Central Maine Power
An Avangrid company

Central Maine Power

Climate Change Protection Plan

12/29/2023

Strategic Planning

Table of Contents

Executive Summary

Emissions of greenhouse gases (GHG) are changing the global climate resulting in sea level rise, heatwaves, floods, more frequent storms, among other effects. In response to growing concerns over the effects of climate change on the resilience of the electric system Governor Janet Mills signed into law "An Act Regarding Utility Accountability and Grid Planning for Maine's Clean Energy Future" Public Law Chapter 702[1]. This act requires, among its other contents, electric transmission and distribution utilities to study the effects of climate change on its ability to delivery electric power to its customers through the Climate Change Protection Plan (CCPP).

Central Maine Power's (CMP) CCPP is comprised of two main parts 1) a Climate Change Vulnerability Study (CCVS) focused on developing projections for the future climate in Maine, including how CMP's assets and processes may be affected, and 2) a Climate Change Resilience Plan (CCRP) that builds on the results of the CCVS with a focus on identifying and developing resilience measures necessary to build or maintain resilience of CMP's electric system to climate change.

Stakeholder Engagement

CMP believes that providing regular updates on its study process and outcomes, as well as getting feedback from the communities it serves, is an important component of developing a transparent and successful Climate Change Protection Plan.

Throughout the CCVS and the CCRP, CMP will be regularly engaging with stakeholders to hear what concerns they have regarding climate change, but also to share CMP's plans for studying the effects and what can be done to build resilience to climate hazards. CMP anticipates the first stakeholder meeting will be held in Q1 2024 with additional meetings occurring throughout the duration of the CCVS and CCRP. The final frequency and format of stakeholder meetings may be adjusted in recognition of a forthcoming process provided by the Maine Public Utilities Commission (MPUC).

Climate Change Vulnerability Study

The CCVS will start in January 2024 and continue into the first quarter of 2025. This study will begin by developing projections for climate change across the CMP system for each decade starting in 2030 out to 2100 using industry-recognized techniques and science to generate a range of probable climate futures. At a minimum the CCVS will evaluate changes to temperature, inland and coastal flooding, precipitation, drought/wildfire and extreme events. In addition, the CCVS will include engagement of subject matter expert teams to determine how CMP's electrical assets will respond to the expected effects of climate change including determination which assets and climate hazards combinations are the highest priority for continued evaluation in the CCRP.

[1] *http://www.mainelegislature.org/legis/bills/getPDF.asp?paper=SP0697&item=19&snum=130*

Climate Change Resilience Plan

The CCRP will begin in January 2025, once CCVS results are well understood, and will utilize those results to determine if the effects of climate change require resilience measures to maintain or increase resilience of the electric system to the identified hazards. CMP anticipates that most resilience measures will fit into two broad categories:

> **Strategic Resilience Measures:** This type of resilience measure would include activities like updating equipment specifications and/or internal processes to gradually build climate resilience into the electric system through business-as-usual activities.
>
> **Site-Specific Resilience Measures:** These resilience measures would address acute climate hazard vulnerabilities for a specific site or group of assets; for example, a substation that is expected to experience damaging floodwaters due to sea-level rise.

The identified resilience measures will be incorporated into the Integrated Grid Plan (IGP) and prioritized and deployed through rate case proceedings.

CMP's Resilience Journey

CMP has already begun implementing efforts to build resiliency of its distribution, transmission, and substation systems to the effects of climate change, particularly the expected worsening of extreme weather events.

Distribution: CMP created the Resiliency Program to improve its worst performing distribution circuits including replacement of weakened poles, installation of additional tree-wire, circuit-ties, grid automation, etc. For example, CMP was awarded a $30 million federal grant to expand deployment of self-healing technology to help prevent or restore outages more quickly.

Transmission: On the transmission side CMP is now utilizing steel poles for transmission construction to boost resilience to extreme weather events, and prevent incipient damage due to rot, infestation, and woodpecker damage.

Substations: CMP's Transmission and Substation Asset Condition Mitigation program is reviewing the health and capability of its substations to optimize solutions to address any identified issues, which now include requirements to mitigate equipment exposure to Federal Emergency Management Authority (FEMA) 100-year return period flooding.

Looking Ahead

CMP is committed to building resilience throughout its electric system as demonstrated by its on-going projects and initiatives, as well as the commitment to perform the CCVS and CCRP while engaging stakeholders. These activities will help to ensure that the CMP system remains resilient to the future effects of climate change.

1. Background & Overview

The global climate is changing, and these changes are expected to have wide ranging effects. To effectively plan for future climate conditions Central Maine Power (CMP) must develop projections for the future climate, and while working with stakeholders, identify what activities may be necessary to mitigate against the identified effects. Once these effects and mitigation measures are identified they can be incorporated into the Integrated Grid Plan (IGP) and efficiently deployed as part of future rate cases.

