NYSEG RG&E

Part of the AVANGRID Family

Climate Change Vulnerability Study and Resilience Plan

Working Group Meeting 1

December 14th, 2022

Welcome & Introductions

Project Background

Climate Science

Assets and Exposures

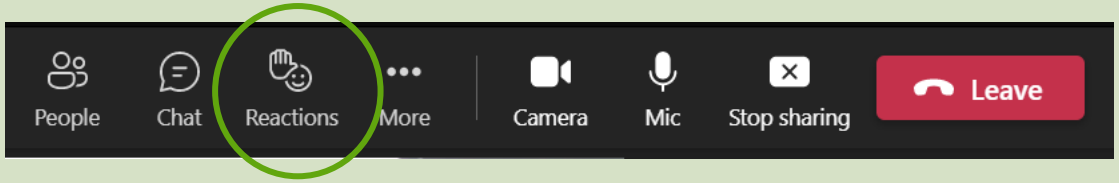
Discussion

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
Avni Pravin	AGREE
Ziang Zhang	Binghamton University
Aimee Dailey	Broome County Planning
Beth Lucas	Broome County Planning
Brian Eden	Campaign for Renewable Energy
Barry Carr	Clean Communities of CNY
Kristen Van Hooreweghe	Climate Solutions Accelerator of the Genesee-Finger Lakes Region
Molly Ryan	Clinton County IDA
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
Amanda Kaier	Mohawk Valley Economic Development District, Inc
Clement Chung	Monroe County Department of Environmental Services
Aferdita Bardhi	NYS Department of Public Service
Biola Daniel	NYS Department of Public Service
Bridget Frymire	NYS Department of Public Service
Eric Moore	NYS Department of Public Service
Greg Crawford	NYS Department of Public Service
Michael Richard	NYS Department of Public Service
Moutasim Hamayel	NYS Department of Public Service
Nicole Sallese	NYS Department of Public Service

Name	Organization or Affiliation
Bob Mack	NYSERDA
Carol Chock	Ratepayer and Community Intervenors
Judy McKinney Cherry	Schuyler County Partnership
Kerri Green	Schuyler County Partnership for Economic Development
Jeffrey Eisenhauer	Siemens
Jack Wheeler	Steuben County
Heather Brown	Sullivan County
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
Brendan Ryan	Town of Brighton
Evert Garcia	Town of Brighton
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
Erika Pierce	Westchester County
Ryan Dwyer	Westchester County
Brian Meyers	Wyoming County

Interactive Exercise

- What does climate change mean to you?

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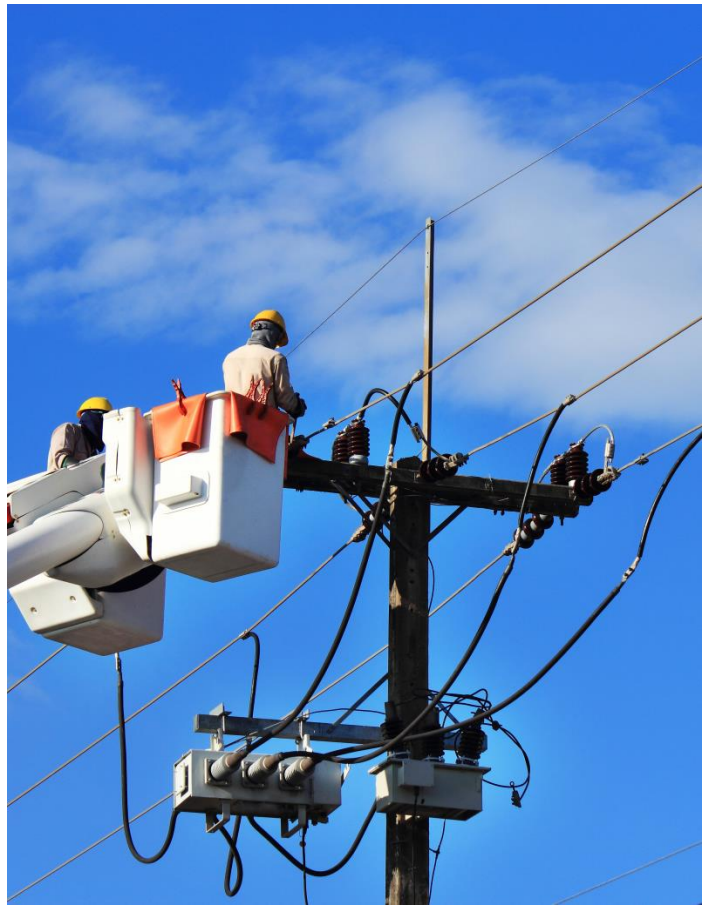
- Question is up now!
- Code: ###

Example



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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

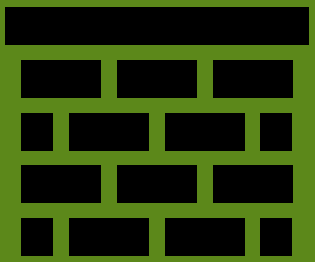
Working Group Overview

- 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 Working Group will meet at each step of the process through the fall of 2023

Today's Focus

- Establish Working Group goals and expectations
- Provide information on the climate science, assets, and exposure for the Climate Change Vulnerability Study and Resilience Plan
- Review study process for determining **physical impacts** of climate change on electric utility infrastructure
- Discuss project details, identify related studies and opportunities to align efforts

Adaptation



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

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Interactive Exercise

- What weather trends have you observed to date?

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- Question is up now!
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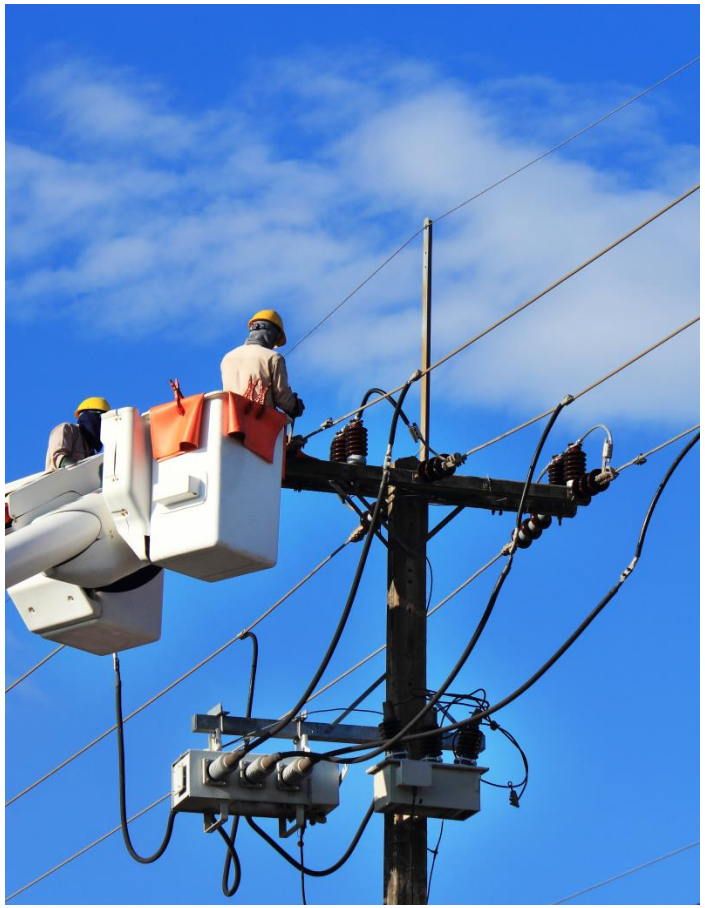
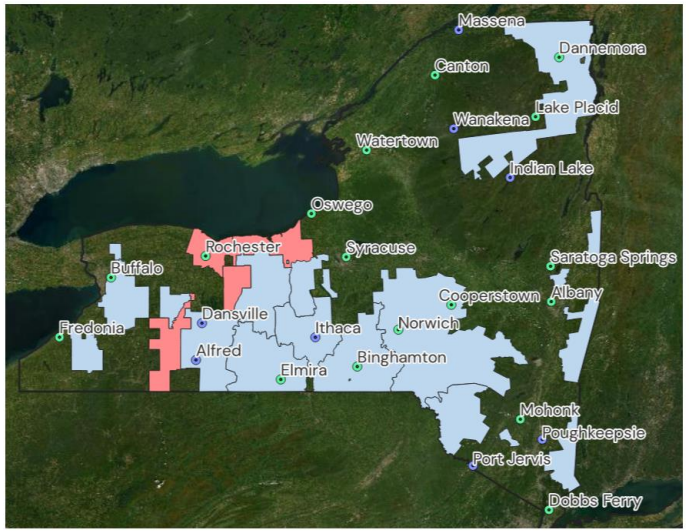


