2025-2029 Capital Plan

Q. Page 5. At Footnote 13, Newfoundland Power references the Federal Government's statement on the importance of adapting the Atlantic energy sector to climate change.

a) Has Newfoundland Power prepared a climate change adaptation strategy? If yes, has this strategy been formalized in writing? Please provide a copy of the document or details of the strategy.

b) Does Newfoundland Power believe a climate change adaptation strategy would provide clarity on the grid investments required to provide grid resiliency and reliability for the future?

A. a) Newfoundland Power has a climate change adaptation plan, which is provided as Attachment A. The plan provides a high-level analysis on potential electricity infrastructure vulnerabilities within the Company's service territory, and identifies actions that can be taken to improve resiliency to the impacts of climate change.

b) Newfoundland Power believes its statutory obligations under the *Public Utilities Act* and the *Electrical Power Control Act, 1994* provide sufficient clarity to establish priorities for investments required to provide grid resiliency and reliability.

As more climate data specific to Newfoundland and Labrador becomes available for analysis, climate adaptation strategies can be further developed to enhance grid resiliency and reliability.

Changing climate conditions can be expected to pose challenges to the reliability of the grid into the future,[1] highlighting the role of adaptation strategies. For example, the Atlantic Economic Council has stated that a greater occurrence of severe weather events is currently impacting the electricity industry and is presenting system planning and operational challenges for utilities.[2] The council also notes that a future risk of climate change is the increasing need to build reliable electricity systems as the climate becomes more unpredictable.[3]

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1 For example, as provided in the Canadian Climate Institute (formerly the Canadian Institute for Climate Choices) report *Enhancing the Resilience of Canadian Electricity Systems for a Net Zero Future,* page 5, powerlines, poles, and towers can be downed or damaged by severe weather events that may become more frequent as a result of climate change.

2 See the Atlantic Economic Council's report, *An Overview of Atlantic Canada's Coming Economic Transition*, page 4.

3 Ibid.

ATTACHMENT A:

Climate Change Adaptation Plan

CLIMATE CHANGE ADAPTATION PLAN

December 2021

WHENEVER. WHEREVER.
We'll be there.

NEWFOUNDLAND POWER
A FORTIS COMPANY

Table of Contents

1.0 INTRODUCTION

Climate Change Action is comprised of two broad acknowledgements: mitigation, and adaptation. Mitigation occurs through lowering the Greenhouse Gas Emissions ("GHGs") that contribute to environmental pollution, along with climate change. Mitigating GHGs by reducing the amount that is emitted into the atmosphere is necessary to prevent worse impacts from climate change in the future. Newfoundland Power's (the "Company's") *Clean Energy Plan* highlights initiatives to not only reduce, but in some cases, eliminate GHGs from those sources. Adaptation planning manages and prepares for the impacts of the already existing and projected effects of climate change. This report details the Company's adaptation plan to manage and prepare for the impacts of the current and projected effects of climate change.

Some climate change impacts are already "locked-in" and are unavoidable as a result of the GHGs already in the atmosphere. The World Meteorological Organization ("WMO") reports that in 2020, despite the temporary drop in emissions during the COVID-19 pandemic, carbon dioxide levels have increased to 413.2 parts per million. As long as greenhouse gas emissions continue, the global temperature will continue to rise. Today, the rate of increase in heat trapping gasses is on track to result in temperature rises far in excess of the Paris Agreement target of no more than 1.5 degrees Celsius above pre-industrial levels this century.[1] To withstand these unavoidable effects of climate change, planning and adaptation is key.

When it comes to planning for and adapting to climate change, having information is only the first step. This information needs to be understood and utilized, then incorporated into planning and other decisions to translate into reduced losses and stronger systems. This is the approach taken by the Company in this Climate Change Adaptation Plan, that being to plan and adapt our electricity system to withstand the projected climate change effects in Newfoundland and Labrador.

2.0 BACKGROUND

The Company has been delivering safe, reliable electricity to the people of the province for over 135 years. It operates an integrated electricity generation, transmission and distribution system throughout the island portion of Newfoundland and Labrador. The Company has approximately 12,850 kms of transmission and distribution lines, 131 substations, and operates 29 generating plants comprised of 23 small hydro and 6 backup generators. Being a largely coastal province, the geographic nature and location of our electricity system exposes our infrastructure to some of the harshest weather conditions in North America. This means that change-related impacts such as sea-level rise, coastal erosion and storm surges from extreme weather events that are anticipated to become more frequent and intense, can have significant impact on the electrical system.

1 See WMO (2021, October 25) "*Greenhouse Gas Bulletin: Another Year Another Record*" https://public.wmo.int/en/media/press-release/greenhouse-gas-bulletin-another-year-another-record

3.0 FRAMEWORK

Climate hazards are projected to become more frequent and intense in the decades ahead, and extreme weather hazards pose a continuing risk to energy systems. As climate change progresses, energy infrastructures that were built to withstand the known range of historical conditions are becoming more vulnerable to increasingly frequent, intense, and/or sustained heavy precipitation events, extreme temperatures, hurricanes, droughts, wildfires, and rising sea levels.

Representatives from Generation, Distribution, Substation and Transmission groups within the Company were selected to form the Climate Change Task Group ("CCTG"). Their mandate was to use a staged approach and conduct a high-level analysis to determine where exactly the infrastructure vulnerabilities to climate change may be present and what can be done to adapt to them. This approach in Figure 1 falls in line with recommendations made from both government and industry organizations such as:

- Infrastructure Canada's *Climate Lens – General Guidance* (2019) https://www.infrastructure.gc.ca/pub/other-autre/cl-occ-eng.html
- Electricity Canada's *Adapting to Climate Change - A Risk Management Guide for Utilities* https://www.electricity.ca/files/reports/english/Adaptation-Through-Risk-Management-Electricity-Sector-Climate-Adaptation-Planning-Guide.pdf

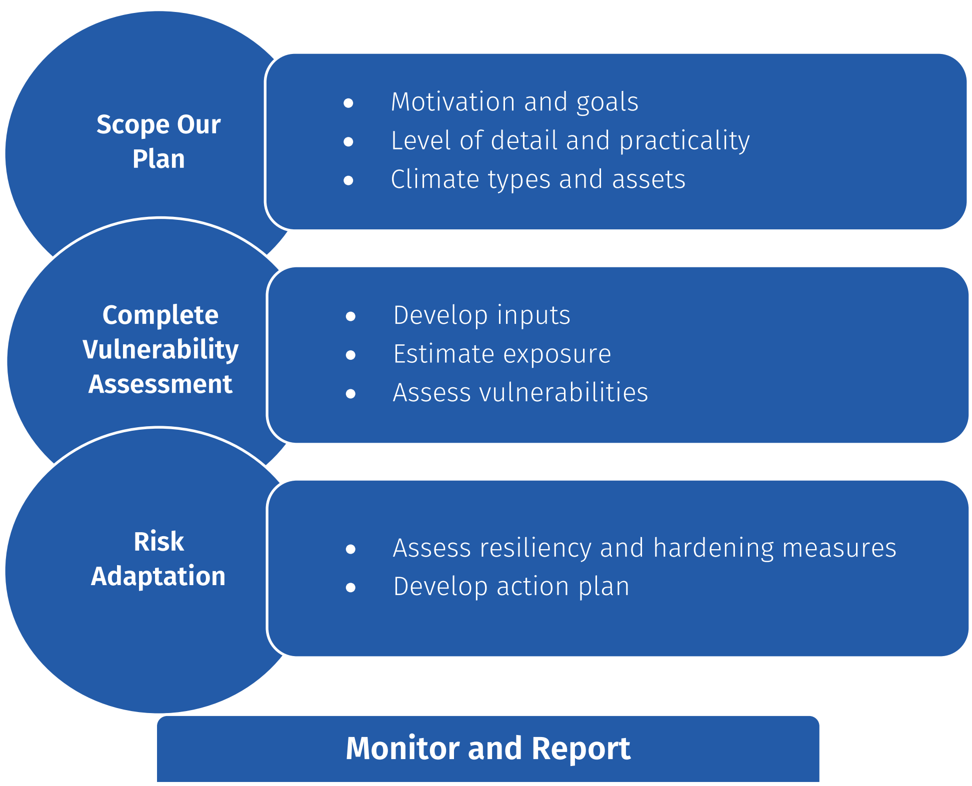


Figure 1: Staged Approach of Plan Development

4.0 WHY IS THE CLIMATE CHANGING?

Greenhouse gases are produced by many natural processes and are essential to life on earth. They absorb and trap in the atmosphere some of the infrared radiation produced by solar rays that reach the earth's surface (See Figure 2). However, human activity is rapidly contributing to the concentration of greenhouse gases in the atmosphere. Since the beginning of the Industrial Revolution carbon dioxide ("CO_2") levels in the atmosphere have escalated tremendously, with nearly half of the CO_2 emitted by human activities remaining in the atmosphere today.

Increases of greenhouse gases in the atmosphere bring about a host of changes. The most obvious effect is global warming. Warmer average temperatures are not the only effect of higher concentrations of greenhouse gases. A warmer atmosphere leads to a cascade of changes that are of concern here in Newfoundland and Labrador.

Although this document is related to climate change adaptation, it does not diminish what has been done by the Company already in reducing emissions. Ultimately if these GHGs are not reduced globally then impacts will be more intense and the likelihood of adaptation will be increasingly difficult.

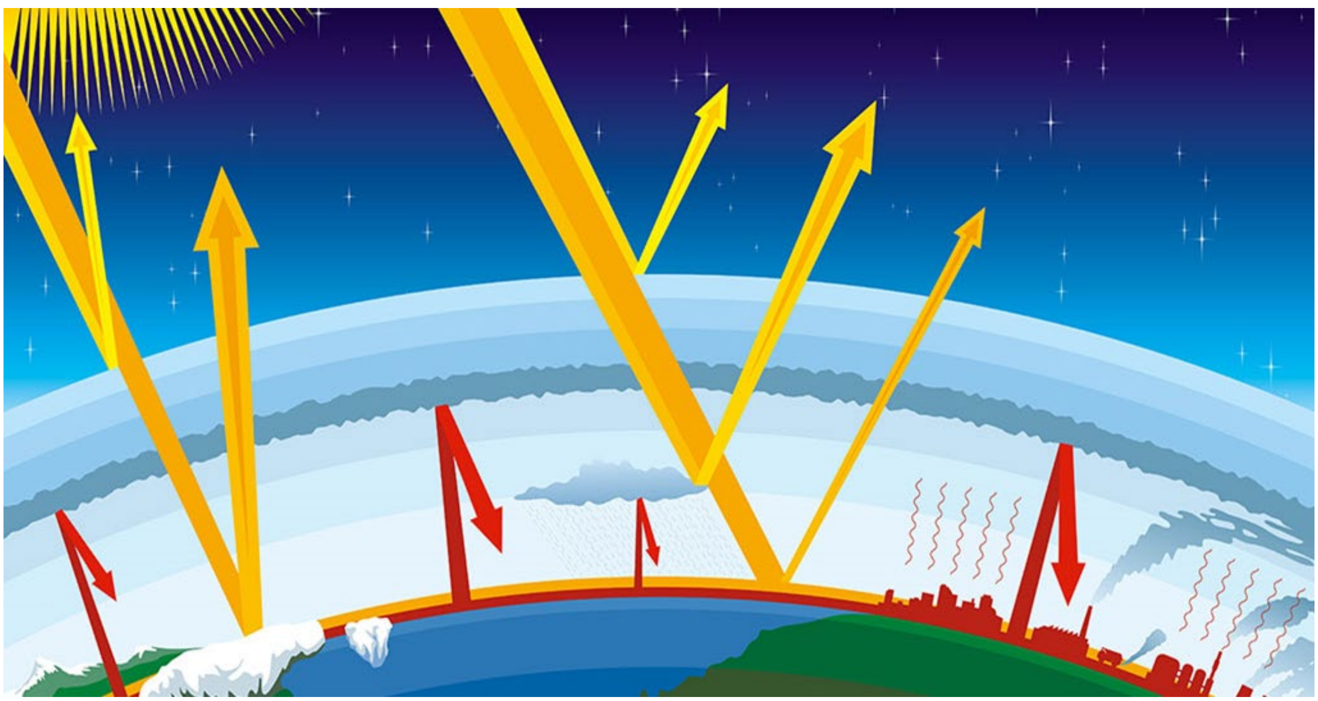


Figure 2: The Greenhouse Effect

5.0 PROJECTED CLIMATE TRENDS

Generally, climate change is characterized by a rise in air and sea surface temperature, sea level, heat waves, and heavy precipitation. In effect, these temperature rises will have an associated decrease in snow cover, sea ice, glaciers and fast ice sheets. These trends are depicted in Figure 3.

