

# Emerging Modeling Resources

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U.S. Department  
of Transportation

**Federal Highway  
Administration**

# Presentation Overview

- Planning Challenges and Modeling Needs
- Selected Model Resources Under Development
  - VisionEval
  - TMIP-EMAT
  - GeoEconomic Multimodal System (GEMS)
  - National Household Transportation Survey (NHTS)

# Planning Challenges

- Transportation: Connecting People with What They Need
  - Getting from “Point A” to “Point B”
- Traditional Performance Targets:
  - Mobility
  - Safety
  - Efficiency

# The Scope of Transportation Planning is Expanding

- For Example...
  - Economic Activity and Access to Destinations
  - Equity, Resilience, and Sustainability
  - Financing System Development, Operation, and Maintenance

# How We Meet Transportation Needs is Changing

- New Business Models
  - Freight on demand
  - App-based connectivity
  - Remote work
- Land Use Priorities
  - Livable communities / active transportation
  - Transportation system as an impediment (not just an opportunity)

# How We Meet Transportation Needs is Changing

- New Transportation Technologies
  - Electric Vehicles
  - Connectivity / “ITS 2.0”
  - Automation
  - Micromobility

# How We Fund Transportation is Changing

- Highway Trust Fund / Gas Tax / Road-Use Fees / VMT Tax
- Tolling
- Managed Lanes
- Other Pricing Policies

# Less Clarity on What Comes Next

- COVID and its aftermath
- Sea-level Rise
- “Virtual” Economy / Remote Work / Home-Based Shopping

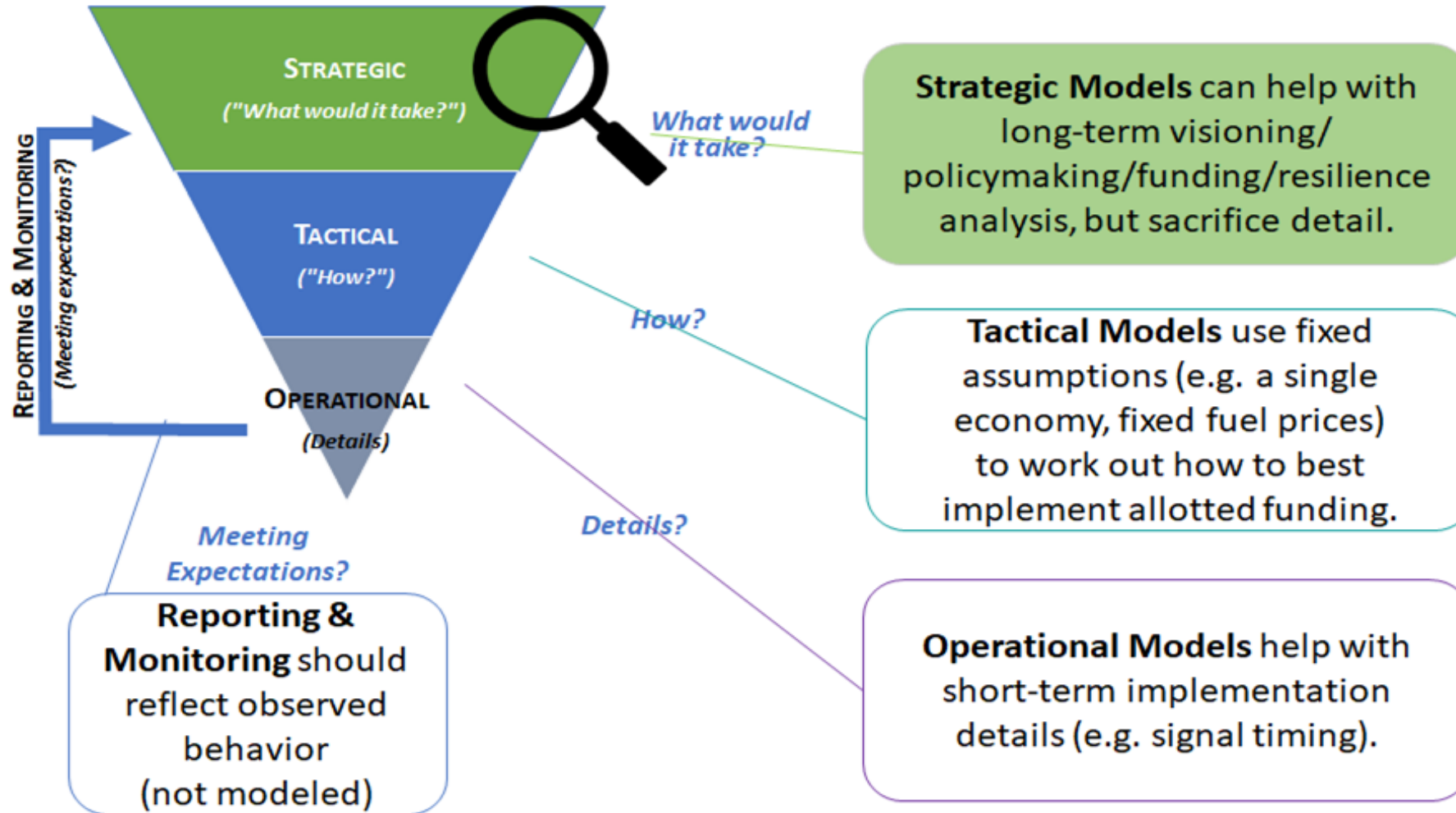
Bottom Line: Complex Needs with Uncertain Outcomes



