



Micromobility & Vehicle Design of Today (and Tomorrow)

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WALKING AND BIKING: USER INSIGHTS AND THE TOOLKITS YOU NEED TO KNOW ABOUT!

TUESDAY, JULY 20, 2021



Growth of Shared Micromobility

1960s-1990s: Bike share 1.0
(informal systems)

2000s: Bike share 2.0
(structured, dock-based system)

2016: Dockless bike share
(private)

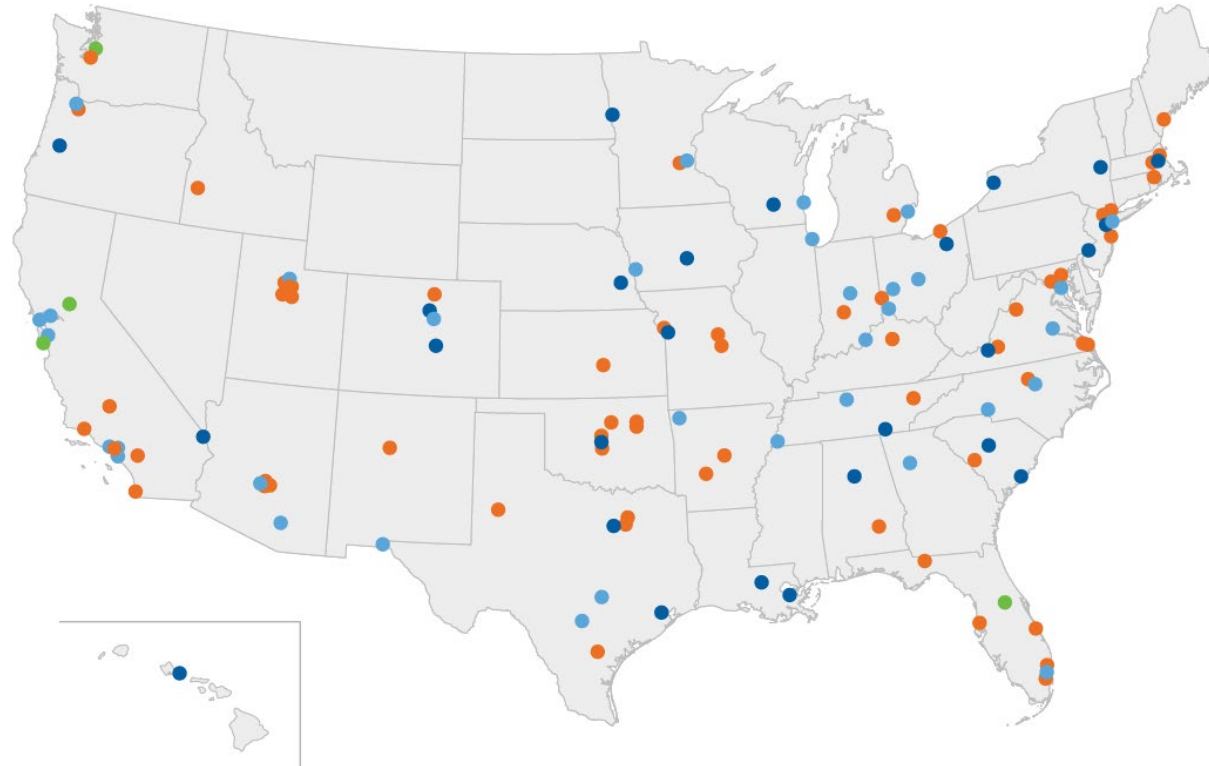
2017: E-scooters

2019: E-bike share & adaptive

SHARED MICROMOBILITY ACROSS THE US

As of 12/31/2019. Source: NACTO

- Station-based systems only
- Both dockless & station-based systems
- Dockless scooters and/or bikes only
- Dockless bikes only



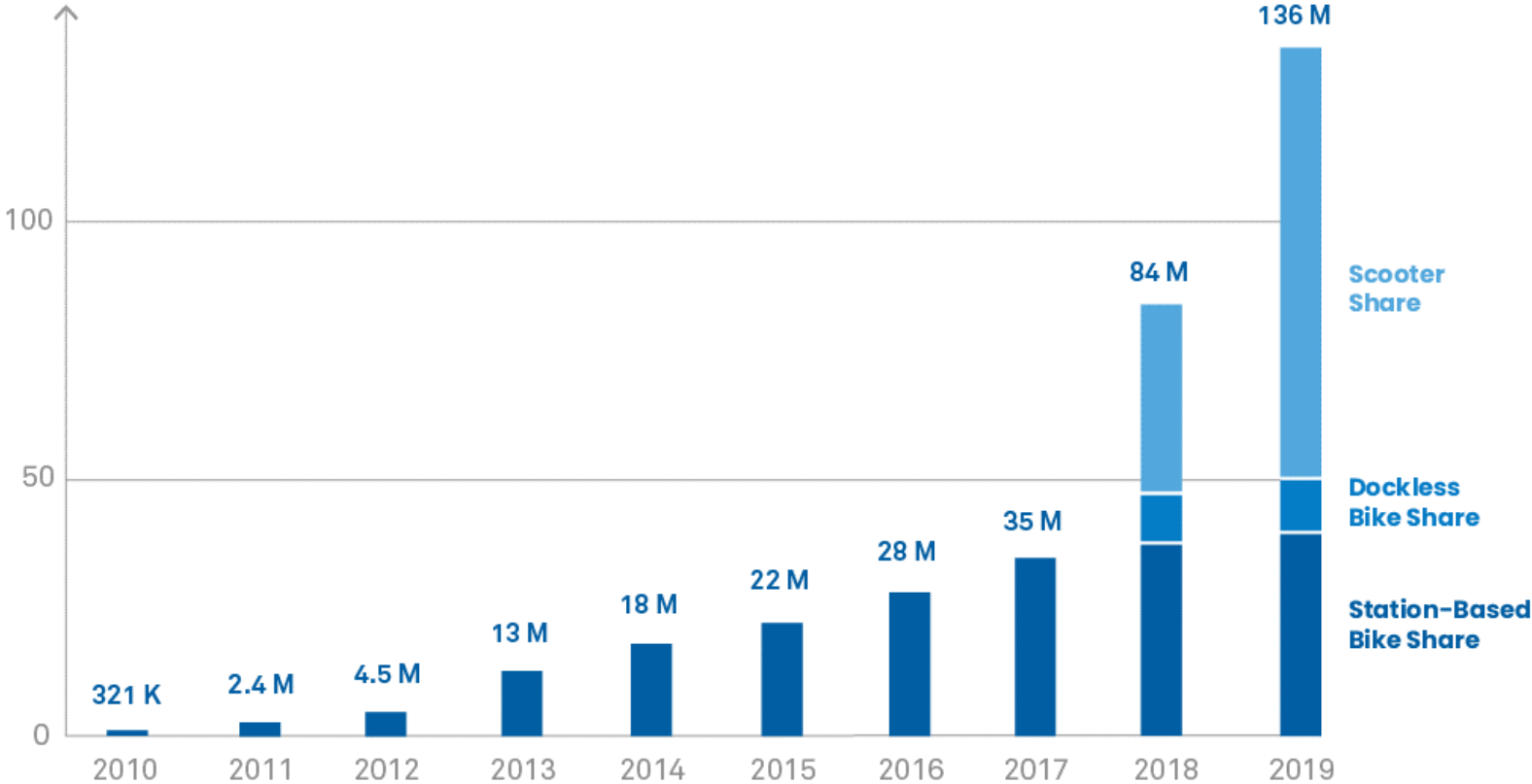
Source: National Association of City Transportation Officials, *Shared Micromobility in the U.S.: 2020*



Ridership of Shared Micromobility

SHARED MICROMOBILITY RIDERSHIP GROWTH FROM 2010-2019,
IN MILLIONS OF TRIPS

Source: NACTO



Source: National Association of City Transportation Officials, *Shared Micromobility in the U.S.: 2020*



Evolution of E-bike Regulations

MODEL LEGISLATION

» States that have enacted PeopleForBikes' model law, which defines and regulates three classes of electric bicycles within states' motor vehicle codes, gives riders similar rights and duties to that of traditional bicycle riders.