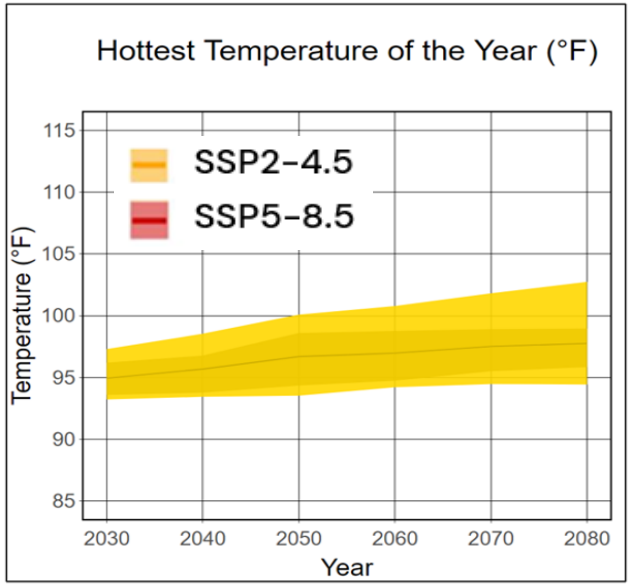
Climate Science Tailored to NYSEG & RG&E's System

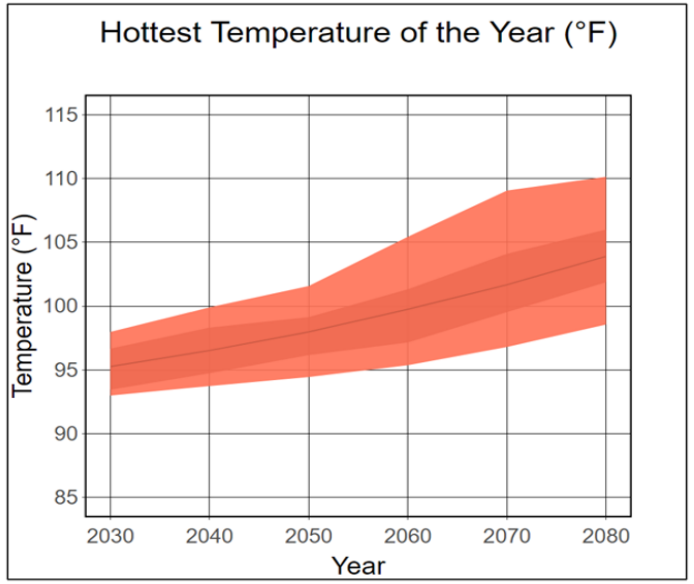
- Evaluate projections for range of climate hazards and variables related to NYSEG and RG&E's system (e.g., system sensitivities based on equipment, operations, etc.)
- Global Climate Models localized to match historical weather and produce meteorologically-realistic climate projections through late-century
- Multiple greenhouse gas concentration scenarios to support a risk-based assessment
- Supplementary High Impact and Low Likelihood extreme event analysis
- Primarily source is climate projections from NYSERDA/Columbia University, augmented by ICF analysis.

Example Hazards

Mean and extreme temperatures	Humidity and heat index
	Wind
Extreme precipitation	Inland flooding

