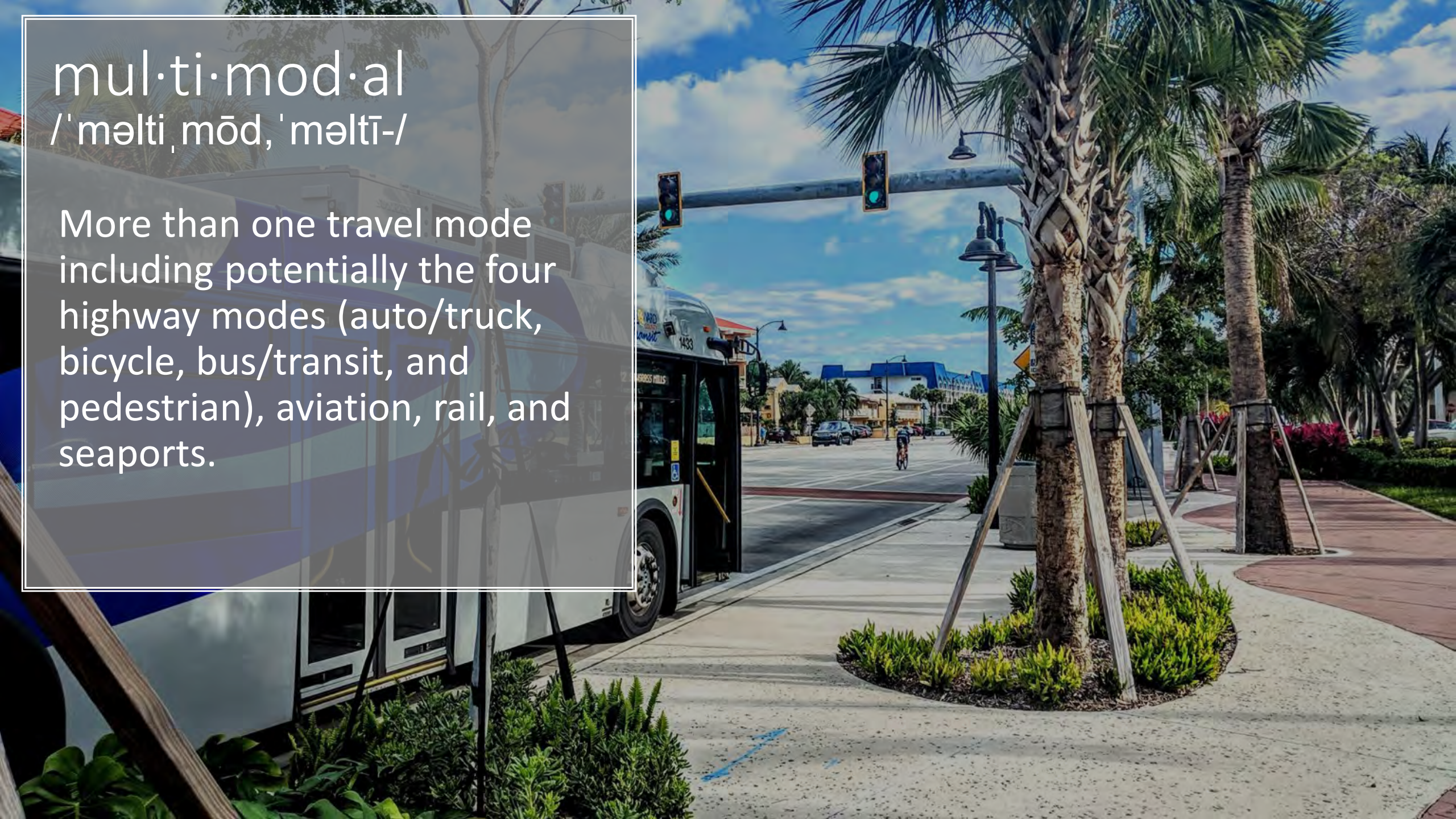
# Multimodal Transportation

## Emerging Thought, Trends & Practices



# mul·ti·mod·al

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More than one travel mode including potentially the four highway modes (auto/truck, bicycle, bus/transit, and pedestrian), aviation, rail, and seaports.

PRIVATE MOTOR VEHICLES
600–1,600/HR

MIXED TRAFFIC WITH FREQUENT BUSES
1,000–2,800/HR

TWO-WAY PROTECTED BIKEWAY
7,500/HR

DEDICATED TRANSIT LANES
4,000–8,000/HR

SIDEWALK
9,000/HR

ON-STREET TRANSITWAY, BUS OR RAIL
10,000–25,000/HR

**FIGURE 15** EXPECTED USER TYPES IN DIFFERENT CONTEXT CLASSIFICATIONS

# Shifting perspectives…

- Traditionally roadway performance measures are for <u>Level of Service (LOS)</u>
  - Auto travel
  - The Quality of Service from the Driver's perspective
  - Traced back to as early as 1950 Highway Capacity Manual
  - Does not measure if you are able to reach your destination