1.1. Future Climate

Emissions of greenhouse gases (GHG) are changing the global climate. The Intergovernmental Panel on Climate Change (IPCC) comprised of over 190 member countries[2], recently released its Sixth Assessment Report identifying that human "…influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years" (IPCC, 2021). Evidence of these impacts is illustrated in Figure 1 showing observed changes in global surface temperature compared to simulated results that separate the impact of human activity on global surface temperature compared to natural (solar and volcanic) effects alone for the past two centuries.

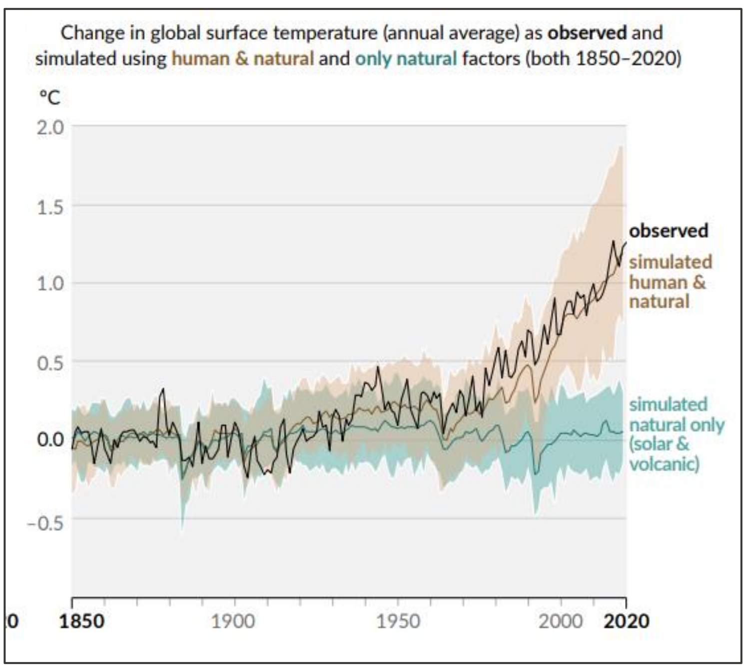

Figure 1 - Changes in Global Surface Temperature Relative to 1850-1900 (IPCC 6th)

GHG emissions, which include carbon dioxide, methane, nitrous oxide, chlorofluorocarbons (CFCs) and others, trap heat within earth's atmosphere, slowing the rate at which it escapes into space, gradually warming the earth. This warming is upsetting the delicate balance of our climate, and consequentially many of Earth's ecosystems. Some of the other more apparent

[22] https://www.ipcc.ch/site/assets/uploads/2019/02/ipcc_members.pdf

effects of climate change are increased temperatures, increased and more variable precipitation, more intense and frequent storm activity, and sea level rise.

The recently observed and projected future increase in the global temperature has numerous direct and indirect effects the communities that CMP serves, as well as CMP assets and processes that are used to deliver electricity to customers. For example, Maine estimates that climate fluctuations reduced fishing employment in New England by 16% from 1996 to 2017, and that tourism spending could drop by over $750 million per year in 2100 due to sea level rise[3] of which Maine has already experienced 8" and is projected to experience 1.5' by 2050, with four additional feet by 2100[3].

As CMP customers become more reliant on their electric service, particularly with the expected electrification of heating and transportation, it necessitates that electric service be safe, reliable, and resilient[4]. However, the effects of climate change are expected to challenge electric utilities' ability to transmit and distribute power.

1.2. Legislative Overview

On May 2, 2022, Governor Janet Mills signed into law "An Act Regarding Utility Accountability and Grid Planning for Maine's Clean Energy Future" Public Law Chapter 702. In response to growing concerns over the effects of climate change on the resilience of the electric system to changing climate hazards, this act requires, among its other contents, electric transmission and distribution utilities to study the effects of climate change on its ability to delivery electric power to its customers through a Climate Change Protection Plan (CCPP):

> **§3146. Climate Change Protection Plan[5]**
>
> No later than December 31, 2023, and every 3 years thereafter, a transmission and distribution utility shall submit to the commission a 10-year plan that includes specific actions for addressing the expected effects of climate change on the utility's assets needed to transmit and distribute electricity to its customers. The commission shall provide a process to allow for the input from interested parties on the transmission and distribution utility's plan. The commission may use the plan and the input received from interested parties in rate cases or other proceedings involving the transmission and distribution utility.

The CCPP must be submitted every three years and include a 10-year plan for addressing the expected effects of climate change. CMP's CCPP is designed to meet the requirements of that portion of the Act.

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[3] *https://www.maine.gov/climateplan/climate-impacts*

[4] *"The term "resilience" means the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions. Resilience includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents." Presidential Policy Directive -- Critical Infrastructure Security and Resilience | whitehouse.gov (archives.gov)*

[5] *https://legislature.maine.gov/legis/bills/getPDF.asp?paper=SP0697&item=19&snum=130*

1.3. Climate Change Protection Plan Overview

Proactively planning for the effects of climate change can help allow for CMP to ensure that its system remains resilient to climate change. CMP has designed its CCPP in a two-phase approach that will be used to identify climate hazards, and then develop mitigation strategies.

