



CLIMATE ADAPTATION

EXECUTIVE SUMMARY

GOALS & OBJECTIVES

In 2013, Seattle City Light's Strategic Plan established a Climate Initiative with two primary objectives: (1) research the impacts of climate change on the utility and (2) develop an adaptation plan with strategic actions to minimize these impacts. In 2015, Seattle City Light completed a Climate Change Vulnerability Assessment and Adaptation Plan.

One goal of adapting or preparing for a changing climate is to ensure that Seattle City Light (City Light) can continue to meet its mission to produce and deliver environmentally responsible, safe, low cost, and reliable power as the climate changes. A changing climate is one consideration in designing the utility of the future. A second goal of adaptation planning is to increase knowledge within the utility of the risks of climate change and potential actions to reduce these risks so that City Light and its employees can make informed decisions.

WHAT IS ADAPTATION PLANNING & WHY PLAN FOR CLIMATE CHANGE NOW?

Climate change adaptation is also referred to as preparedness, readiness, and resilience. Regardless of the name, adaptation planning is the process of identifying and implementing actions that reduce vulnerability to the impacts of climate change. To some people, climate change may seem like a far-off risk that will not affect the utility in the near-term. It can be tempting to label climate change as only a "challenge for future generations," but this is not the case for several reasons:

1. Climate change is happening now. Temperatures have warmed and the effects of these warmer temperatures on snowpack, heat waves, and extreme weather have been detected globally, nationally, and locally in the Pacific Northwest.
2. These impacts are expected to intensify and new impacts will emerge over the 21st century, regardless of reductions in the emissions of greenhouse gases that cause global warming.
3. Decisions are being made today that will shape the resources and infrastructure of the utility for decades into the future.
4. It will be easier and more cost-effective to plan for the impacts of climate change in the design of new infrastructure and selection of power resources now than it will be to retrofit infrastructure or replace power resources once impacts intensify.



Goodell fire near Newhalem, WA, August 2015

HOW DOES ADAPTATION PLANNING DIFFER FROM CLIMATE CHANGE MITIGATION?

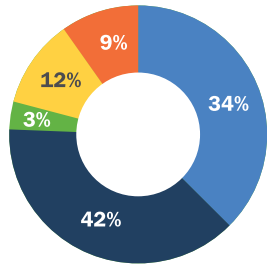
In contrast to adaptation, climate change mitigation is the reduction of greenhouse gas emissions that contribute to global warming. Mitigation actions focus on slowing and reducing the magnitude of changes in the climate. Mitigation has the potential to reduce changes in the climate in the latter half of the 21st century. However, for the next few decades, adaptation is necessary to prepare for the now inevitable impacts of climate change.

CLIMATE CHANGE IMPACTS & ADAPTATION ACTIONS

Seattle City Light's Climate Change Vulnerability Assessment and Adaptation Plan (Plan) describes changes in the climate, and resulting changes in natural hazards and streamflow that could affect five aspects of City Light's operations and infrastructure: **shoreline properties, hydroelectric project operations, electricity demand, transmission and distribution, fish habitat protection and restoration.**

In our plan, we have identified potential adaptation actions to reduce the impacts of climate change on the utility. Adaptation actions are intentional changes in policies and operations, or upgrades to infrastructure designed specifically to reduce vulnerability and increase resilience. Most actions identified in this plan will be refined in more detail for specific projects, plans, or decisions. To view the whole Plan, visit seattle.gov/light/enviro/climatechg.htm.

WHAT DO SEATTLE CITY LIGHT'S CUSTOMERS THINK ABOUT THE CITY PREPARING FOR CLIMATE CHANGE?



- Strongly Favor
- Somewhat Favor
- Somewhat Oppose
- Strongly Oppose
- Other

Based on a survey of 603 registered voters, conducted by Harstad Strategic Research, Inc. for the city of Seattle in June 2013.

ARE OTHER ELECTRIC UTILITIES PREPARING FOR CLIMATE CHANGE?

Seattle City Light is one of 18 electric utilities in the nation participating in the U.S. Department of Energy (DOE) *Partnership for Energy Sector Climate Resilience*. The Partnership Agreement signed by the participating utilities expresses a commitment to increasing resilience to climate change. The utilities in this partnership collectively represent about 20 percent of the nation's generating capacity and 25 percent of customers.