# What Models Do

- Models Can:
  - Assess how well people's needs are being met
  - Understand possible outcomes of complex interactions
  - Evaluate possible impacts of future conditions, policies and projects
- Models Cannot:
  - Tell us what will happen
  - Tell us what to do
  - Resolve uncertainty

# The Life-Cycle of Models (“STORM” Diagram)



Source: Oregon DOT

# Key Research Themes for Emerging FHWA Tools

- Assess a wider range of interacting outcomes
  - ... more factors, less detail
- Support Decision-Making under Uncertainty
  - ... make the best decision possible given what we know
- Find robust solutions
  - ... handle whatever comes at us

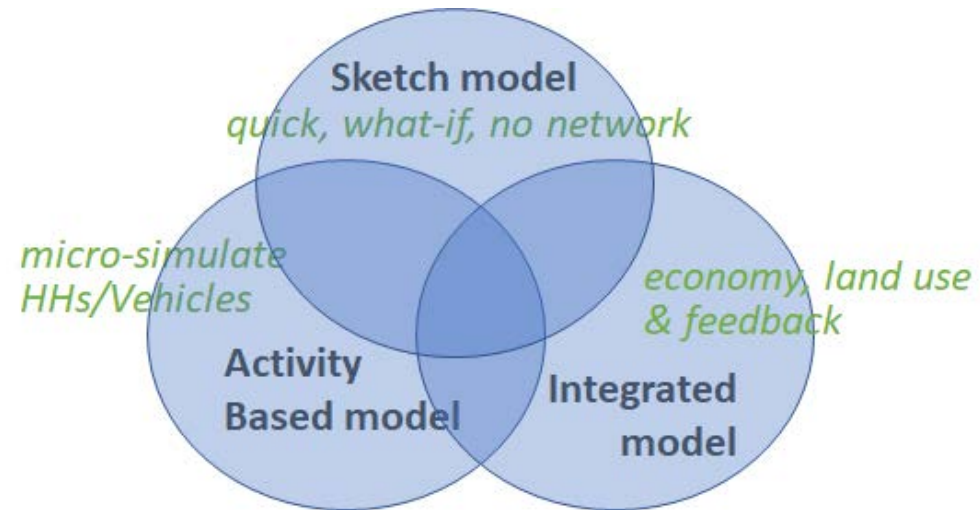
# Resources Under Development

- Strategic Planning / Scenario Planning
  - VisionEval
- Planning under Uncertainty
  - TMIP-EMAT
- Geospatial Analysis
  - GeoEconomic Multimodal System (GEMS) model
- National Household Transportation Survey (NHTS)