The first phase, the Climate Change Vulnerability Study (CCVS) will begin in January 2024 and is expected to continue throughout the year. In this phase CMP will develop projections for the expected effects of climate change are across its service area.

The second phase, development of the Climate Change Resilience Plan (CCRP) will begin in January 2025 and finish by December of that year. Working with stakeholders and using the knowledge from the CCVS, CMP will determine what mitigation efforts may be required to address the hazards presented by climate change. The details of implementation of resilience measures will be included in the CCRP.

Figure 2 - Climate Change Protection Plan Overview

The focus of the CCVS and CCRP will be on identifying the effects of climate change, and what resilience measures may be necessary to continue reliable and resilient delivery of electric power to CMP’s customers. The CCVS and CCRP will not include evaluation or consideration of on-going efforts to reduce CO_2 emission reduction.

1.3.1. Climate Change Vulnerability Study

CMP's Climate Change Vulnerability Study (CCVS) will use a three-step approach to assess the impact of climate change on their assets and processes. First, the study will develop projections for Maine's future climate using industry-recognized techniques including CMIP6 Global Climate Models (GCMs) and Shared Socioeconomic Pathways (SSPs) identified by the IPCC. Two key scenarios, SSP2-4.5 and SSP5-8.5, will be considered to understand the range of greenhouse gas emission pathways and potential climate futures. The study will stress test CMP's electric system using the conservative SSP5-8.5 scenario to identify vulnerabilities and design resilience measures.

The second step of the CCVS involves identifying climate hazards such as temperature, precipitation, sea-level rise, and extreme wind speeds that could affect CMP's electrical assets. Additionally, the study will examine how climate change may impact CMP operational processes such as load forecasting, and asset management.

The final step will focus on assessing the impact of the identified climate hazards using subject matter expert input to determine priority vulnerabilities based on asset sensitivity, and consequence. The CCVS aims to provide a comprehensive report detailing climate change projections, priority vulnerabilities, stakeholder engagement, and potential resilience measures for CMP's electric system in the Climate Change Resilience Plan (CCRP).

1.3.2. Climate Change Resilience Plan

The CCRP, building upon the results of the CCVS, will use a risk-based approach to identify climate resilience measures that mitigate the effects of climate change on CMP's assets.

It is anticipated that these resilience measures will fit into two broad categories: Strategic Resilience Measures and Site-Specific Resilience Measures.

- Strategic Resilience Measures: This type of resilience measure includes activities like updating equipment specifications and/or internal processes with the goal of gradually incorporating climate resilience into the electric system through business-as-usual activities. For example, updating transformer specifications so that future equipment would be designed to withstand higher ambient temperatures projected to be experienced in an asset's lifetime.
- Site-Specific Resilience Measures: These resilience measures would address acute climate hazard vulnerabilities for a specific site or group of assets. For example, a substation found to have an elevated risk of being inundated by floodwaters due to the effects of climate change.

Site-specific resilience measures identified through the CCRP will be incorporated into the grid planning process at the project identification or prioritization phases. For example, if a substation is not at a material risk of damaging flooding in the current day but is projected to become threatened by damaging floodwaters by 2050, it could be prioritized accordingly. For all adaption strategies that will be generated through the Climate Protection Plan, CMP will strive to identify and prioritize "no-regrets" and/or multi-value solutions that can address multiple issues simultaneously. The details of the CCRP are further discussed in Section 3.

1.4. Stakeholder Engagement

Stakeholder engagement will play an important role in the development of CMP's Climate Change Vulnerability Study and Resilience Plan. Involving a variety of stakeholders, including environmental, equity and environmental justice (EEEJ) communities that CMP serves, can help develop a more complete understanding of the concerns, challenges, and vulnerabilities faced by CMP and its customers.

The Maine Public Utilities Commission (MPUC) will provide a process for interested parties to provide input to CMP's plan. CMP envisions engaging with stakeholders throughout the development of both the CCVS and CCRP though the specifics of the process to be provided by may affect the structure of CMP's Stakeholder Engagement. Discussion with stakeholders will provide an opportunity for each group to share what is important or concerning to them regarding climate change; as well as provide an opportunity for CMP to share results, discuss the future climate of Maine, how the developed climate projections may impact CMP's ability to transmit and deliver electricity, and what resilience measures can be used to build resilience to the effects of climate change.

CMP anticipates holding the first stakeholder meeting in the first quarter of 2024 to provide an introduction and overview of the CCVS and CCRP, with additional meetings occurring approximately once per quarter through 2024 and 2025.

An inclusive approach, aimed at promoting transparency and collaboration in the study process, will give stakeholders regular opportunities to provide feedback to CMP's overall plan to study climate change and design effective resilience strategies to the identified hazards.

