



# Integrating Climate Change Preparedness & Adaptation Strategies in Asset Management

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# Learning Objectives

At the end of this presentation, the attendees will be able to:

1. Understand how the climate change might impact the transit industry.
2. Establish an approach for climate change preparedness for managing physical assets.
3. Recognize the challenges of managing physical assets due to the climate vulnerabilities.
4. Prepare for reducing vulnerabilities in transportation systems.



## Presentation Outline

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1. Sound Transit Case Study
2. Climate Change Impacts
3. Adaptation to Future Vulnerabilities
4. Integrating Recommendations

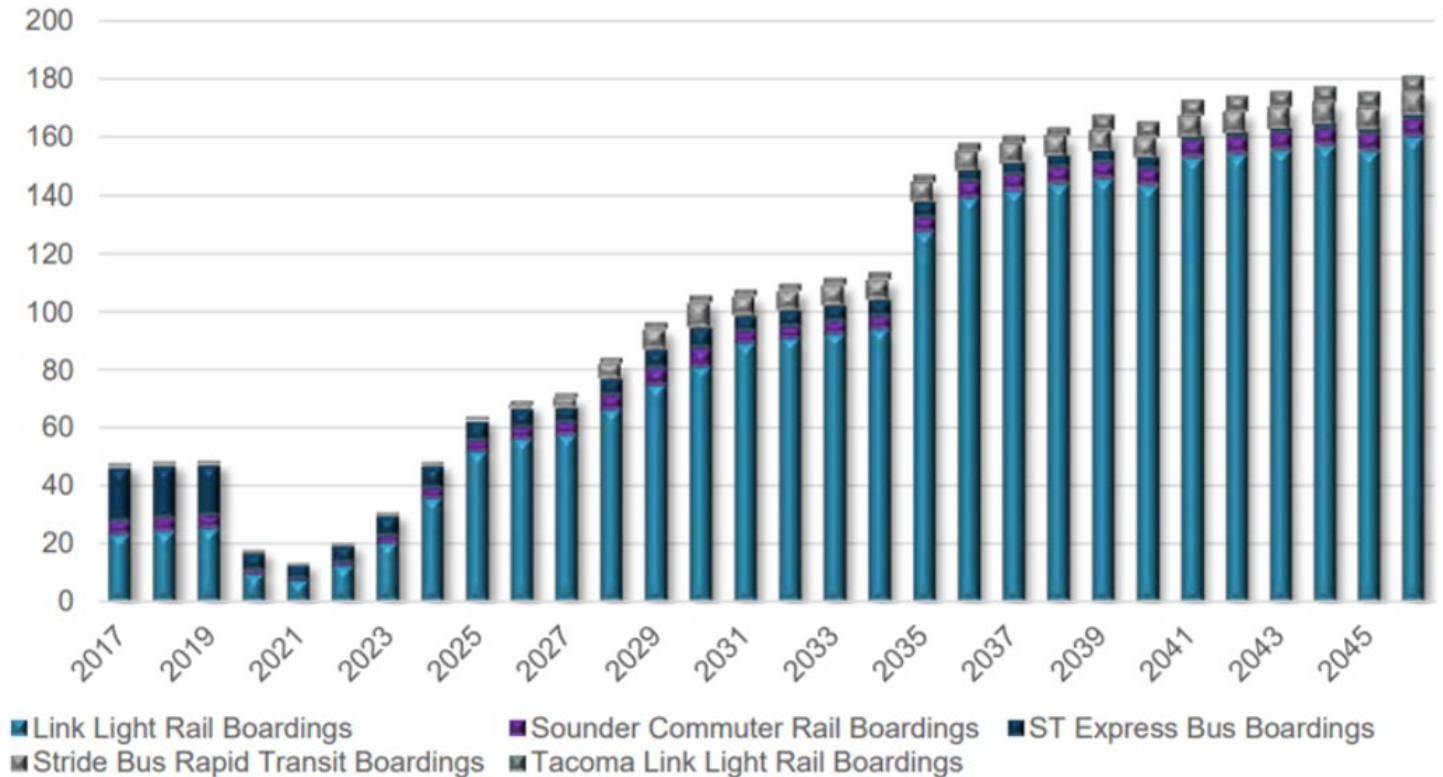
# Sound Transit

- Sound Transit builds and operates transit service in the 3-county regions around Seattle, Washington
  - light rail
  - commuter rail
  - express bus
- Began providing services in 1999
- Expanding transit system through 2041
- Facilitating mobility for approximately 28 million riders annually



