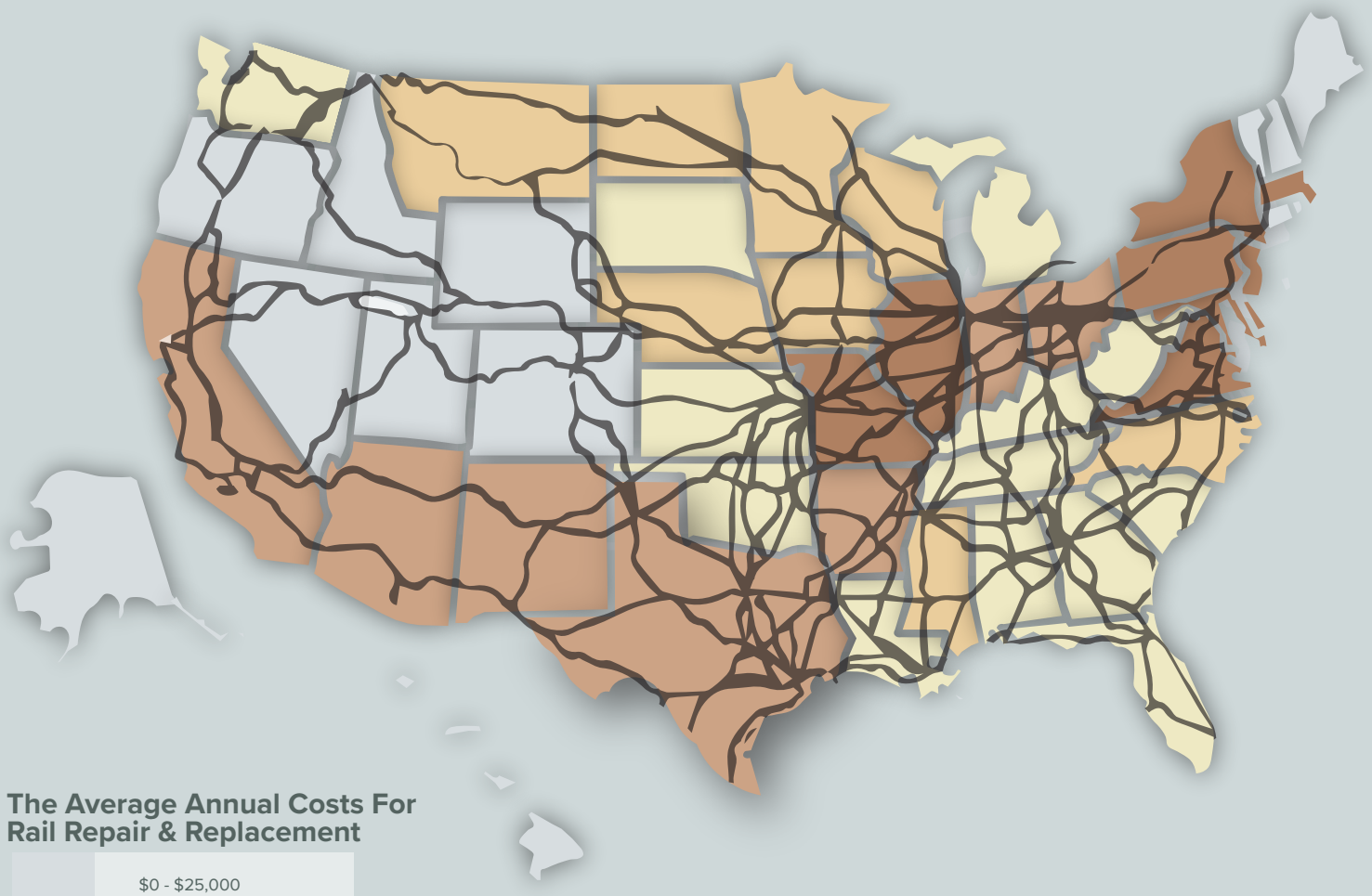
IMPACTS OF CLIMATE CHANGE ON OPERATION OF THE US RAIL NETWORK



The Average Annual Costs For Rail Repair & Replacement

- $0 - $25,000
- $25,000 - $75,000
- $75,000 - $100,000
- $100,000 - $500,000
- $1,000,000 +

Additional costs due to delays while repairs are made are included in the full study

The primary freight and passenger rail network in the US comprises 140,000 miles of Class 1 rails operated by seven railroad companies

Each person in the US requires 40 tons of freight to be moved each year either through direct goods purchased or indirectly through bulk products such as coal which is required to generate electricity for individual users.

About Resilient Analytics

Resilient Analytics answers climate impact questions with the Infrastructure Planning Support System (IPSS). IPSS is a unique, first-of-its-kind system that performs engineering analysis within a broader resiliency perspective. IPSS models infrastructure vulnerability to future climate conditions, considers specific adaptation scenarios, and provides a cost benefit based risk analysis. IPSS draws its data from a range of climate science projections, engineering and materials studies, and environmental research to provide users with decision support that is based in real-world risk scenarios.

Resilient Analytics Project Summaries

The rail system in the United States is comprised of over 140,000 miles of passenger and freight Class 1 rails. It is owned and operated by private companies in the same manner as air transportation. The rail system is an essential component of infrastructure, both for its passenger use and its cost effectiveness for transporting goods. However, due to recent climate shifts, the rail network is becoming increasingly vulnerable to rising thermal conditions and precipitation shifts.

The vulnerability of the rail network is due to minimal tolerance of rails to temperature shifts. Each segment of track is designed for a Neutral Temperature. Neutral Temperature is defined as the temperature at which the net longitudinal force in the rail is zero. In other words, it is the temperature at which rails are least likely to experience damage due to changes in temperature. When temperatures increase above this neutral temperature the steel that was laid for rail transportation is at risk for deformations known as sun kinks.

Sun kinks cause the steel in the rails to bend and distort as temperatures rise and train cars continue to utilize the tracks. A typical welded length of 1800 feet of rail can expand up to 1 in. per ten degrees of temperature increase. These kinks and distortions in rail tracks can ultimately lead to derailments. The issue of deformations is one that is currently addressed by speed controls that go into effect when temperatures increase. However, climate change induced increases in temperatures is leading to increasing concerns about further disruptions in rail traffic across the United States.

In a current study by Resilient Analytics, Inc. it has been determined that the vulnerability of rail across the U.S is increasing. The study combined climate data projections with current data on rail inventory and volume. Through the National Transportation Atlas Database (NTAD), GIS files were utilized of existing railroads, stations, as well as rail bridges. With these data sets, two different RCP's in five different GCM's were used to determine a range of plausible futures and uncertainties.

The study found that when incorporating both costs to repair tracks as well as the cost of delays, the cumulative impacts by 2100 can range from $103 to $138 billion using a 3% discount rate. These costs are not only associated with temperature but also precipitation considering events such as flash floods that can disrupt the structural integrity of the rail tracks.

Adaptation options exist to reduce these events, both in costs and in extent of impact as detailed in the study.

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