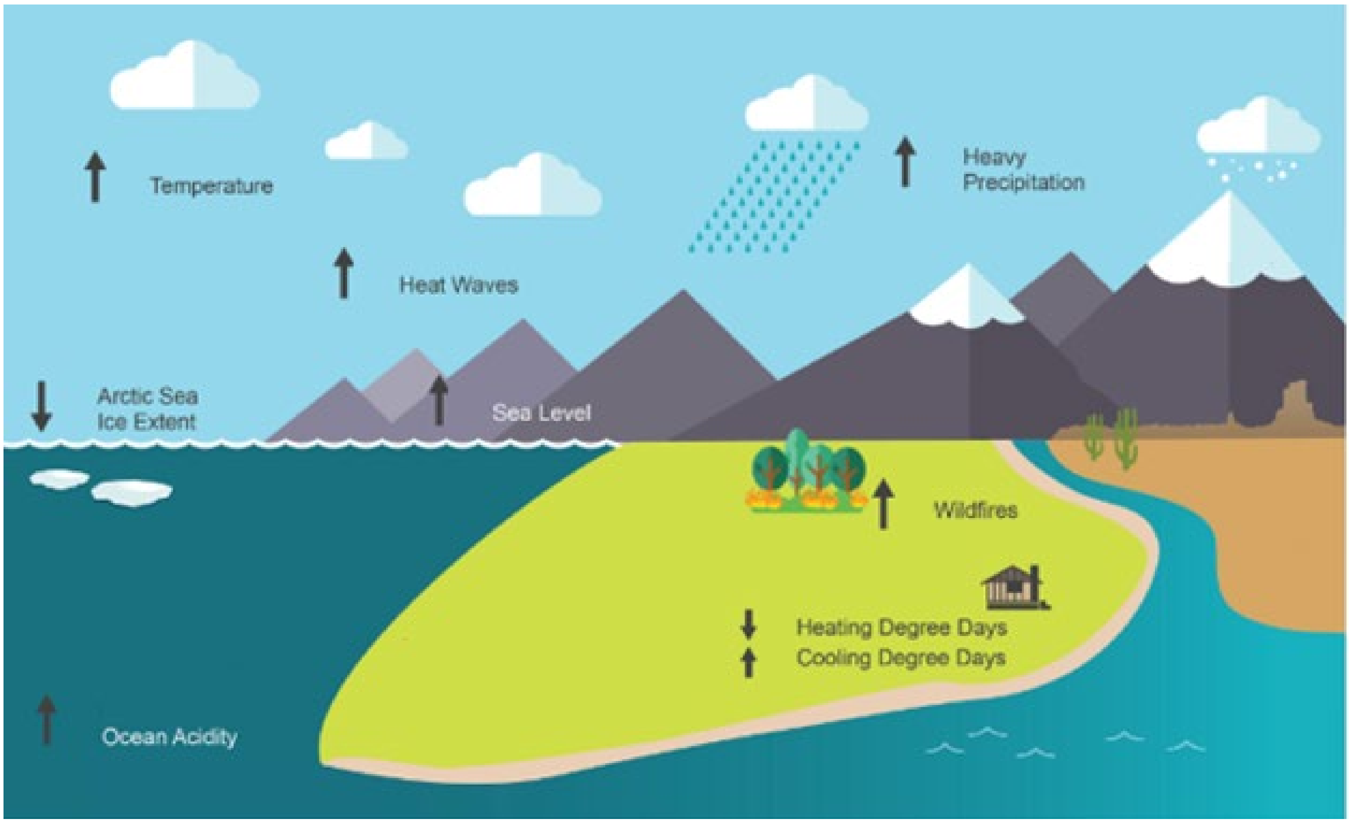


Figure 3: Demonstration of climate related trends and effects based on long-term observations[2]

The climate and projected changes in the Province are unique from those of mainland Canada. The climate fluctuations caused by North Atlantic Oscillation, along with the climate influence of the cold Labrador current running along our shore, subject coastal areas to climate effects independent of interior areas.

[2] See US Global Change Research Program (USGRCRP), 2018, Indicator Platform at https://www.globalchange.gov/indicators

North Atlantic Oscillation

North Atlantic Oscillation ("NAO") is a phenomenon of cyclic fluctuation in atmospheric pressure of the North that influences climate in areas of the North Atlantic (see Figure 4). NAO is driven by the interaction of the low air pressure of high latitudes, and the higher air pressure of the central NAO, to the south. Fluctuations influence the intensity and latitude of the jet stream, in-turn impacting the weather of the North Atlantic regions.[3]

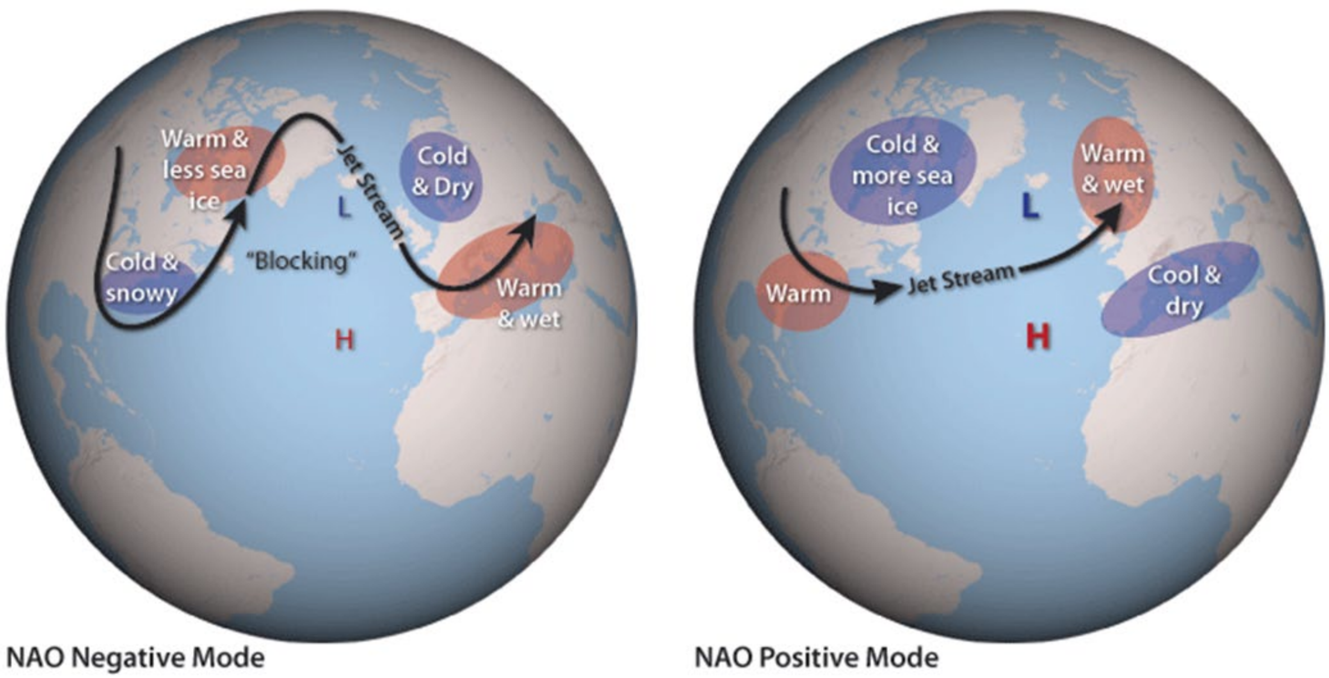


Figure 4: This figure illustrates the pressure and climate differences in each phase of NAO.[4]

As climate change progresses, NAO has been trending toward more frequent positive phase anomalies with significantly higher average pressure differences (see Figure 5). This effect has accounted for some of the dramatic changes in the climate of eastern Canada. With increasingly severe weather conditions projected, this region-specific plan will provide guidelines to ensure that our service remains reliable to our customers despite the adversity we face from our unique climate.[5]

3 See National Oceanic and Atmospheric Administration publication "*Climate Variability: North Atlantic Oscillation*" https://www.climate.gov/news-features/understanding-climate/climate-variability-north-atlantic-oscillation

4 Donev, 2017 August 29. *North Atlantic Oscillation*. Retrieved from Energy Education: https://energyeducation.ca/encyclopedia/North_Atlantic_Oscillation#cite_note-1

5 See The Proceedings of the National Academy of Sciences (PNAS) research paper "*The North Atlantic Oscillation: Past, present, and future*" https://www.pnas.org/content/98/23/12876