*A qualitative measure of the effect of a number of factors, which include speed and travel time, traffic interruptions, freedom to maneuver, safety, driving comfort and convenience, and operating cost*

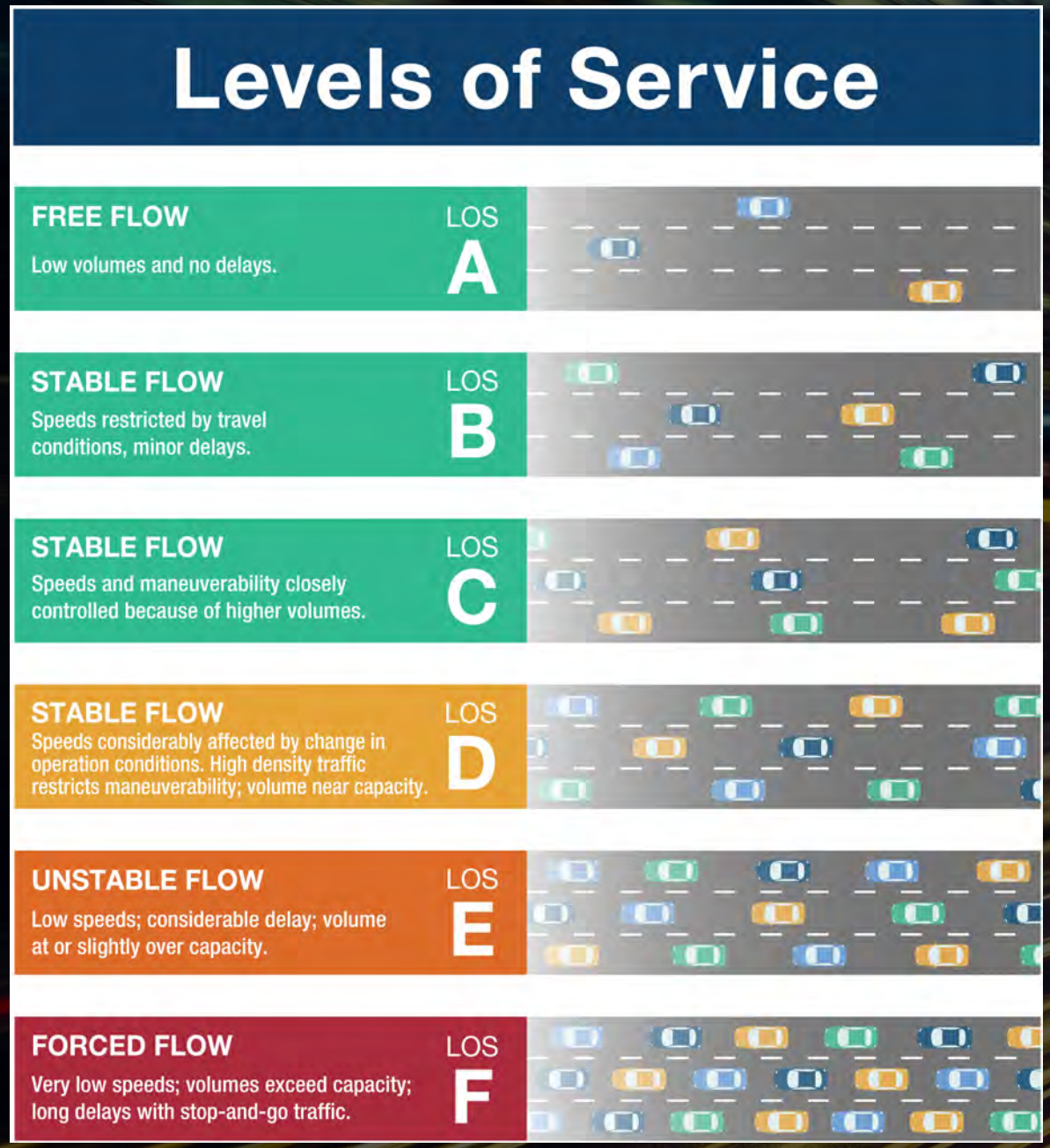



**Figure 2 Total Lateral Clearance Adjustment Factor $f_{TLC}$ Values (mph)**

| Four-Lane Highways | | Six-Lane Highways | |
|---|---|---|---|
| TLC (ft) | Reduction in FFS, $f_{TLC}$ (mi/h) | TLC (ft) | Reduction in FFS, $f_{TLC}$ (mi/h) |
| 12 | 0.0 | 12 | 0.0 |
| 10 | 0.4 | 10 | 0.4 |
| 8 | 0.9 | 8 | 0.9 |
| 6 | 1.3 | 6 | 1.3 |
| 4 | 1.8 | 4 | 1.7 |
| 2 | 3.6 | 2 | 2.8 |
| 0 | 5.4 | 0 | 3.9 |

Source: HCM 6th Edition, Exhibit 12-22.
Note: Interpolation to the nearest 0.1 is recommended.