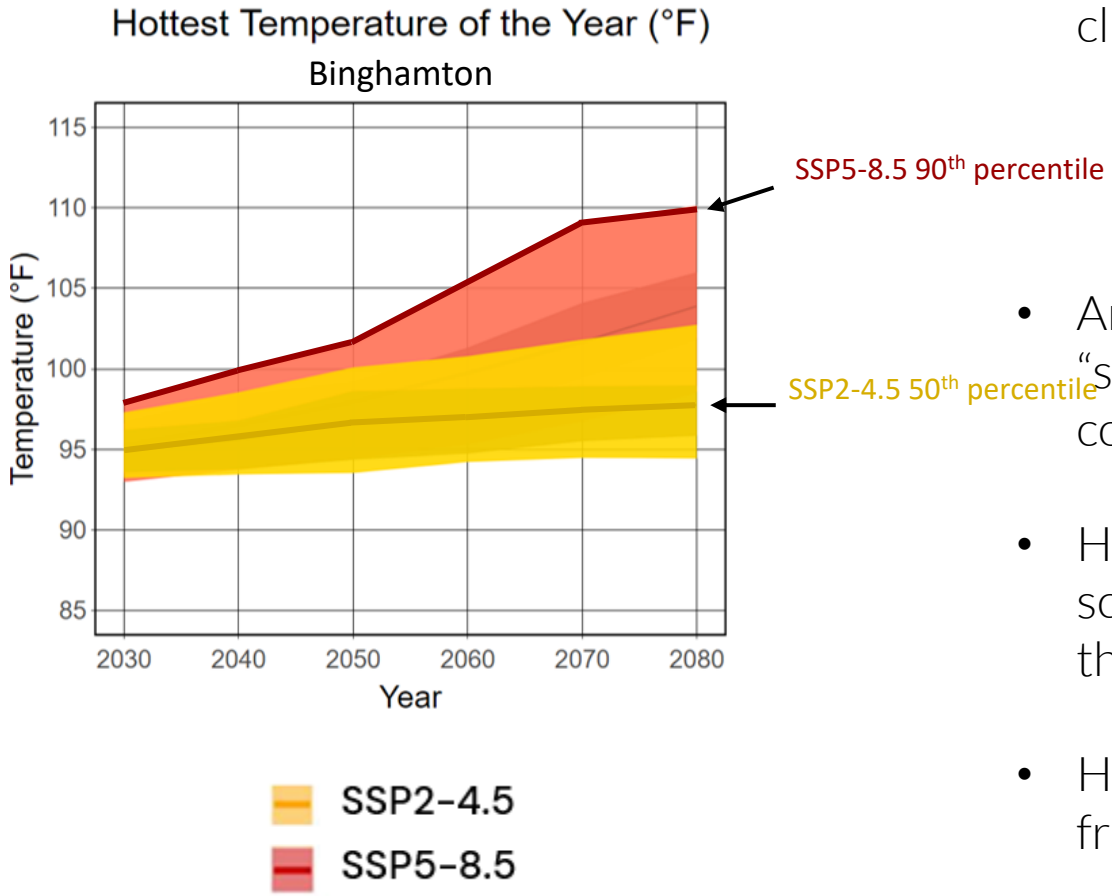






Projections for Binghamton, NY

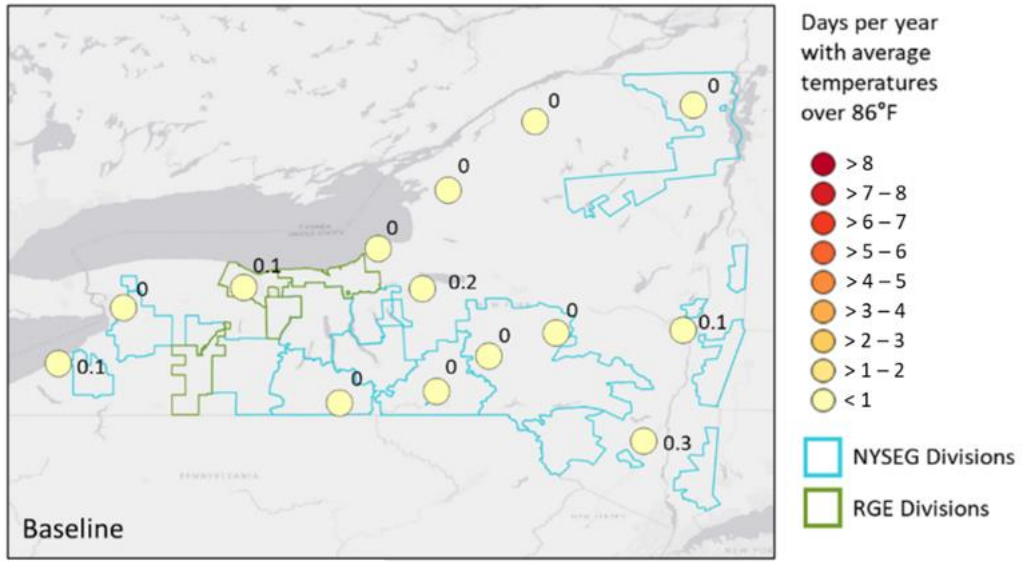
Climate Change Scenarios

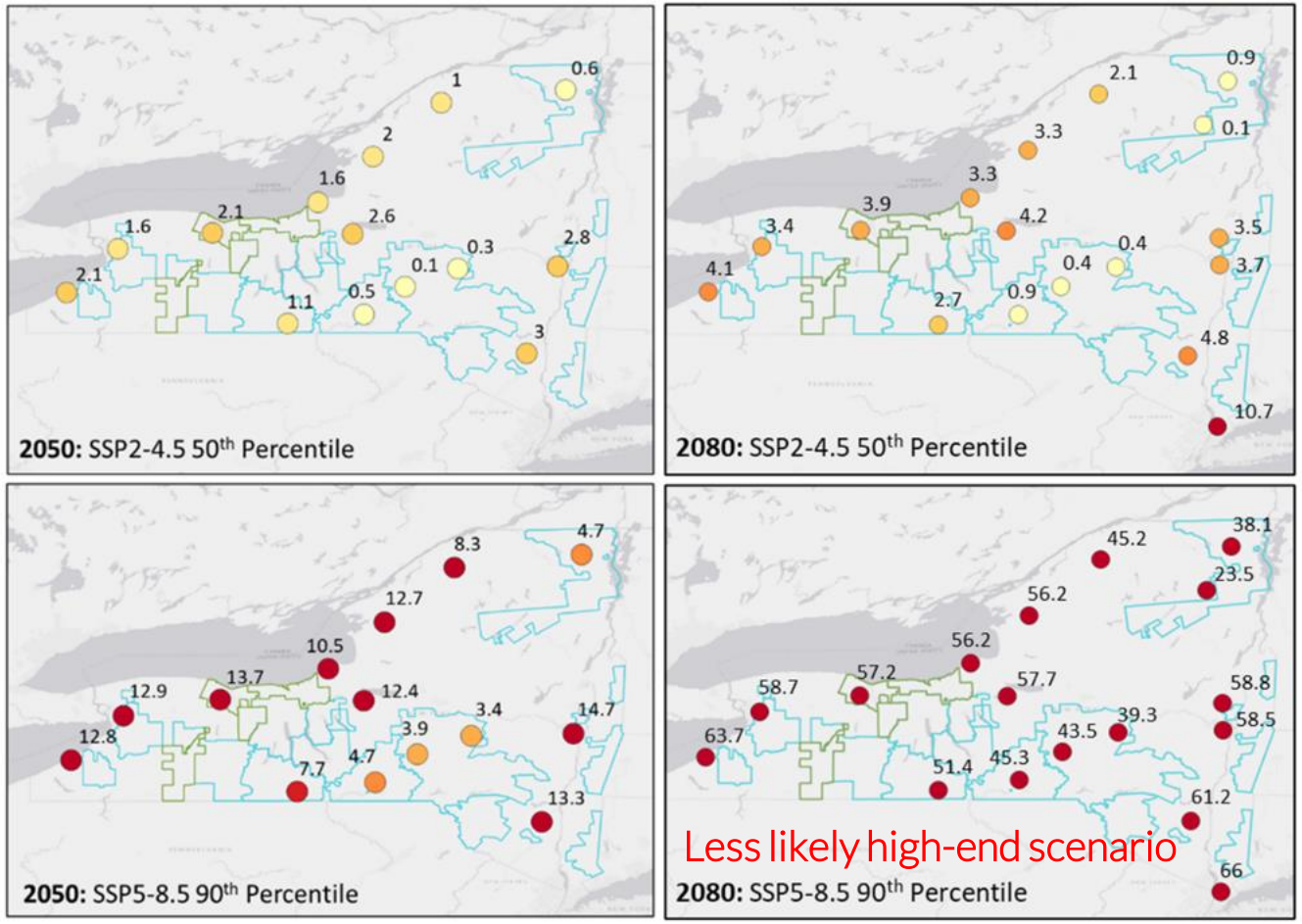


- Vulnerability analysis will focus on **upper and lower bounds** of climate model projections, characterized by:
  - SSP5-8.5 90th percentile of models (high-end)
  - SSP2-4.5 50th percentile of models (lower bound)
- Analyzing high-end projections provides a conservative "stress test," which the study will also complement with consideration of plausible extreme event scenarios
- Higher-end warming is possible even under lower emissions scenarios, particularly if carbon cycle feedbacks are stronger than reflected in some models.
- High and low emissions scenarios differ more significantly from each other later in the century.
- Scenarios for risk assessment are not indicative of scenarios that will be used for planning, which are likely to fall between these bounds.

Example Climate Projections

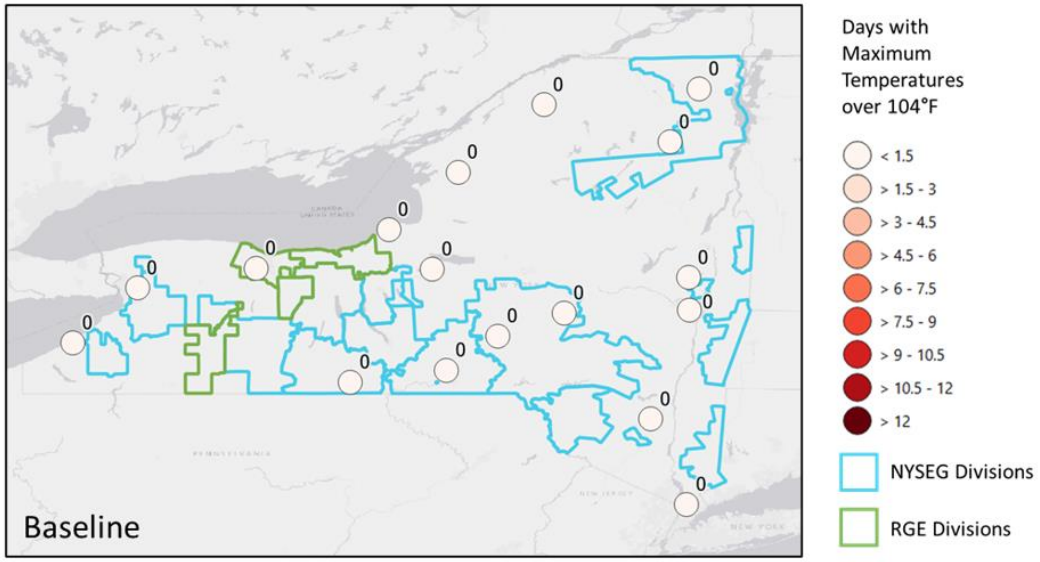
- Projections show worsening extreme heat
- Number of days per year with average daily temperature exceeding 86°F could increase from ~0 days historically to ~0-15 days by 2050 across the service areas