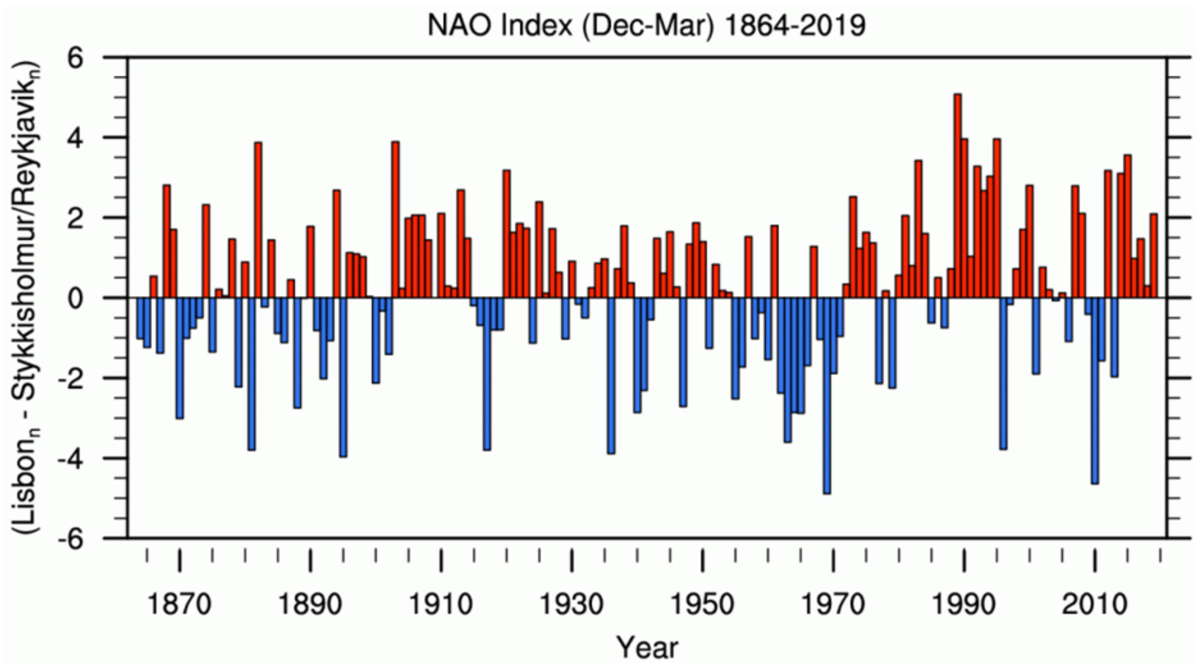


Figure 5: Normalized winter index of NAO, based on pressure differences of sea level pressure measured at stations between Lisbon, Portugal and Stykkisholmur/Reykjavik, Iceland. Notice the increase in Positive Phase anomalies since the 1970s.[6]

5.1 Temperature Trends

Across Canada, temperature trends are increasing at twice the global rate. The average annual temperatures around Newfoundland and Labrador have risen 0.8°C above the normal historical average.[7] Figure 6 shows the projected temperature changes by mid-century for both summer and winter, with respect to temperatures recorded at the end of the last century. Notice that the temperature change is in the winter months, and that with increasing latitude the temperature change escalates even further.

The Northeast Avalon region has experienced an increase in the warmest temperatures, and a slight increase in colder temperatures. The highest and lowest temperatures recorded in the area have increased by approximately 1.0°C and 0.5°C respectively above pre-industrial levels. Despite this, the region has seen a downward trend in days demonstrating freezing and thawing.[8]

6 See Hurrell, James & National Centre for Atmospheric Research Staff (Eds). Last modified 24 Apr 2020. "*The Climate Data Guide: Hurrell North Atlantic Oscillation (NAO) Index (station-based)*" https://climatedataguide.ucar.edu/climate-data/hurrell-north-atlantic-oscillation-nao-index-station-based

7 See the Government of Newfoundland and Labrador climate action plan "The Way Forward – On Climate Change in Newfoundland and Labrador" https://www.gov.nl.ca/ecc/files/publications-the-way-forward-climate-change.pdf

8 Ibid.

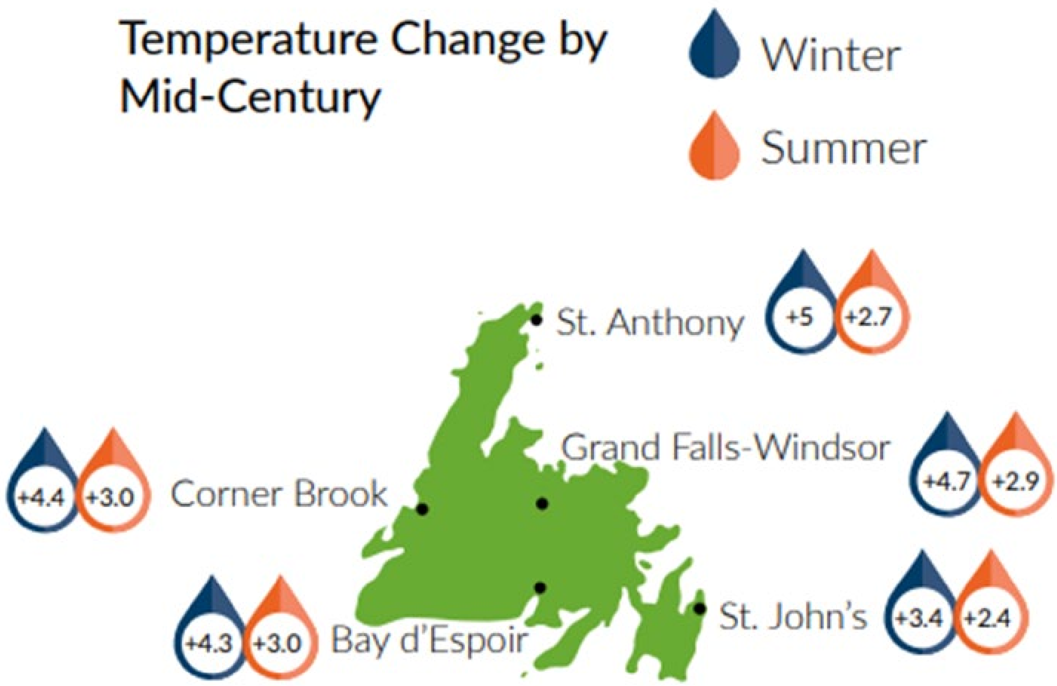


Figure 6: Seasonal temperature changes at sites throughout the province based on data collected in 2018.[9]

5.2 Sea Level and Ocean Temperature Trends

As ancient glaciers and ice sheets melt at an increasing rate, ocean temperatures rise, and groundwater is pumped from the land, the volume of water in our oceans is increasing. These changes lead to the globally observed trend of sea level rise. Sea level observations taken on the Northeast Avalon have recorded a long-term rising trend since the 1940s. Measurements taken at stations located near St. John's have recorded a sea level rise of 1.9 mm per year relative to the land. As St. John's is an area where the ground sediments are settling, the land height is slowly dropping. This contributes to the rate of sea level rise, as measurements are taken relative to the land despite any rising or falling trends. The rise in sea level is projected to continue, reaching 75 to 100 cm by the year 2100.[10]

[9] Ibid.
[10] Ibid.

Around the world, the impact of carbon uptake by the ocean has been a tremendous benefit as it stores over half the carbon emitted by human activity, in turn keeping atmospheric levels low. However, as CO_2 concentration rises in the ocean a corresponding warming effect has been observed. In Newfoundland and Labrador, a sea surface warming trend of 0.13 °C per decade was observed at the ocean surface. A somewhat lower warming of 0.02 °C per decade was observed below the surface (0-175 m).[11] Sea surface temperatures are projected to increase further as GHG levels in the earth's atmosphere and oceans increase, resulting as well in further reductions in sea ice cover. Based on what we know in the trends of sea level and our changing climate, our coastlines will become increasingly vulnerable to erosion and flooding.

Figure 7: Coley's Point, Bay Roberts, Newfoundland and Labrador

[11] Ibid.

5.3 Wind Trends

There is a limitation in the analysis of wind due to available observations and the limited research on the mechanisms that cause observed and projected changes in Canada. The information in this section is based on observations gathered at the St. John's International Airport, as presented in the St. John's Climate Profile.[12]

In the Avalon region, the strongest average sustained winds, as well as most of the strongest sustained wind events were observed in the winter months. The strongest average sustained winds were recorded at roughly 41.76 km/h, while the strongest sustained winds which are most common in the winter season were recorded at most of 61.56-59.76 km/h. Trends show that the summer season is the least windy with average sustained winds of 22.68-24.48 m/s.

Although high-speed sustained winds above 90 km/h are rare, the St. John's region often experiences destructive wind gusts. These are among the greatest concerns when considering the climate impact on Newfoundland Power infrastructure. Wind gusts can be defined as the sudden increases of wind speed that lasts no more than 20 seconds. These gusts at their highest speeds can increase damage to infrastructure. St. John's has been named the region with the most frequent wind gusts in the country, experiencing nearly 1,424 hours each year with winds gusting above 40 km/h, 151 hours of wind gusts at or above 70 km/h, and 24 hours of gusts recorded at over 90 km/h.[13]

Figure 8: Wind damage to Newfoundland Power distribution line during Hurricane Igor, 2010

12 See document St. John's Climate Profile (2020) https://www.engagestjohns.ca/14975/widgets/62501/documents/37788
13 Ibid.

5.4 Precipitation Trends

Based on weather data collected at the St. John's International Airport, there is a noticeable increase in the frequency and intensity of storm events. Consistent with the projected trend of storm events, the region has recorded an increase in the intensity and frequency of storms lasting 15 minutes or more, with a significant increase in the intensity and frequency of storms lasting more than 1 hour but less than 12 hours. Going forward storm events are expected to continue to increase in frequency, duration, as well as intensity.

Precipitation by definition encompasses both snow and rainfall, along with sleet, hail, and freezing rain. Snowfall trends are in decline, with slightly more precipitation falling as freezing rain or rain than trends have shown in the past. Analogous to this trend, Canada's Changing Climate Report 2019 reports that Eastern Canada has observed a 5-10% decrease in snow cover during the winter season.[14] Snowfall is expected to continually decrease in association with the projected decline in annual precipitation.

Figure 9: Ice loading on Newfoundland Power lines during 2010 ice storm

[14] See *"Canada's Changing Climate Report"* released in 2019 https://changingclimate.ca/CCCR2019/

6.0 OPERATIONAL RISKS

Climate change and Company operations are interconnected. To ensure our electricity remains reliable for years to come, the risks of climate change to our assets must be considered. With the impacts of climate change, climate related hazards are expected to increase. More frequent and intense weather events as well as and changing climate patterns continually elevate the risk of climate related impacts to our electricity system.

Severe storms, hurricanes, lightning, extreme precipitation, and extreme heat and cold events have the potential to damage poles, overhead lines, generation assets, transformers, substations and other transmission and distribution assets. These climate patterns increase physical loading on conductors, structures and other components of the system. On occasion, this may result in downed conductor lines, damaged structures and other components, and overloaded equipment. In many cases these impacts will result in power outages.

Expectation of flooding and road washouts due to increased storm and precipitation events create public hazards as well as accessibility issues such as flooding and road washouts. These circumstances will create difficulty in accessing outage locations to restore power to the area.

Events of high winds, heavy snow and freezing rain which often overlap with extreme weather will have similar impacts of loading on conductors, structures, and other components potentially leading to downed lines and asset damages. Additionally, increased snow cover could result in conductor clearance issues.

Being an island province with abundant inland waterways, there are many cases in which Company assets are located near waterbodies. Rising sea levels, storm surge, as well as increased precipitation will increase coastal erosion and could impact footings, foundations, and poles, as well as buried infrastructure.

The greatest risk of flooding to our assets relates to low lying infrastructure where footings, foundations, and poles could be undermined, as well as in coastal areas or within flood plains where infrastructure could become inundated. In coastal areas, increased salt spray during storm and extreme wind events will create significant risk of power outages, which have been observed to date in the Company's electricity system for this reason.

Recent summer seasons have demonstrated record breaking high temperatures. Higher temperatures have the potential to affect the thermal rating of transformers, breakers and wires, and accelerate growth of vegetation. Temperature change may also support new pests and diseases that could not previously exist in Newfoundland and Labrador.