As of February 2016, Seattle City Light's Climate Change Vulnerability Assessment and Adaptation Plan is the most comprehensive effort by an electric utility to assess and prepare for the impacts of climate change and represents a decade of progressive action by the utility on this issue. City Light's plan was submitted to the DOE as part of our involvement in the partnership.

The city of Seattle is located along Puget Sound, which has experienced tidal flooding in the past associated with high tides and is exposed to sea level rise. City Light owns several properties near Puget Sound and is a "potentially responsible party" in the Duwamish Superfund Site located on the Duwamish Waterway in an area exposed to sea level rise.

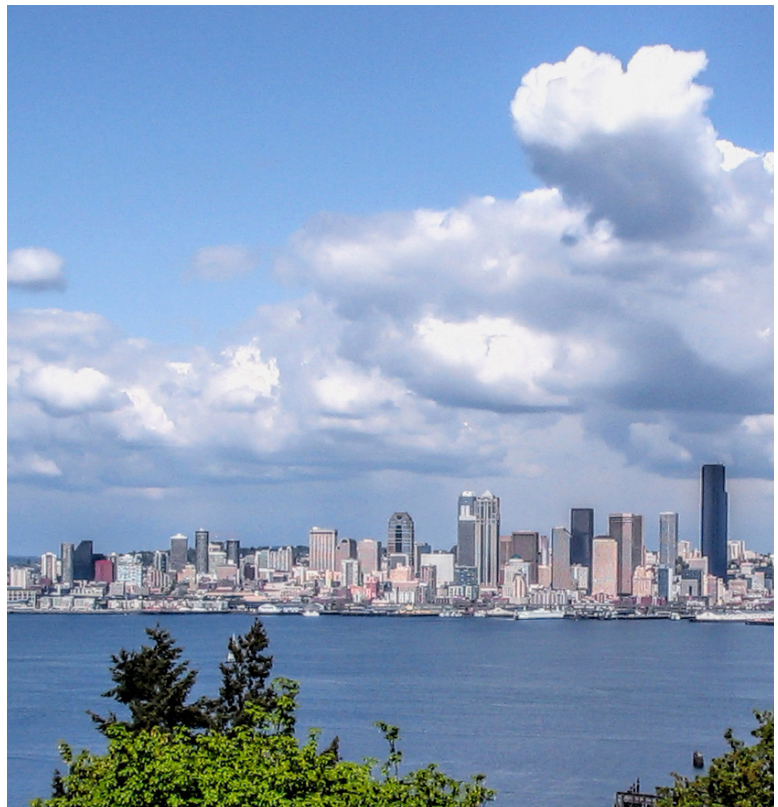
CLIMATE CHANGE IMPACTS



- More frequent tidal flooding of coastal properties could damage facilities, interrupt operations and have financial consequences for the utility.

POTENTIAL ADAPTATION ACTIONS

- Make spatial information on projected sea level rise and storm surge readily available throughout the utility. This information can be used to identify and plan for current facilities and equipment that are located in areas that will be exposed to sea level rise and more frequent tidal flooding.
- Consider establishing a utility-wide policy to identify future tidal flooding impacts in the design and positioning of proposed capital improvement projects located in areas that are projected to be affected by sea level rise.



HYDROELECTRIC PROJECT OPERATIONS

Seattle City Light’s power resources are composed of 90 percent hydropower. In addition to power generation, City Light operates hydroelectric projects for flood control, instream flows for fish, reservoir recreation, and coordinates operations of two projects with Seattle Public Utilities for municipal water supply. All these objectives are dependent on snowpack and the seasonal timing of streamflow. The Boundary and Skagit Projects and the Bonneville Power Administration (BPA) generation resources are located in high-elevation, snow-dominated watersheds on which impacts will be slower to emerge but significant by mid-century. The Cedar Falls and South Fork Tolt Projects are located in mid-elevation, mixed-rain-and-snow watersheds that will be more exposed to changes in snowpack and streamflow.

2014 SOURCES OF POWER FOR SEATTLE CITY LIGHT

Generated

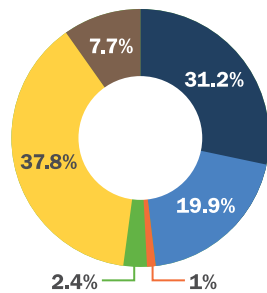
- Boundary
- Skagit
- Cedar Falls & South Fork Tolt

Treaty

- BC Hydro

Purchased

- BPA
- Other



Diablo Dam, Skagit Hydroelectric Project

CLIMATE CHANGE IMPACTS



- Less snowpack and earlier snowmelt could challenge seasonal operations of hydroelectric projects that are based on historical conditions of water storage in snowpack and snowmelt timing in spring.