2. Climate Change Vulnerability Study

CMP's CCVS has three main steps; developing projections for the future climate of Maine; identifying how those projections may be hazardous to CMP assets and processes, and how vulnerable assets and processes are to the projected hazards. Development of details of climate change modeling is explained in Section 2.1, development of climate hazards data is detailed in Section 2.2, while equipment and process vulnerabilities are explained in Sections 2.3 and 2.4.

Figure 3 – CCVS Overall Methodology

2.1. Climate Projection Methodology

The future climate of earth will be defined by how effectively the global economy decarbonizes, and how sensitive earth's climate and related systems are to the effects of human emitted GHGs.

The study of climate change aims to resolve each of these variables through use of Shared Socioeconomic Pathways (SSP) and a variety of Global Climate Models (GCMs). The SSPs and GCMs utilized to be used in the CCVS are all industry recognized scientifically peer-reviewed and aligning with the science performed by IPCC and CMIP6.

2.1.1. Shared Socioeconomic Pathways

SSPs are five narratives that describe possible future global economies and what socioeconomic development strategies and climate policies that may be adopted across the globe. These SSPs, further defined and discussed in IPCCs 6th assessment, are based on a comprehensive assessment of the literature on future socioeconomic development as well as expert judgment. In alignment with many utility peers, the CCVS will utilize two "bookend" SSPs to establish the range of possible greenhouse gas emission pathways and climate futures:

- SSP2-4.5: A scenario where CO_2 emissions are maintained at current-day levels until approximately 2050 and then decline to near zero by 2100. This scenario limits warming to 3°C.
- SSP5-8.5: An unabated / business as usual emissions scenario where CO2 emissions continue to increase until late into the 21st century when CO2 emissions begin to level off. In this scenario warming exceeds 4°C.

The first number in the SSP taxonomy (e.g., "SSP2" or "SSP5") simply denotes the global narrative that was used to generate the GHG emissions scenario it represents. The second number (e.g., "4.5" or "8.5") identifies the radiative forcing[6] (W/m^2) that the earth experiences in each SSP.

2.1.2. Global Climate Models (GCM)

GCMs are computer-based simulations of Earth's climate and physical processes; for example, precipitation, and effects of Earth's albedo change on warming. These models are used to simulate how different levels of greenhouse gas emissions, solar radiation, and other factors may affect future climates.

GCMs may be configured with different assumptions or expectations for how Earth's climate processes react to increased levels of GHG emissions. The exact climate future and how Earth responds to continued emissions includes some uncertainty; to incorporate a variety of possible outcomes the results from multiple GCMs are combined into a probabilistic distribution of the results. This distribution is then used to determine the likelihood of specific climate change outcomes. For example, one data point that Figure 4 is trying to convey is that 50% of GCM results for SSP5-8.5 in 2050 show that the temperature for this example hazard will be ~84°F.

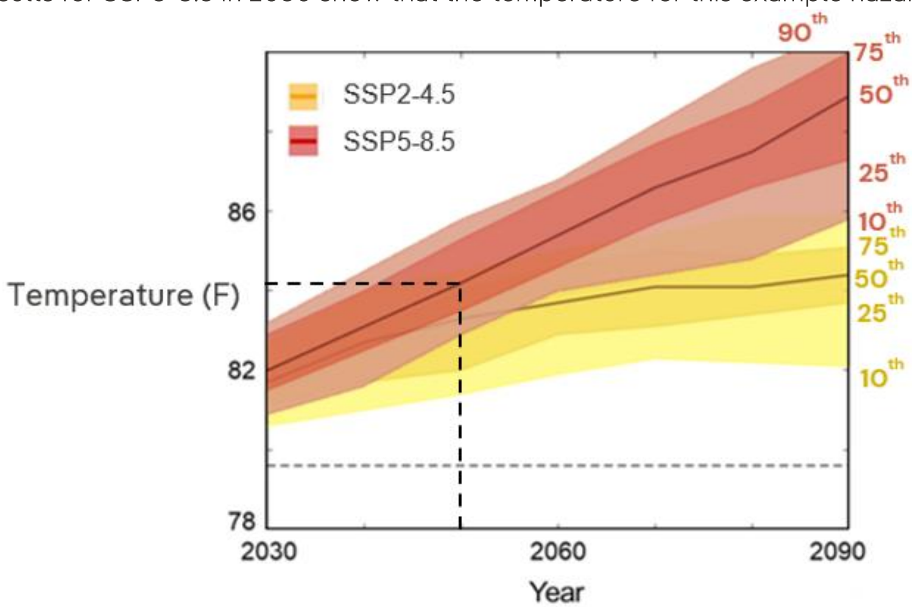

Figure 4 – Example SSPs and Distribution of Results (Percentiles)

2.1.3. Planning Scenario Selection

Initially CMP intends to utilize the SSP5-8.5 50th percentile of results in 2050 as its planning scenario. CCVS and CCRP results will be tailored to identify vulnerabilities and design resilience measures based on results that occur in 50% of the GCMs using unabated greenhouse gas emissions. This conservative selection of results provides a "stress test" of CMP's electric system but it is also important to note that the differentiation in future climate results becomes more

[6] Radiative forcing is the amount of energy imparted to the Earth from the Sun; the higher the amount of radiative forcing the more global temperatures are expected to increase[6]. Therefore, SSP2-4.5 corresponds to a 2nd Shared Socioeconomic Pathway scenario with a radiative forcing of 4.5 W/m^2.

pronounced after 2050 as shown in Figure 4. The selection of CMP's Planning Scenario will be further discussed during Stakeholder Meetings.