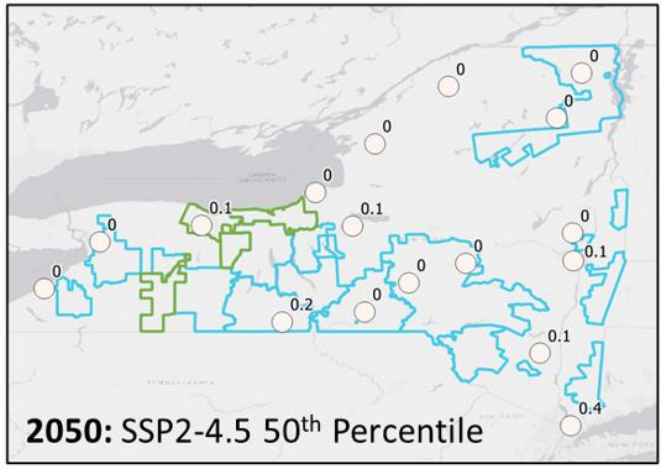


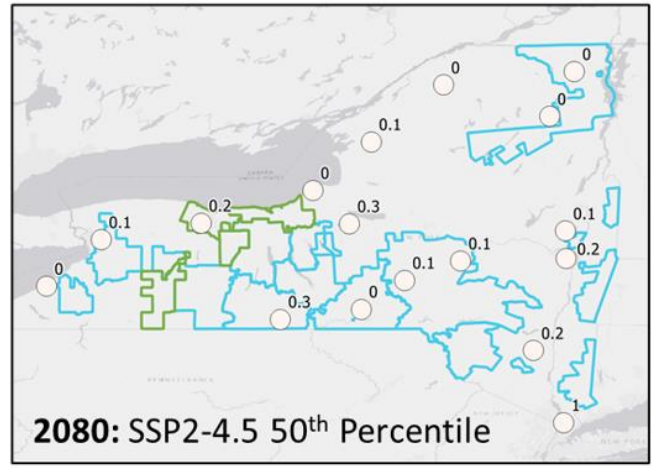


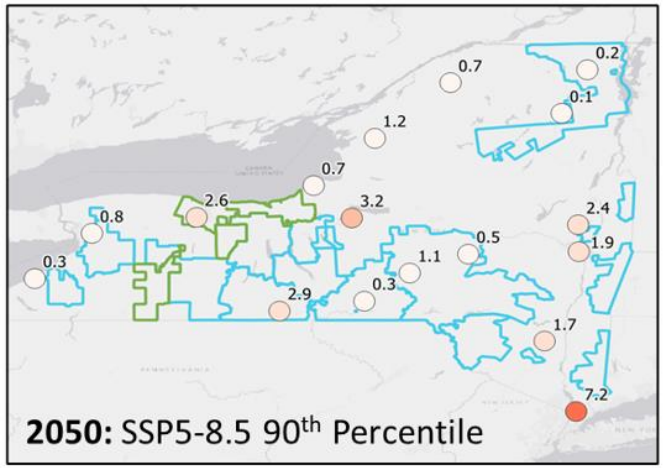
Example Climate Projections

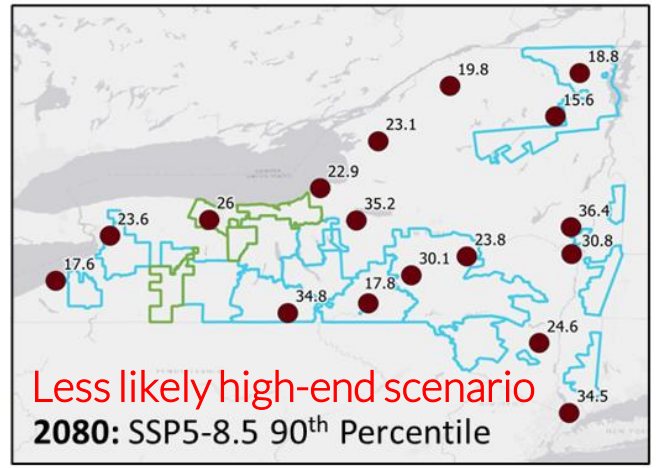
- Relatively rare historical temperature threshold could become a regular occurrence by late century
- Number of days per year with maximum temperatures exceeding 104°F could increase from ~0 days historically to ~0-15 days by 2050





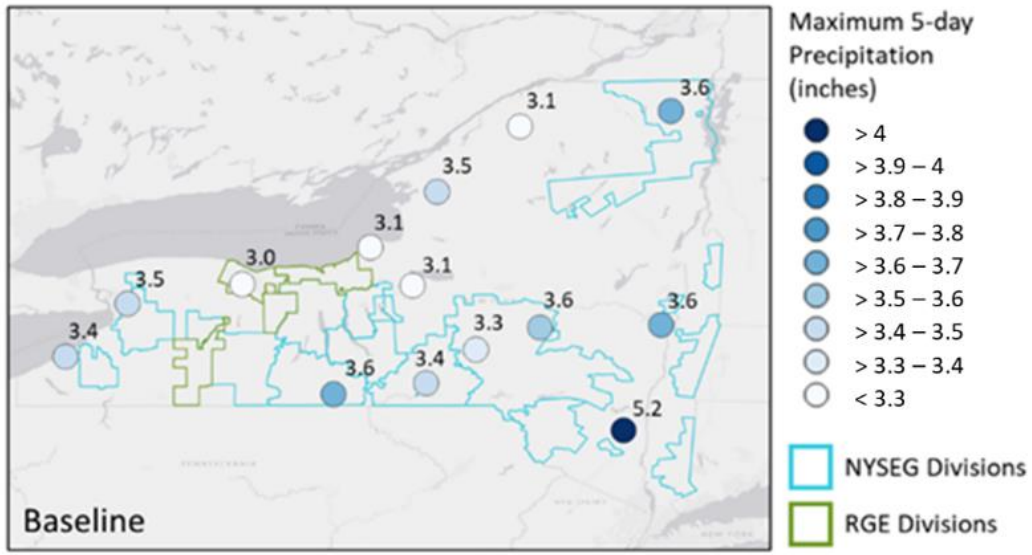


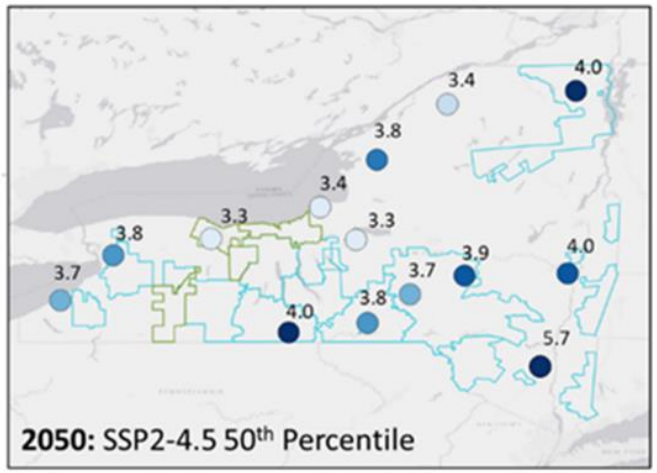


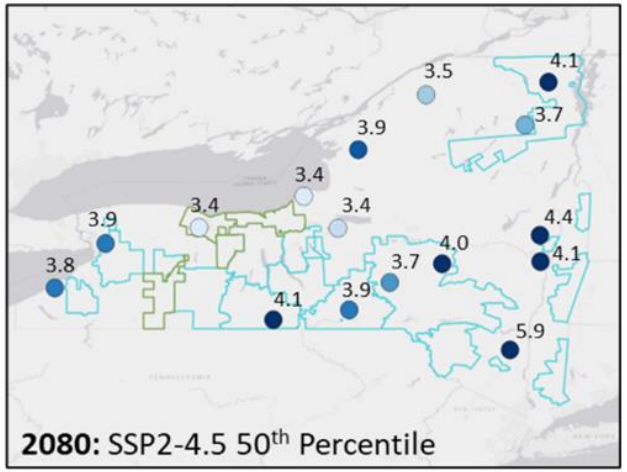


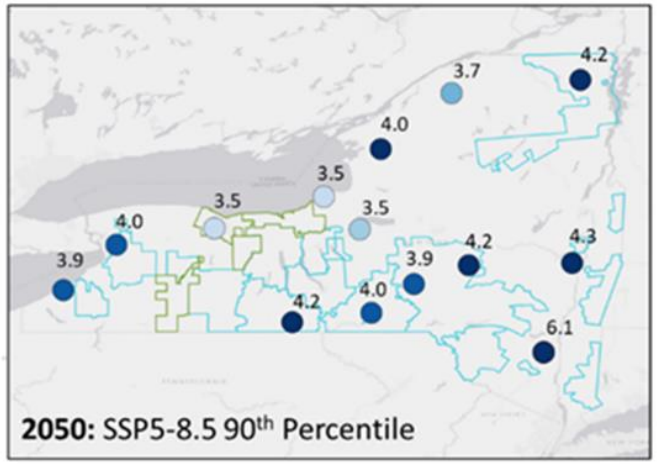
Example Climate Projections

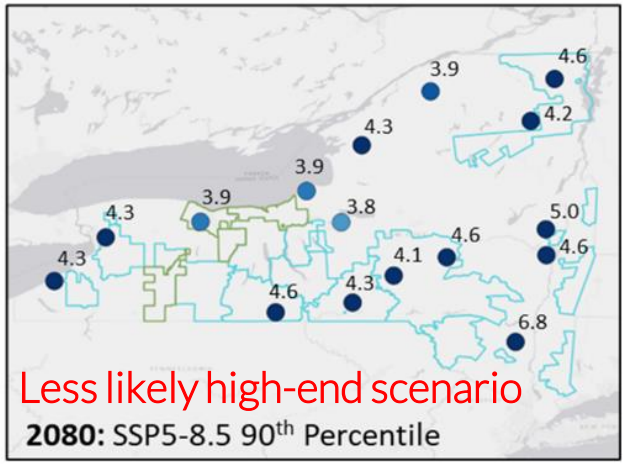
- Projections show smaller potential increases in extreme precipitation relative to temperature
- Projections do not fully resolve the worst types of storm events, including strong hurricanes