Temperature increases also heighten the risk of forest fire ignition. As vegetation grows around our lines, there is a greater potential for vegetation contact incidents and sparking of wildfires. Forest fires are a significant threat to the environment, public safety, nearby communities, as well as our assets in the region. However, our system remains at medium to low risk of forest fire ignition.

Figure 10: Photographs of Newfoundland Power assets after major storm events.

7.0 THE FINANCIAL IMPORTANCE OF ADAPTATION

The impact of climate change is an increasingly important consideration when making investment decisions and determining the value of a business. Climate change and business valuations are inextricably linked. All risks and opportunities are considered when determining the value of a business, and climate change is a significant one. It is for this reason that climate change risk will stand alone in the Company's Enterprise Risk Management matrix and the impacts on operations evaluated at the governance level of the organization.

Climate change has the potential to disrupt operations and impact the Company's revenues, costs, risk profile and ultimately its value. It also comes with investment opportunities. As the world shifts from a carbon economy to a renewable one, there will be significant opportunities from investing in the transition. The ability of an electricity system to remain reliable under the pressure of climate change may interfere with investor decisions. The adaptability of the system would reduce investment deterring risks such as high cost repairs.

Without adaptation measures in place, extreme weather events can be costly to utilities, namely those in island regions. For example, in 2019 Hurricane Dorian brought maximum wind speeds of 122 km/h in Prince Edward Island. This found 65,000 (75%) Maritime Electric Customers out of power, taking eight days to complete restoration. Restoration costs to the utility from the devastating storm amounted to CDN$3.5M, with 97 poles and 93 distribution transformers replaced.

Trends in Newfoundland and Labrador see storm events expected to occur once every century, referred to as 100-year storms, becoming four times more frequent. Storms of the 100-year magnitude are now expected to occur every 25 years in Newfoundland and Labrador. As the frequency of these storms increases, so does the financial loss due to damaged infrastructure repairs, equipment replacement, maintenance programs, and additional labour crews. Newfoundland Power's Climate Change Adaptation Plan is intended to protect the value of existing assets, while creating value through the increased capability of our system to withstand the harsh climate.

8.0 DOING OUR PART

Regardless to the degree of inevitability of climate change, the Company knows everyone needs to do their part. Working towards mitigation and the building of a roadmap to reduce emissions that cause climate change within the Company has already begun. Engaging multiple stakeholders in planning and implementation ensures both mitigation and adaptation considerations are taken into consideration for future climate conditions. Even though the impacts from operational emissions are relatively low, a *Clean Energy Plan* has been created to determine the largest areas of impact and focus for GHG reductions (see Figure 11). Using 2019 as our baseline year and finalizing the corporate GHG inventory the Company was able to firm up a strategy to reduce its GHG by 50% by 2035.

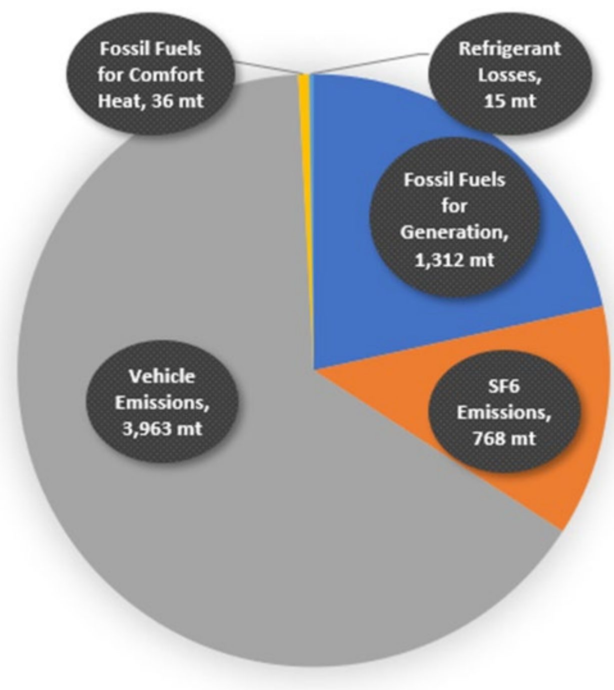


Figure 11: GHG inventory using 2019 as a baseline.

The island grid is expected to be primarily renewable in the near future which leaves the Company in a great position to have one of the cleanest electrical systems in Canada. Electrifying the vehicle fleet will be key to meeting reduction targets as it made up 65% of all emissions in 2019. Advancing technologies in mobile generation and alternatives to Sulfurhexaflouride ("SF6") should also play a role but will be lessened in the early years because of supply chain issues caused by the global pandemic.

9.0 CURRENT RESILIENCY AND HARDENING

Extreme weather is not new to the residents of Newfoundland. Over the past 25 years, the number of storms impacting the Company that have resulted in them being classified as "Major Events" in accordance with the IEEE 1366 standard has grown from a one in ten- year event to an average of two annually. Incorporating hardening and resiliency into day to day planning for operations and capital projects is one of the reasons in 2021 the Company was named the first recipient of the *Resiliency and Reliability Award* from the Canadian Electrical Association, now called Electricity Canada.

Over the last 10 years significant investment in operational technology has been made to address these changing climate conditions:

- A centralized dispatching process was implemented in 2014. The technologies include a Workforce Management System, Automatic Vehicle Location System, and Mobile Technology in line trucks.
- A new SCADA system and Geographic Information System ("GIS") were implemented in 2016 providing real time data on the status of the electrical system.
- A state-of-the-art Outage Management System was implemented in 2019. The system, called Responder, automatically assesses outage reports from customers and groups related outages. Responder reduces the amount of time required to assess outages enabling a prompt response to customers.
- Achieved 100% automation of its distribution feeders at year-end 2019. This automation provides real-time information on the status of the electrical system and allows distribution feeders to be operated remotely restoring power to customers without dispatching field crews.
- Increased installation of feeder downline reclosers. These devices are controlled remotely to isolate a fault so only a portion of customers on a feeder experience an outage instead of all customers.

General readiness for weather events is incorporated into operations and undergoes testing during the year. Emergency preparedness for impacts from floods or fires simulate actual real events and confirm employees have been trained properly while also incorporating lessons learned from previous simulations.

Hardening infrastructure to make it less susceptible has included standardizing that pole lines are built to the CSA Severe Loading Standards. Regular maintenance and inspections of all assets is done on regular interval while also maintaining all vegetation management standards are incorporated.

10.0 INFRASTRUCTURE ASSESSMENT

Methodology for Assessment

For the purposes of the assessment the island system has been divided into four quadrants to aide in evaluating climate risk on infrastructure in Transmission, Distribution, Generation and Substations (see Figure 12).

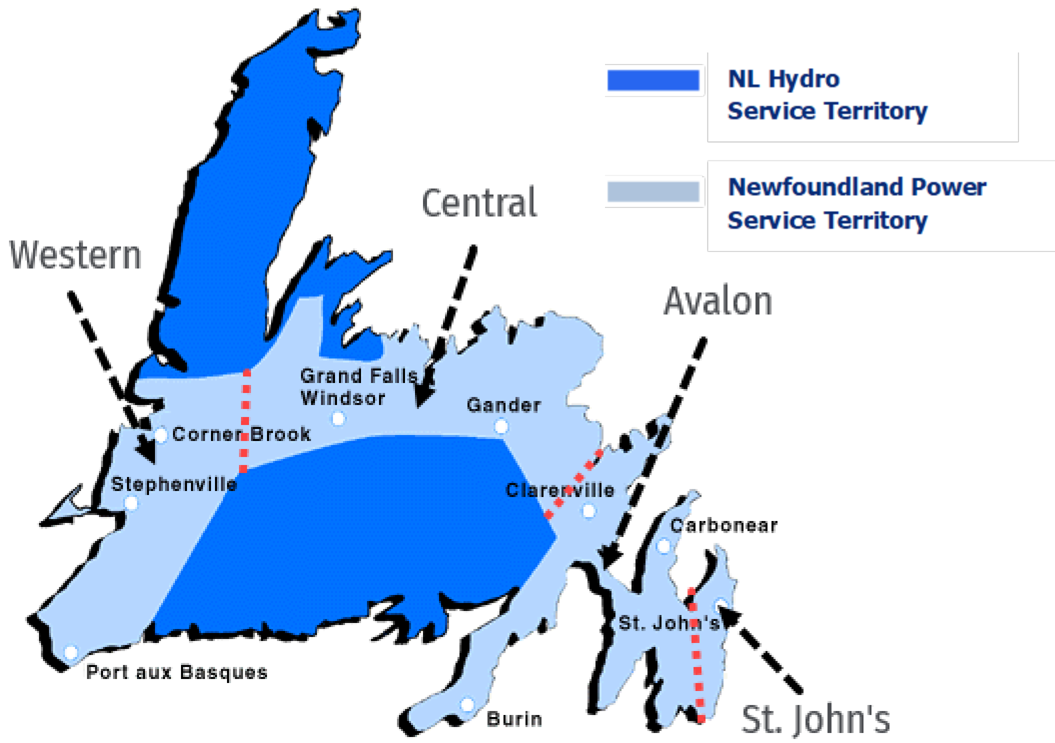


Figure 12: Service Territory Divided for the Purpose of Climate Assessment

Using the Projected Impacts of Climate Change for the Province of Newfoundland and Labrador Report, 2018, the CCTG each assessed the vulnerabilities of their infrastructure in each area and gave rankings of low, medium or high. Criteria varied for each proponent but as a baseline, the catastrophic loss of the asset, extended outages to customers, and immediate impact on the general public or the environment were used to determine ranking.

10.1 Transmission

The transmission component of an electrical system delivers generated electricity in bulk to the consumer region. Consisting of transmission lines and transformers located both inland and in coastal areas, our transmission facilities are all subject to the influence of ice and wind. Without mitigation, as climate change progresses, environmental risk to transmission infrastructure will increase. With the projected increase in frequency of wind gusts, sustained high winds, and storm events, this infrastructure is among the most vulnerable of our assets to climate change impact. The infrastructure is exposed to risk of flooding, extreme winds, ice loading, forest fire, and in some cases coastal erosion. This impact varies with each region, and with each individual section of transmission line. For the most accurate report, assessments were conducted on individual sections of each Company operated transmission line, separated based on climate risk. The assessment considered the climate risk infrastructure will be subject to if no mitigations are applied in the short-term (less than 25 years), and the long-term (25 to 50 years).

10.1.1 St. John's

Short-term Climate Risk

In the St. John's region, a total of 53 sections of transmission line were assessed. Transmission Line 22L, reaching from the Morris Plant to the Morris Plant Tap transmission line has been classified as high climate risk by 2050, with wind and ice listed as the most significant impacts. Due to the radial nature of this line and its current substandard condition, this line has been placed at high priority and will be rebuilt by 2050. As with all rebuilds, the new design will involve hardening of assets to increase the resiliency of structures. 27 sections of transmission line infrastructure in this region will be at medium climate risk by 2050 without mitigation. 93% of these will be replaced by this time. 25 transmission lines in the St. John's region will remain at low risk for the next 25 years. Priority for reconstruction has been placed on medium to high risk infrastructure, therefore no low risk lines are planned to be replaced within the next 25 years.