- Higher peak flows could increase the frequency of spilling at hydroelectric projects in fall and winter for flood control, which could have financial consequences associated with lost revenue.



- Higher peak flows could challenge operations to protect fish, because more frequent spilling directly causes fish mortality and higher flows damage fish habitat downstream of the projects.



- Lower streamflow in summer will decrease water availability for reservoir recreation, instream flows for fish protection, and hydropower generation, which could lead to financial consequences for the utility associated with lost revenue from surplus sales and wholesale purchases to meet summer demand.

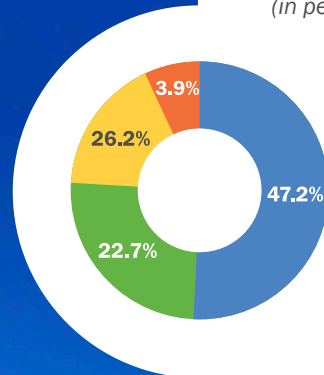
POTENTIAL ADAPTATION ACTIONS

- Update and expand the utility’s analyses of how operations of the Skagit and Boundary projects could be adapted to reduce impacts associated with less snowpack, changes in streamflow timing, lower streamflow in summer, and higher peak flows in fall and winter.
- Collaborate with Seattle Public Utilities to evaluate the effects of changes in snowpack and streamflow timing on operations of the South Fork Tolt and Cedar Falls Projects.
- Consider further diversification of power resources by increasing renewable energy sources that have a seasonal pattern of generation complementary to expected changes in seasonal hydropower generation.

ELECTRICITY DEMAND

2014 USES OF POWER

(in percentage of megawatt hours)



Services

- Non-residential
- Residential

Other

- Wholesale & Other
- Seattle City Light Operations & Losses

Seattle City Light provides power to more than 360,000 residential customers and 40,000 non-residential customers. We are a winter-peaking utility; more power is used by customers in winter than in summer and the highest hourly peaks in electricity use occur in winter. The non-residential sector has a relatively high load in summer, because of heating, cooling, and ventilation systems; air conditioning use is currently low in the residential sector.

CLIMATE CHANGE IMPACTS



- An increase in electricity demand for cooling in summer, which could cause summer peaks to approach winter peaks in localized areas of the distribution system.



- A decrease in electricity demand for heating in winter, which could lower retail sales and have financial consequences for the utility.

POTENTIAL ADAPTATION ACTIONS

- Expand Seattle City Light's analysis of the relationship between warming temperatures, seasonal base and peak loads, and related financial impacts.
- Identify and evaluate potential co-benefits of existing energy efficiency programs to reduce electricity demand for cooling in summer.
- Assess the potential of demand response for reducing peak commercial load on the hottest days in summer for localized areas of the distribution system that currently have less capacity.

TRANSMISSION & DISTRIBUTION

Seattle City Light owns and operates a transmission system consisting of more than 650 miles of transmission lines and towers connected to the utility's five hydroelectric generation facilities. We also own and operate a distribution system in the Seattle area consisting of 2,337 distribution circuit miles (1,763 overhead and 574 underground circuit miles), a downtown network of 220 underground circuit miles, and 14 distribution substations. Many miles of transmission lines pass through rural, forested areas in Western Washington with steep, rugged topography.

CLIMATE CHANGE IMPACTS



- More frequent tidal flooding and salt water corrosion of distribution equipment could reduce the life expectancy of equipment, increasing costs for maintenance, repair, and replacement.



- Warmer temperatures and less nighttime cooling could reduce the life expectancy of insulated equipment, increasing costs for maintenance, repair, and replacement.



- Warmer temperatures and drier soils could increase damage and failure of underground cables.



- More intense precipitation could slow outage restoration times following storms where inadequate drainage creates areas of standing water that prevent safe access for repairs.



The 2014 Oso landslide threatened City Light transmission towers.



- More frequent wildfires could increase damage to transmission lines and interruptions of transmission and generation at hydroelectric facilities.



- More frequent landslides and erosion could increase damage to transmission lines and access roads, increasing maintenance and repair costs, and impeding access.