The base FFS is taken to be the design speed (if available), or can be estimated as the speed limit plus 5 mph (for speed limits ≥50 mph) or the speed limit plus 7 mph (for speed limits <50 mph). If the segment contains one or more horizontal curves with an advisory speed less than the speed limit, use the lowest advisory speed as the base FFS.

*Highway free flow speed is considered to be the speed a driver chooses under low volume conditions when the interaction between vehicles and the influence of traffic control devices is minimal.*

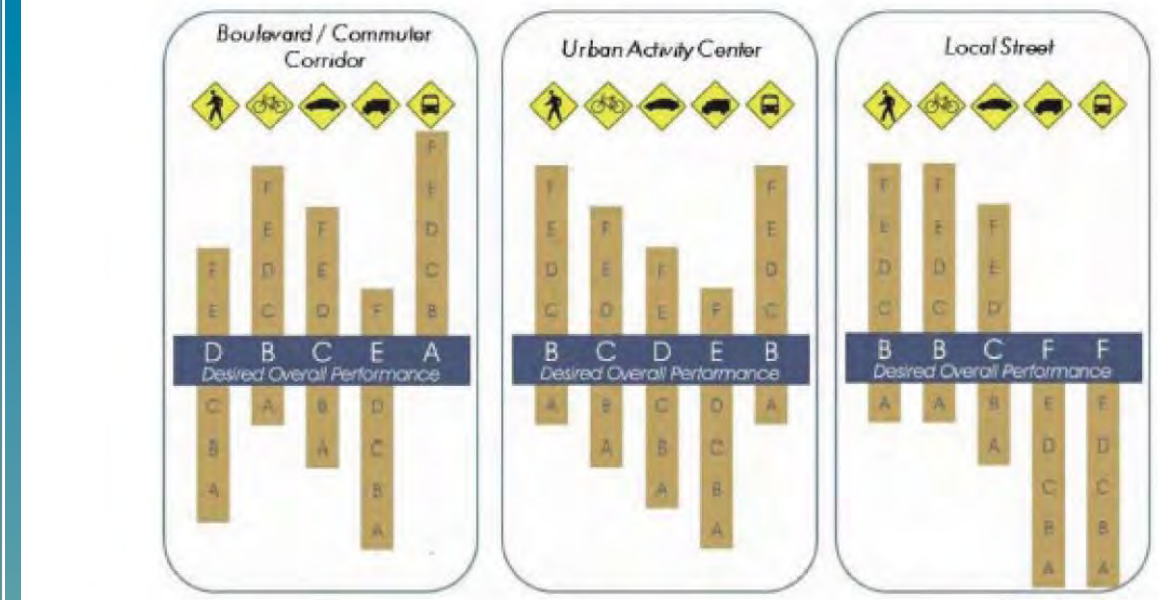
# Multimodal Level of Service

Developing the framework

- Goal to provide a well-rounded performance measure of the roadway and person throughput
- Growing interest and methods in practice and in development

# Multimodal Level of Service

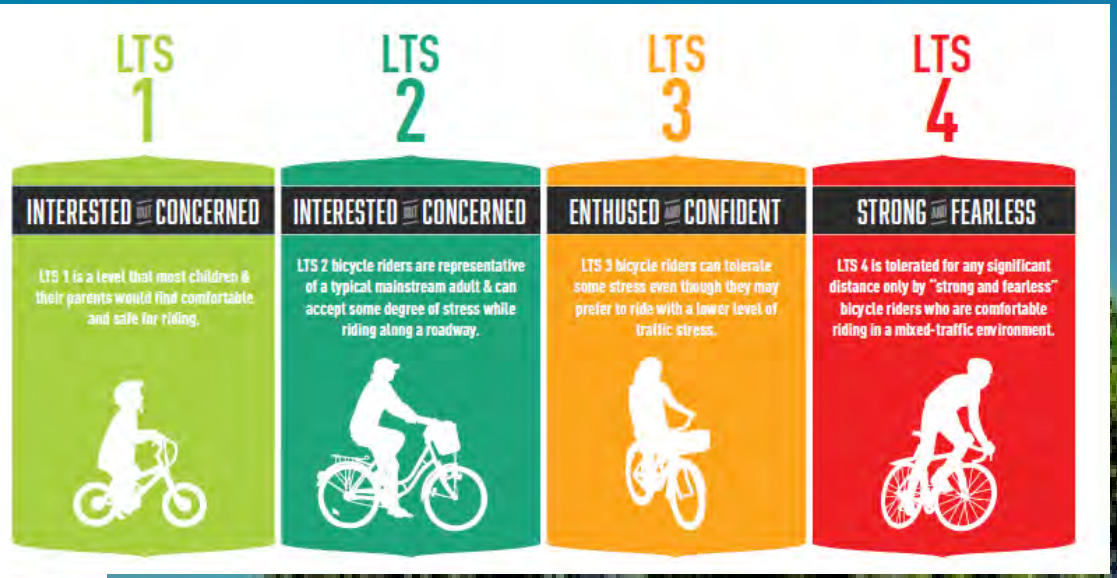
- Research states that a combined MMLOS may dilute results
- Instead, recommendations are to keep individual level of service evaluations for each mode