Long-term Climate Risk

In 25 to 50 years, transmission line 24L and a 0.49 km section of line 14L beginning at the Stamps Lane Substation will increase from medium to high risk. Lines which are low risk in the short-term rise to medium risk in 25 to 50 years, these make up 47% of lines in the region. High and medium risk lines are planned to be rebuilt in this period. 49% of lines in this region will be at low risk having been rebuilt in the previous period. See Figure 13 for a summary of transmission climate risk level for the St. John's region.

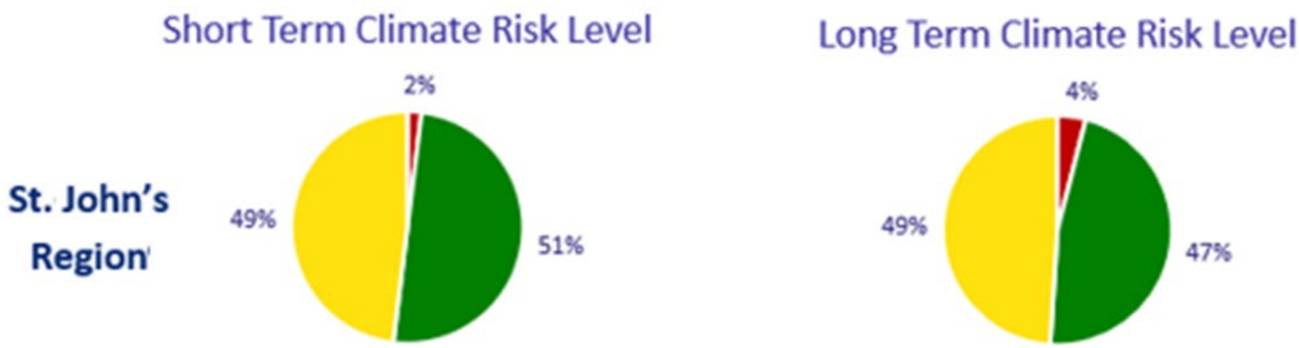


Figure 13: Summary of transmission climate risk level for the St. John's region in the short-term (less than 25 years) and long-term (25 to 50 years).

10.1.2 Avalon

Short-term

In the Avalon region, a total of 31 transmission lines were assessed (evaluated in 37 sections). Radial Transmission Line 65L reaching from New Chelsea to Old Perlican, and the portion of Transmission Line 305L running from Webbers Cove to Greenhill are projected to be at high climate risk by 2050. Due to the extreme winds prominent in the area and recommendation from the Company's Planners, these lines have also been placed at high priority and will be rebuilt by 2050. As stated above, the new design will involve hardening of assets to increase the resiliency of structures. Twenty-three sections of transmission line infrastructure in this region will be rated at medium climate risk by 2050 without mitigation. 91% of these will be replaced in less than 25 years. Twelve transmission lines in the Avalon region will remain at low climate risk, with Transmission Line 94L from Blaketown to Riverhead being rebuilt within the next 25 years.

Long-term

In 25 to 50 years, transmission line 117L which reaches from Catalina to Bonavista will increase from medium to high risk as it is a radial line at risk of persistent high winds and ice in locations. This line is in the long-term plans for rebuild. In 20 to 25 years, 12 transmission line sections (32% of lines in this region) will upgrade to the medium risk level. In this period 24 transmission line sections (65% of lines in this region) will be reduced to the low risk category by way of asset hardening and reconstruction. See Figure 14 for a summary of transmission climate risk level for the Avalon region.

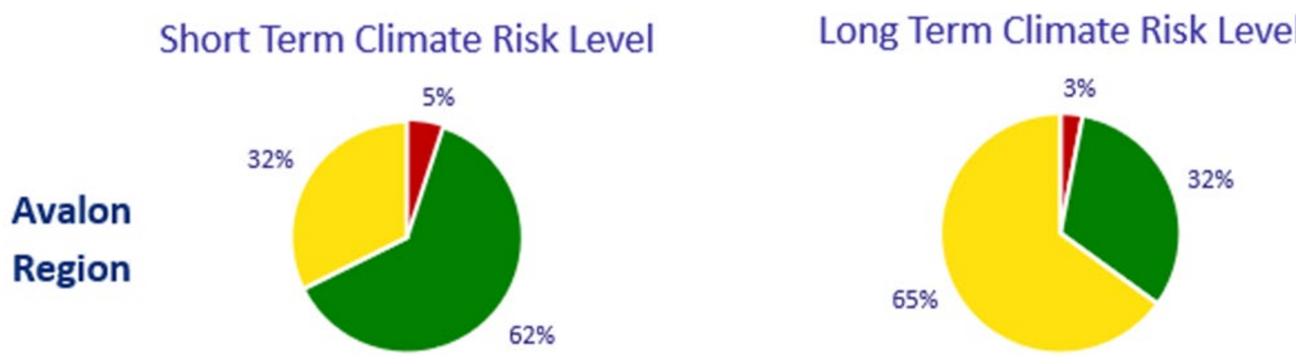


Figure 14: Summary of transmission climate risk for the Avalon region in the short-term (less than 25 years) and long-term (25 to 50 years).

10.1.3 Central

Short-term

In the Central region, a total of 19 transmission lines were assessed. Radial Transmission Line 114L reaching from Gander Bay, and Transmission Line 140L running from Summerford to Twillingate are projected to be at high climate risk by 2050. Due to risk of high winds, ice loading, and coastal erosion these will be rebuilt by 2050. New design standards will involve hardening of assets to increase the resiliency of structures, and in the case of 114L relocation will be considered to increase climate change resiliency. Thirteen sections of transmission line infrastructure in this region are or will be rated at medium climate risk by the year 2050 without mitigation, and therefore will be replaced in less than 25 years. Four transmission lines in the Central region will remain at low climate risk.

Long-term

In 25 to 50 years, 6 transmission line sections (32% of lines in this region) will upgrade to the medium risk level. In this period 13 sections of transmission line (68% of transmission lines in this region) will be reduced from medium to the low risk category following the reconstruction of these lines planned to occur within the next 25 years. See Figure 15 for a summary of transmission climate risk level for the Central region.

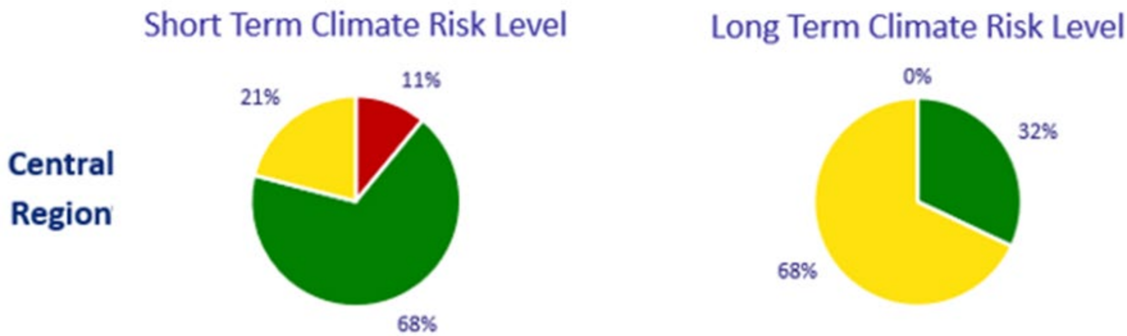


Figure 15: Summary of transmission climate risk level for the Central region in the short-term (less than 25 years) and long-term (25 to 50 years).

10.1.4 Western

Short-term

In the Western region, a total of 14 transmission lines were assessed. Within the next 25 years, eight of these will have reached the high climate risk category. The greatest climate risk in this region pertains to wind, ice, flooding and coastal erosion. To mitigate these risks, relocation away from the coastline and outside flood plains has been considered, as well as increasing pole class. These transmission lines will be rebuilt with additional measures taken to increase climate resiliency of structures by 2050. In the next 25 years, 10 sections of transmission line infrastructure in this region will reach the medium climate risk category without additional measures of mitigation. Three transmission lines in Western are projected to remain at low risk of climate change effects.

Long-term

In 25 to 50 years, three transmission line sections (14% of lines in this region) that are not planned for reconstruction in the next 25 years will increase to the high-risk category. Nine transmission lines in the Western region will be classified as medium climate risk in this period, with the remaining three transmission lines not previously rebuilt undergoing reconstruction. Thirteen sections of transmission line (38% of transmission lines in this region) will be reduced from medium to the low risk category following the reconstruction of these lines occurring within the next 25 years. See Figure 16 for a summary of transmission climate risk level for the Western region in the short-term (less than 25 years) and long-term (25 to 50 years).

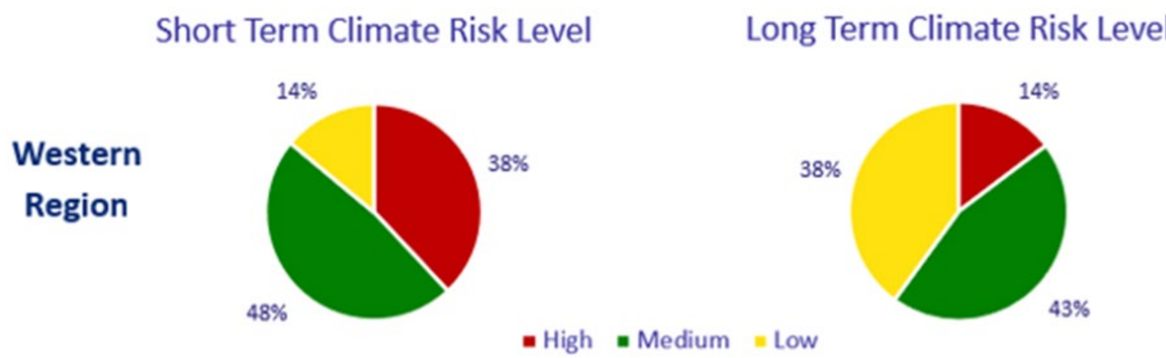


Figure 16: Summary of transmission climate risk level for the Western region in the short-term (less than 25 years) and long-term (25 to 50 years).

10.1.5 Forest Fire Risk to Transmission

Climate heavily influences the potential for the ignition of forest fires. Across the Newfoundland Power service district, transmission lines have been assessed to determine the threat level of electrical infrastructure related ignitions that could lead to wildfires, and the risk of forest fires to the electrical system. All transmission infrastructure operated by Newfoundland Power has been classified at medium risk or lower based on how easy it is to ignite vegetation; how difficult a fire may be to control; and how much damage a fire may do.

In the St. John’s region, 17% of transmission lines have a low forest fire risk potential, while the remainder are not at risk. In the Avalon region, 14% of transmission lines are at a medium forest fire risk potential. 65% of transmission lines in this region are at low risk potential and 21% have no risk of forest fire potential. In the Central region, 63% of transmission lines are at a medium forest fire risk potential, and 37% are at low risk potential. In the Western region, 29% of transmission line infrastructure will be subject to a medium risk level of forest fire, while 24% are at low risk.

As transmission lines are rebuilt, infrastructure will become more resilient to the highest risk drivers for potential wildfire caused ignitions by modernized design standards and hazard mitigation measures. The monitoring of forest fire risk potential by Newfoundland Power will guide and inform various operating decisions such as off-highway vehicle activity restrictions, and work restrictions. See Figure 17 for a summary of transmission forest fire risk by region.