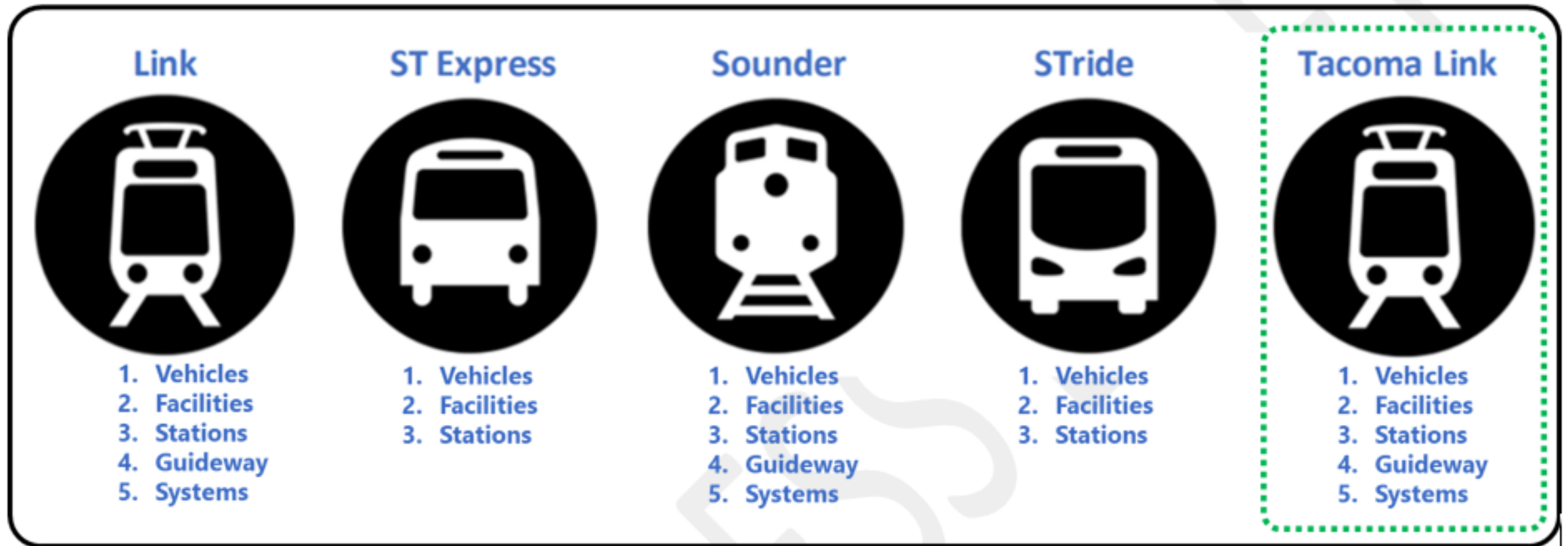
# Ridership Growth Projection

RIDERSHIP BY MODE 2017 — 2046  
(in millions)



<https://www.clarkcountytoday.com/opinion/opinion-in-five-years-sound-transit-has-racked-up-an-additional-50-billion-for-rail-plan/>

# Sound Transit's Asset Portfolio





# Tacoma Link Light Rail

Tacoma Link is a 1.6-mile or 2.56 km at-grade segment servicing 6 stations between the Tacoma Dome and the Theater District. Tacoma

Link was Washington State's first light rail service when it began operations in August 2003.

- 4 Union Station
- 5 S 25th
- 6 Tacoma Dome



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# Climate Change Drivers & Impacts

- **Increases in temperature**, including seasonal, annual, and extreme temperature trends.
- **Changes in precipitation**, including seasonal, annual, and extreme precipitation trends.
- **Changes in hydrology**, including runoff, streamflow and flood risk.
- **Sea level rise**, and storm surge.

# Projected Temperature Change for Puget Sound

Period	Annual	Summer (June–August)	Winter (December–February)
2040–2069	<b>+5.5 °F</b> +4.3 to +7.1 °F	<b>+6.8 °F</b> +4.8 to +9.7 °F	<b>+4.9 °F</b> +3.2 to +6.5 °F
2070–2099	<b>+9.1 °F</b> +7.4 to +12 °F	<b>+11 °F</b> +8.8 to +15 °F	<b>+8.3 °F</b> +6.0 to +10 °F

Sources: Mote *et al.* 2015 (table adapted from Mauger *et al.* 2015).