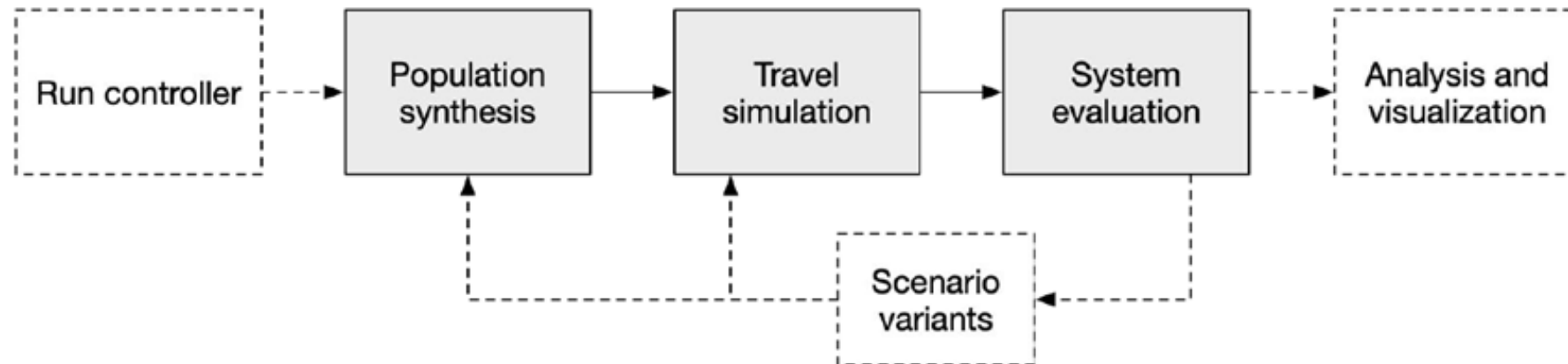
# VisionEval

# VisionEval Strategic Modeling System

VisionEval models occupy niche between...



... balancing rapid computation & accurate representation



# VisionEval Performance Measures

## Mobility

- Daily VMT per capita
- Annual walk trips per capita
- Daily Bike trips per capita

## Economy

- Annual all vehicle delay per capit
- Daily household parking costs
- Household (HH) vehicle operating cost (fuel, taxes, parking)
- HH ownership costs (depreciation, vehicle maintenance, tires, finance charge, insurance, registration)

## Land Use

- Residents living in mixed use areas
- Housing type (SF: MF)

## Environmental

- GHG emissions per capita, per HH
- Commercial and Transit GHG/mile

## Energy

- Fuel consumption per capita (gallons)
- Fuel efficiency (net miles per gallon)
- Annual external social costs per HH (total/% paid)

# VisionEval Key Features

- Rapid Scenario Evaluation
- Scenario Planning
- Strategy Development

“Understand the Problem”  
rather than  
“Implement the Solution”