*The identification of context-sensitive quality-of-service objectives for each mode of travel is one way to consider modal emphasis. Source: Institute of Transportation Engineers, 2014*

# Multimodal Level of Service

- Example: Bicycle Level of Traffic Stress- Bellevue, WA




| Roadway Characteristics | | Bicycle Facility Components: Guideline to Achieve Intended Level of Service/Level of Traffic Stress | | | | | |
|---|---|---|---|---|---|---|---|
| Speed Limit (MPH) | Arterial Traffic Volume | No Marking | Sharrow Lane Marking | Striped Bike Lane | Buffered Bike Lane (Horizontal) | Protected Bike Lane (Vertical) | Physically Separated Bikeway |
| </= 25 | <3k | 1 | 1 | 1 | 1 | 1 | 1 |
| | 3-7k | 3 | 2 | 2 | 2 | 1 | 1 |
| | >/=7k | 3 | 3 | 2 | 2 | 1 | 1 |
| 30 | <15k | 3 | 3 | 2 | 2 | 1 | 1 |
| | 15-25k | 4 | 4 | 3 | 3 | 3 | 1 |
| | >/=25k | 4 | 4 | 3 | 3 | 3 | 1 |
| 35 | <25k | 4 | 4 | 3 | 3 | 3 | 1 |
| | >/=25k | 4 | 4 | 4 | 3 | 3 | 1 |
| >35 | Any | 4 | 4 | 4 | 4 | 3 | 1 |

# Multimodal Level of Service

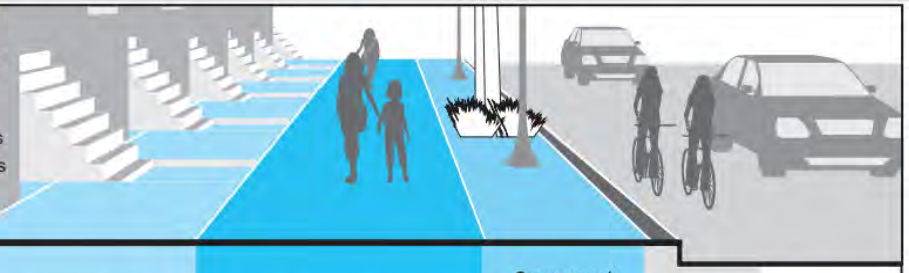
- Example: Pedestrian LOS

| Pedestrian LOS | Metric | Implementation | How to Apply |
|---|---|---|---|
| Sidewalk & Landscape Buffer | Combined Width for sidewalk and landscape buffer | Frontage Improvements Capital Investment Program | Standard per Land Use Code and Transportation Design Manual |
| Intersection Treatment | Design Components | Frontage Improvements Capital Investment Program | Guideline |
| Mid-Block Crossings | Spacing of Crossings | Frontage Improvements Capital Investment Program | Guideline |

Above: Bellevue, WA- PLOS example

Right: Boston, MA- guideline example

The width and design of sidewalks will vary depending on street typology, functional classification, and demand. Below are the City of Boston's preferred and minimum widths for each Sidewalk Zone by Street Type.



| Street Type | Frontage Zone | | Pedestrian Zone* | | Greenscape/ Furnishing Zone | | Curb Zone | Total Width | |
|---|---|---|---|---|---|---|---|---|---|
| | Preferred | Minimum | Preferred | Minimum | Preferred | Minimum | | Preferred | Minimum |
| Downtown Commercial | 2' | 0' | 12' | 8' | 6' | 1'-6" | 6" | 20'-6" | 10' |
| Downtown Mixed-Use | 2' | 0' | 10' | 8' | 6' | 1'-6" | 6" | 18'-6" | 10' |
| Neighborhood Main | 2' | 0' | 8' | 5' | 6' | 1'-6" | 6" | 16'-6" | 7' |
| Neighborhood Connector | 2' | 0' | 8' | 5' (4')* | 5' | 1'-6" | 6" | 15'-6" | 7' |
| Neighborhood Residential | 2' | 0' | 5' | 5' (4')* | 4' | 1'-6" | 6" | 11'-6" | 7' |
| Industrial Street | 2' | 0' | 5' | 5' (4')* | 4' | 1'-6" | 6" | 11'-6" | 7' |
| Shared Street | 2' | 0' | Varies | 5' (4')* | N/A | N/A | N/A | Varies | Varies |
| Parkway | N/A | N/A | 6' | 5' | 10' | 5' | 6" | 16'-6" | 10'-6" |
| Boulevard | 2' | 0' | 6' | 5' | 10' | 5' | 6" | 18'-6" | 11'-6" |

## Notes

* 5' is the preferred minimum width of the Pedestrian Zone in the City of Boston. The Americans with Disabilities Act (ADA) minimum 4' wide Pedestrian Zone can be applied using engineering judgement when retrofitting 7' wide existing sidewalks where widening is not feasible.