# Present Vulnerabilities

- Extreme temperature increase
- Extreme Rainfall
- Extreme snow fall
- Sea-level Rise



# Increased Temperature Impacts on Rail System

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## **Rail/track-bed:**

- Rail buckling/sun kinks, cracking
- Pavement rutting
- Switch failures

## **Overhead Catenary System (OCS):**

- OCS line sag
- Possible power loss in heat events (brownouts/blackouts)

## **Bridges/Elevated Structures:**

- Malfunction of expansion joints for moveable bridges



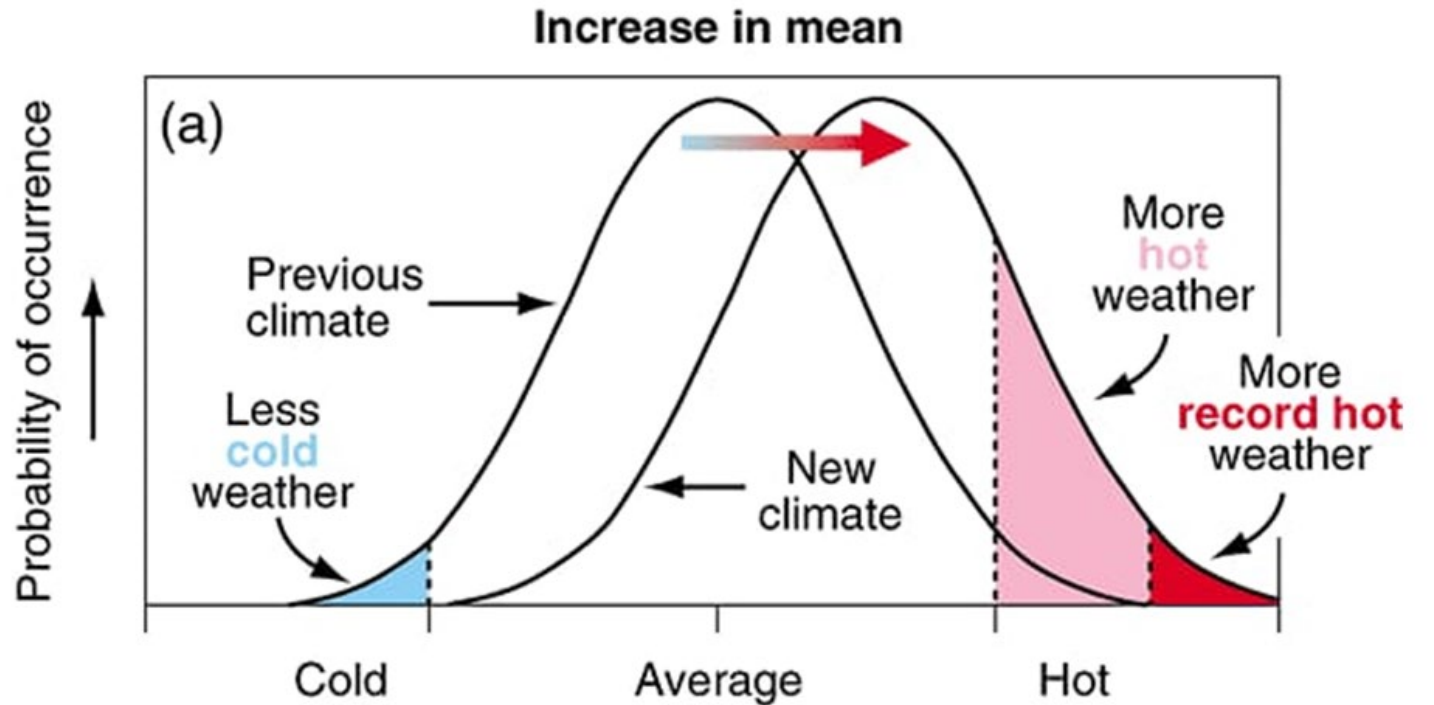


# Increased Precipitation Impacts on Rail System

# Future Vulnerability

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- More frequent extremes
- Extremes would be the new normal





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# Climate Change Preparedness

## Forecasting & Projection

## Adaption Policy

- To minimize losses/disruption
- Measures to minimize impacts
- Changing measures with time
- Stakeholder participation

## Resource

- Human
- Technology
- Financial
- Information



# How to Adapt to the Future Vulnerabilities?

## 1. Strategic approach

- Greenhouse gas reduction/net zero emission
- Sustainable land management
- The rate and magnitude of climate change

## 2. Adaptation options

- Adjustment to infrastructure
- Adjustment to operations and maintenance

## 3. Improved emergency preparedness

## 4. Long-range financial planning

## 5. Closer integration of disaster risk management and climate change adaptation

# Adaptation Options

- Adjustments to Infrastructure – retrofitting, replacing, or relocating infrastructure
- Adjustments to Operations and Maintenance – changes in maintenance frequency or standard operations
- Design Changes – changes in design criteria for new and existing infrastructure