2.2. Climate Hazards

Electrical assets are sensitive to a range of climate hazards including, but not limited to, ambient temperature, extreme precipitation, sea-level rise, flooding and extreme wind speeds. An example of the climate hazards that will be evaluated in the CCVS are shown in Figure 5.

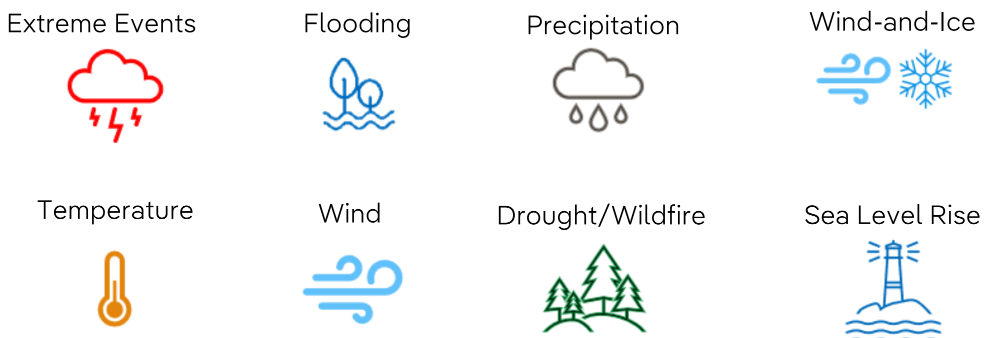

Figure 5 - Example Climate Hazards

These climate hazards, and the related climate variables, represent the constraints and sensitivities of CMP's assets to climate change. To perform these analyses, climate variables will be quantified, to the extent possible, and then compared to design or operational parameters of the assets; for example, the annual frequency that temperatures exceed 104°F is one climate variable that will be calculated and assessed.

In broad terms, the effects of climate change can manifest in two ways:

- Chronic Effects: effects that are due to gradual changes to the climate over time, for example changes to temperature or precipitation.
- Acute Effects: short duration but impactful events like intense storms, or heatwaves.

For example, CMP transformers are currently designed to for a daily average temperature maximum of 86°F; and an overall maximum ambient temperature of 104°F. The chronic effects of climate change are expected to increase the frequency with which the daily average exceeds 86°F; acute temperature effects are expected to result in extreme heat events where the maximum temperature of 104°F is at risk of being exceeded.

While many climate hazards will be included in the CCVS there are some hazards that affect electric generation in Maine and must be considered by others; for example, changes to precipitation or extreme cold weather may affect hydro and natural gas generation, respectively. CMP's CCVS will only be assessing hazards that affect CMP's assets and processes.

2.2.1. Quantitative Projections

GCMs are not intended to be used as a daily or future weather forecast, instead they aim to simulate the future possibilities for measurable climate quantities like temperature, precipitation, etc. The results from GCM simulations are often large sets of time-series data covering one or more decades in time; this dataset is then processed to identify how measurable climate quantities can change over time. In the CCVS CMP will be generating quantitative projections for each decade from 2030 to 2100 for SSP2-4.5 and SSP5-8.5 to determine a range of possibilities for the future climate hazards.

Due to the quantity of data included in the raw GCM output, it is not easy to utilize this data without additional analytical techniques designed to capture key statistics about the GCM. Creation of these derivative and specialized statistics, denoted as "climate variables", allows users to define what thresholds are of particular importance to their work.

For example, CMP substation transformers are specified and designed with the expectation that ambient air temperature around the transformer does not exceed 104° F, and that daily average temperature does not need 86° F. Determining how often these values are exceeded can allow for enhanced understanding of the risk to CMP assets and processes over time. The CCVS will quantify the change in the list climate variables listed in Table 1. As the CCVS progresses CMP anticipates that this listing of variables may be updated.

Table 1 - Quantified Climate Variables

1-in-10-year Minimum 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 Max. Temperatures >104°F (40°C)	Avg. Annual Max. 1- & 5-day Precipitation
Days Per Year with Average Relative Humidity > 95%	Median (1-in-2 Year) Cumulative Temperature-Humidity Index (CTHI)
Annual Duration of Heat Waves	Sea Level Rise
Annual Frequency of Heat Waves	Heating / Cooling Degree Days
	Standardized Precipitation Evapotranspiration Index (SPEI)

2.2.2. Qualitative Projections

Unfortunately, not all climate phenomena lend themselves to being easily simulated using a range of GCMs and SSPs. For example, while capabilities in simulating climate change and extreme events (e.g., tornadoes, severe storms, etc.) have improved in recent years, uncertainty remains for the most intense extreme weather events because of (1) the rarity of the event relative to the length of the historical record, (2) the small spatial and time scales at which the events occur, and (3) the limited ability of current global-scale climate models to resolve events at these scales.

