Micromobility & Vehicle Design of Today (and Tomorrow)

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PORTLAND STATE UNIVERSITY

WALKING AND BIKING: USER INSIGHTS AND THE TOOLKITS YOU NEED TO KNOW ABOUT!
TUESDAY, JULY 20, 2021

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Growth of Shared Micromobility

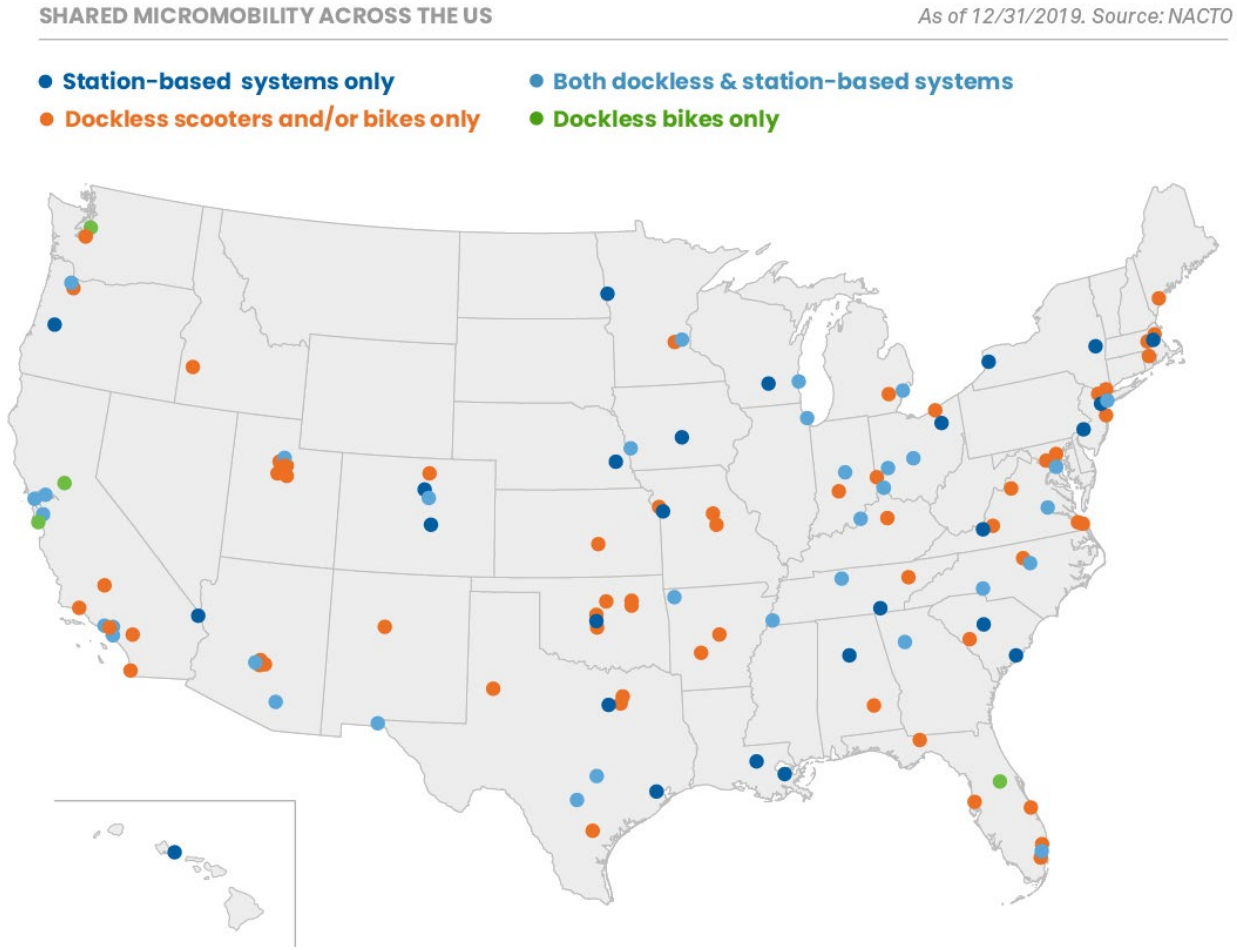
1960s-1990s: Bike share 1.0
(informal systems)

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

2016: Dockless bike share
(private)