ACCEPTABLE

» Regulated as a bicycle
 » Passengers allowed
 » No age minimum
 » No licensing or registration required
 » Can use existing bike infrastructure

PROBLEMATIC

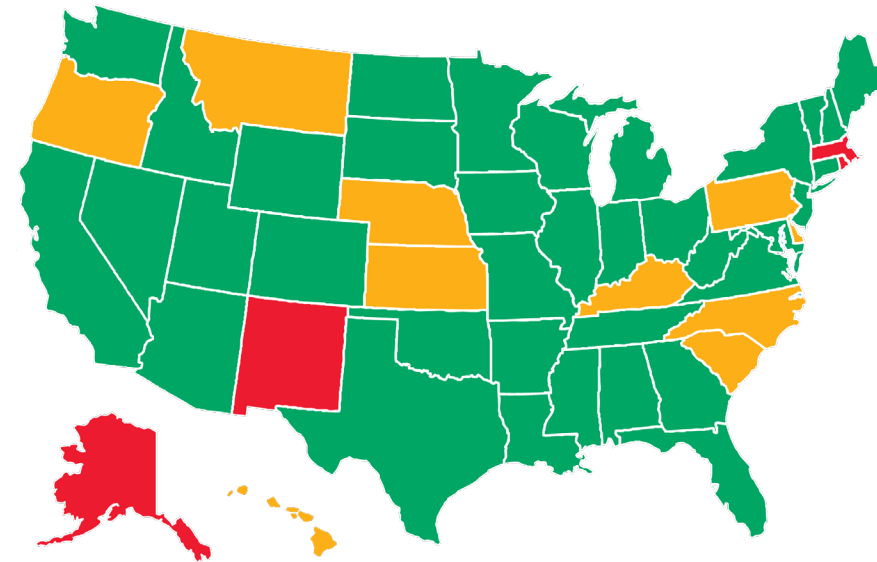
» Regulated as a moped or motor vehicle
 » Confusing equipment + use requirements
 » Confusing licensing + registration requirements
 » Confusing access to bike infrastructure

Class 1: pedal-assist only, ≤ 20 mph

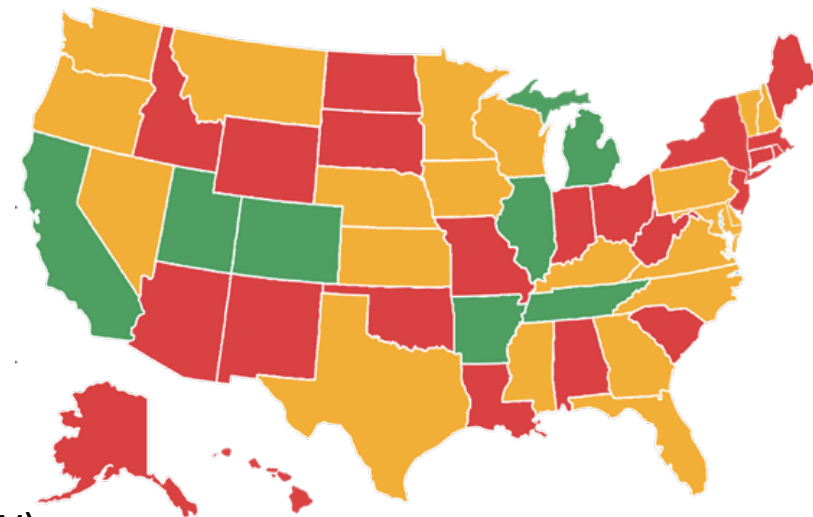
Class 2: with throttle-assisted, ≤ 20 mph

Class 3: pedal-assist only, ≤ 28 mph

All classes limit the motor's power to 1 horsepower (750W).