Example Climate Projections

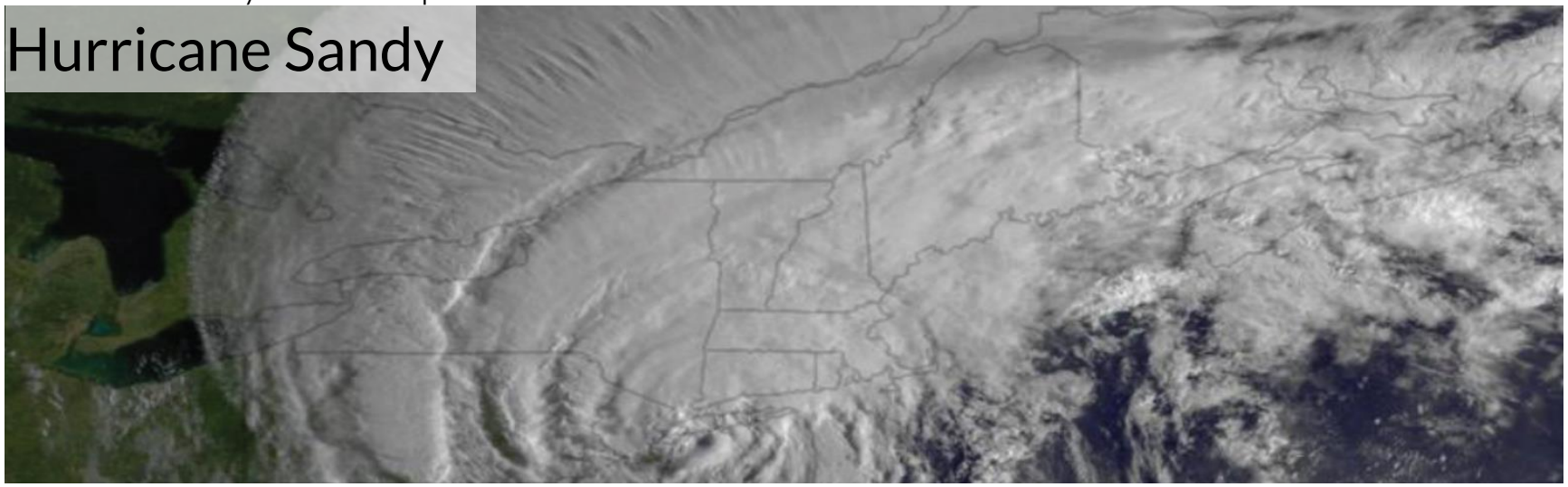
- Projections show potential for increases in relative humidity, particularly under the less-likely higher emissions scenario
- Combined temperature and humidity increases could drive increases in peak demand

	Number of Days per Year with Average Daily Relative Humidity Above 95%				
Year	Dannemora, NY	Binghamton, NY	Rochester, NY	Albany, NY	Lake Placid, NY
Observed	5.5	4.9	3.6	2.1	3.6
2030	4.5 – 8.7	4.1 – 6.9	2.9 – 4.7	2.1 – 4.8	7.3 – 13.8
2050	4.8 – 12.3	3.3 – 12.1	2.6 – 5.5	1.9 – 8.1	7.3 – 19.1
2080	4.9 – 18.9	3.9 – 12.4	3.2 – 7.9	2.1 – 13.4	7.6 – 28.8

Projection spread shown is from SSP2-4.5 50th percentile (lower value) to SSP5-8.5 90th percentile (higher value)

High Impact Low Likelihood 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



Climate Science Discussion Questions

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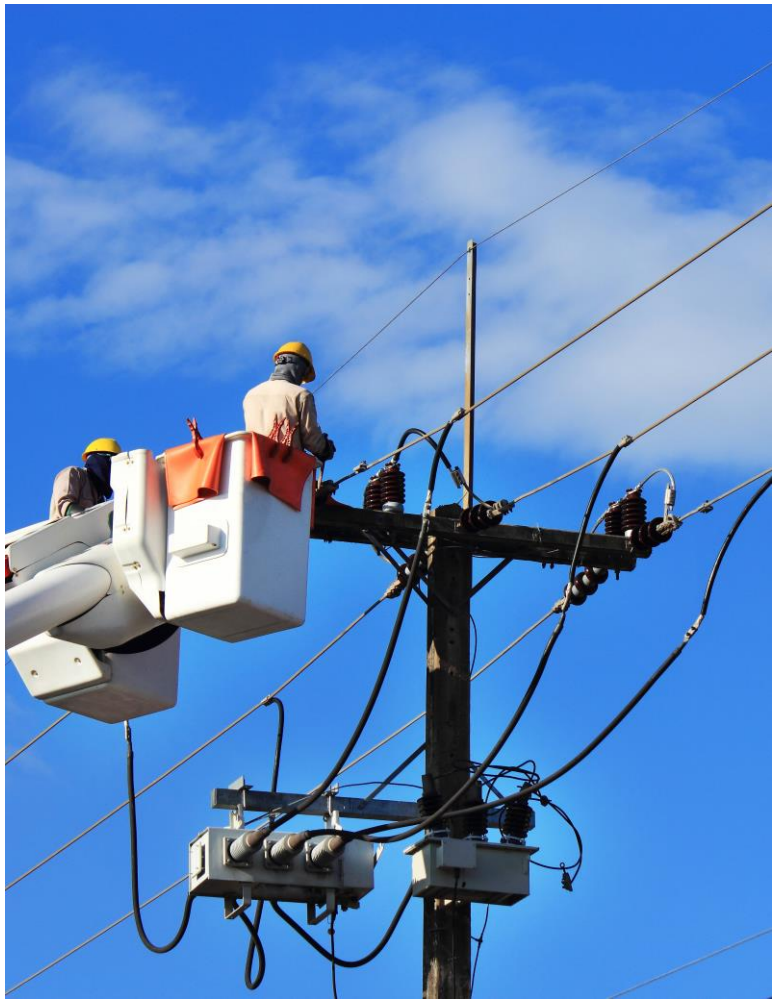
- Questions are up now!
- Code: ###

Example

- What climate hazards do you see as most impactful to your community/organization?
- What is your community/organization doing to prepare its infrastructure for climate change?



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Project Overview

Climate Change Vulnerability Study

Climate Science

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

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

Sensitivity
The degree to which assets, operations, or systems could be affected by exposures.

Consequence
Estimated magnitude of negative outcomes associated with impacts. Incorporates criticality and adaptive capacity.

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

Resilience Plan

Resilience Framework

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

Key Planning, Design, Operations, and Emergency Response Changes

Resilience Measures for Next 10 and 20 Years

Estimated Costs and Benefits

Q2 2022 | Q3 2022 | Q4 2022 | Q1 2023 | Q2 2023 | Q3 2023 | Q4 2023

Vulnerability Assessment Approach

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

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

Sensitivity
The degree to which assets, operations, or systems could be affected by exposures.

Consequence
Estimated magnitude of negative outcomes associated with impacts. Incorporates criticality and adaptive capacity.

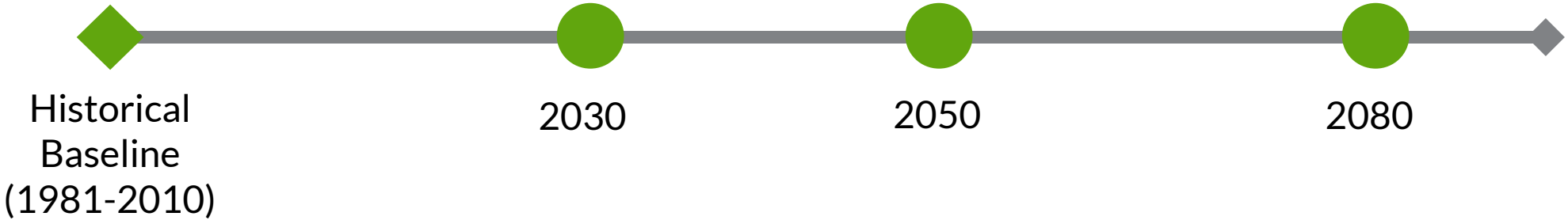
Vulnerability
The potential of assets or operations to be affected by projected hazards, and the significance of the potential consequences.

Vulnerability Assessment Methods

- Use climate projections and scenario analysis to quantitatively analyze future conditions facing NYSEG and RG&E assets and operations.
- Identify key vulnerabilities and risks based on equipment and operational sensitivity characteristics, informed by design specifications and historical experience of utilities in New York and elsewhere.
- Identify potential consequences associated with vulnerabilities, in order to inform highest-benefit resilience measures.

Study Focal Timeframes

Vulnerability analysis will take a primary focus on near-term (2030), mid-century (2050), and late-century (2080) timeframes.



Asset Scope

The study will assess the hazard exposures of major asset groups, and also consider the sensitivities of the key subcomponents listed below.

Category	Primary Unit	Priority Subcomponents	
Distribution	Distribution Circuits	Overhead structures (poles)	Switching devices
		Conductors (both overhead and underground)	Shunt capacitors
		Transformers/voltage regulators (pad mounted and overhead)	Surge arrestors
Transmission	Transmission Lines	Transmission line structures (poles/towers)	Switching devices
		Overhead conductors	Shunt capacitors
		Underground conductors	Surge arrestors
Substations	Substations	Substation transformers/regulators	Instrument transformers
		Circuit breakers	Control room/control house
		Protection and control devices	Shunt capacitors

Operations and Planning Functions Scope

The study will evaluate the climate readiness of key NYSEG and RG&E's operations and planning functions, identifying areas where future process updates may be needed.