To complement the quantitative projections CMP will utilize qualitative information from peer-reviewed research and literature to determine a reasonable expectation of future conditions related to climate hazards that cannot be assessed quantitatively. For example, qualitative projections are likely to include hazards like storm intensity or frequency, vegetation growth pattern, ice accumulation, and others.

2.3. Determining Vulnerabilities

The CCVS will identify which asset and climate-hazard combinations are considered priority vulnerabilities determined through subject matter expert (SME) input. These priority vulnerabilities will be a focus of the CCRP.

Some key terms which will be used throughout the CCVS are listed, below:

- **Exposure:** Exposure is the degree to which assets could face climate hazards. This is determined based on an asset's location and climate hazard projections in that area.
- **Sensitivity:** Sensitivity is the degree to which assets could be adversely affected by exposure to climate hazards. Assets which are highly susceptible to damage from climate hazards will have a high sensitivity rating, for example transmission structures. Assets that have a minimal or no sensitivity to a hazard would be scored lower; for example, specific overhead equipment (e.g., pole-top transformers) are not directly sensitive to flooding because of the elevated position.
- **Consequence:** Consequence is defined as the magnitude of negative outcomes for the CMP systems, our customers, or CMP staff when an asset is damaged. For example, if substation transformer fails a significant number of customers could be impacted so it would receive a higher consequence rating than a pole-top transformer that would directly impact a smaller number of customers.
- **Vulnerability:** Vulnerability is the degree to which asset and hazard combinations (e.g., substation transformers and extreme temperatures) are expected to be impactful. Determination of a vulnerability rating is a combination of an asset's sensitivity to a particular climate hazard as well as its consequence rating.

Vulnerability Rating

Determining an assets' vulnerability rating to a climate hazard can be done by combining the asset's sensitivity to that climate hazard with its consequence rating. Vulnerability communicates not just if an asset could be impacted by a climate hazard, but the implications and criticality of the impact.

The vulnerability assessment uses SME input to determine the sensitivity of each asset class to climate hazards as well as the consequence of failure for each asset class. The highest vulnerability ratings, along with additional SME feedback, will be used to generate a list of priority vulnerabilities. As the CCVS progresses the sensitivity and consequence scores may be revised based on insight gained during the study. An overview of the vulnerability assessment methodology is shown in Figure 6 - Vulnerability Assessment Methodology.

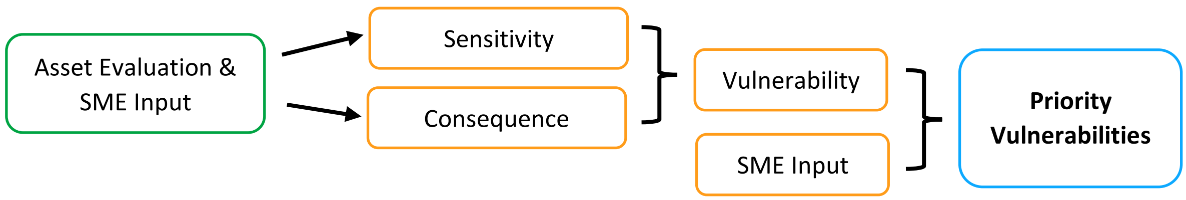

Figure 6 - Vulnerability Assessment Methodology

The vulnerability rating each asset-hazard combination ranges from "not applicable" to "severe" depending upon its consequence and sensitivity ratings. The color-coded cells in Table 2 show the vulnerability rating for an asset-hazard combination that result when combining sensitivity and consequence ratings. The categorization of vulnerability ratings will allow for the most impact asset-hazard combinations to be identified as Priority Vulnerabilities for further evaluation in the CCRP.

Table 2 – Sample Vulnerability Rating Rubric

Consequence / Sensitivity	Minimal	Low	Medium	High	N/A
Low	Minimal	Minimal	Low	Medium	N/A
Medium	Minimal	Low	Medium	High	N/A
High	Low	Medium	High	Severe	N/A

2.4. Operational Process Vulnerabilities

In addition to assessing the vulnerabilities of assets to the effects of climate change the processes used by CMP must also be evaluated to determine if they should be updated to account for climate change. The initial listing of process functions could potentially be affected by climate change are included below including the hazard identified as a risk. The CCVS and CCRP will include additional exploration of the specific risks due to climate change and actions that can be taken to mitigate.