### Frontage Zone

- Where buildings are located against the back of the sidewalk and constrained situations do not provide width for the Frontage Zone, the effective width of the Pedestrian Zone is reduced by 1', as pedestrians will shy from the building edge.
- The preferred width of the Frontage Zone to accommodate sidewalk cafés is 6'.

### Pedestrian Zone

- Based on engineering judgment in consultation with PWD and the Mayor's Commission for Person's with Disabilities, the ADA minimum 4' Pedestrian Zone (plus 5'of width every 200') may be applied.

### Greenscape/Furnishing Zone

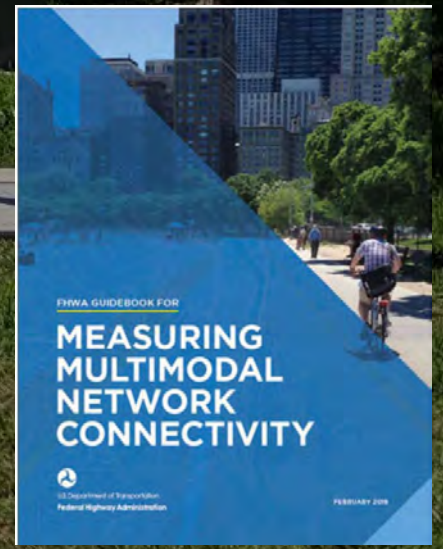
- The minimum width of the Greenscape/Furnishing Zone necessary to support standard street tree installation is 2'-6".
- Utilities, street trees, and other sidewalk furnishings should be set back from curb face a minimum of 18".

### Curb Zone

- Although the typical width of the Curb Zone is 6", widths may vary; additional width beyond 6" should be calculated as a part of the Greenscape/Furnishing Zone.

# Becoming Multimodal- Considerations

- Performance Measures- MMLOS/MMQOS, Counts
  - Connectivity
- Safety and perceptions of safety
  - Vision Zero, Target Zero, Road to Zero
  - Speed Management
  - Managing conflict with other modes
- Roadway real estate/ curbside management
- Right-of-way, Easements
- Funding and Programming



# Safety

- A big part of becoming truly multimodal is safety and creating the appeal for a mode shift
  - Perception of Safety
  - Real Safety
- Speed management-
  - Speed is the single greatest indicator of injury severity

# Vision Zero

- Goal to eliminate all deadly and severe injury crashes
- Safety Program for all modes and all people
  - Emphasizes the vulnerable roadway  users
  - Targets the High Injury Network
  - Equity

# Vision Zero

- A shift in thinking

# Safe System Approach

## Guiding Principles

1. The human body has a known and limited ability to tolerate crash forces.

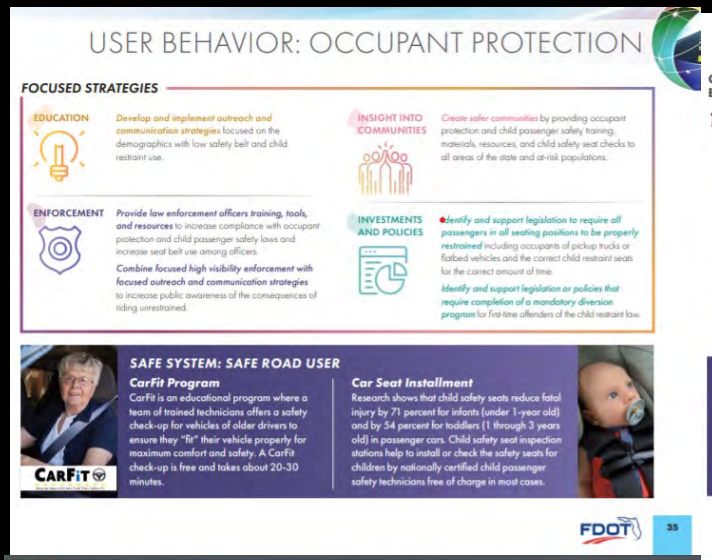
2. People make mistakes that lead to crashes.