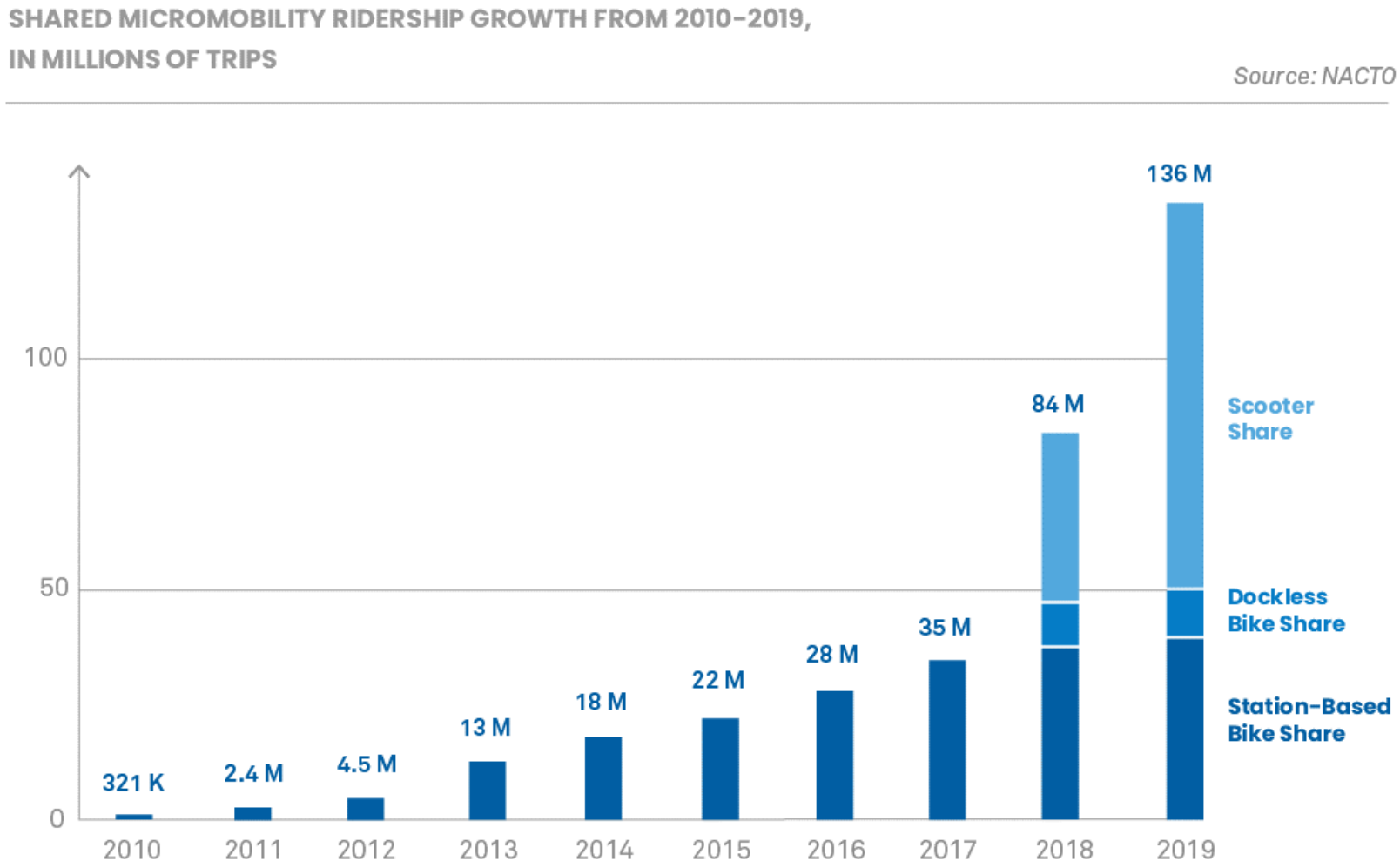
2017: E-scooters

2019: E-bike share & adaptive



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

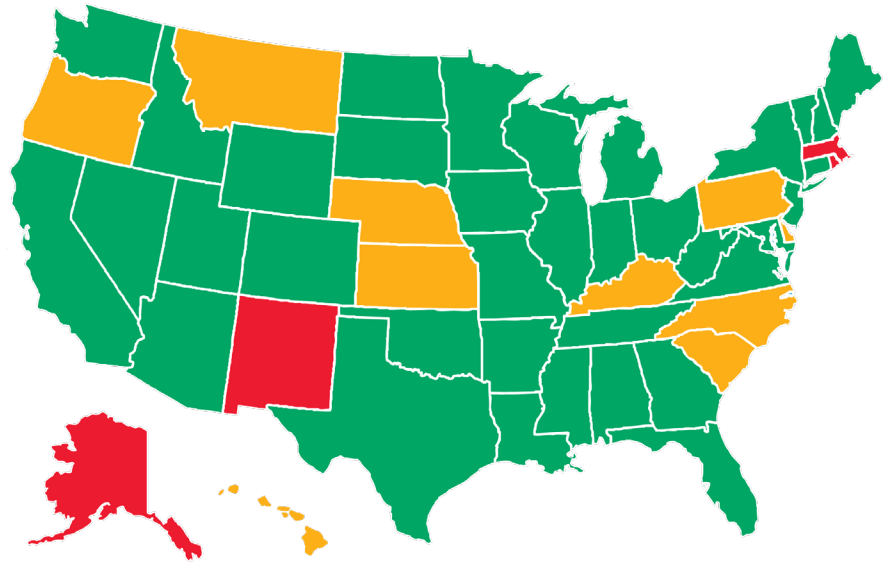
Ridership of Shared Micromobility



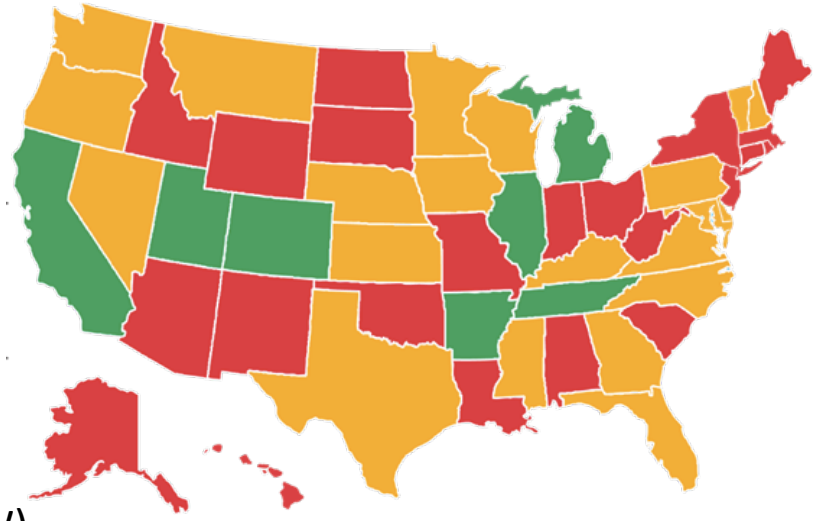
Source: National Association of City Transportation Officials, *Shared Micromobility in the U.S.: 2020*