2021



2017

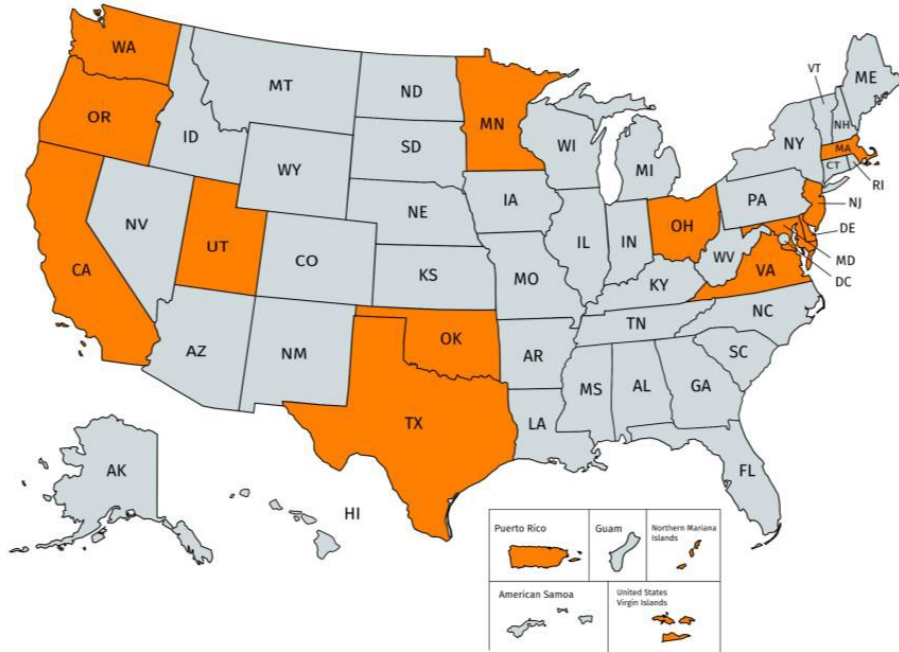


peopleforbikes

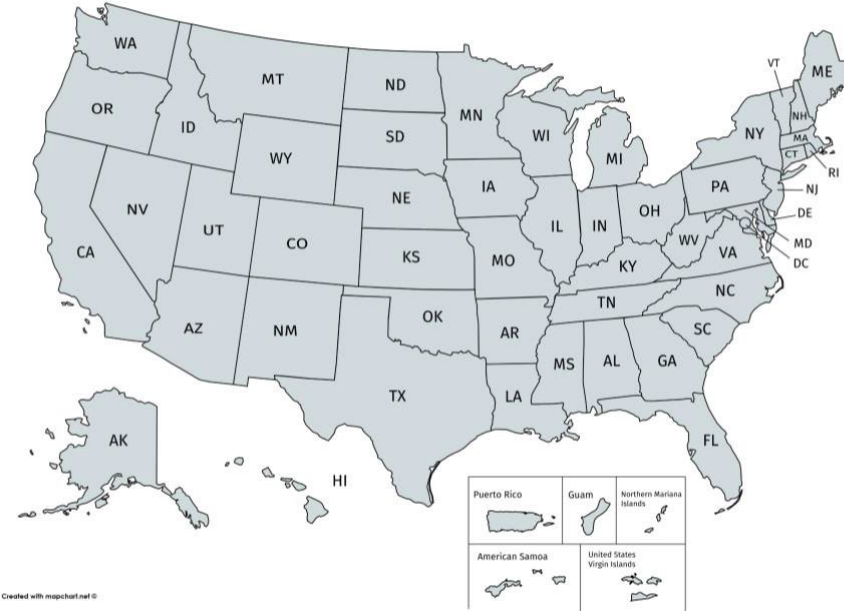


Emerging vehicles regulations

Motorized "scooter"



Hoverboards



Electric personal assist mobility device (EPAMDs) : 36 states (23 allow on sidewalks)



Adaptive Bicycles & Scooters



Trikes/quadricycles



Tandems



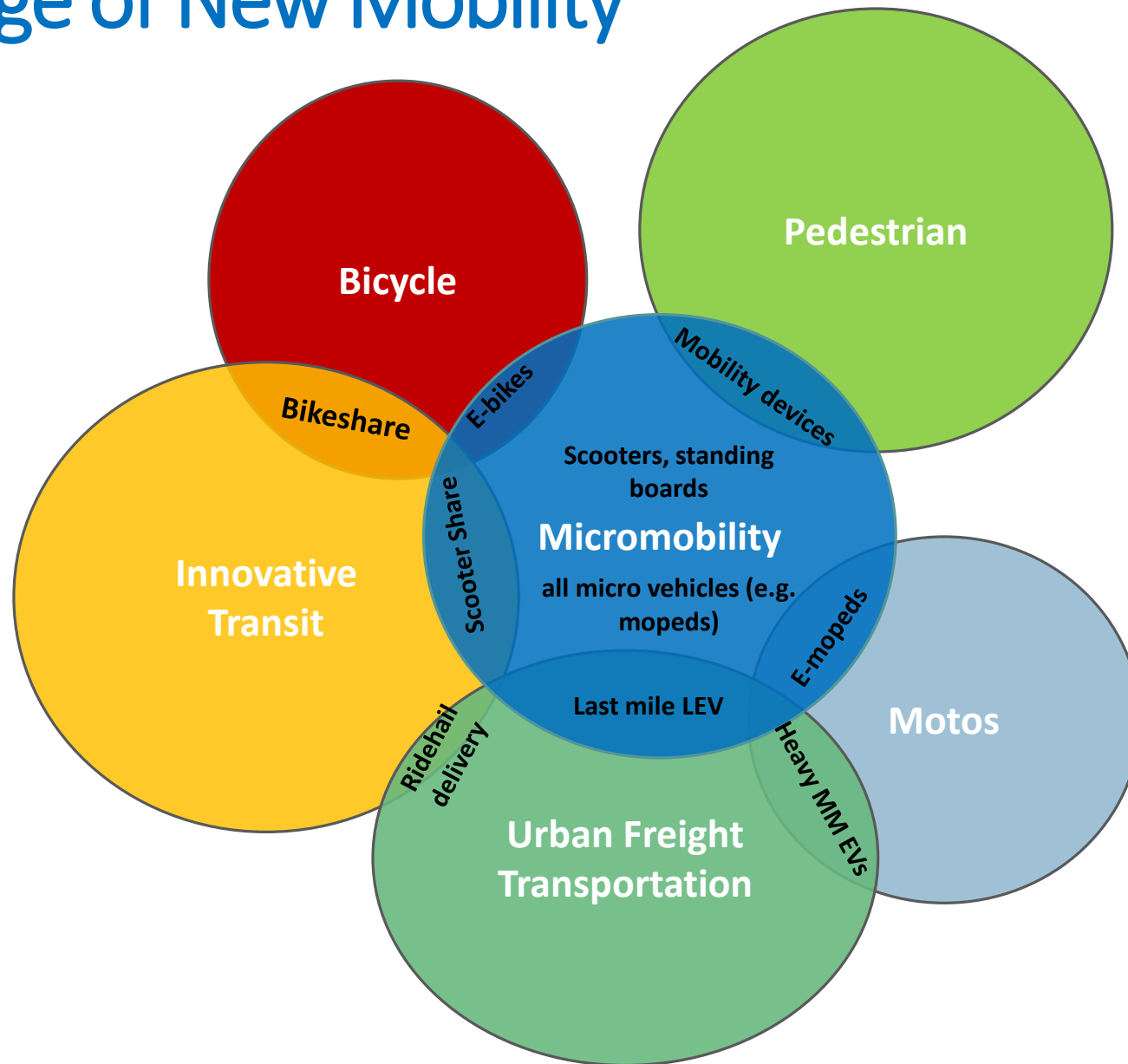
Hand cycles



Electric bikes/scooters



Age of New Mobility



Micromobility refers to any small, low-speed, human or electric-powered vehicle, including:

- bicycles
- electric-assist bicycles (e-bikes)
- powered standing scooters (e-scooters)
- powered seated scooters (scooter/moped)
- electric personal assistive mobility device (EPAMD)
- personal delivery devices
- other small, lightweight, wheeled device





What is that?