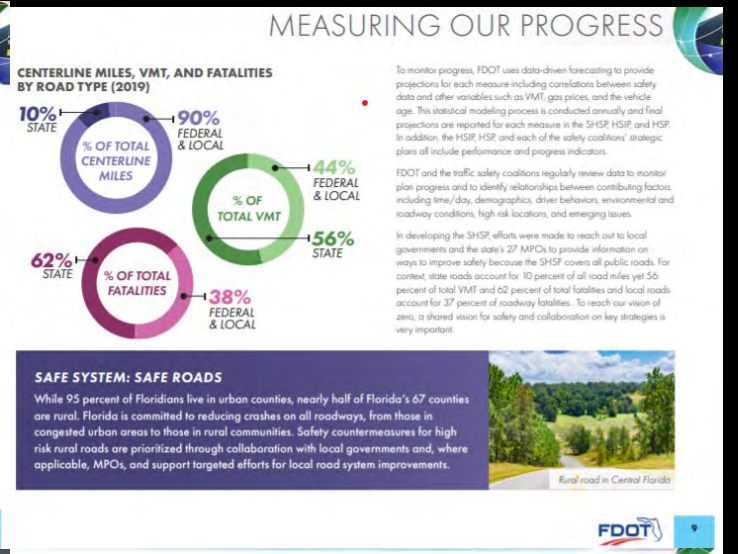
3. System designers share responsibility with road users for crash prevention.

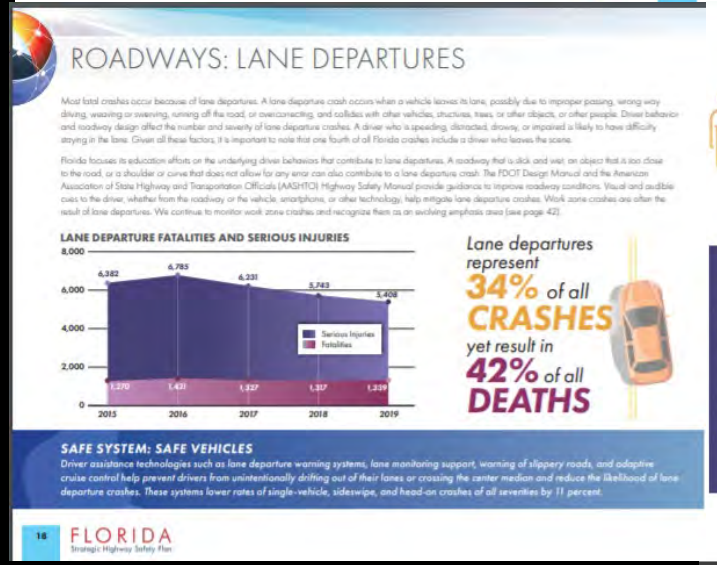
4. All elements of the system should be strengthened to multiply their effects.

# Safe System Approach +

- FDOT Strategic Highway Safety Plan, 2021


# Safe System Approach

- FAU Publications Examples

FAU

FLORIDA ATLANTIC UNIVERSITY

**Toward Safe Systems: Traffic Safety, Cognition, and the Built Environment**

Eric Dumbaugh, Dibakar Saha, Louis Merlin

First Published August 13, 2020 | Research Article | Check for updates
https://doi.org/10.1177/0739456X20931915

Collaborative Sciences Center for ROAD SAFETY

FINAL REPORT

**Implementing Safe Systems in the United States:**
**Guiding Principles and Lessons from International Practice**

June 4, 2019

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Louis Merlin
Florida Atlantic University

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# Complete Streets

- Complete Streets discussions are evolving
- Previously, generally described as livable streets designed for all users regardless of ability or mode of travel

# Update Complete Streets Policies

- Increasing emphasis on Equity, Speed, Safety, Comfort, Public Health
- Complete Streets are streets for everyone.
  - designed and operated to prioritize safety, comfort, and access to destinations
  - are  for all people who use the street,
  - addresses equity – race and ethnicity, ADA, vehicle ownership

  - A Complete Streets policy can empower communities “to direct their transportation planners and engineers to routinely design and operate the entire right of way to prioritize safer slower speeds for all people who use the road, over high speeds for motor vehicles.”

# Update Complete Streets Policies

- 4’ or 5’ bike lanes are not appropriate for all roadways
- Direct routes vs Low Stress Routes
- Integration of greenways and neighborhood greenways or bicycle boulevards
- There are many different methodologies to assess connectivity

# Emerging Micro-Mobility

Emerging Mobility – Disruptors:

- Serve as First – last mile solutions and remove vehicular trips
- Personal Devices, or
- Mobility as a Service (MaaS)
  - Bikeshare- standard and e-assist bikes
  - E-scooters
  - Docked and Dockless

# Emerging Micro-Mobility

- For example, Fort Lauderdale E-Scooter Dockless Mobility:
  - Regulated by local ordinance
  - E-scooter estimated average trip length less than 2 miles.
  - Average ride duration 27.78
  - Averaged over 100k trips per month
  - 75% of riders reported that their e-scooter ride replaced a vehicular trip
    - Personal  car or TNC (e.g., Uber, Lift, Taxi)