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



2021



2017

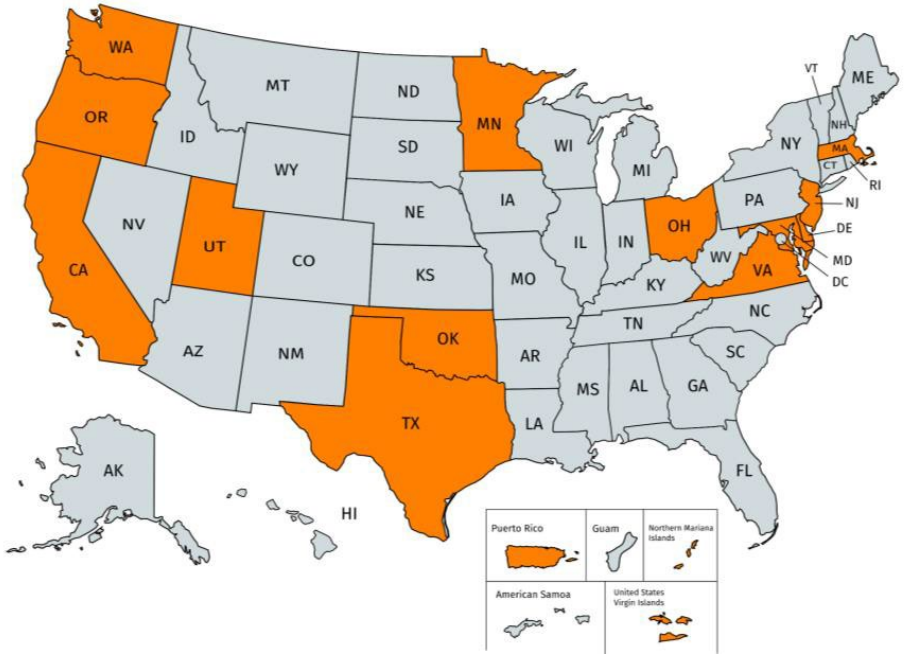
peopleforbikes

Class 1: pedal-assist only, ≤ 20 mph
Class 2: with throttle-assisted, ≤ 20 mph
Class 3: pedal-assist only, ≤ 28 mph

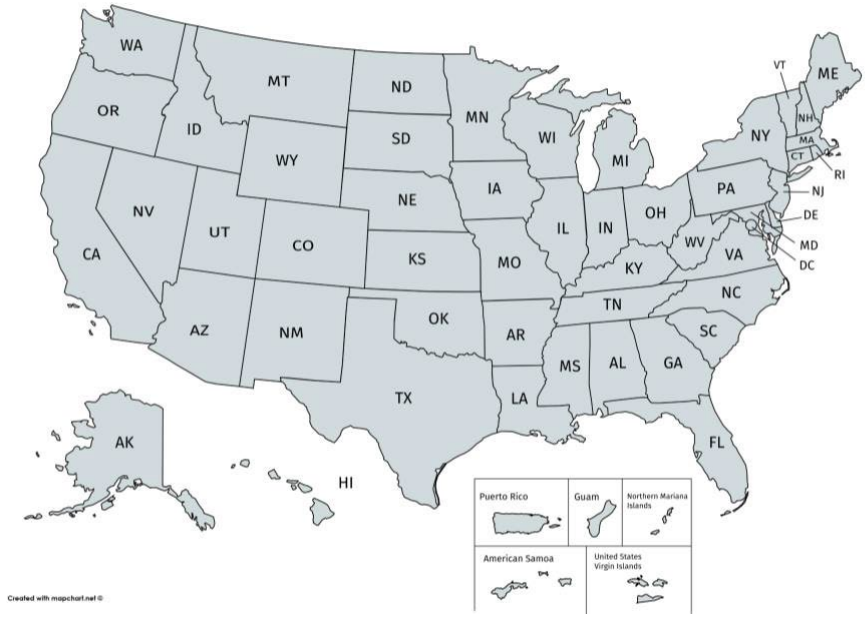
All classes limit the motor's power to 1 horsepower (750W).

Emerging vehicles regulations

Motorized ”scooter”



Hoverboards



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

Fang, et al. 2019

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Adaptive Bicycles & Scooters