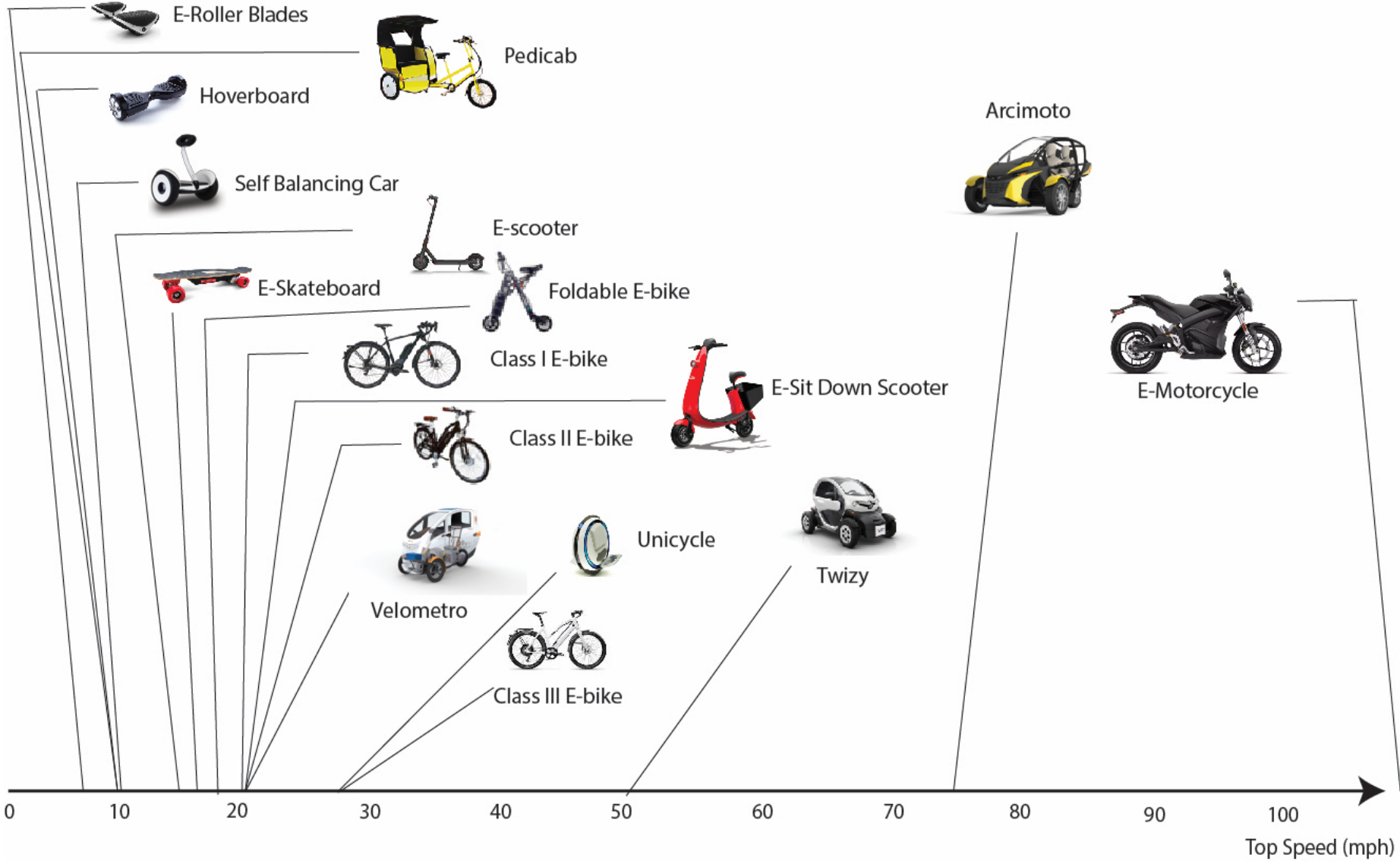
Seated powered scooter Motor-driven cycle
Scooter Motorized skateboard Motorcycle
E-trike Electric skateboard Motorized bicycle
Pedicab Electric scooter Kick scooter
Motorscooter Electric skates Hoverboard
Electric unicycle Electric kick scooter E-bike
Electric personal assist mobility device
E-scooter Powered Cycle Moped
Electric unicycle Light electric vehicle
Motor-assisted bicycle Electric mobility vehicle
Motorized scooter Push scooter Segway



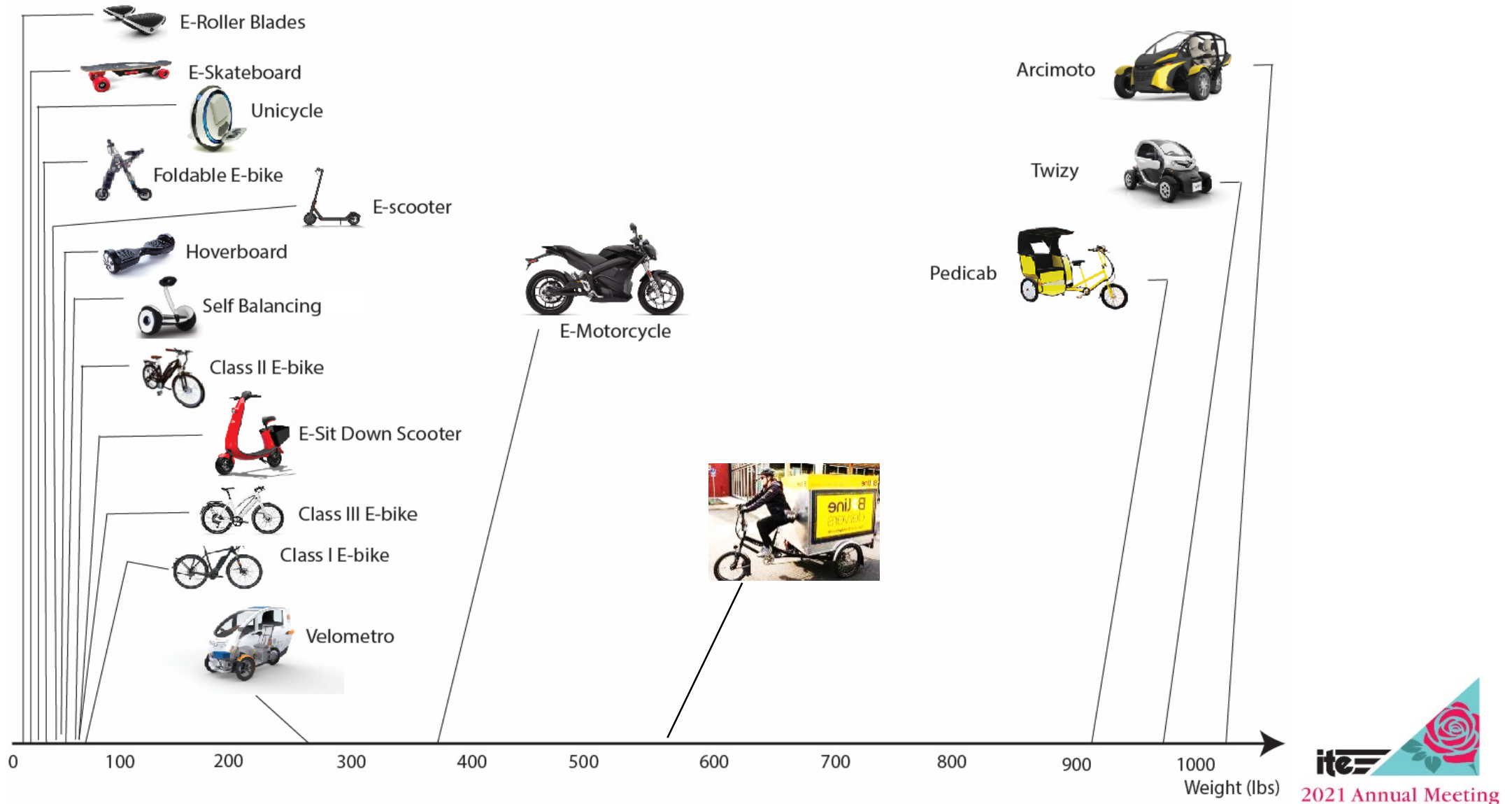
Are these different?