<https://visioneval.org/docs>





# **Travel Model Improvement Program Exploratory Modeling and Analysis Tool**

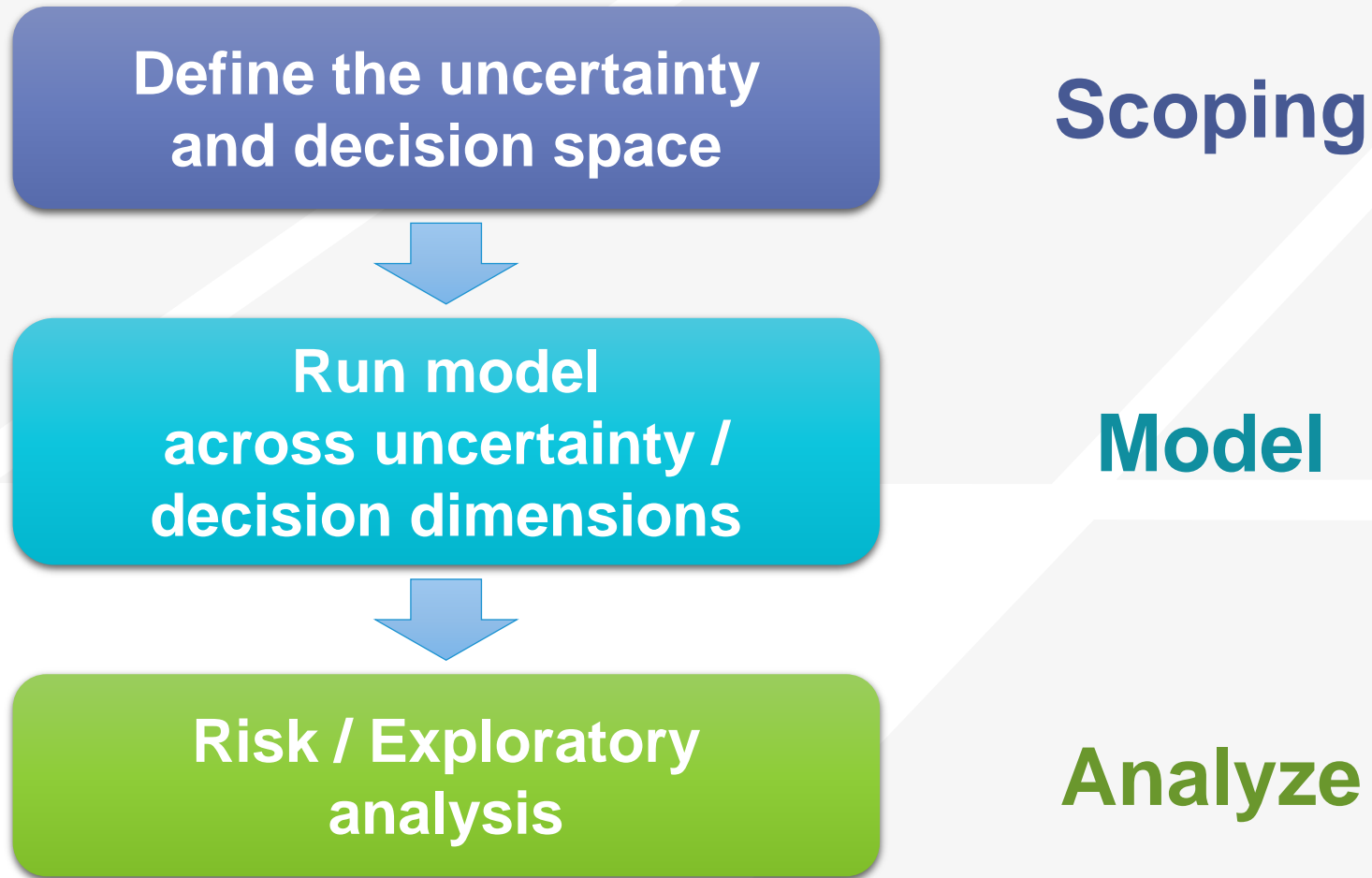
## **TMIP - EMAT**

# TMIP-EMAT

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- Turn a large model into an exploratory tool
  - Develops “Meta-Models” (a “model of the model”)
  - Meta-Models can rapidly explore a wide range of scenarios
  - Assess risks under scenarios impractical to evaluate otherwise
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- Can also be used to test sensitivity and applicability of a model