- More frequent river flooding could increase damage to transmission towers and erosion near towers and access roads, increasing maintenance and repair costs, and impeding access.

POTENTIAL ADAPTATION ACTIONS

- Monitor and consider replacing transmission and distribution equipment that is more sensitive to corrosion by salt water in areas that are projected to experience more frequent tidal flooding or inundation by sea water.
- Monitor failures of and damage to underground cables to determine if alternative fill materials are needed to reduce heat-related failures.
- Increase the capacity of employees to prepare for and respond to wildfire risk through additional training, upgrading infrastructure with fire-resistant materials, and maintaining defensible space around critical infrastructure.
- Collaborate with state resource management agencies and academic institutions to map landslide hazards along Seattle City Light's transmission line rights of way, including where heavier precipitation due to climate change could increase future landslide risk.
- Upgrade current transmission infrastructure to be more resilient to higher peak flows and flood hazard in locations that currently experience flood-related damage. Consider projected increases in flooding in the design and positioning of new transmission projects located in floodplains.

FISH HABITAT RESTORATION

As part of Seattle City Light’s environmentally responsible operations, we restore and protect fish habitat to mitigate any adverse effects of our hydroelectric projects on fish populations. City Light acquires and restores habitat mitigation lands that are primarily located in mid-elevation, mixed-rain-and-snow watersheds. These watersheds are projected to experience the largest changes in the timing of streamflow, lower low flows, and higher peak flows.

CLIMATE CHANGE IMPACTS



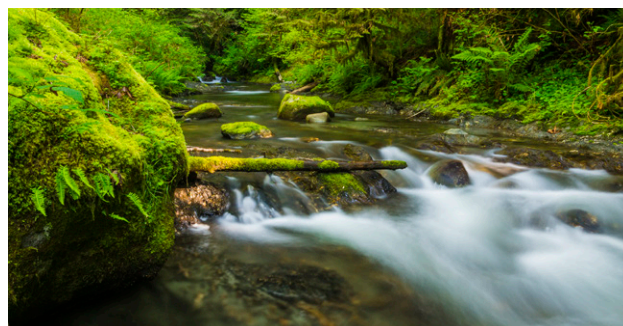
- Higher peak flows and more frequent flooding in fall and winter could adversely affect fish populations and challenge City Light’s objectives for restoring and protecting fish habitat.



- Lower low flows in summer and warmer stream temperatures could adversely affect fish populations and challenge City Light’s ability to meet objectives for restoring and protecting fish habitat.

POTENTIAL ADAPTATION ACTIONS

- Consider increases in peak flows and lower low flows directly in prioritizing acquisitions of habitat mitigation lands by selecting habitats that provide refuge for fish or increase resilience to more extreme low and high flows.
- Focus objectives and design of restoration projects on ameliorating the impacts of lower low flows and warmer stream temperatures on fish populations and habitat.



Jones Creek, Seattle City Light,
ESA Salmon Habitat Land

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IMPLEMENTATION & NEXT STEPS

Seattle City Light’s Climate Change Vulnerability Assessment and Adaptation Plan will be used to guide the implementation of adaptation actions throughout the utility. Some impacts require action now, whereas others can be monitored and addressed as they emerge. However, effectively preparing for the impacts of a changing climate requires a long-term planning timeline, because it may be too late to implement some actions if we wait until the impacts intensify. Next steps in implementation include the following:

- Establish an interdisciplinary team with representatives from relevant sections of the utility. Solicit further feedback on the feasibility and priorities of adaptation actions.
- The interdisciplinary team will identify specific capital projects, long-term plans, or decisions for which climate change impacts could affect project design or decisions.
- Develop methods and a process for conducting cost-benefit analysis of adaptation actions.
- Develop metrics to measure the success of adaptation actions for reducing vulnerability, increasing resilience, and enhancing the utility’s capacity to prepare for a changing climate.
- Update the Plan in 2018 to include new research findings on climate change impacts, results of internal assessments on specific impacts, and benefits gained from adaptation actions.

WE POWER SEATTLE

Seattle City Light is the 10th largest public electric utility in the United States. It has some of the lowest cost customer rates of any urban utility, providing reliable, renewable and environmentally responsible power to nearly 1 million Seattle area residents. City Light has been greenhouse gas neutral since 2005, the first electric utility in the nation to achieve that distinction.