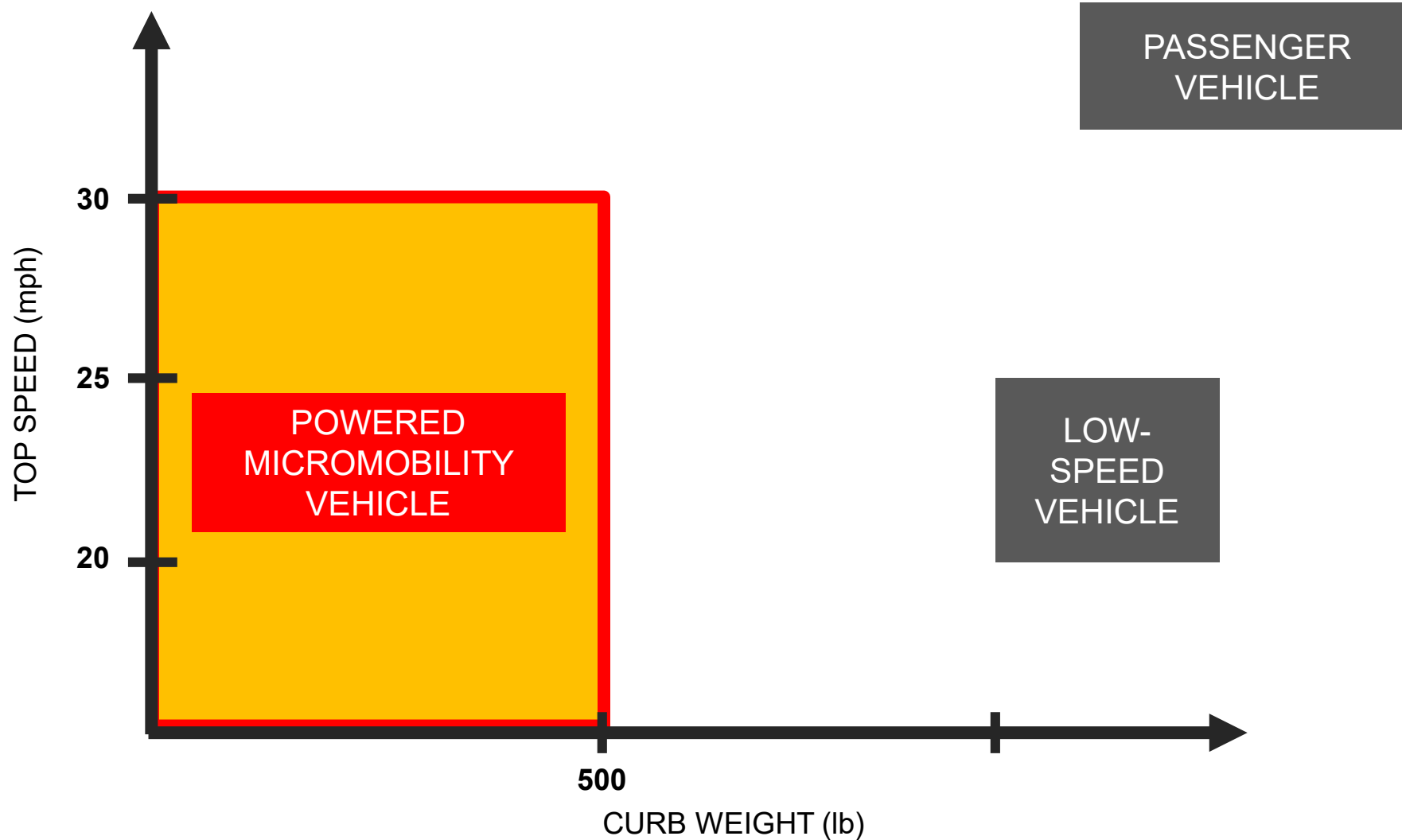
Looking at LEVs and Micromobility: Defining by speed?



Looking at LEVs and Micromobility: Defining by weight?



Defining the Powered Micromobility Vehicles



SAE Powered Micromobility Vehicles Committee



POWERED MICROMOBILITY VEHICLE

A wheeled vehicle that must:







- Be fully or partially powered
- Have a curb weight \leq 500 lb (227 kg)
- Have a top speed \leq 30 mph (48 km/h)

J3194: Taxonomy and Classification of Powered Micromobility Vehicles

J3230: Kinematic Performance Metrics for Powered Standing Scooters

J3163: Taxonomy of On-Demand and Shared Mobility

TYPES OF POWERED MICROMOBILITY VEHICLES¹

	Powered Bicycle	Powered Standing Scooter	Powered Seated Scooter	Powered Self-Balancing Board	Powered Non-Self-Balancing Board	Powered Skates
						
Center column	Y	Y	Y	Possible	N	N
Seat	Y	N	Y	N	N	N
Operable pedals	Y	N	N	N	N	N
Floorboard / foot pegs	Possible	Y	Y	Y	Y	Y
Self-balancing ²	N	N	N	Y	N	Possible

Source: https://saemobilus.sae.org/content/J3194_201911/



CLASSIFICATION SYSTEM

The classification system consists of the micromobility vehicle type with descriptors of curb weight, vehicle width, top speed and power source.

Name	Code	Description
Curb weight		
Ultra lightweight	WT1	Curb weight \leq 50 lb (23 kg)
Lightweight	WT2	50 lb (23 kg) < curb weight \leq 100 lb (45 kg)
Midweight	WT3	100 lb (45 kg) < curb weight \leq 200 lb (91 kg)
Midweight Plus	WT4	200 lb (91 kg) < curb weight \leq 500 lb (227 kg)
Vehicle width		
Standard-width	WD1	Vehicle width \leq 3 ft (0.9 m)
Wide	WD2	3 ft (0.9 m) < vehicle width \leq 4 ft (1.2 m)
Extra-Wide	WD3	4 ft (1.2 m) < vehicle width \leq 5 ft (1.5 m)
Top speed		
Ultra low-speed	SP1	Top speed \leq 8 mph (13 km/h)
Low-speed	SP2	8 mph (13 km/h) < top speed \leq 20 mph (32 km/h)
Medium-speed	SP3	20 mph (32 km/h) < top speed \leq 30 mph (48 km/h)
Power source		
Electric	E	Powered by an electric motor
Combustion	C	Powered by an internal combustion engine

Source: https://saemobilus.sae.org/content/J3194_201911/

GUIDANCE ON TERMINOLOGY USE

The following naming convention may be used to develop either word- or code-based terms using classifiers and vehicle types.



- Curb weight: 40 lb
- Width: 2 ft
- Top speed: 18 mph
- Propulsion: electric

“Ultra lightweight, standard-width, low-speed, electric standing scooter”

“WT1/WD1/SP2/E standing scooter”



- Curb weight: 190 lb
- Width: 2 ft
- Top speed: 30 mph
- Propulsion: electric

“Midweight, standard-width, medium-speed, electric seated scooter”

“WT3/WD1/SP3/E seated scooter”



Ongoing Work for SAE Powered Micromobility Committee



- J3230/2: Expanding Kinematic Standards on Scooters
- Labeling for the identification of vehicles
- Lighting and reflectors

EXAMPLE OF GENERIC CLASS LABELS

CLASS 1: 350W // 20MPH

a) A rectangular label with a grey background. The text 'CLASS 1' is in large, bold, black letters, and '350W // 20mph' is in smaller, black letters below it.

b) A rectangular label with a white background. The text 'CLASS' is in small, black letters at the top, '1' is in large, bold, black letters in the center, and '350W' and '20mph' are in smaller, black letters at the bottom.

c) A rectangular label with a black background. The text 'CLASS' is in small, white letters at the top, '1' is in large, bold, white letters in the center, and '350W' and '20mph' are in smaller, white letters at the bottom.