# TMIP-EMAT



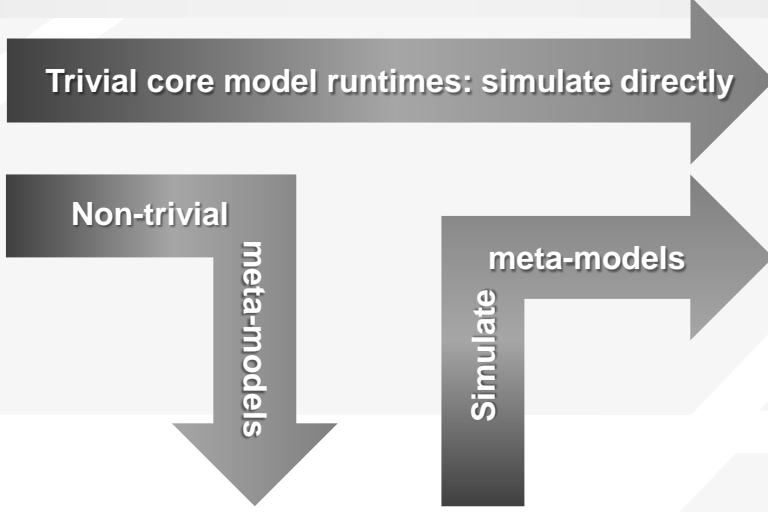
# TMIP-EMAT Workflow Details

Step 1: Scoping—Define uncertainty and decision space

**Scoping**

- Strategy levers
- Measures
- Uncertainties

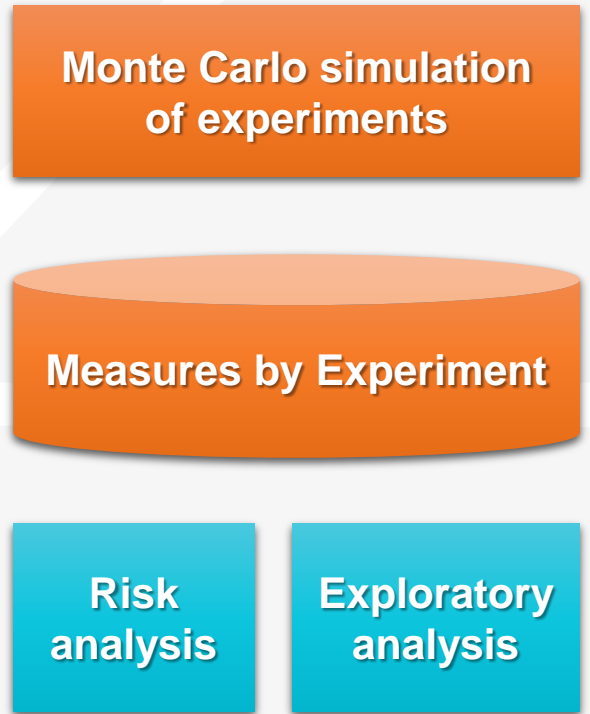
Step 2: Meta-model development to produce outcome space



- Meta-model development**
- Design experiments
  - Run experiments in core model
  - Derive meta-model

*Meta-models are regression models of the Core Model outputs that run very fast.*

Step 3: Simulation (populate outcome space) and analysis



➤ Where necessary, leverages **Core Model** outputs to produce **Meta-models** that can quickly explore the range of uncertainty



# TMIP-EMAT Key Features

- Turns Regional Model into exploratory tool
- Explore scenarios
- Test model sensitivity
- Integration with VisionEval (forthcoming)



<https://tmip-emat.github.io>

# **GeoEconomic Multimodal System**

**GEMS**

# GeoEconomic Multimodal System (GEMS)

- Under Development as ArcGIS Extension (no release yet)
- Geo-Spatial Exploration of Transportation Policies
  - Macro-level impacts of regional- or national-level policy changes
  - Least-cost solutions and investment strategies preserving equitable accessibility
- Considers:
  - Socio-Economic Characteristics
  - Land Use Context
  - Transportation Network

# GEMS Key Outputs

- Vehicle Miles Traveled (VMT) and Person Miles Traveled (PMT) by mode
- Congestion and speed for each mode
- Accessibility to destinations for different population groups using different modes
- Mode share by different population groups
- Externality costs including safety, noise, emissions, and environmental costs
- Costs to system users, owners, and operators



