Precipitation | Wind + Ice |
|---|---|---|---|---|---|
| Asset Families with highest impact ratings | Substations | Transmission Distribution Substations | Transmission Substations | N/A | Transmission Distribution Substations |
| Climate regions of highest hazard exposure | Brewster, Elmira | N/A | Floodplains span service area; evaluated on asset-by-asset basis | Brewster, Saratoga | N/A |

# Project Overview

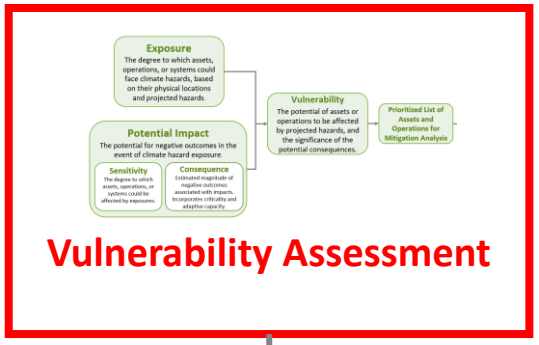


# Check-in: Priority Vulnerabilities

Any questions about priority vulnerabilities findings?



# Vulnerability Assessment → Risk Assessment and Resilience Plan




**Vulnerability Assessment**

**Quantification of Identified Risks**

**Likelihood of Damage & Asset Specific Consequence**

**Identification of Risk Mitigation Measures**

**Quantification of Risk Mitigation Potential**

**Ability of Measures to Reduce Likelihood of Damage & Asset Specific Consequence of Identified Risks Defined per order as Customer Outages and Cost of Restoration**

**Quantification of Risk Mitigation Costs**

**Identification of Cost-Effectiveness**

**Identification of Optimal Portfolio of Resilience Measures**



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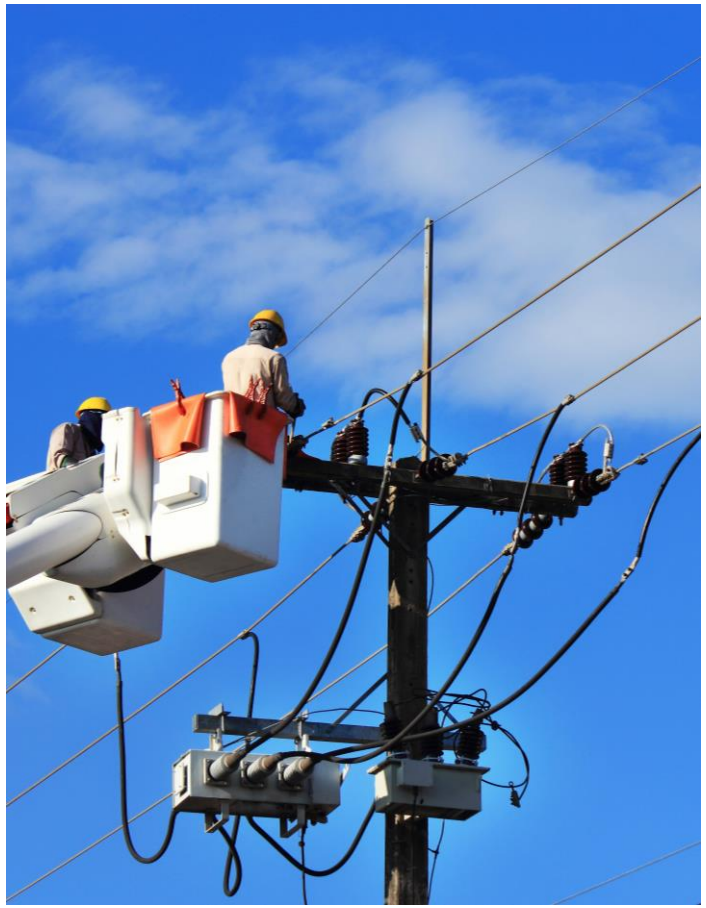
# Discussion

Additional questions about methods or findings?

Anything you'd like to learn more about in the next update?