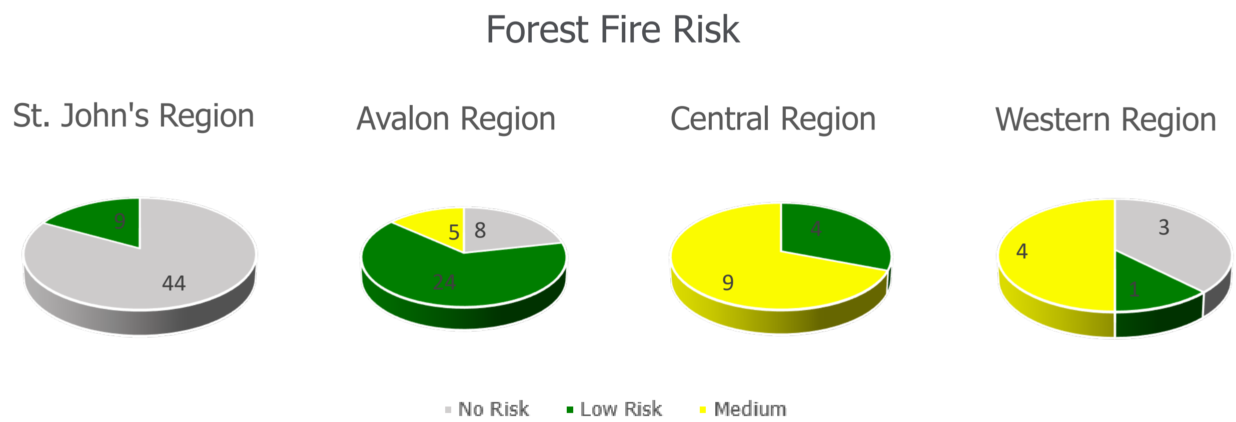


Figure 17: Summary of transmission forest fire risk by region.

10.2 Distribution

The distribution component of an electrical system scales down the electricity transported by transmission lines and delivers it to individual consumers across the province. Delivering electricity to rural areas, homes, businesses, industrial sites, and other facilities throughout the Newfoundland Power service district, distribution lines are exposed to some of the harshest climates the Province has to offer. With the projected increase in frequency of wind gusts, sustained high winds, and storm events, this infrastructure is among the most vulnerable of our assets to climate change impact. The greatest climate impact varies with each region, and with each individual distribution line. Without proactive measures of mitigation, the effects of climate change may impact the reliability of certain lines. For the most accurate report, assessments were conducted on each Newfoundland Power operated distribution line, the assessment considered the climate risk infrastructure will be subject to if no mitigations are applied in the next 25 years (short-term), and the long-term risk in 25 to 50 years from now taking into consideration the lines rebuilt prior to 2050. This report prioritized assessment of the distribution lines expected to be at the greatest risk, therefore not all lines have been included in this assessment. Those not included are of the lowest projected climate risk.

10.2.1 St. John’s

Of 108 distribution lines in the St. John’s region, 53 were assessed. Due to inaccessibility as well as climate change effect on flooding, extreme winds, sleet, coastal erosion, and vegetation, 12 distribution lines in the area are considered to be at medium risk of climate change impact to reliability. The rest are at low risk. In 25 to 50 years, one distribution line in the region will increase from low to medium risk due to increased precipitation placing the line within a flood plain. The rest of lines will remain at low or no risk. See Figure 18 for a summary of distribution climate risk for the St. John’s region.

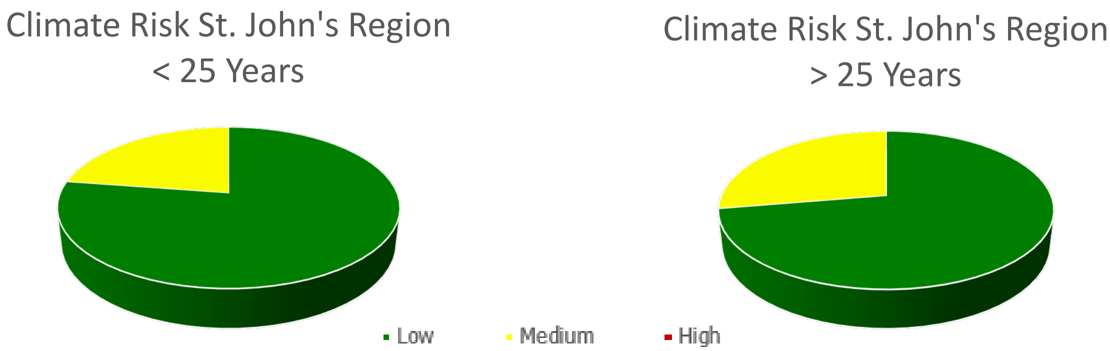


Figure 18: Summary of distribution climate risk for the St. John's region less than 25 years, as well as 25 to 50 years.

10.2.2 Avalon

Of 99 distribution lines in the Avalon region, 59 were assessed. It expected that the greatest risk to lines in this area will be flooding, extreme wind, coastal erosion, and forest fire. Nineteen distribution lines in the area have been considered medium risk with some lines exposed to extreme winds, and experiencing inundation of flood plains. Forty distribution lines in the Avalon region are at low risk. These risks are expected to continue affecting the same lines in this region for the next 50 years. See Figure 19 for a summary of distribution climate risk for the Avalon region.

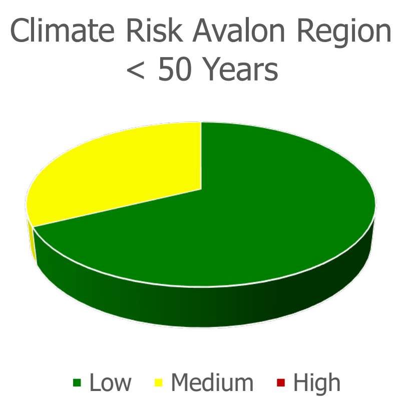


Figure 19: Summary of distribution climate risk for the Avalon region in less than 50 years.

10.2.3 Central

Of 60 distribution lines in the Central region, 44 were assessed. It expected that the most significant climate related risk to distribution lines in this area will be extreme wind, inundation, sleet, and vegetation growth. Twenty-six distribution lines in the area have been considered medium risk. Two distribution lines in this region considered to be at medium risk are or will become inaccessible in the coming years. Twenty-eight distribution lines in the Central region are at low risk. These risks are expected to continue affecting the same lines in this region for the next 50 years. See Figure 20 for a summary of distribution climate risk for the Central region.

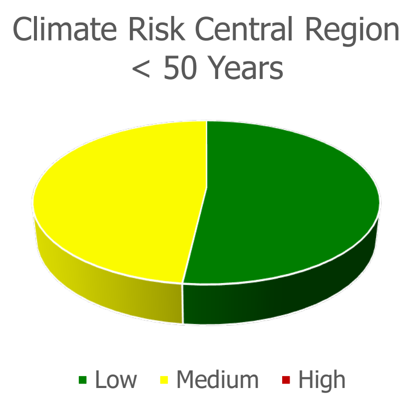


Figure 20: Summary of distribution climate risk for the Central region in less than 50 years.

10.2.4 Western

Of 49 distribution lines in the Western region, 39 were assessed. Due to climate change effect on extreme wind, tree growth, sleet, flooding and in some cases significant flooding, 15 distribution lines in the area are considered to be at medium risk of climate change impact to reliability. Twenty-four distribution lines in the next 25 years will remain at low risk of climate impact, being under the influence of only minor flooding and wind. After 2050, 16 lines will remain at low risk with 8 reduced from low to no risk following design standard improvements, right of way widening, and relocation away from flood plains. See Figure 21 for a summary of distribution climate risk for the Western region.

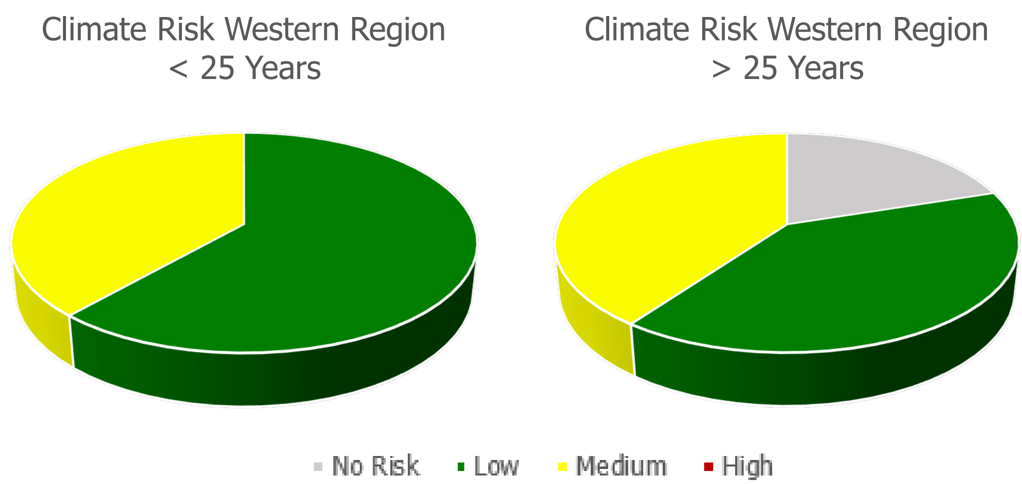


Figure 21: Summary of distribution climate risk for the Western region in less than 25 years, as well as 25 to 50 years.

10.3 Substations

At the substation, electricity is transformed from low voltage to high, or the converse. It is here that the "handoff" occurs from the high voltage transmission lines to the lower voltage distribution lines that carry power to homes, businesses, and other locations for use. Newfoundland Power operates 131 substations across our service district. This assessment focused on the impacts of flooding, extreme weather, wind events, coastal erosion, and forest fires on substations. With respect to flooding, the geographic location of each substation was identified and proximity to water bodies was considered. Future designs may consider increased drainage requirements, raised foundations for transformers in high risk areas, and in extreme situations substation relocation. Precipitation impacts such as extreme rainfall, extreme snowfall, freezing rain, sleet, hail, snow melt and flash freezing, flooding, and seasonal rainfall may affect substation assets.

The geographic location of each substation was identified, and proximity to the ocean as well as storm surges was considered with respect to sea level rise. This impacted a minimal number of substations. Sea level rise impacts such as tides, wave run-up, coastal flooding and erosion may affect substation assets. The proximity to heavily treed areas of each substation was identified and as well as forecasted temperature increases were considered for potential to spark forest fires. Real time fire risk may be monitored virtually to consider in daily tailboard meetings and project planning. Temperature impacts such as increases in average global temperature, freeze-thaw cycles, heat waves, forest fire index increase, and increased frequency of extreme events will produce the greatest risk of forest fire. Due to the compact nature of substations, wind events typically have minimal impact to Newfoundland Power substation reliability. Structure design already consider increased wind and ice loading to account for the projected impacts, and this is site specific to the location. Although some infrastructure is considered to be at risk, in all cases the risk level was categorized by the assessment as low.