Trikes/quadricycles

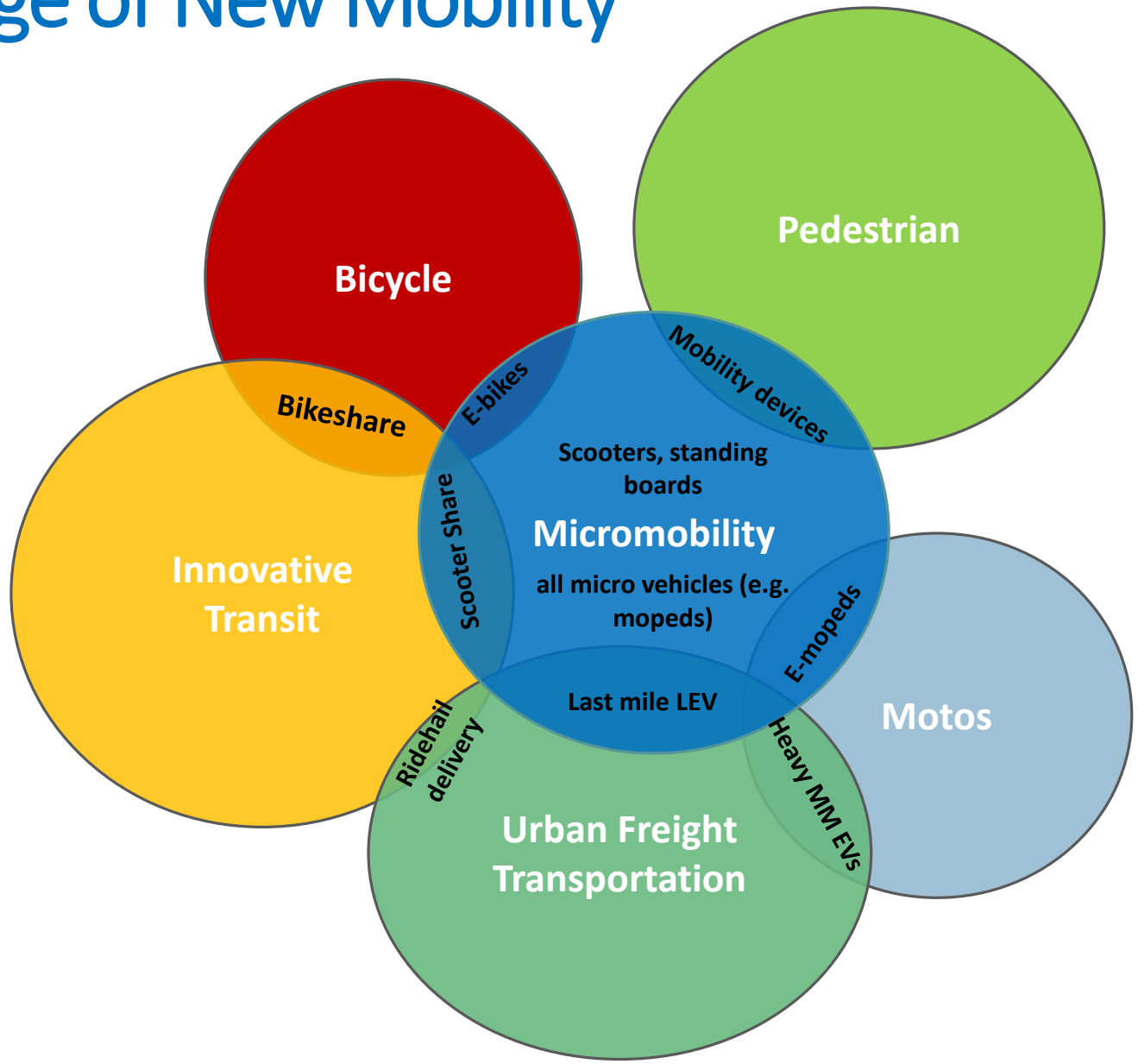
Tandems

Hand cycles

Electric bikes/scooters

MacArthur, J., et al., "Adaptive Bike Share: Expanding Access to Bike Share for People with Disabilities and Older Adults", TRR, June 2020 DOI: 10.1177/0361198120925079

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

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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