# Emerging Micro-Mobility

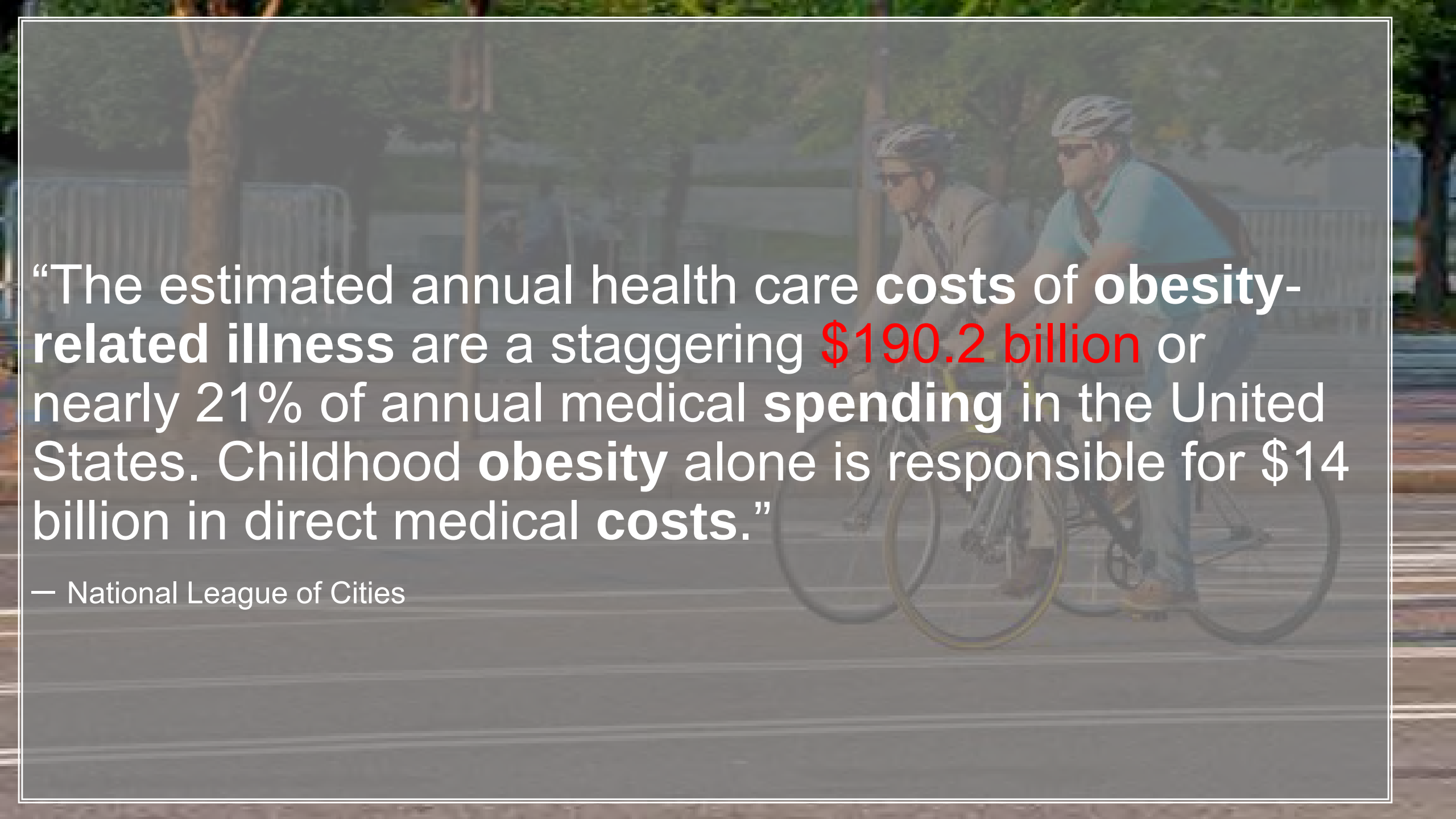
MaaS has had their own challenges

- Curbside management
- Safety- increase in injuries
- May expose a lack of safe and connected infrastructure-
  - Highlight and justify the need for greater bike lane/facilities to be rebranded as micro-mobility
  - Highlights the imperfections in pavement or uneven surfaces- the need for smooth seamless infrastructure or a required design change for technology itself
- Parking
  - Although less than 25% of scooters were found to be mis-parked in Fort Lauderdale's study, it is often cited as a nuisance