CLASS 2: 500W // 20MPH

a) A rectangular label with a grey background. The text 'CLASS 2' is in large, bold, black letters, and '500W // 20mph' is in smaller, black letters below it.

b) A rectangular label with a white background. The text 'CLASS' is in small, black letters at the top, '2' is in large, bold, black letters in the center, and '500W' and '20mph' are in smaller, black letters at the bottom.

c) A rectangular label with a black background. The text 'CLASS' is in small, white letters at the top, '2' is in large, bold, white letters in the center, and '500W' and '20mph' are in smaller, white letters at the bottom.

CLASS 3: 350W // 28MPH

a) A rectangular label with a grey background. The text 'CLASS 3' is in large, bold, black letters, and '350W // 28mph' is in smaller, black letters below it.

b) A rectangular label with a white background. The text 'CLASS' is in small, black letters at the top, '3' is in large, bold, black letters in the center, and '350W' and '28mph' are in smaller, black letters at the bottom.

c) A rectangular label with a black background. The text 'CLASS' is in small, white letters at the top, '3' is in large, bold, white letters in the center, and '350W' and '28mph' are in smaller, white letters at the bottom.



TRB Emerging Vehicles for Low Speed Transportation Joint Subcommittee (ACH20, ACH10, ANB40, AP020)

Activities & Needs/Synthesis Statements

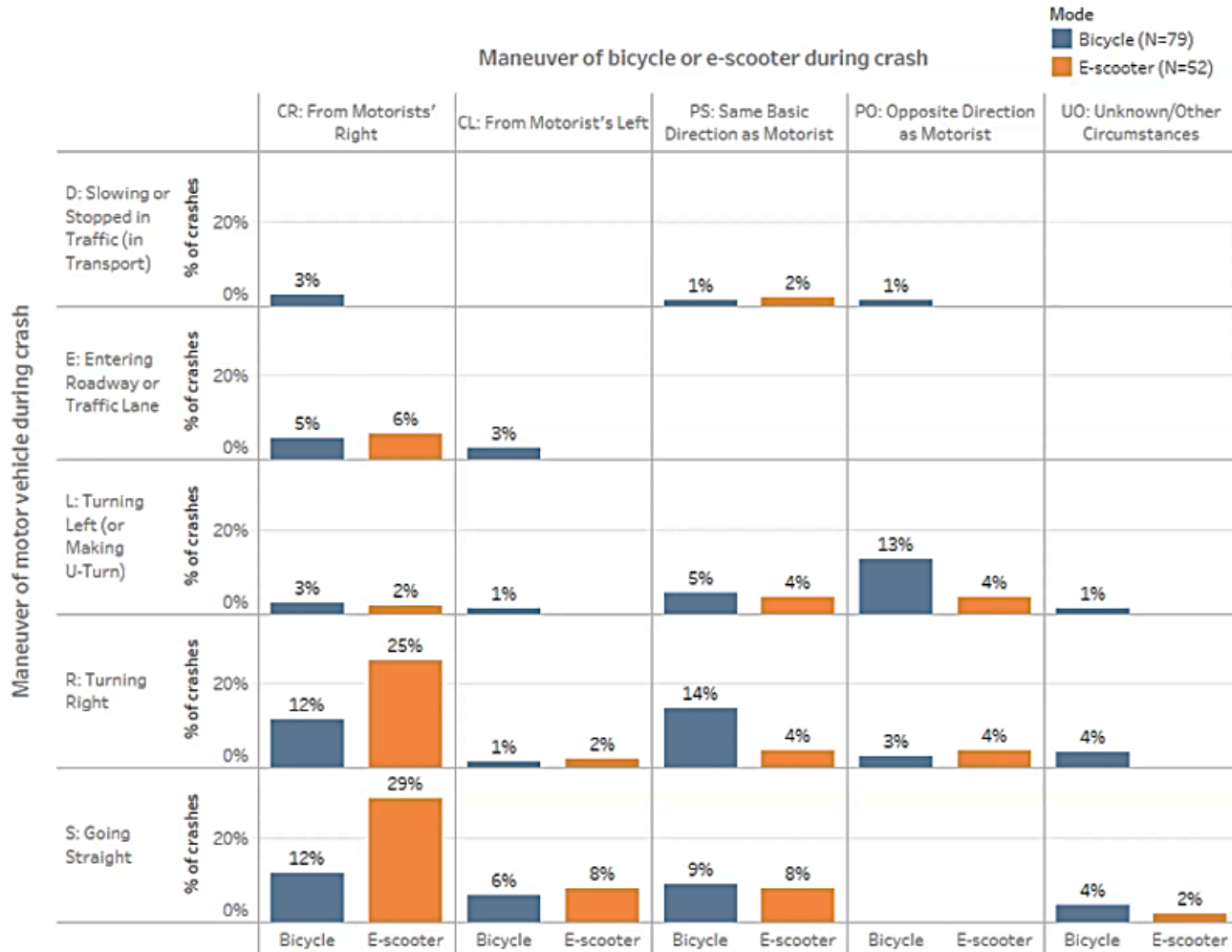
- 1) Review subcommittee name, scope, and organization
 - 2) Potential new name: Micromobility Vehicles Subcommittee
 - 3) Restructuring Committee leadership
 - 4) Developing research agenda
- TCRP J-11/Task 37: Transit and Micro-Mobility
 - BTSCR 10: E-Scooter Safety: Issues and Solutions
 - NCHRP Synthesis 52-13: Micromobility Policies, Permits, and Practices
 - TCRP B-47: Impact of Transformational Technologies on Underserved Populations



How to address the growing conflicts?



Intersections are important



80% of bicycle *and* scooter crashes occur at intersections

But...