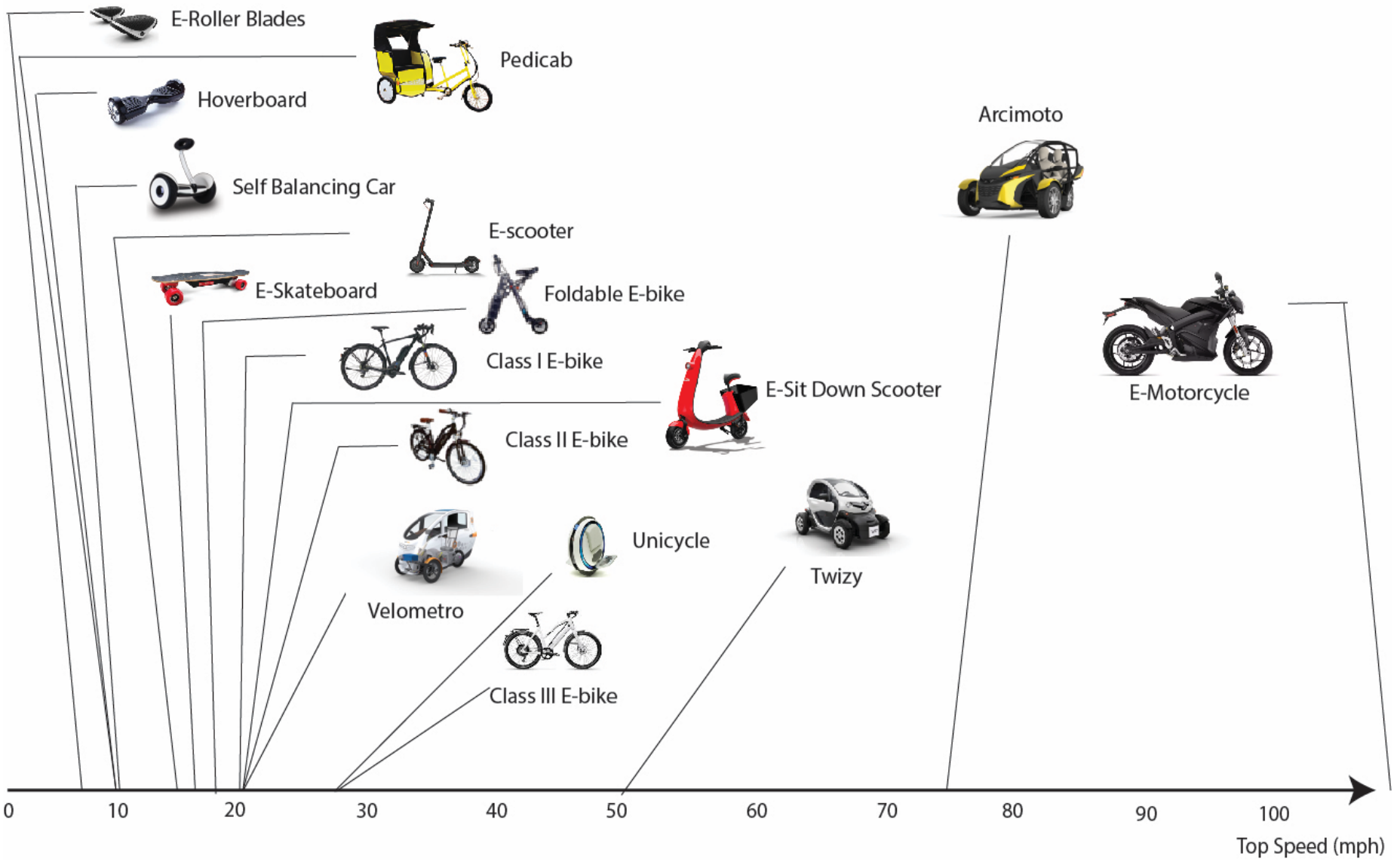
Motorized scooter

Push scooter

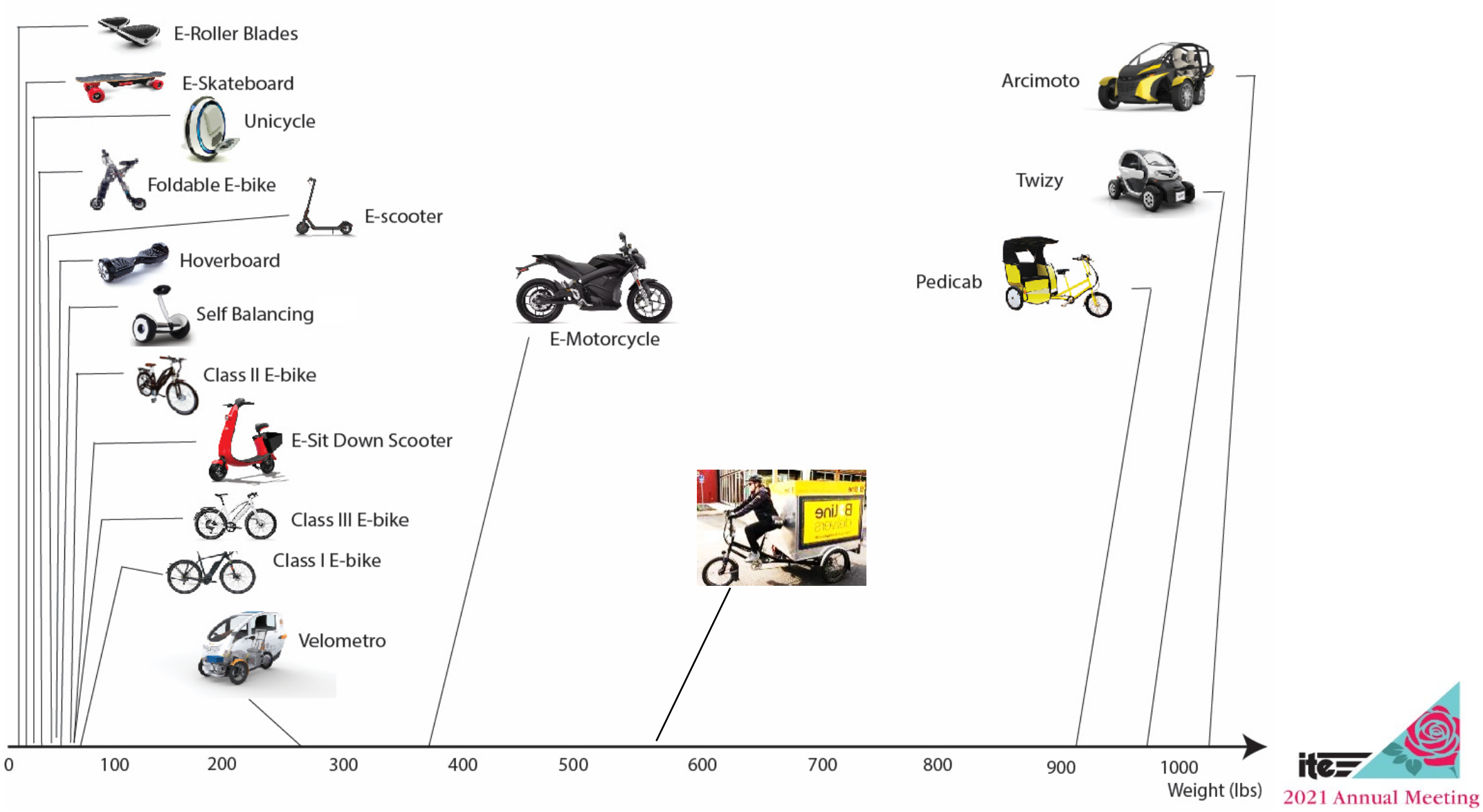
Segway

Are these different?