Function	Definition	Climate Vulnerability Considerations
Emergency Response	Activities to prepare and respond to adverse events that affect the NYSEG/RG&E system, including extreme weather. Includes event preparedness, storm restoration, and partnerships with local governments and emergency services.	Potential for increasing severity and frequency of storms and heat waves may impact the effectiveness of emergency response.
Workforce Safety	Policies and procedures designed to keep NYSEG/RG&E workers safe and healthy while performing their jobs.	Potential for increasing storms and heat waves could require more frequent periods of work under adverse conditions.
Vegetation Management	Ongoing activities to maintain reliable service by monitoring, trimming, and/or removing vegetation that could pose risks to T&D assets.	Increased frequency/intensity of storms may increase vegetation related interruptions. Climate change may also affect vegetation growth and health, increasing risk of outages.
Asset Management	Processes to monitor and maintain T&D assets and systems, ensuring that components meet performance standards. Includes inspections, monitoring, condition-based maintenance, and asset replacement programs.	Increasing temperatures, precipitation and other hazards may affect asset health and require increased/altered management.

Operations and Planning Functions Scope (continued)

Function	Definition	Climate Vulnerability Considerations
Facility Ratings	The process of determining the energy delivery capacity of T&D assets and systems. Ratings are based on a set of assumptions which include climate factors such as ambient temperature.	The potential for increasing average temperatures, and frequency, severity & duration of heat waves may require changes to the facility rating process.
Reliability Planning	Activities to achieve reliability performance targets, projected future reliability performance and identify investments to meet reliability performance targets.	Changes to a variety of climate variables may require changes to the reliability planning process to maintain performance targets.
Load Forecasting	Processes to forecast customer demand based on customer behavior and weather conditions.	Warmer temperatures will increase summer loads and may also decrease winter heating loads.
Load Relief Planning	Process of identifying where demand is forecasted to exceed equipment or system ratings and selecting actions to address overloads.	Increasing ambient temperatures will reduce equipment capacity and may also change the expected peak demand reductions offered by energy efficiency solutions.

Sample Exposure Analysis - Precipitation

Data-driven vulnerability analysis methods will leverage climate projections and NYSEG and RG&E's geospatial asset data to produce site-specific projections of changes.

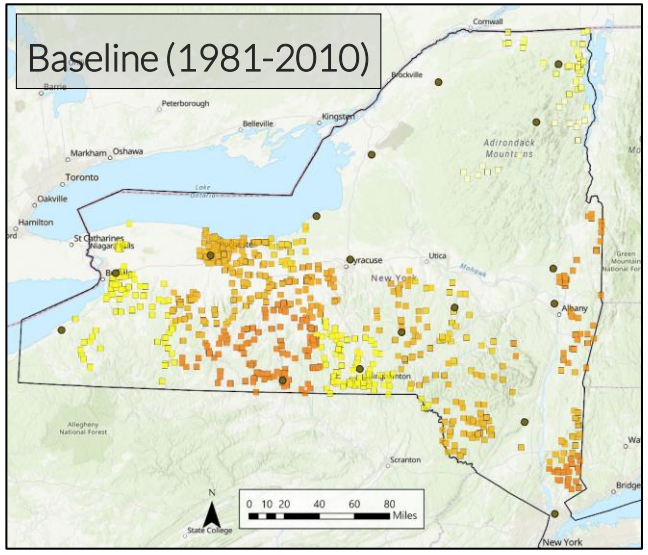
Table with substations listing annual 5-day annual maximum precipitation at the nearest neighbor weather station in historical, 2030, 2050, and 2080 timeframes (SSP5-8.5 90th percentile)

Substations		Annual Average 5-Day Maximum Precipitation (inches)			
Substation	Closest Weather Station	Historical (1981-2010)	2030	2050	2080
Adams Corners	Brewster	5.00	5.62	5.95	6.45
Afton	Binghamton	3.34	3.69	3.91	4.07
Alden	Lancaster	3.48	3.80	3.97	4.32
Alice Falls	Plattsburgh	3.63	4.06	4.23	4.45
Allegheny Ludlum	Lockport	3.48	3.80	3.97	4.32
AllVac	Lockport	3.48	3.80	3.97	4.32
Amawalk	Brewster	5.00	5.62	5.95	6.45

Sample Exposure Data - Substations

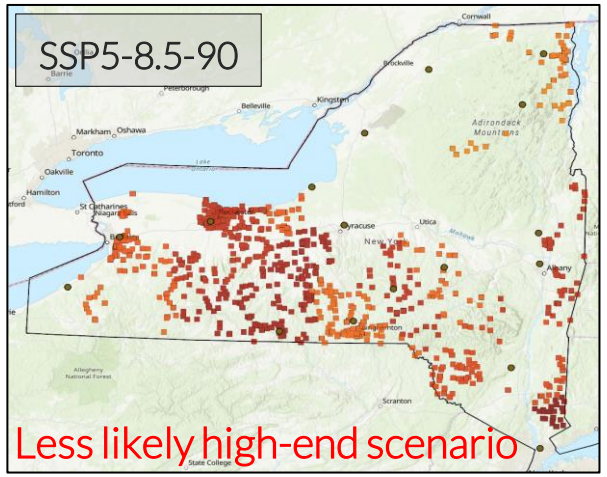
- Projected temperatures at substations on the hottest day in a typical year for the 2050 time period, diverging across two climate scenarios.

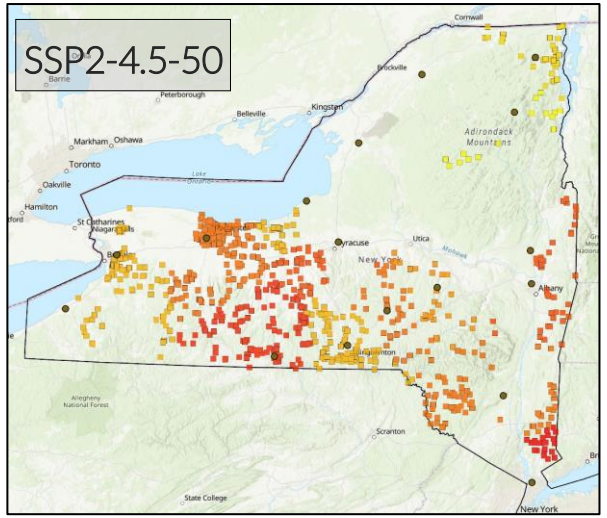
- Extreme heat at substations, coupled with high equipment loading, can reduce effective transformer capacity and accelerate equipment aging.



Substations:
Average annual hottest day in 2050

2050

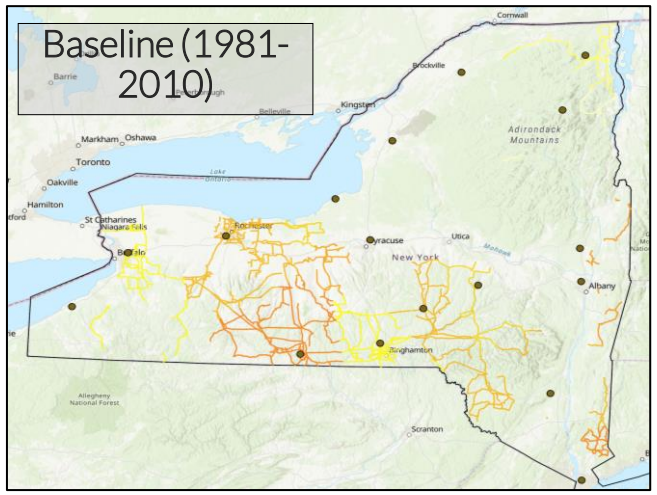




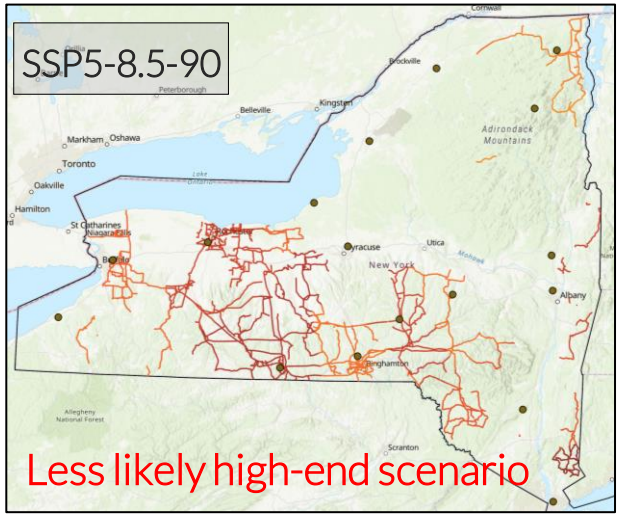
Legend
Annual average hottest day (°F)
110
105
100
95
90
Weather station