10.3.1 St. John's

In the St. John's region, 32% of substations are at low risk of forest fire. 9% are at low risk of precipitation impact as described above, while 4% of substations in this region are subject to a low risk of rising sea level and coastal erosion. See Figure 22 for a summary of climate risk to substations in the St. John's region.

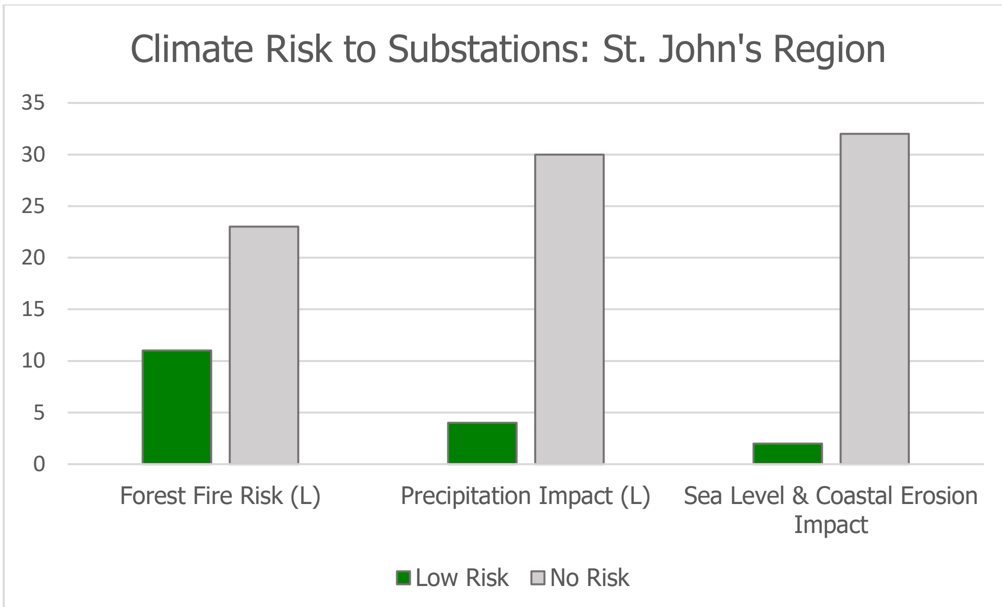


Figure 22: Summary of substations at risk of forest fire, precipitation impact, and sea level and coastal erosion impact in the St. John's region.

10.3.2 Avalon

In the Avalon region, 51% of substations are at low risk of forest fire. 12% are at low risk of precipitation impact, while 4% of substations in this region are subject to a low risk of rising sea level and coastal erosion. See Figure 23 for a summary of climate risk to substations in the Avalon Region.

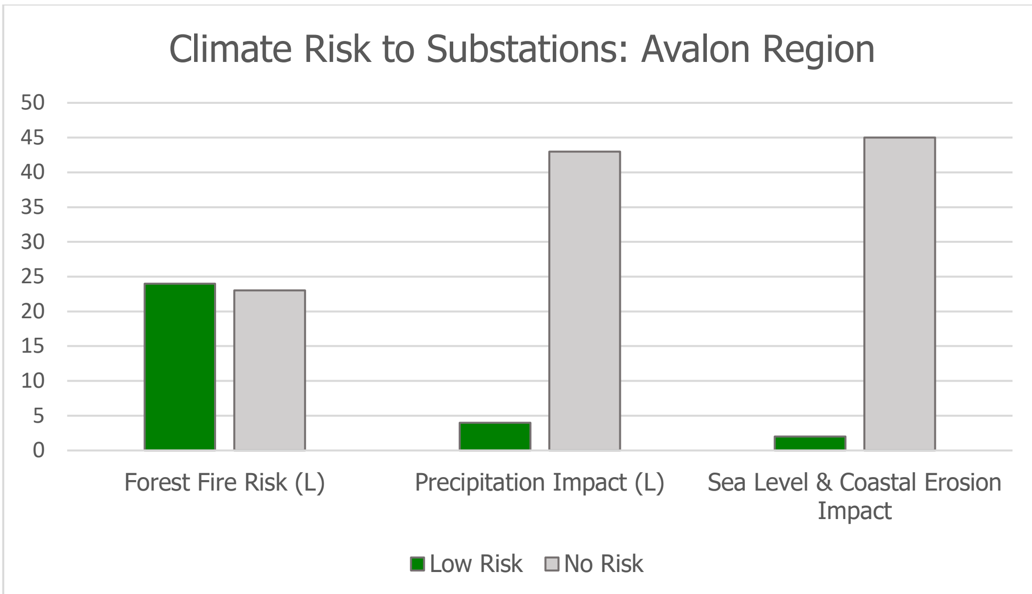


Figure 23: Summary of substations at risk of forest fire, precipitation impact, and sea level and coastal erosion impact in the Avalon region.

10.3.3 Central

In the Central region, 65% of substations are at low risk of forest fire. 12% are at low risk of precipitation impact, while only one substation in this region is subject to a low risk of rising sea level and coastal erosion. It should be noted that one substation in this region is to be removed from the circuit, but has been included in this assessment. See Figure 24 for a summary of climate risk to substations in the Central Region.

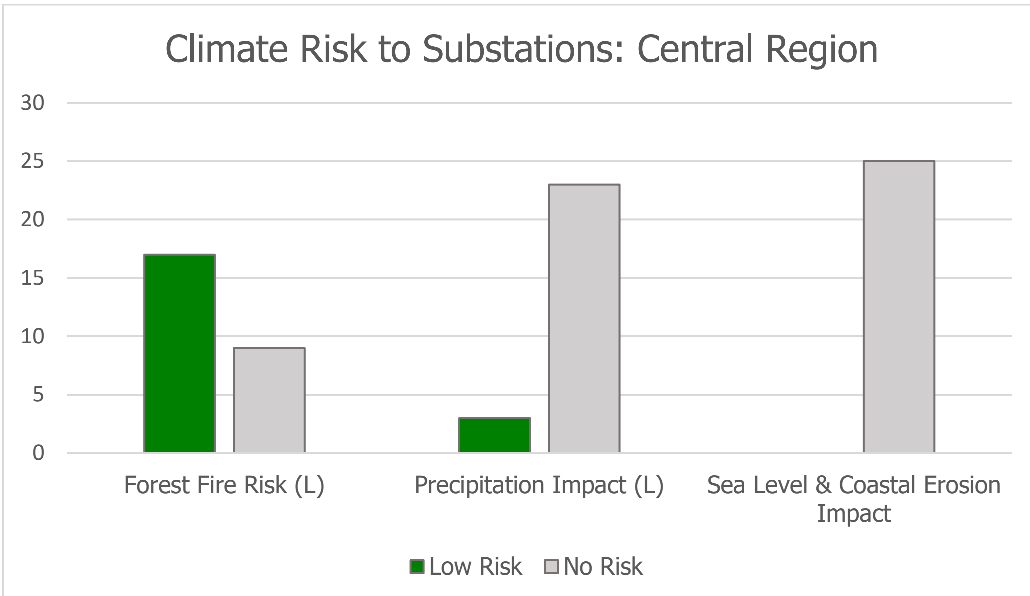


Figure 24: Summary of substations at risk of forest fire, precipitation impact, and sea level and coastal erosion impact in the Central region.

10.3.4 Western

In the Western region, 65% of substations are at low risk of forest fire. 12% are at low risk of precipitation impact while no substations in this region are subject to a low risk of rising sea level and coastal erosion. See Figure 25 for a summary of climate risk to substations in the Western Region.

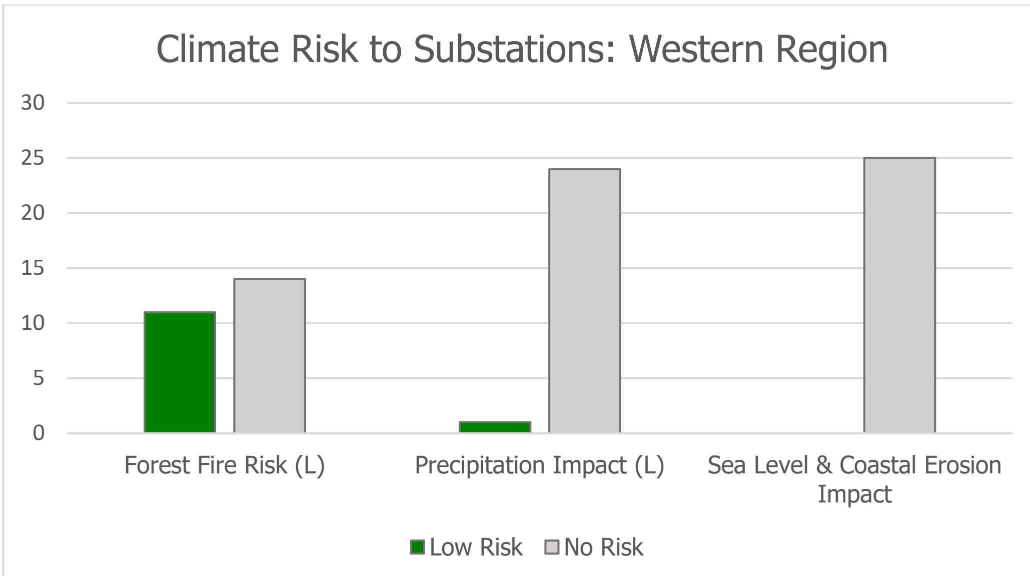


Figure 25: Summary of substations at risk of forest fire, precipitation impact, and sea level and coastal erosion impact in the Western region.

10.4 Generation

The Company operates 29 generating plants comprised of 23 small hydro and 6 combustion turbines across the island portion of the Province. It should be noted as well that these plants which are in operation for the company are only used as needed to offset power or for emergencies.

Due to the location of our hydro plants near water bodies many sites are subject to the risks of coastal erosion, sea level rise, increased precipitation, and extreme weather events. To ensure that backup generation is available for years to come, adaptations will be incorporated into existing sites to protect the infrastructure, and the reliability of electricity service from the impacts of climate change.

Dam infrastructure has been designed to requirements ranging from a 1/100 year flood and the Probable Maximum Flood for the appropriate geographical locations of the infrastructure depending on the structures hazard classification as defined by the Canadian Dam Associations Dam Safety Guidelines 2007 (2013 Edition).

10.4.1 St. John's

In the St. John's region, each component of 10 generation plants was assessed. In this region, 30% of generation infrastructure has been considered to be at risk of coastal erosion, while 10% is at risk of forest fire. Of the 19 structures assessed at 10 generation sites, one was placed at extreme risk, one at very high risk, and 17 at high risk of increased precipitation and extreme events. See Figure 26 for a summary of climate risk to generation in the St. John's region.