# Strategic Adaptation

## Climate change

- May accelerate the need for these adaptation options
- Require implementation at a scale larger than would normally be expected
- May raise the need for new approaches or require reprioritizing activities

# Which Options to Implement & When?

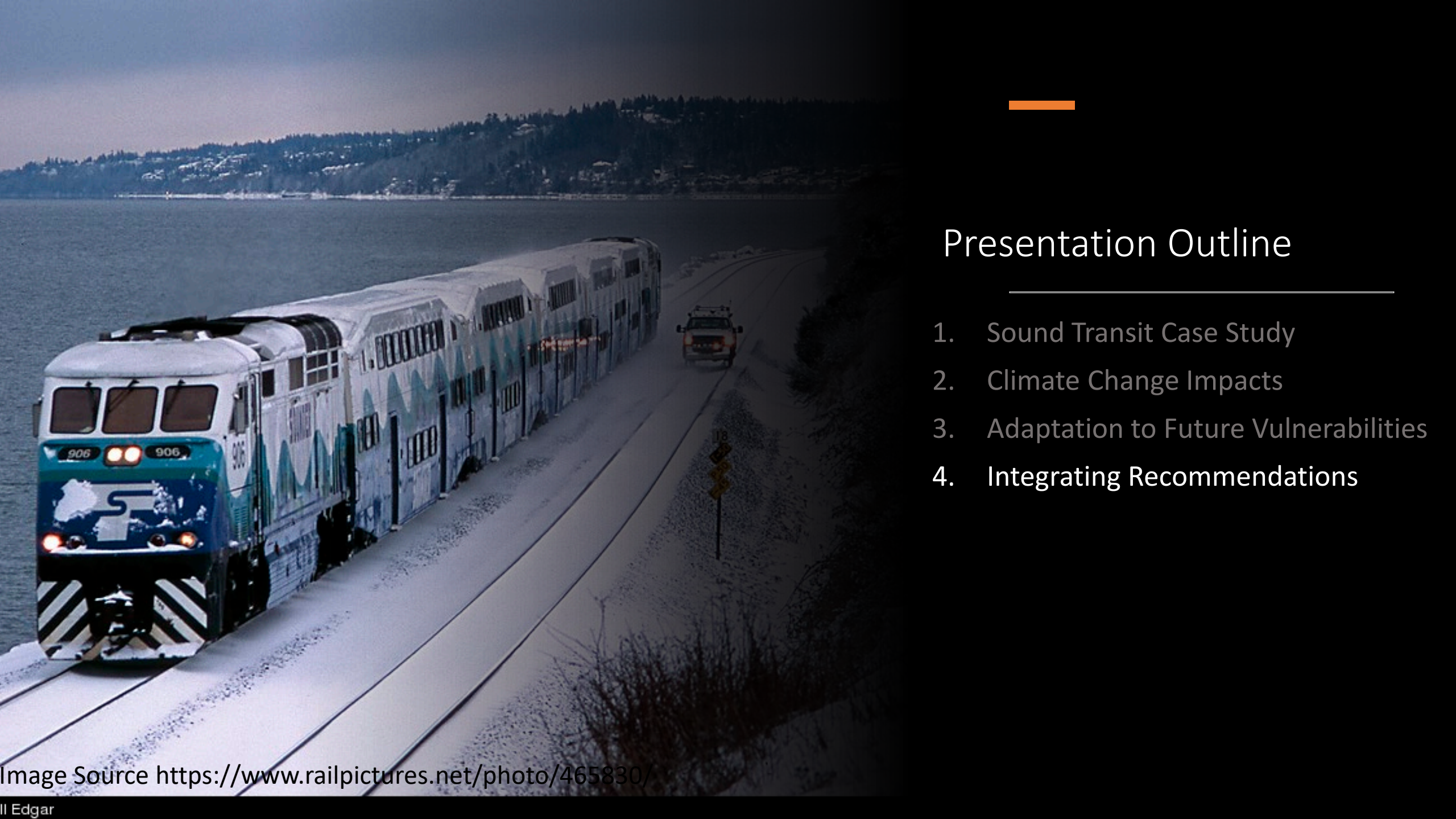
- How rapidly climate change occurs
- The cost of implementing the adaptation option(s)
- The scale of deployment
- How readily the option can be integrated into routine asset maintenance and replacement cycles

# Sound Transit's On-going Efforts

- Environmental Policy
- Environmental and Sustainability Management System
- Climate Change Vulnerability Guidance Document
- Climate Risk Reduction Project - assesses how the agency can build resilience to the potential impacts of climate change