Looking at LEVs and Micromobility: Defining by speed?



Looking at LEVs and Micromobility: Defining by weight?



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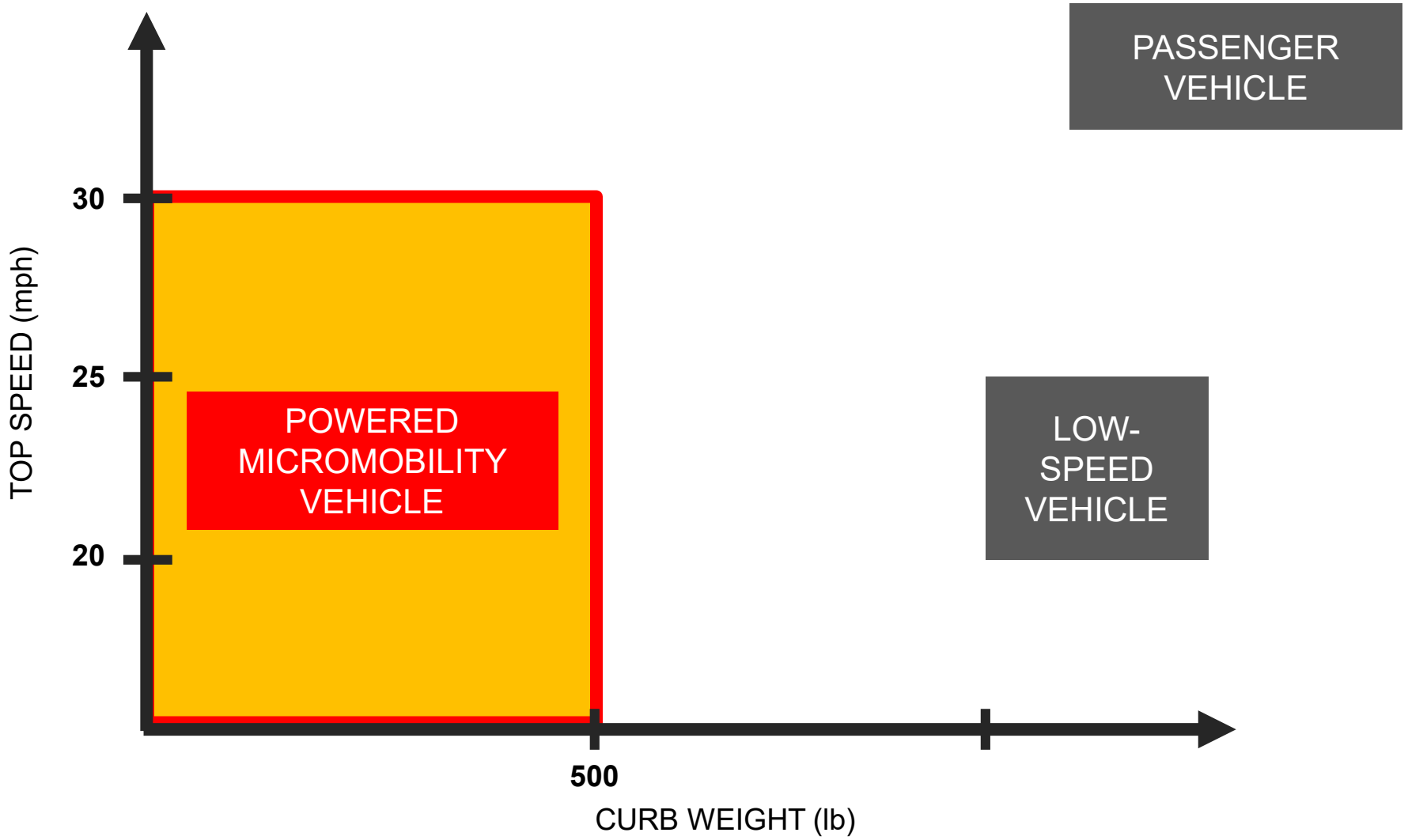
Defining the Powered Micromobility Vehicles



SAE Powered Micromobility Vehicles Committee

POWERED MICROMOBILITY VEHICLE

A wheeled vehicle that must:

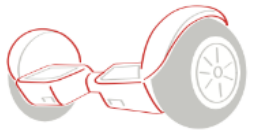
- Be fully or partially powered
- Have a curb weight ≤ 500 lb (227 kg)
- Have a top speed ≤ 30 mph (48 km/h)

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 VEHICLES[1]

	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 ≤ 50 lb (23 kg)
Lightweight	WT2	50 lb (23 kg) < curb weight ≤ 100 lb (45 kg)
Midweight	WT3	100 lb (45 kg) < curb weight ≤ 200 lb (91 kg)
Midweight Plus	WT4	200 lb (91 kg) < curb weight ≤ 500 lb (227 kg)
Vehicle width		
Standard-width	WD1	Vehicle width ≤ 3 ft (0.9 m)
Wide	WD2	3 ft (0.9 m) < vehicle width ≤ 4 ft (1.2 m)
Extra-Wide	WD3	4 ft (1.2 m) < vehicle width ≤ 5 ft (1.5 m)
Top speed		
Ultra low-speed	SP1	Top speed ≤ 8 mph (13 km/h)
Low-speed	SP2	8 mph (13 km/h) < top speed ≤ 20 mph (32 km/h)
Medium-speed	SP3	20 mph (32 km/h) < top speed ≤ 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"