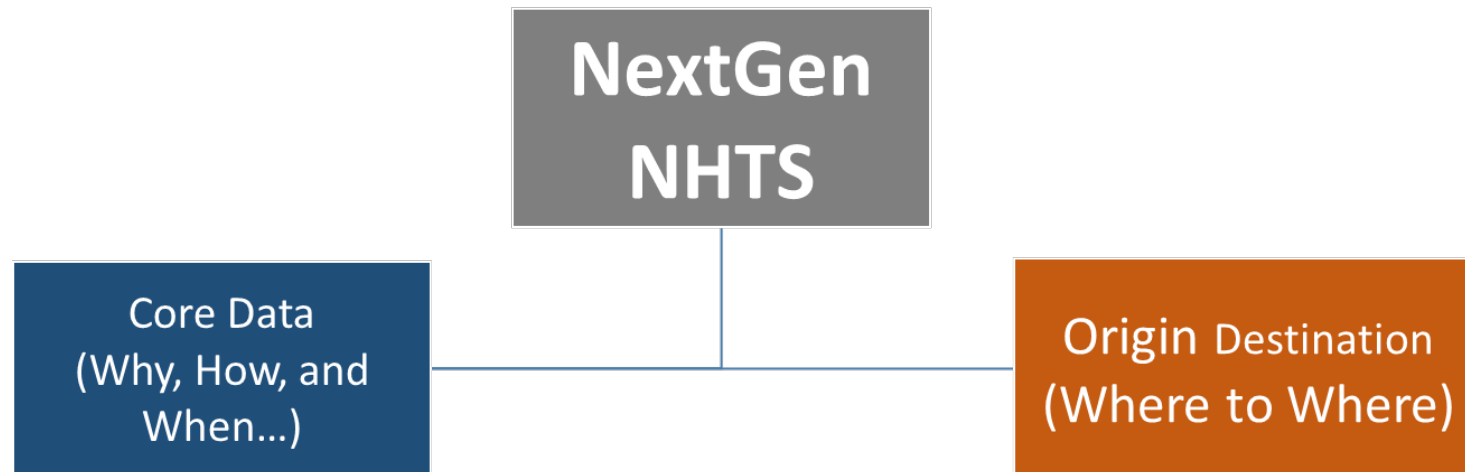
# **National Household Transportation Survey**



# “Next Gen” National Household Transportation Survey

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- Take advantage of new data sources (passive OD data)
- Switch to a biennial household survey
- Pool resources to take advantage of economy of scale
- Collect both trip rate and OD data