# What is Next for Sound Transit?

- Develop Modal Level Climate Change Preparedness and Adaptation Plans
  - Vulnerability assessment at asset class levels
  - Preparedness strategies
  - Resiliency planning to recover from significant hazards
  - Adaptive measures at asset class levels
  - Continuous improvement
- Tacoma-Link is the pilot

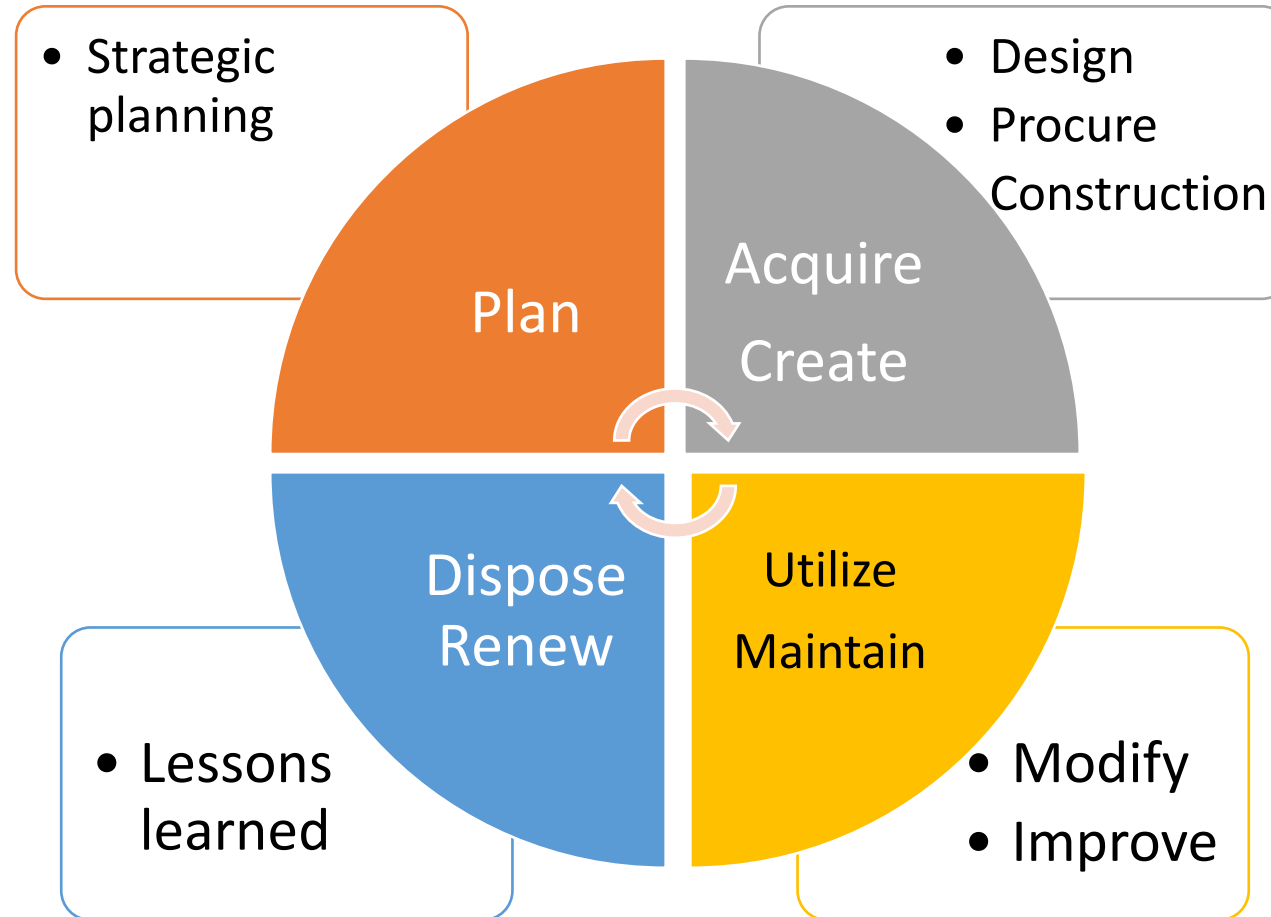


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# Integrating Climate Change & Adaptation in Asset Lifecycle





# Integrating Climate Change & Adaptation

## Planning

- Climate Action Policy Integration
- Climate Change and Adaptive Management

## Design

- Design Requirements
- Specifications

## Maintain

- Retrofitting Assets to Integrate Adaptive Approach
- Updating Operations Plan

# Thank you!

Let's continue the conversation!  
Connect with me on LinkedIn!



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