Table 3 - Operational Climate Risk Overview

Function	Temperature	Wind	Flooding	Precipitation	Wind & Ice	Drought/ Wildfire
Emergency Response	✓	✓	✓	✓	✓	✓
Workforce Safety	✓	✓	✓	✓	✓	✓
Vegetation Management	✓	✓		✓	✓	✓
Asset Management	✓	✓		✓	✓	✓
Facility Ratings	✓					
Reliability Planning	✓	✓			✓	
Load Forecasting	✓					

2.5. CCVS Results

The final product of the CCVS will be a publicly available and comprehensive report detailing the methods used by CMP to identify climate change projections across the CMP system for the quantified climate variables discussed in Section 2.2; as well as a list of Priority Vulnerabilities.

The study will include details on the stakeholder engagement, the projected future climate of Maine, evaluation of CMP equipment and process, and the degree to which climate hazards are projected to change and impact CMP and its customers.

These results will be used in the CCRP to determine if and where resilience measures may be needed to build or maintain resilience to climate change across the CMP's electric system.

3. Climate Change Resilience Plan

3.1. CMP's On-Going Resilience Efforts

In response to extreme weather events CMP began actively build resilience to climate hazards into its system starting in 2019. The following are some examples of activities being performed at CMP that help to directly mitigate some of the expected impacts of climate change.

Distribution Circuits

In 2019 CMP created the Resiliency Guide that updated distribution circuit construction designs to meet or exceed the National Electric Safety Code (NESC). In addition, CMP created the Resiliency Program to focus on circuit-wide improvements of the worst performing circuits on its system. These resiliency projects are aimed at decreasing customer outages experienced during major weather events. The scope of these projects can include resolution of distribution line inspection (DLI) items including replacement of weakened poles, installation of tree-wire, enhanced vegetation management, creating ties to adjacent circuits, and installation of automated devices that allow for isolation, sectionalizing, restoration following a fault on the distribution system.

Transmission Lines

CMP has recently begun to perform aerial inspections of transmission structures using drone technology; this new approach allows for more detailed assessments of aerial components. In addition, to boost resilience to extreme weather events and prevent incipient damage to due to rot, infestation, or woodpecker damage that commonly effect wood poles; CMP has standardized on using steel poles for transmission construction.

Substations

CMP has developed a Transmission and Substation Asset Condition Mitigation program aimed at conducting surveys of all its substations to determine the overall health of these systems and to develop a long-term mitigation strategy. This strategy can include partial replacement of substation components to enhance the condition of these assets. There are two main alternatives to mitigation the issues found in substations; a partial replacement solution where individual components issues are addressed; or a full rebuild solution that mitigates all issues by building a new facility.

3.2. Resilience Plan Approach & Framework

In addition, these on-going resilience efforts, CMP will use the CCRP, and the results of the CCVS to determine what additional or expanded resilience measures are necessary to maintain or increase CMP's assets resiliency to the expected impacts of climate change.

This evaluation will look to improve resilience in two distinct timeframes. First, the CCRP will identify any immediate resilience measures required to address impacts of climate change to date, for example has sea-level rise increased the risk to some assets that warrant a resilience measure. Second, the CCRP will utilize the long-term climate hazard projections to determine what changes are required to CMP processes and specifications that would build climate resilience gradually through business-as-usual processes.

CMP expects to use a four-part resilience framework to classify resilience measures and their impact on overall resilience to climate change:

1. **Strengthen and Withstand**: Resilience measures designed to increase the ability of CMP's assets to withstand the effects of climate change and climate hazards.
2. **Absorb and Adapt**: Resilience measures design to reduce the impact, or extent, of climate hazards on CMP's assets.
3. **Respond and Recover**: Resilience measures designed to decrease the time or effort necessary to respond to a climate hazard event.
4. **Advance and Adapt**: Resilience measures design to have feedback to the resilience planning process with the aim of reducing the extent or severity of subsequent climate hazards events.

3.3. Resilience Measure Implementation

This CCPP process is being initiated as the electric grid is undergoing numerous other major changes and transitions including, but not limited to, electrification of heating and transportation, interconnection of distributed energy resources and renewables, and addressing aging infrastructure. Introducing climate resilience measures proactively, but gradually, into the CMP system is the most efficient way to build necessary climate resilience while also minimizing the economic burden borne by CMP's customers. As discussed previously, when possible, CMP will incorporate resilience measures into business-as-usual activities to capture multiple benefit streams simultaneously through the use of Strategic Resilience Measures.

> **Strategic Resilience Measures:** This type of resilience measure would include activities like updating equipment specifications and/or internal processes with the goal of gradually incorporating climate resilience into the electric system through business-as-usual activities.

However, there may be cases where the CCRP identifies a climate hazard event that can be reasonably expected to occur in the near-term, in these cases CMP will identify a Site-Specific Resilience Measure

> **Site-Specific Resilience Measures:** These resilience measures would address acute climate hazard vulnerabilities for a specific site or group of assets.

These Site-Specific Resilience Measures would be included in CMP's typical project planning and prioritization processes alongside other system investments like reliability, capacity, and/or asset condition projects. Like the Strategic Resilience Measures, the goal would be to maximize benefits to the system by meeting multiple needs simultaneously.