# NextGen NHTS Components

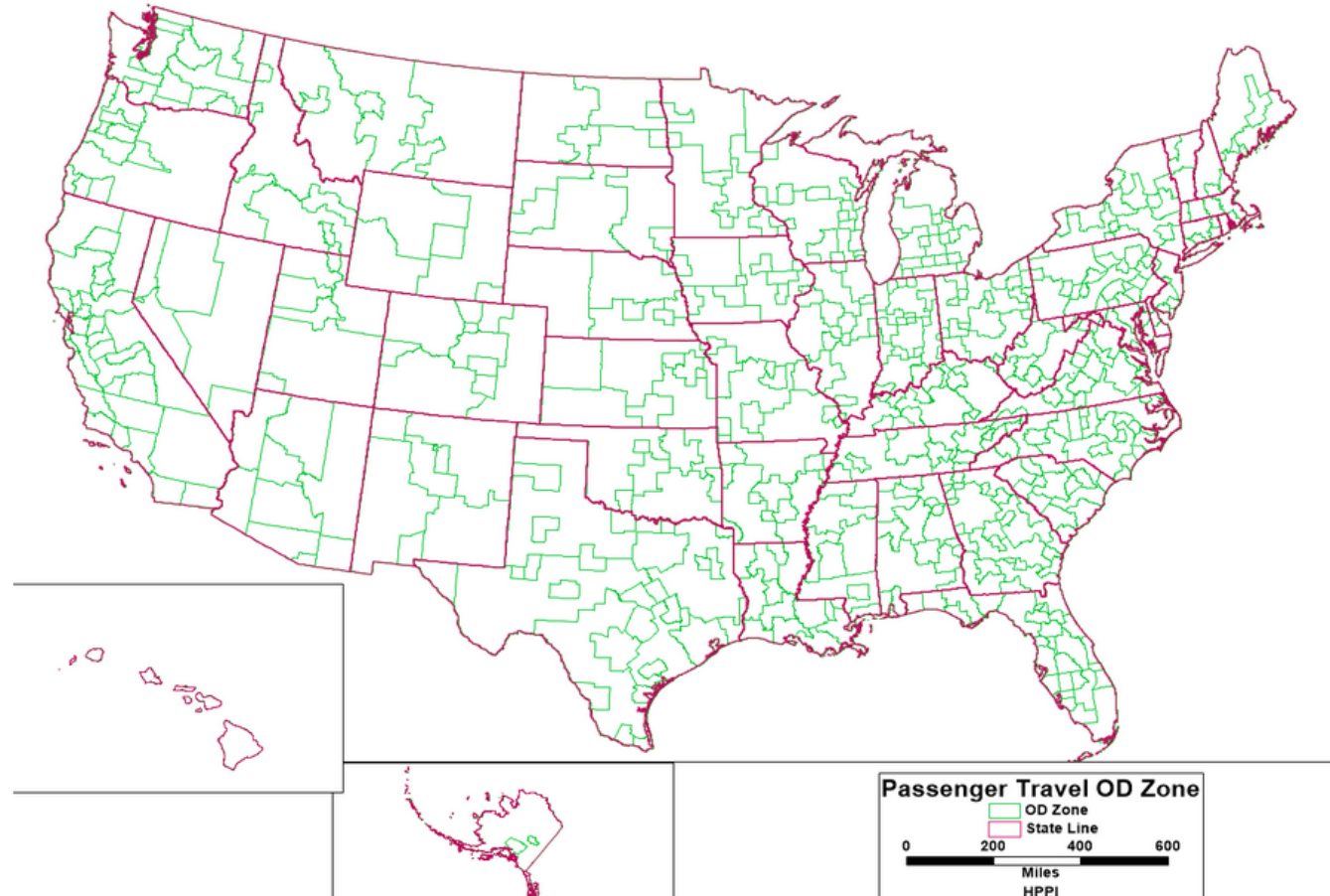
## National survey core travel behavior data

- National survey data collected on a biennial basis starting in 2022
- Probability-based sampling approaches
- Independent surveys every other year
- **Smaller data collection effort than previous NHTSs**

## National OD data

- National OD (passenger and truck) on collected on an annual basis, 2020-2024
- 583 OD zones (primarily MSA based)
- Includes air, rail, highway (passenger vehicles and buses), and active travel (bike, pedestrian, etc.) and ferry trips

# OD Zones (583 Zones)



Source: <https://www.fhwa.dot.gov/policyinformation/analysisframework/04.cfm>

# Current NextGen NHTS Data Collection and Delivery Status

## Core data

- 2022 data collection complete (collected January 2022-January 2023)
- 7,500 households surveyed under two approaches: address based and panel frame
- Data release ~~circa end of 2023~~  
**November 15, 1pm Eastern <https://nhts.ornl.gov>**
- Procurement work for 2024 core data collection underway

## OD data

- 2020 national passenger and truck data released June 2022
- 2021 national passenger and truck data released April 2023

# NHTS Participation

- Continues to have pooled fund participation
- Participants can purchase additional data
- Currently (Fall 2023)
  - 14 states
  - 5 local agencies
  - Two other organizations participating

# NHTS Tools and Resources

- Data files
- Technical and supporting documentation
- Interactive analytics & visualizations for both survey core and OD data



<https://nhts.ornl.gov/>

# FHWA Contacts

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