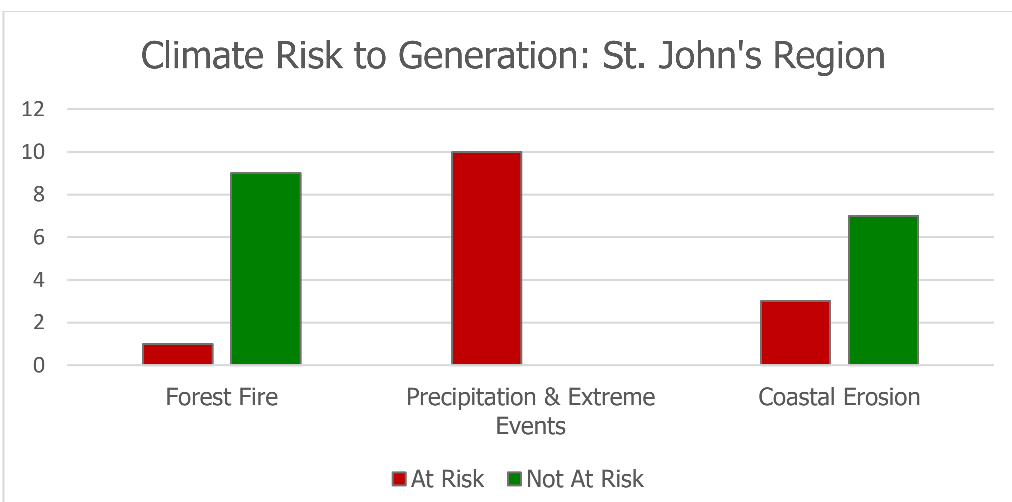


Figure 26: Summary of generation structures at risk of forest fire, precipitation & extreme events, and coastal erosion in the St. John's region.

10.4.2 Avalon

In the Avalon region, each component of 10 generation plants was assessed. In this region, 50% of generation infrastructure has been considered to be at risk of coastal erosion, while 40% is at risk of forest fire. Of the 11 structures at 5 generation sites were at risk of increased precipitation and extreme events. One was considered to be at very high risk, while 10 were placed at high risk. See Figure 27 for a summary of climate risk to generation in the Avalon region.

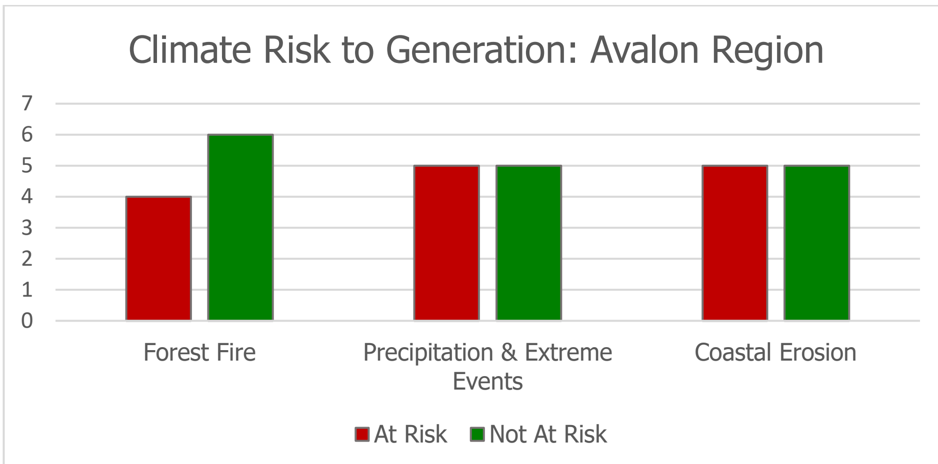


Figure 27: Summary of generation structures at risk of forest fire, precipitation & extreme events, and coastal erosion in the Avalon region.

10.4.3 Central

In the Central region, each component of 3 generation plants was assessed. In this region, no generation infrastructure will be at risk of coastal erosion, however, 67% is at risk of forest fire. Of the 4 structures assessed at the one generation site that was classified as at risk of increased precipitation and extreme events, all four structures were considered to be at high risk. See Figure 28 for a summary of climate risk to generation in the Central region.

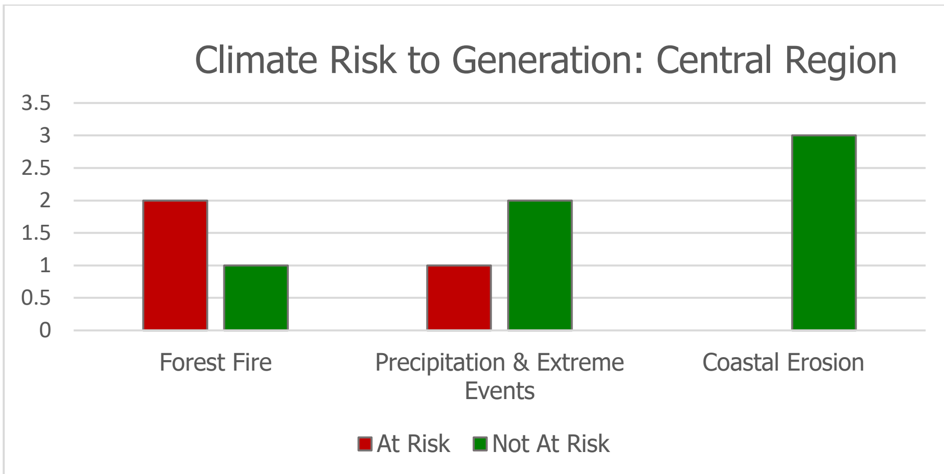


Figure 28: Summary of generation structures at risk of forest fire, precipitation & extreme events, and coastal erosion in the Central region.

10.4.4 Western

In the Western region, each component of 3 generation plants was assessed. In this region, no generation infrastructure will be at risk of coastal erosion, however, 67% is at risk of forest fire. Similarly to Central, of the four structures assessed at the one generation site that was classified as at risk of increased precipitation and extreme events, all four structures were considered to be at high risk. See Figure 29 for a summary of climate risk to generation in the Western region.

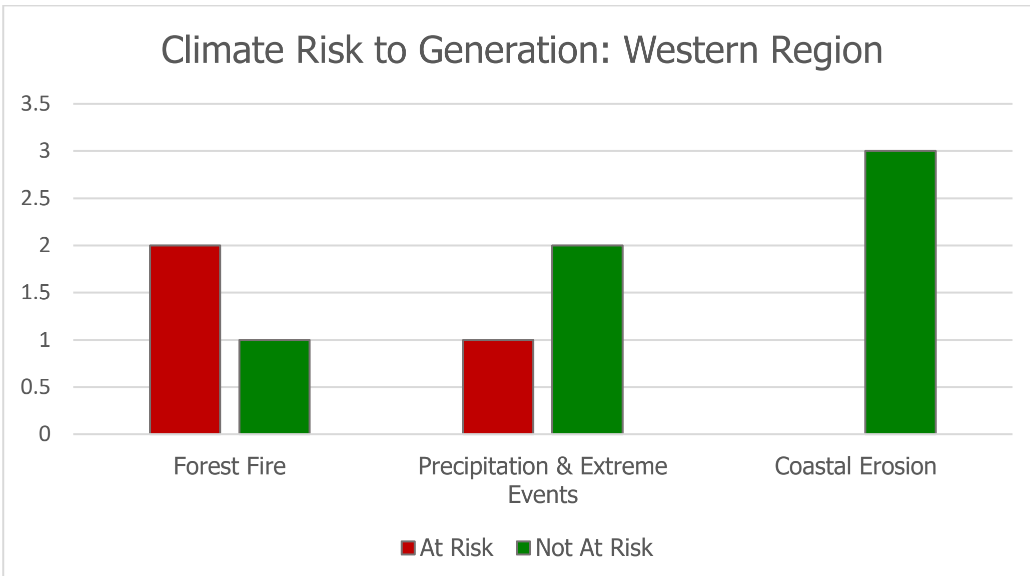


Figure 29: Summary of generation structures at risk of forest fire, precipitation & extreme events, and coastal erosion in the Western region.

11.0 CLIMATE ADAPTATION PLAN

As the assessment by the CCTG has shown, climate change will have an impact on the Company's operations. Decisions made now and, in the future, will influence the Company's resilience to impacts of future climate change. The Company has been making efforts to harden its system and to incorporate resiliency but more will need to be done to reduce risk to the electrical system. Continuing to improve the resiliency ensures the system can continue to operate during damage and return to normal operations quickly if outages occur.

Further to the what is already being done by the Company the recommendations below in Figure 30 have been highlighted as adaptation efforts which will reduce risk in both the short term and long term from climate change.

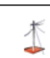
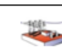
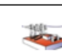
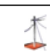
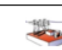
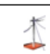
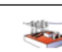
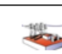
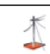
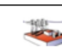
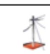
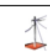
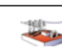
Adapatation Efforts	Generation	Distribution	Transmission	Substations
Move assets from back country to roadside where possible				
Elevating substations that maybe prone to floods				
Avoid building new or rebuilding in flood plains				
Avoid building new or rebuilding near coastlines.				
Utilize GIS for flood zones and fire hazard map				
Create training for staff and contractors in wildfire management				
Review Emergency Prepardness plans to ensure we can react to a major climate event				
Create a process in which climate scenarios can be incorporated into planning of all projects				
Pilot Polesaver Technology on untreated poles				
Pilot Drone program to determine effectiveness on enahnacing inspections				
Pilot heavy salt standard on lines prone to salt spray				
Adapt CSA standard updates for Climate Change that exceed current standard when avaliable				

Figure 30: Adaptation Plan to reduce risk on Company infrastructure from Climate Change.

Monitoring and evaluation can identify advances in the underlying science, provide critical analysis of issues, and highlight key findings and key unknowns that can guide the CCTG annual review.

12.0 DEFINITIONS

Radial Transmission Line

A one-way transmission line that serves a group of customers from one power source. A power failure on a radial line would interrupt power for distribution below the point causing the failure. This would result in a power outage affecting all customers receiving power beyond that point.

Climate Change Mitigation

In this document Climate Change mitigation refers to the reduction of risk and/ or impact of climate change driven weather events to the electrical system.

Projected effects

Climate Change projections are the forecasted weather trends based on a study of present weather change trends due to Climate Change. For the purpose of this report, the projected effects of climate change refers to the impact of these changes that are expected to occur on the natural environment as well as the electricity system.

Carbon dioxide

A heat trapping gas composed of carbon and oxygen. Carbon dioxide is released through natural processes such as respiration, decomposition of vegetation and other biomass, venting of the earth, and wildfires. The augmenting concentration of atmospheric CO_2 is caused by human practices such as deforestation and burning of fossil fuels which release CO_2 in excess of natural amounts, attributing to the rising global temperature.

Electricity system

Electricity systems consist of the equipment and infrastructure needed to generate, transmit, transform and distribute electrical power, including overhead and underground lines, poles, transformers, and other equipment. For the purpose of this report, an electricity system refers to Newfoundland Powers electricity generation, transmission, substation, and distribution infrastructure

Sea-level rise

The increasing sea level with respect to the coastline caused by the melting of glacier and ice sheets, ocean temperature rise, and groundwater pumping.

Coastal erosion

The loss or displacement of coastal sediment and rock caused by local sea level rise, strong wave action, and friction with moving water such as runoff.

Storm surges

The temporary elevation of local sea level due to atmospheric pressure change and wind associated with a storm.

Extreme weather events

Severe unseasonal, or uncommon weather or climate events, at the extreme of the historical range in a region.

Normal historical average

The average of recorded data over a given period of time, measured on a common scale for accurate comparison known as "normalization".

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