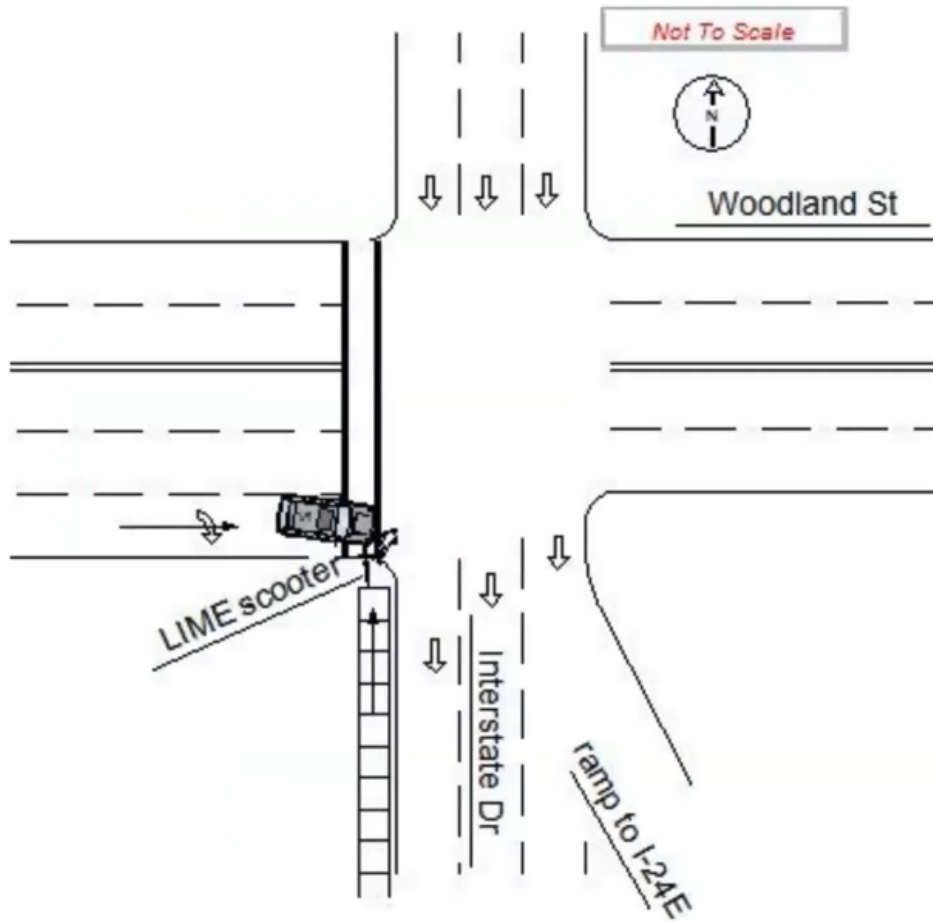
25% of scooter intersection crashes are right turn/right approach crashes (2.5 times higher than bicycle). Mostly sidewalk into road.

Bicyclists experience more car left-turn conflicts (cars fail to yield)

Source: C. Cherry, University of Tennessee - Knoxville



Consider this common case



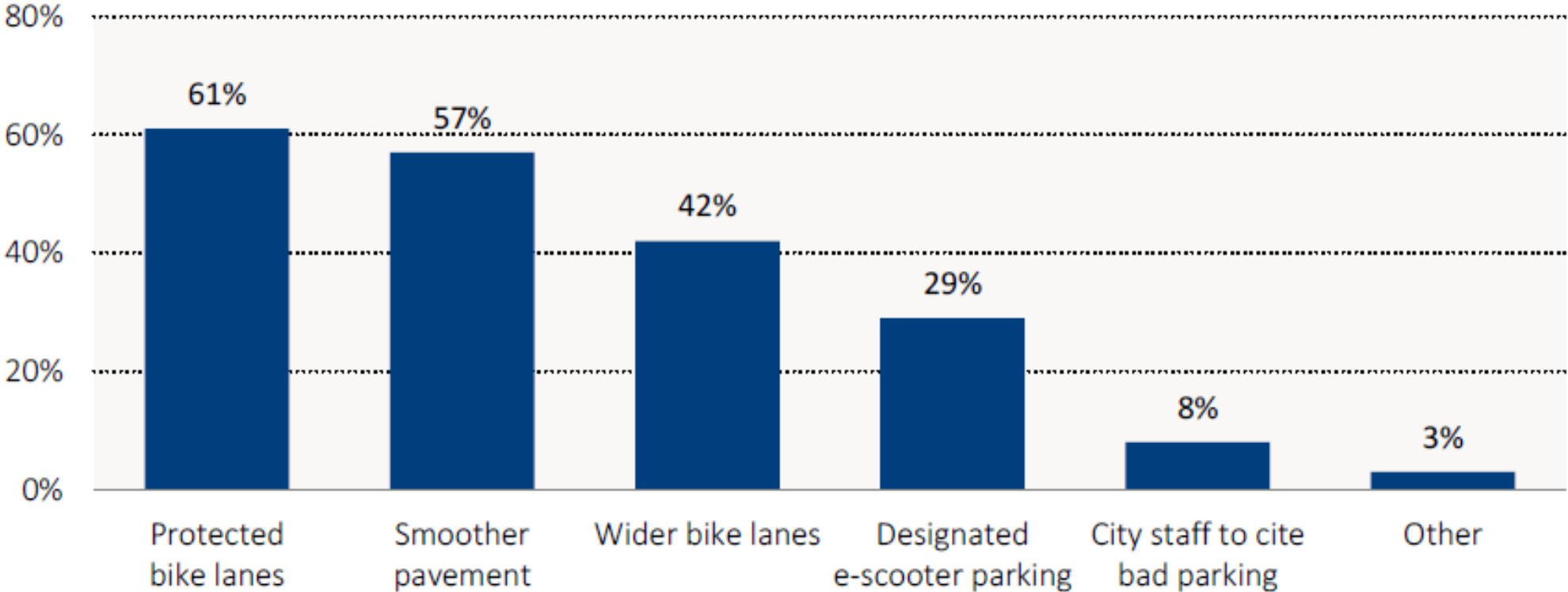
- Education only goes so far.
- Most drivers reported not seeing approaching scooter.
- Right turn on red is a known pedestrian- and safety-risk.
- Disconnected one-way networks increase risky behavior.
- Intersection design should increase visibility, slow turning vehicles.