Signposts

The science of climate change and the associated projections is constantly improving but some uncertainty of future conditions will remain due to the factors like the specific GHG emissions. The CCPP must be updated every 3 years, which at times may include development of new climate change projections. In addition to these regular updates CMP will review hazard projections to determine if there are any signposts that should be used to periodically gauge how climate projections align with experienced effects.

For example, if a substation is located along the coast but is not yet at risk of flooding due to sea-level rise; a signpost for this hazard would be designed such that once that threshold is crossed it triggered implementation of a resilience measure such that the risk was mitigated prior to the asset being impacted by flooding.

3.4. Sample Resilience Measures

The following are a series of sample resilience measures that could be utilized to maintain or build resilience to climate change. This list is intended to represent a sample of possible resilience measures that may be utilized in the CCRP; likewise, there may be resilience measures not included in the list that are identified as part of the CCRP.

Strengthen and Withstand

- Harden substations against flooding events through selective asset elevation, site relocation, or flood-resistant structures or barriers.
- Replace/upgrade at-risk substation transformers that are heavily loaded and are expected to be exposed to extreme temperatures.
- Utilizing concrete or steel poles on the distribution system in certain construction circumstances.
- Update asset specifications (e.g., transformer ambient temperature standard) to account for future temperatures.

Anticipate and Absorb

- Increase distribution circuit automation and circuit ties to limit the extent of outages due to exposure to wind and wind-and-ice climate hazards.
- Procure temporary/deployable flood barriers and train personnel to deploy them in advance of extreme weather events that may cause flooding (e.g., hurricanes and tropical storms).
- Revise transmission and/or distribution facility ratings to account for temperature projections.
- Reconfigure substations or circuits to lessen thermal demand.

Respond and Recover

- Increase stocks of portable assets that provide power supply redundancy (e.g., backup generators and mobile substations).
- Increase stocks of spare assets and parts to avoid supply chain lead times in replacing damaged or destroyed assets.

- Expand the operating capacity and training of emergency response teams, including low probability but high-impact events like concurrent extreme storms, combined climate hazards, or newly identified substations exposed to flooding.
- Evaluate the resource allocation and storm resource staging process in the context of the climate change projections and extreme event scenarios included in this study.
- Evaluate the substations identified as being at risk in the upcoming CCRP against the listing of known areas at risk to identify any gaps. In addition, consideration could be given for projected changes to flood frequency and severity.

Advance and Adapt

- Integrate climate change risk into business-as-usual investment decision-making and risk management tools.
- Reevaluate climate risk vulnerability and related scenarios on a periodic basis.
- Integrate climate considerations across operating processes, as necessary, including load forecasting, asset management, vegetation management, capacity planning, reliability planning, and emergency response.

3.5. CCRP Results

The results from the CCRP will be a publicly available and include comprehensive discussion and evaluation of potential Strategic and Site-Specific resilience measures that can be implemented to increase the resilience of CMP's electric system to the projected effects of climate change.

Resilience Measure Implementation

CMP expects that that Strategic Resilience Measures, performed by updating specifications, construction practices, and/or operations and planning processes. These modifications will build resilience to climate change during normal business activities.

Any Site-Specific Resilience Measures needs identified through the CCRP will be incorporated into the grid planning process at the project identification or prioritization phases. For example, if a particular substation is not at risk of flooding in the current day but is projected to be at risk of subjected to damaging floodwaters by 2050, it could be prioritized accordingly.

Similar to CMP's approach to the identifying needs in the Integrated Grid Plan, CMP will strive to identify and prioritize "no-regrets" and/or multi-value solutions that can address multiple issues simultaneously, including implementation of resilience measures identified through the CCRP.

4. Conclusion

The CCPP and its two main components, the CCVS and CCRP, represent a crucial initiative aimed at studying the effects of climate change what changes CMP must undertake to maintain or enhance the resilience of CMP system in the face of climate change.

In the CCVS CMP will utilize the most appropriate science and subject matter expertise to develop projections for Maine's future climate. Then, using those projections, CMP will identify and analyze the vulnerabilities on CMPs system due to changing climatic conditions. This initial phase will provide valuable insights into the potential risks and challenges that must be addressed in the CCRP.

The CCRP will offer a proactive strategy to fortify CMP's system against the adverse impacts of climate change in the state of Maine. Ultimately, the CCRP will outline a set of resilience measures, including both targeted and strategic approaches to be used. If necessary, targeted resilience measures will focus on mitigating acute vulnerabilities at specific locations on CMP's system; for example, a substation that is at risk of flooding. In parallel, strategic resilience measures will be formulated to build resilience gradually over time. These measures will encompass long-term strategies, such as changing equipment specifications, and will contribute to a more robust and adaptable overall system. By combining both targeted and strategic resilience measures, CMP will actively enhance its ability to withstand the effects of climate change while maintaining the high standards of service and reliability.