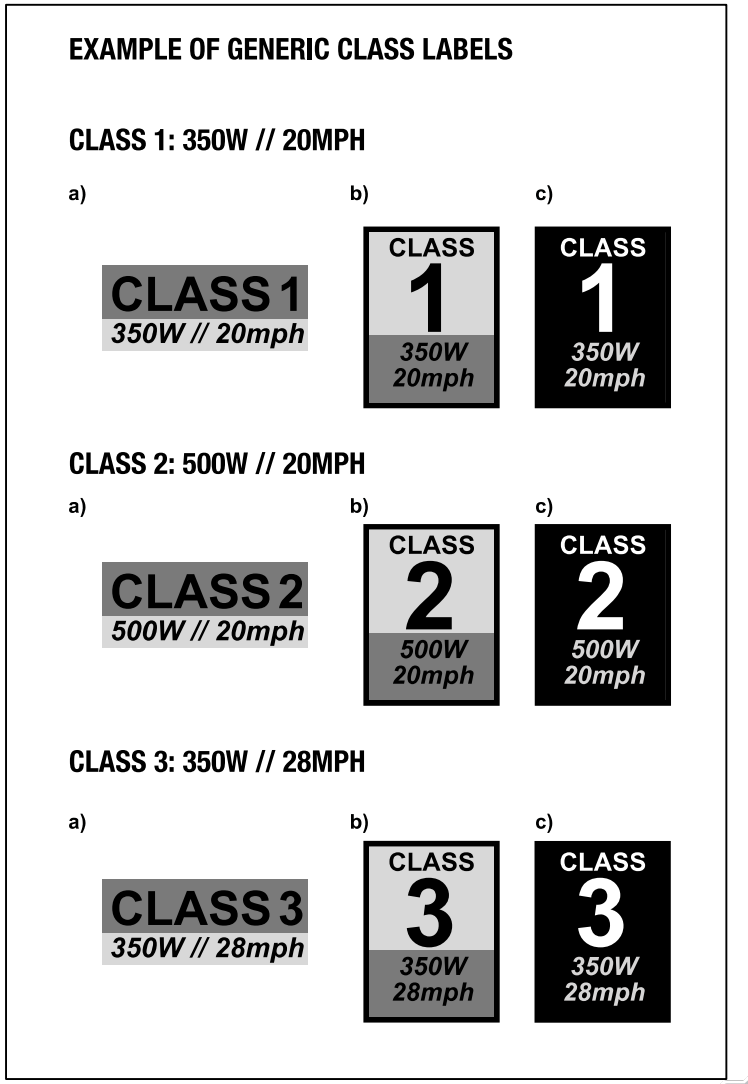
- Curb weight: 190 lb
- Width: 2 ft
- Top speed: 30 mph
- Propulsion: electric

"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



TRB
TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

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
- BTSCRP 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

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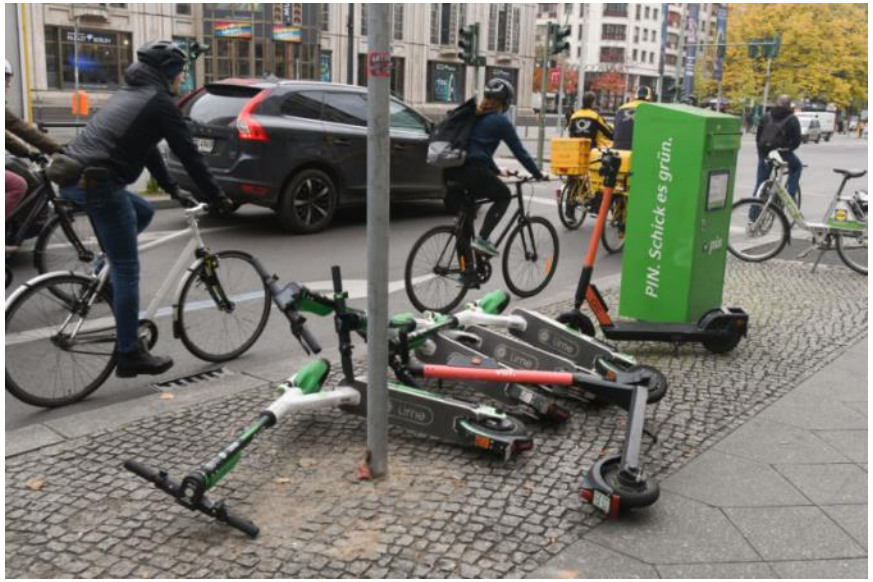
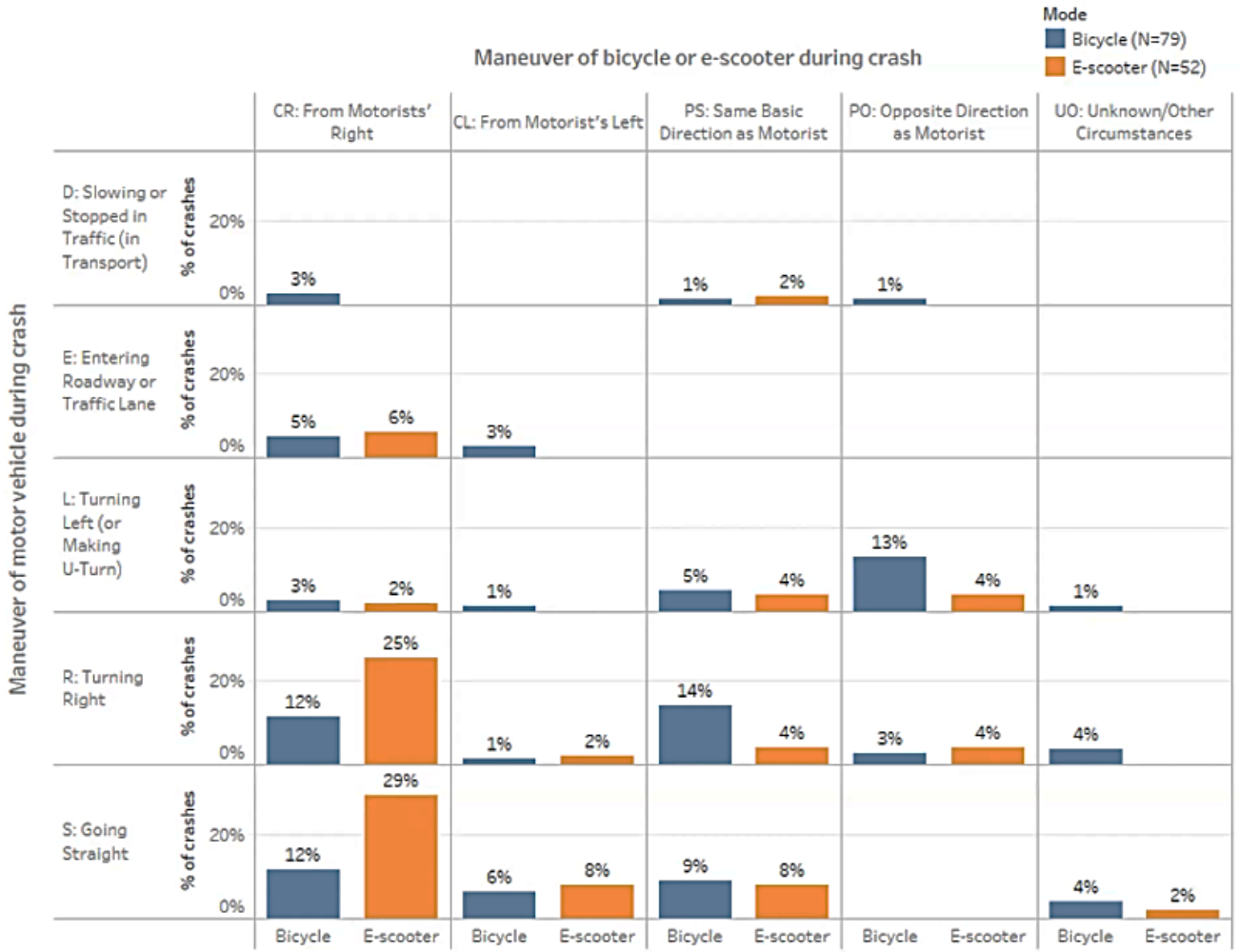
How to address the growing conflicts?