Source: C. Cherry, University of Tennessee - Knoxville



Desired infrastructure improvements

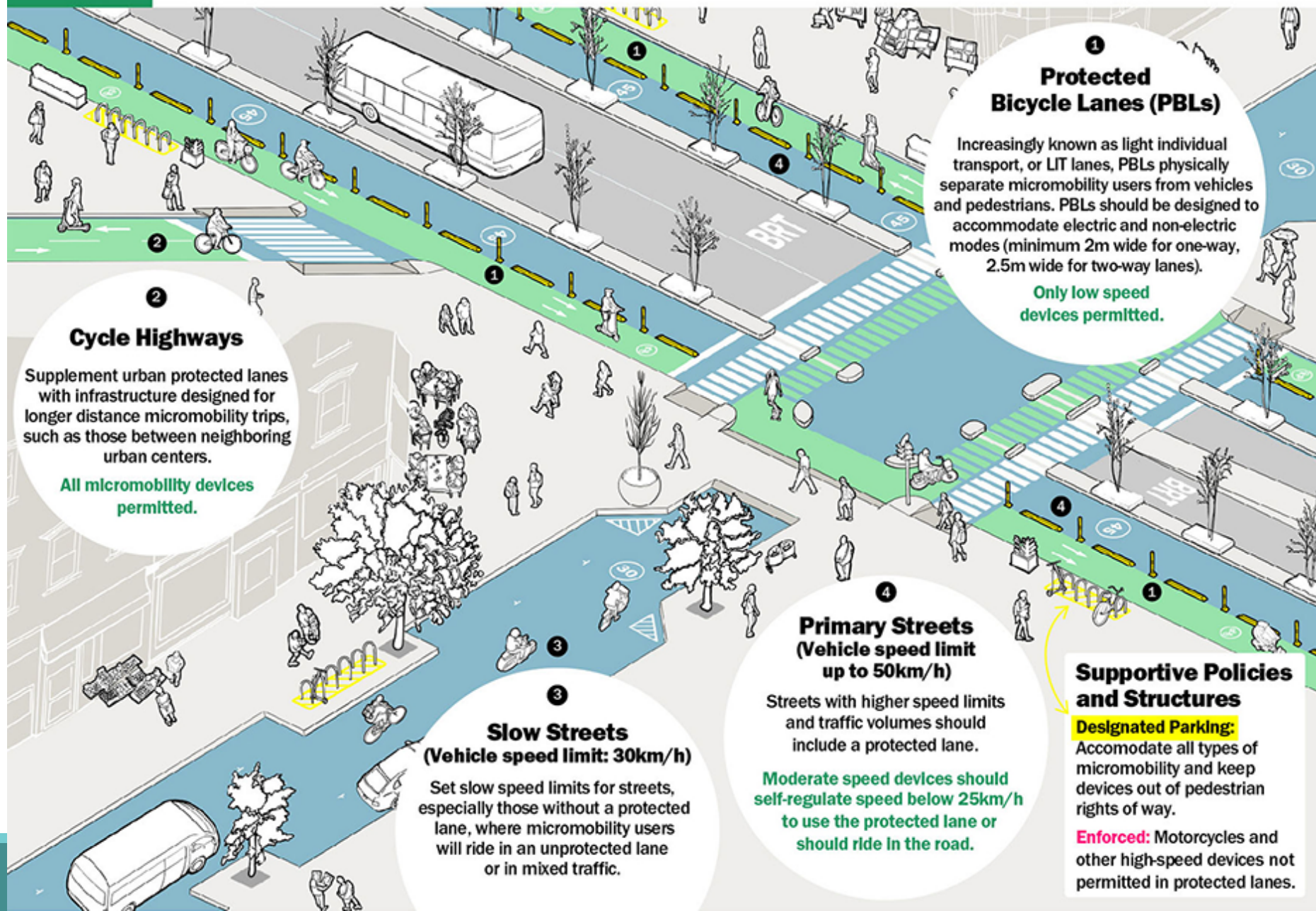
What city infrastructure improvements would make you feel more safe? (% of responses)



Source: Bird (2019).



Safe “micromobility corridors” provide equitable access to more places for more people.



2 Cycle Highways

Supplement urban protected lanes with infrastructure designed for longer distance micromobility trips, such as those between neighboring urban centers.

All micromobility devices permitted.

1 Protected Bicycle Lanes (PBLs)

Increasingly known as light individual transport, or LIT lanes, PBLs physically separate micromobility users from vehicles and pedestrians. PBLs should be designed to accommodate electric and non-electric modes (minimum 2m wide for one-way, 2.5m wide for two-way lanes).

Only low speed devices permitted.

4 Primary Streets (Vehicle speed limit up to 50km/h)

Streets with higher speed limits and traffic volumes should include a protected lane.

Moderate speed devices should self-regulate speed below 25km/h to use the protected lane or should ride in the road.

3 Slow Streets (Vehicle speed limit: 30km/h)

Set slow speed limits for streets, especially those without a protected lane, where micromobility users will ride in an unprotected lane or in mixed traffic.

Supportive Policies and Structures

Designated Parking:

Accommodate all types of micromobility and keep devices out of pedestrian rights of way.

Enforced: Motorcycles and other high-speed devices not permitted in protected lanes.

Source: Institute for Transportation and Development Policy

Integrating Equity into Micromobility

- Equity Policies
- Funding Equity Work
- Workforce Development
- Marketing
- Data Collection and Metrics
- Community Partnerships
- Payment and Access Technology
- Integrating Bike Share and Transit
- Emerging Devices in New Mobility
- Adaptive Bike Share



Emerging Devices in New Mobility

Breaking Barriers to Bike Share
Topics in Bike Share Equity - 9 of 10

OVERVIEW

The rapid roll-out of dockless electric scooter (e-scooter) sharing systems in the past couple of years has marked a major disruption in urban mobility. As of spring 2019, about 10 scooter companies were operating in approximately 70 U.S. cities. E-scooters, electric bicycles (e-bikes) and other new devices offer new mobility options, but they have also raised concerns and issues about how they are being deployed and used in relation to bike share systems, especially related to low-income communities. Over the next few years, as cities and operators determine how these new devices fit into the overall mobility landscape, it is critical that they are intentional in maximizing the benefits of these services for residents with the greatest need and the most barriers.

CURRENT APPROACHES

In our recent national survey of cities and bike share operators, most indicated that it was too early to tell the real impact that e-scooters will have on bike share programs, systems and users. The rollout of e-scooters has changed the business model for docked and dockless bike share, especially privately-owned systems like Lime and JUMP. Many of the approximately 44,000 dockless pedal bikes in the U.S. at the end of 2017 are no longer in operation or have transitioned to e-scooters. Many dockless bike share companies have retooled their fleets to focus primarily on e-scooters.


E-bikes and seated e-scooters are also broadening the micromobility options in some cities, which may complement existing bike share systems and appeal to residents looking to make longer trips, overcome disabilities or physical limitations, and navigate steep terrain. Research has found that lower-income people of color were more likely to perceive distances as being too long to ride on a bike and also more likely to say physical limitations or health issues pose significant barriers to cycling (McNeil et al., 2017). E-bikes, including adaptive ones, are often targeted at people of all abilities and viewed as a means of increasing ridership and access for people not able to ride a standard pedal bike.

Are e-scooters taking ridership from bike share systems? The City of Portland found that only 5% of e-scooter trips replaced a personal bicycle, and most riders were not members of the bike share system BIKETOWN. Nice Ride in Minneapolis estimates that e-scooters took away 10% of bike share trips in 2018. E-scooter use is more likely poaching casual bike share users, which has the potential to impact the bottom line. Erosion of revenue could challenge the business model for public bike share systems. Most operators have kept these systems independent of each other, especially related to low-income discount programs.

 Powered Bicycle	 Powered Self-Balancing Board
 Powered Standing Scooter	 Powered Seated Scooter

S&E J1191™ Taxonomy & Classification of Powered Micromobility Vehicles



National Scan of Bike Share Equity Programs

Approaches and best practices for promoting equity in bike share

Portland State University
Nathan McNeil
John MacArthur
Joseph Broach
Austin Cummings

Toole Design
Rae-Leigh Stark
Rebecca Sanders
Adrian Witte

TRANSPORTATION RESEARCH AND EDUCATION CENTER trec.pdx.edu

<https://trec.pdx.edu/research/bikeshare>



Contact Information

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LEVER

Light Electric Vehicle Education + Research Initiative

LEVER is a consortium of academia, industry, government and non-government organizations aimed to address collective research needs of e-bikes and other LEVs. LEVER is lead by researchers at University of Tennessee and Portland State University

- 1) Research Clearinghouse
- 2) Develop a Research Community by Expanding Partners
- 3) Provide Review/Synthesis Papers
- 4) Provide (Third Party) Policy Support
- 5) Increase Micromobility Research/Policy Visibility
- 6) Interface with Researchers/Practitioners (e.g. TRB)
- 7) Do Research

<http://LEVresearch.com>

@LEVERResearch