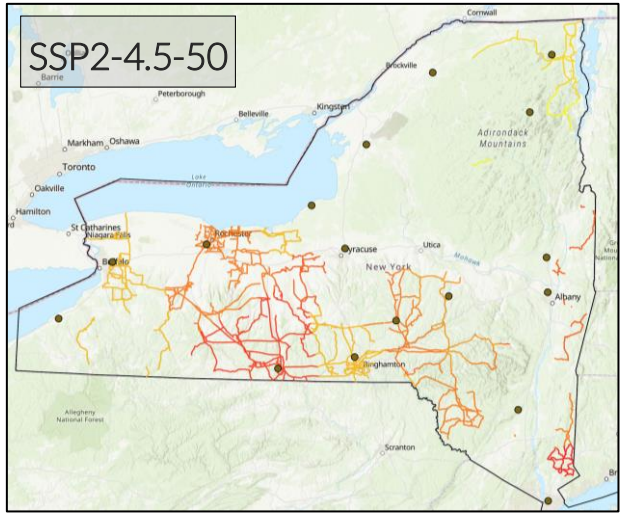
Sample Exposure Data – Transmission Lines

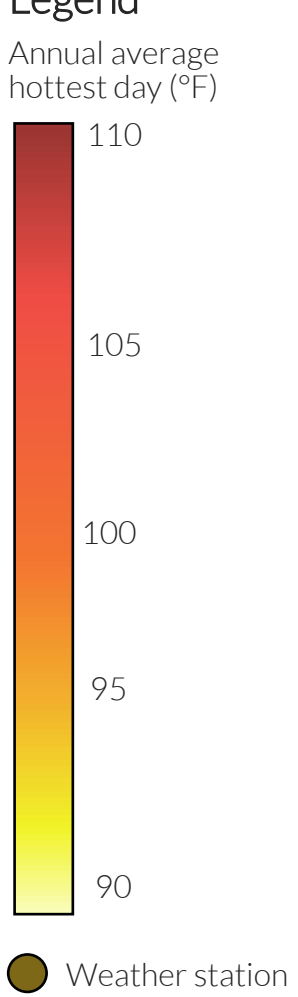
- Projected temperatures for transmission lines on the hottest day in a typical year for the 2050 time period, diverging across two climate scenarios.
- Extreme heat can result in sagging transmission conductor and reduced/derated transmission capacities.



Transmission lines:
Annual average hottest day in 2050

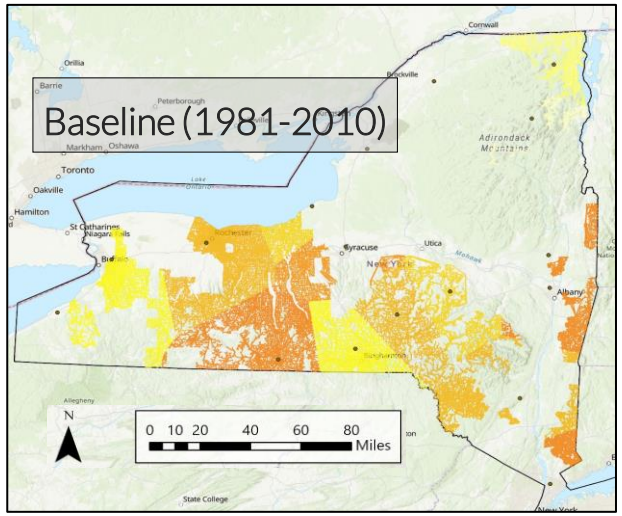


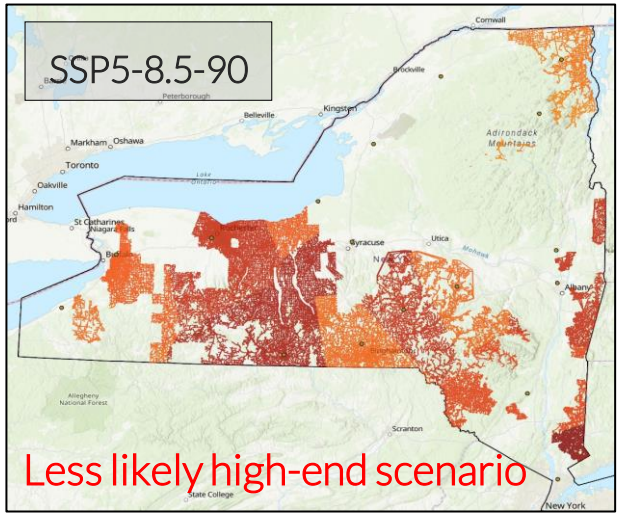


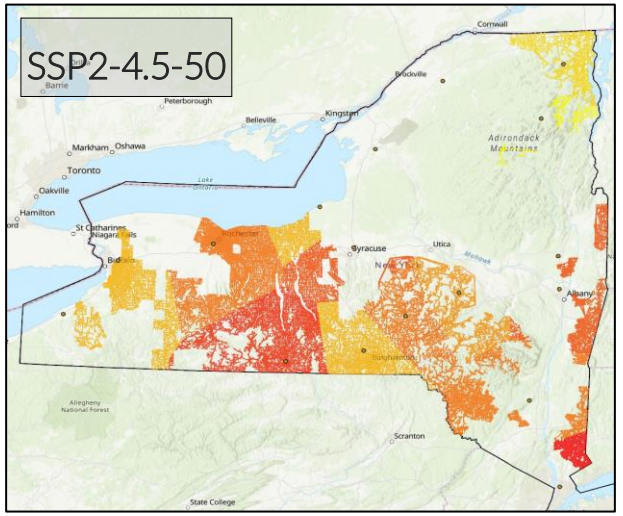


Sample Exposure Data – Distribution Circuits

- This study will leverage geospatial distribution asset data down to the circuit level.
- High temperatures can result in increased cooling demand, line sag, and accelerated equipment aging.







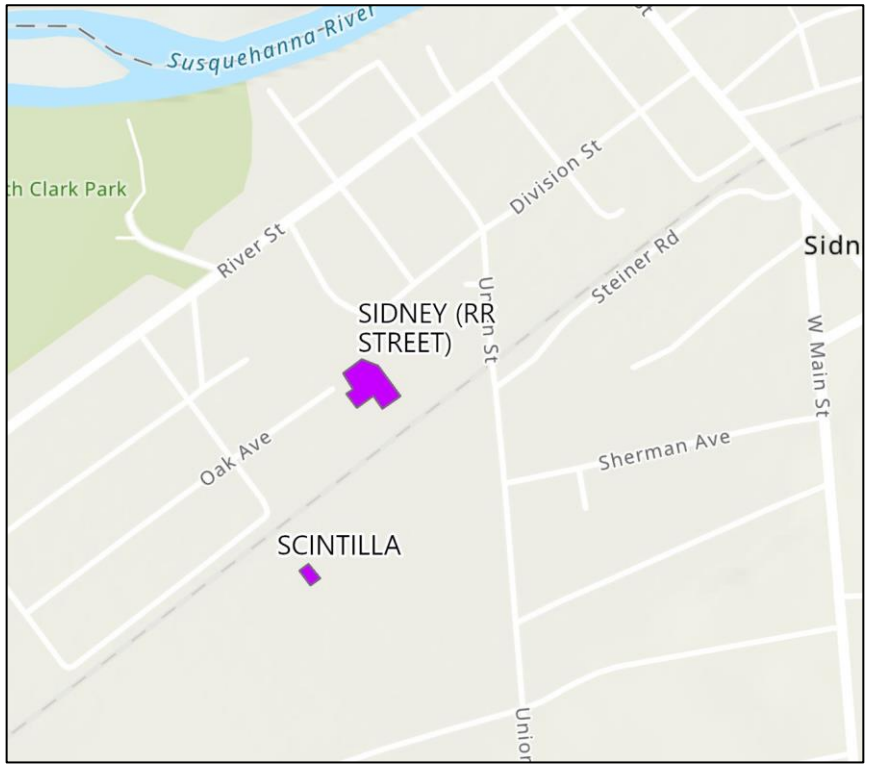
Distribution Circuits:
Annual average hottest day in 2050

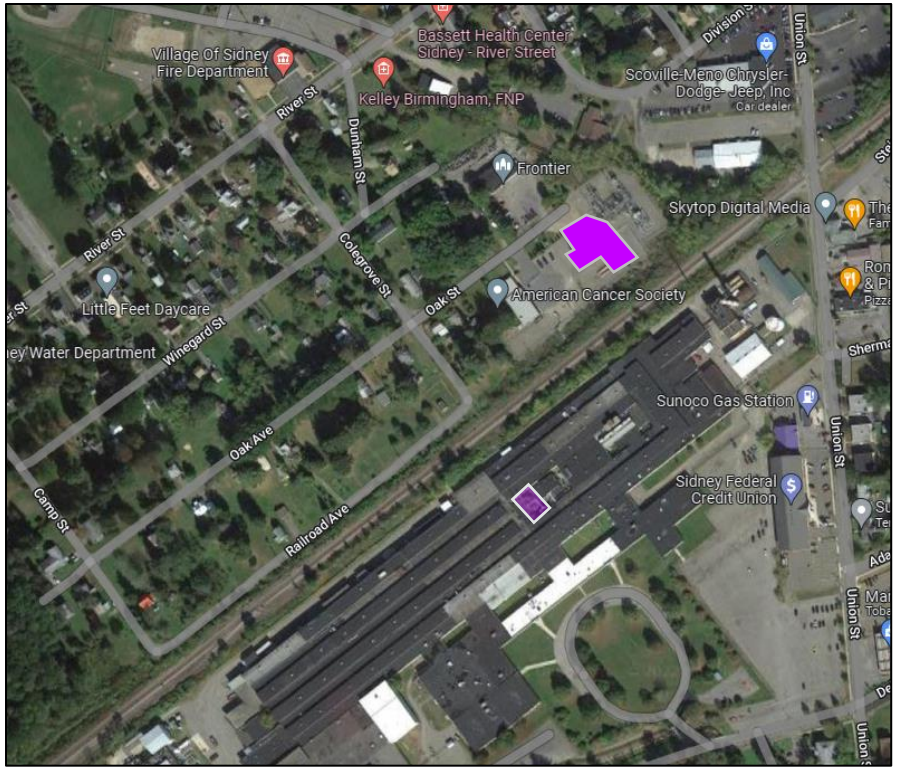
Legend
Annual average hottest day (°F)
110
105
100
95
90
Weather station

