# Mapping Locations for Low-Carbon Autonomous Electric Passenger Ferries: A Data-Driven Analysis of Socioeconomic and Demographic Neighborhood Profiles

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## Background

- Washington is home to the largest and most widely used passenger ferry system in the United States.
- Island and peninsula communities in the Salish Sea are often isolated from regional cities like Seattle and Tacoma due to an extensive transit time by road.
- Autonomous electric passenger ferries are a promising solution to safely and reliably provide transportation for ferry passengers in Washington State, as they can reduce long-term operational and maintenance costs by lowering labor expenses and enabling safer and more efficient service models.

## Objectives

- Assess the associations between the socio-demographics and economics of the regions (census block groups) where ferry terminals are located.
- Identify ferry terminals and marinas with similar characteristics, including poverty rate, education level, vehicle access, transit stop density, and housing conditions such as mobile homes and crowding.
- Identify the most isolated ferry terminals and marinas, understand the challenges and limitations of the Salish Sea region, and map possible connection points/routes for autonomous electric passenger ferries.

## Data and Methods

### Sources

Washington Department of Transportation and census/Social vulnerability index data

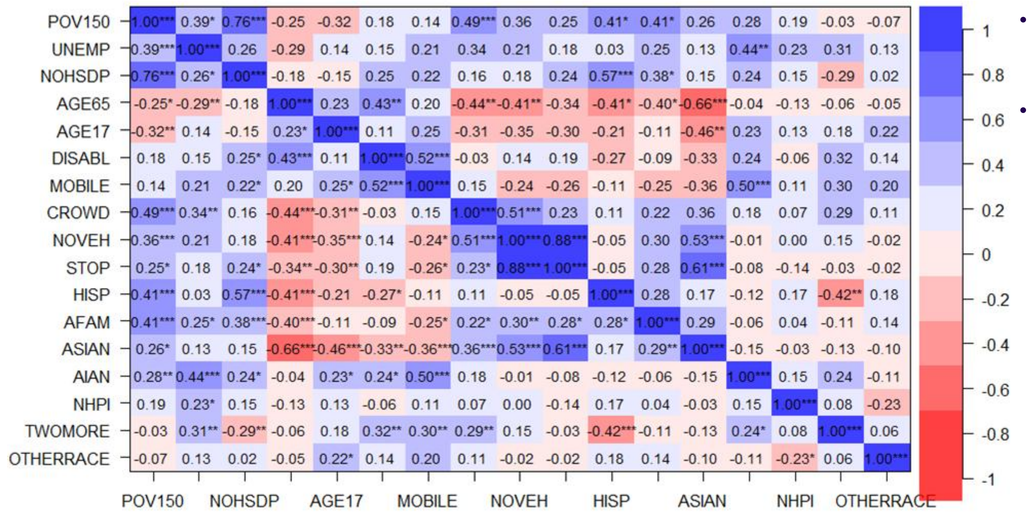
- Geographic coordinates of ferry terminals and marinas
- Transit stops
- Ferry routes
- Socio-demographics and economics of census block groups with ferry terminals: indicators related to poverty, unemployment, education, age, disability, housing, vehicle access, transit, and other relevant factors.

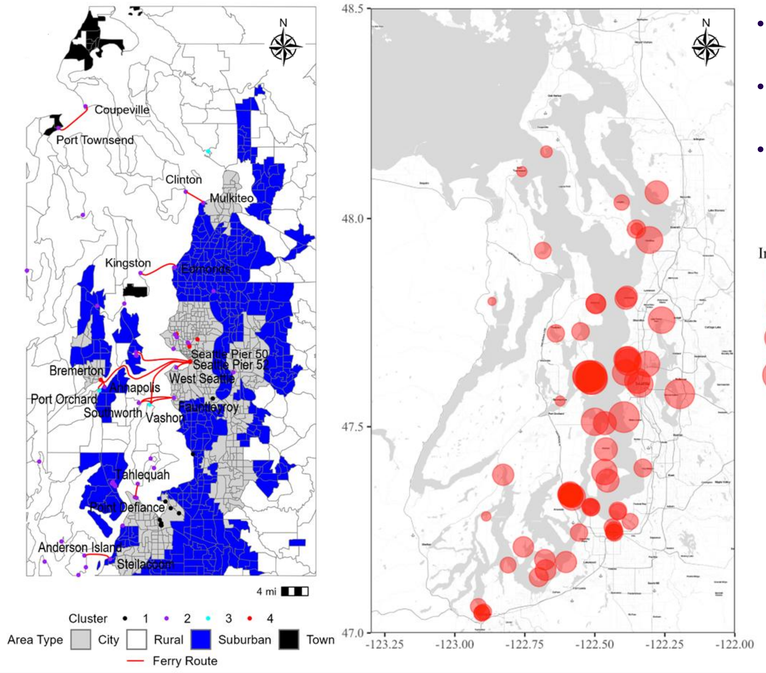
### Methods

Associations between socio-demographics and economics of census block groups with ferry terminals and marinas

- Non-parametric method – Kendall's Tau correlation
- Principal component analysis

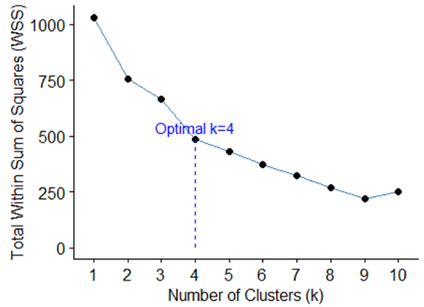
## Results




## Results

- Census tracts with higher levels of overcrowded housing are associated with a greater share of households without access to a vehicle.
- Principal component analysis of the socioeconomic and demographic characteristics of census tracts containing ferry terminals and marinas identified four distinct clusters of terminals and marinas.




- *Cluster 1*: ferry terminals and marinas in urban areas with high poverty and a large Hispanic population, moderate unemployment, and some racial diversity.
- *Cluster 2*: More socioeconomically stable areas with the highest elderly population and predominantly White residents, covering a mix of city, rural, suburban, and town settings.
- *Cluster 3*: Rural communities with pronounced socioeconomic challenges, high unemployment, poverty, and the largest proportion of American Indians or Alaska Natives, alongside higher mobile home prevalence and lower transit availability.
- *Cluster 4:* Highly urbanized, transit-dependent neighborhoods with high transit stop density, high poverty and unemployment rates, the highest Asian population, and significant crowding and vehicle inaccessibility.

## Conclusions

- Based on these clusters, strategic autoferry routes could be proposed to bridge socioeconomic and demographic disparities.
- For example, linking Port Orchard (Cluster 3), characterized by rural hardship and Native populations, to Seattle's Pier 52 (Cluster 4), a transit-reliant urban core, could enhance access to employment and services for vulnerable populations.
- A ferry route connecting Tahlequah (Cluster 3) and Point Defiance (Cluster 2) would support island residents' access to Tacoma's economic and tourism hubs.
- An autoferry connection between West Seattle (Cluster 2) and Seattle Pier 52 (Cluster 4) would enhance intra-urban mobility.

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