# The Health Benefits of Multimodal Planning & modal shift adoption

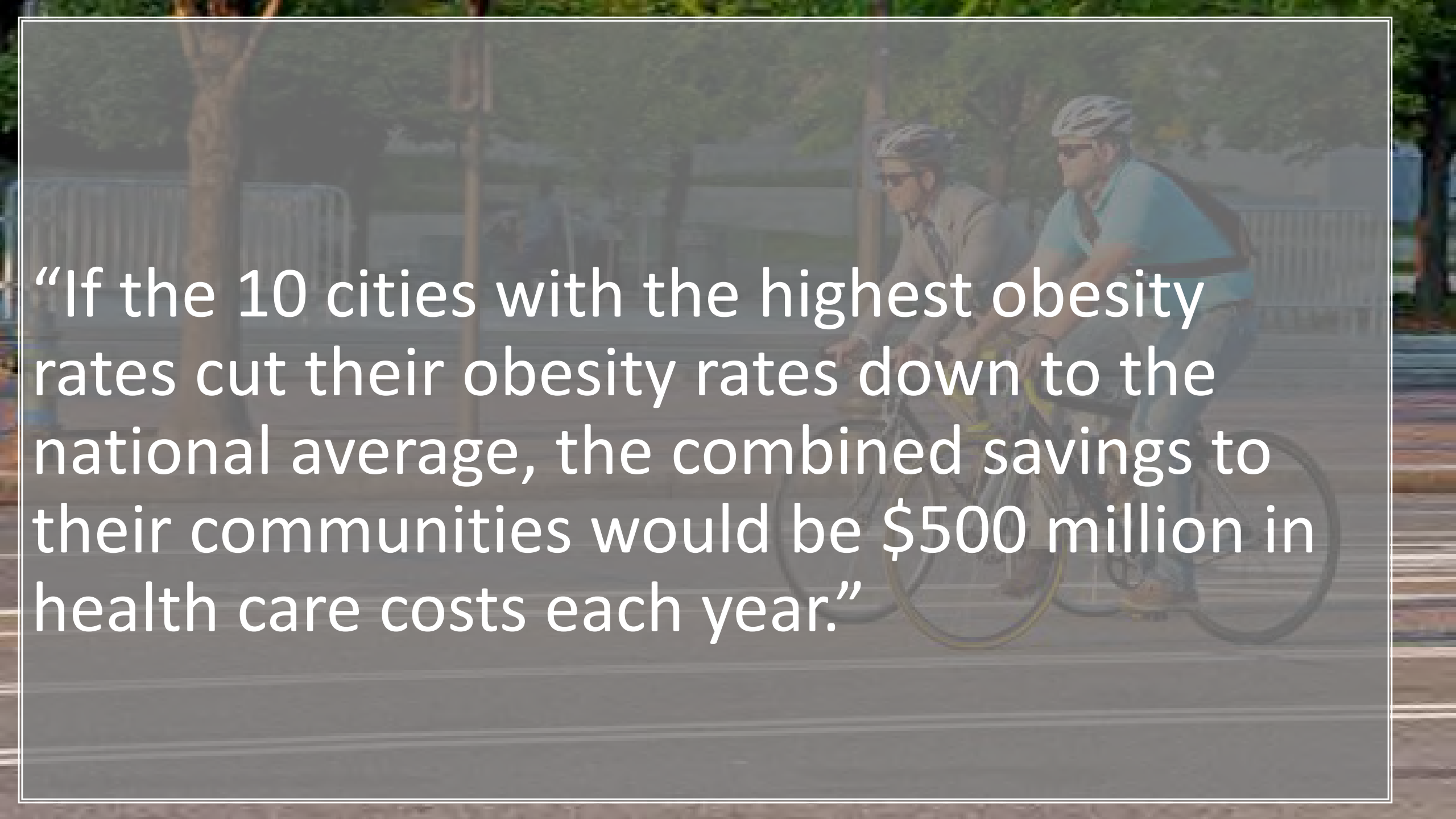
Active Transportation vs. Sedentary forms of transportation

- Sedentary forms of transportation- requires little energy expenditure and is primarily sitting
- Active Transportation is most closely related to Alternative Transportation
  - Walking, Biking, Transit Use
  - Active transportation can play a role on fighting our obesity epidemic and promote health behaviors



“The estimated annual health care **costs** of **obesity-related illness** are a staggering $190.2 billion or nearly 21% of annual medical **spending** in the United States. Childhood **obesity** alone is responsible for $14 billion in direct medical **costs**.”

— National League of Cities



“If the 10 cities with the highest obesity rates cut their obesity rates down to the national average, the combined savings to their communities would be $500 million in health care costs each year.”

# The Health Benefits of Multimodal Planning

- For each additional hour spent in a car per day was associated with a 6% increase in the likelihood of obesity.(Frank et al, 2004)
- Each additional kilometer spent walking was correlated with a 4.8% reduction in the likelihood of obesity. (Frank et al, 2004)
- Americans who use transit spend a median of 19 minutes daily walking to and from transit; 29% achieve > or =30 minutes of physical activity a day solely by walking to and from transit (Besser and Dannenberg, 2009)
- Encouraging people to use public transportation increases physical activity and reduces sedentary time (Bista, Debache, Chaix, 2020)

# The Health Benefits of Multimodal Planning & modal shift adoption

- Designing for multimodal infrastructure to facilitate accessibility and mobility to destinations can help us improve the health of our communities and increase the productivity of our transportation system.

- Land use and zoning play a big role in the urban fabric of our communities
- Diet and nutrition share a great proportion of the impacts on health and a healthy weight
  - Access to healthy foods
  - Decreasing food deserts

# Questions, Comments, Discussion

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