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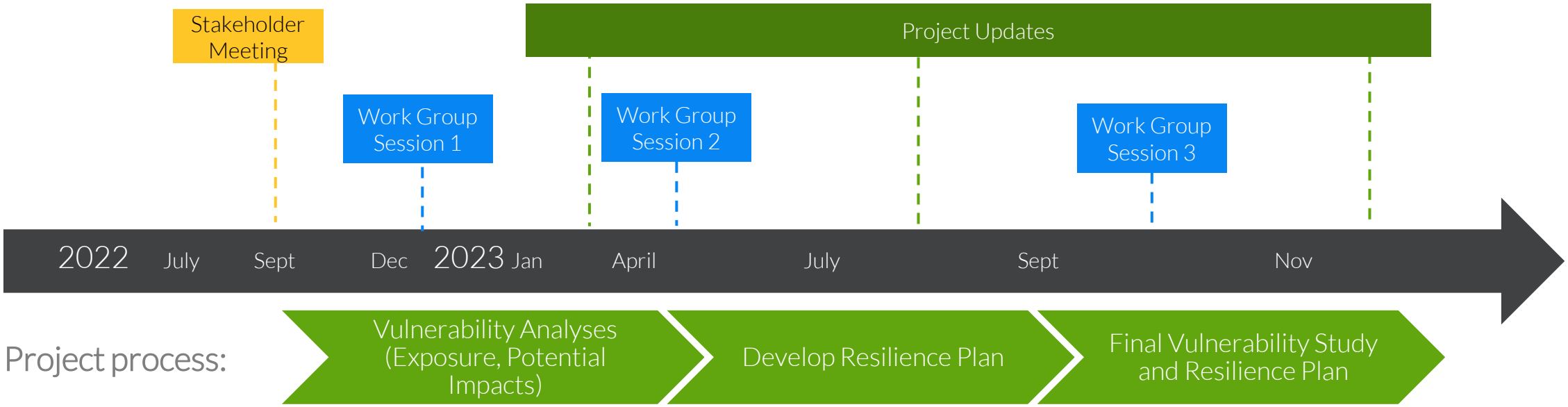
**Next Steps**

# Continued Stakeholder Engagement Opportunities

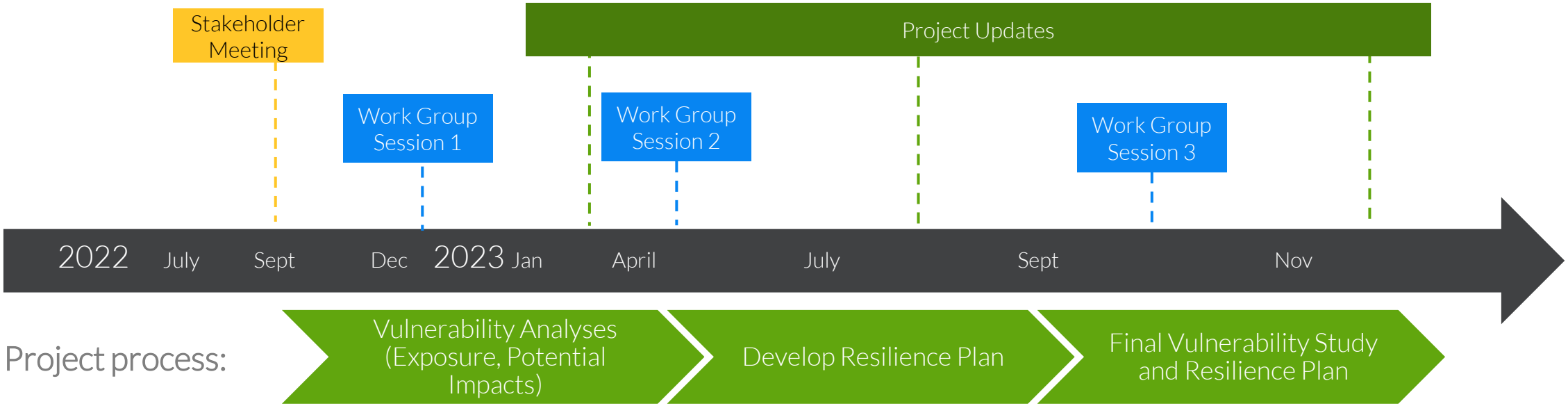
- Updates will continue to be provided via periodic Project Update emails in 2023.
- Next Working Group meeting will be in early Fall of 2023 to further discuss the risk assessment and provide an update on the Resilience Plan
- Continue building towards the climate vulnerability study filing (Sept 2023) and resilience plan filing (Nov 2023)
- Parties are welcome to join the Working Group at any time

# Stakeholder Engagement Timeline



# Stakeholder Engagement Timeline

Key takeaway from today?




Project process:

- Vulnerability Analyses (Exposure, Potential Impacts)
- Develop Resilience Plan
- Final Vulnerability Study and Resilience Plan

# Thank You!

Please send any follow up questions or comments to:
nyseg.rge.publicaffairs@avangrid.com