Substation Boundaries to Support Flood Assessment

The study will leverage available data on 2-dimensional substation boundaries, coupled with best-available flood projections, to support asset-level flood hazard assessment.

Substations experiencing floods in excess of design heights can result in a failure or the need to pre-emptively de-energize to limit recovery duration.





Substation Boundary

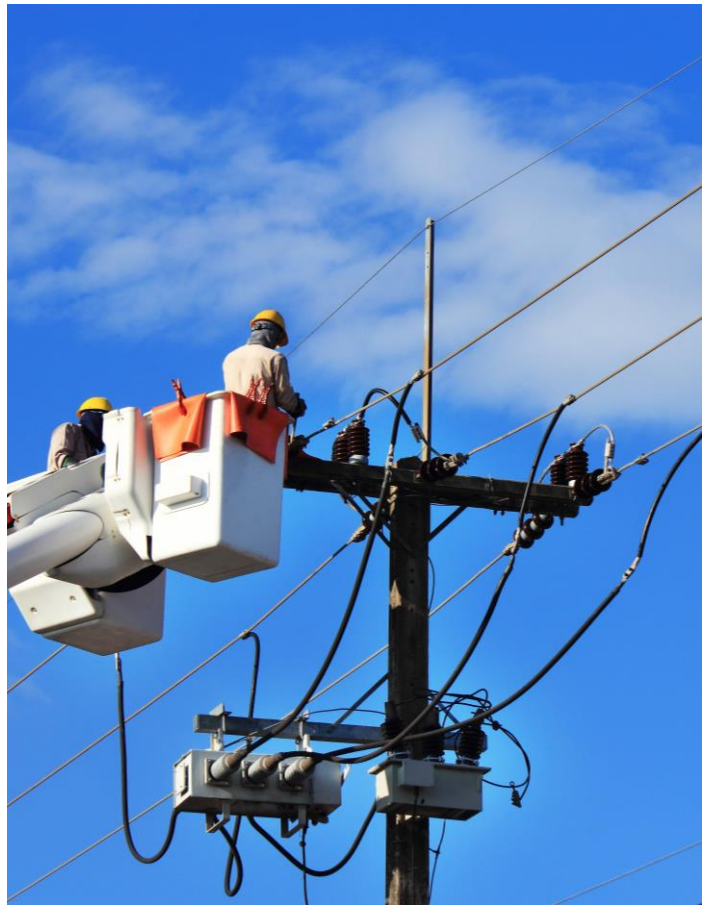
Asset and Exposure Discussion Questions

Menti.com

- Questions are up now!
- Code: ###

Example

- What NYSEG/RGE electrical infrastructure in your community do you feel is most vulnerable to climate hazards?



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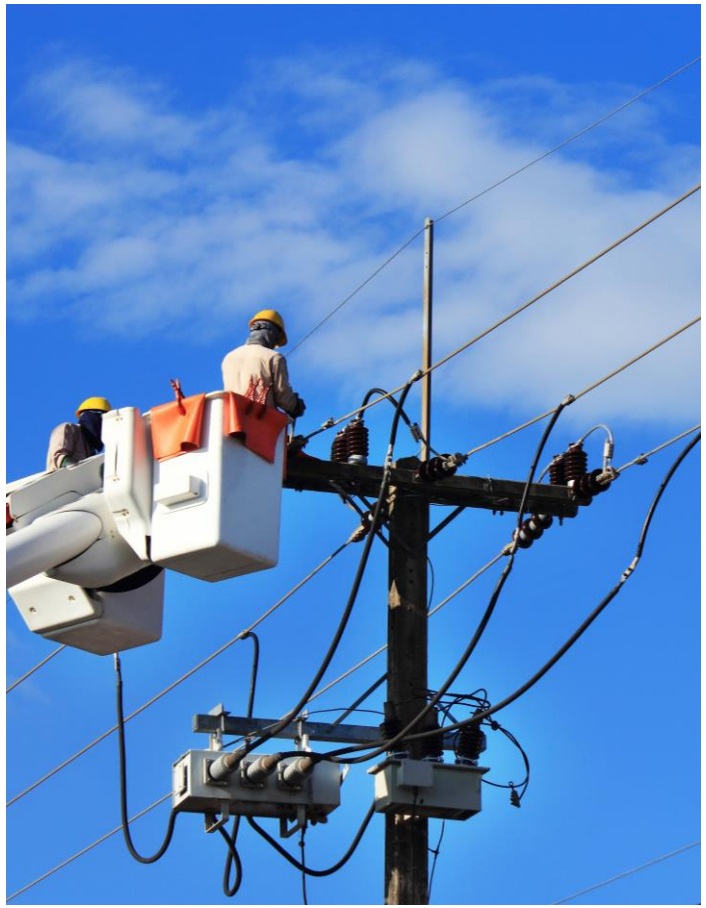
Additional Stakeholder Discussion

- Do you have any additional questions related to the climate science projections or process?
- Do you have any additional questions related to the NYSEG and RG&E climate vulnerability study?
- What type, or format of information, in the Climate Change Vulnerability and Resiliency Plan would be the most useful to your community/organization?
- Have you noticed any unusual or unique events in your community that may be a result of climate change? (e.g., unusual changes in flooding behavior/frequency, water levels, etc.)
- Other items



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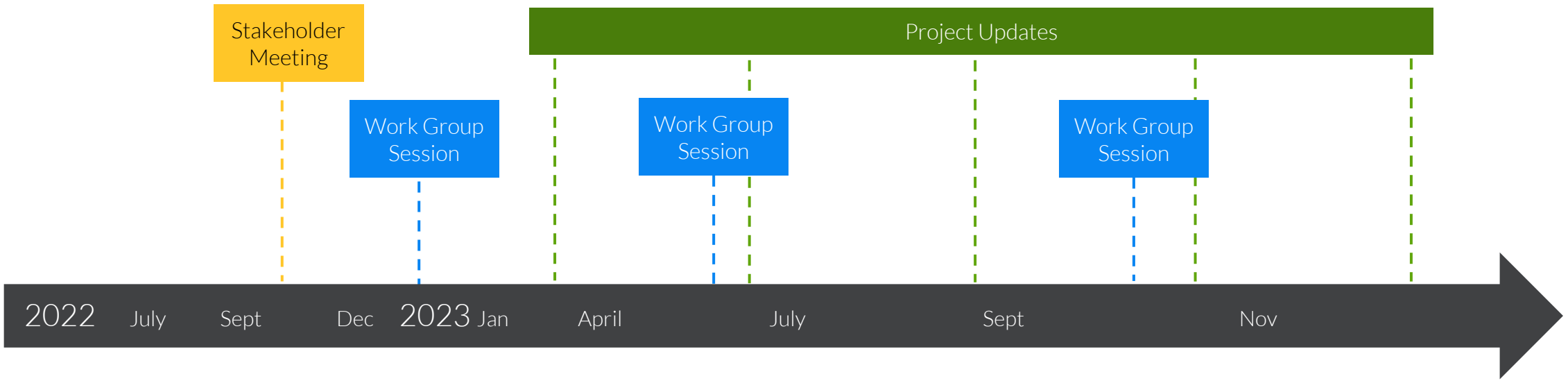
Continued Stakeholder Engagement Opportunities

- Updates will also continue to be provided via periodic Project Update emails in 2023.
- Next Working Group meeting will be in the spring of 2023 and provide updates on the study and further discussion of potential impacts and system vulnerabilities.
- Parties are welcome to join the Working Group at any time.

Stakeholder Engagement Timeline



Project process:

Exposure Analysis → Potential Impacts → Vulnerability Report → Draft Resilience Plan → Final Resilience Plan

Thank You!

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