Intersections are important



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

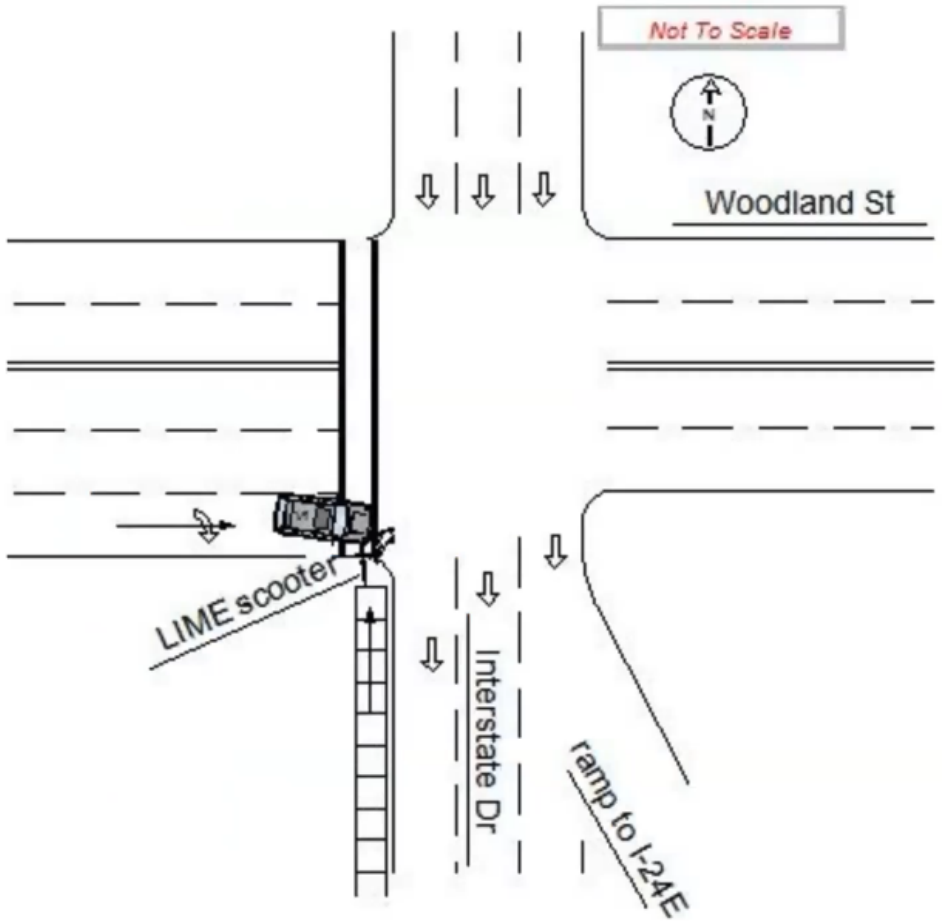
But…

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

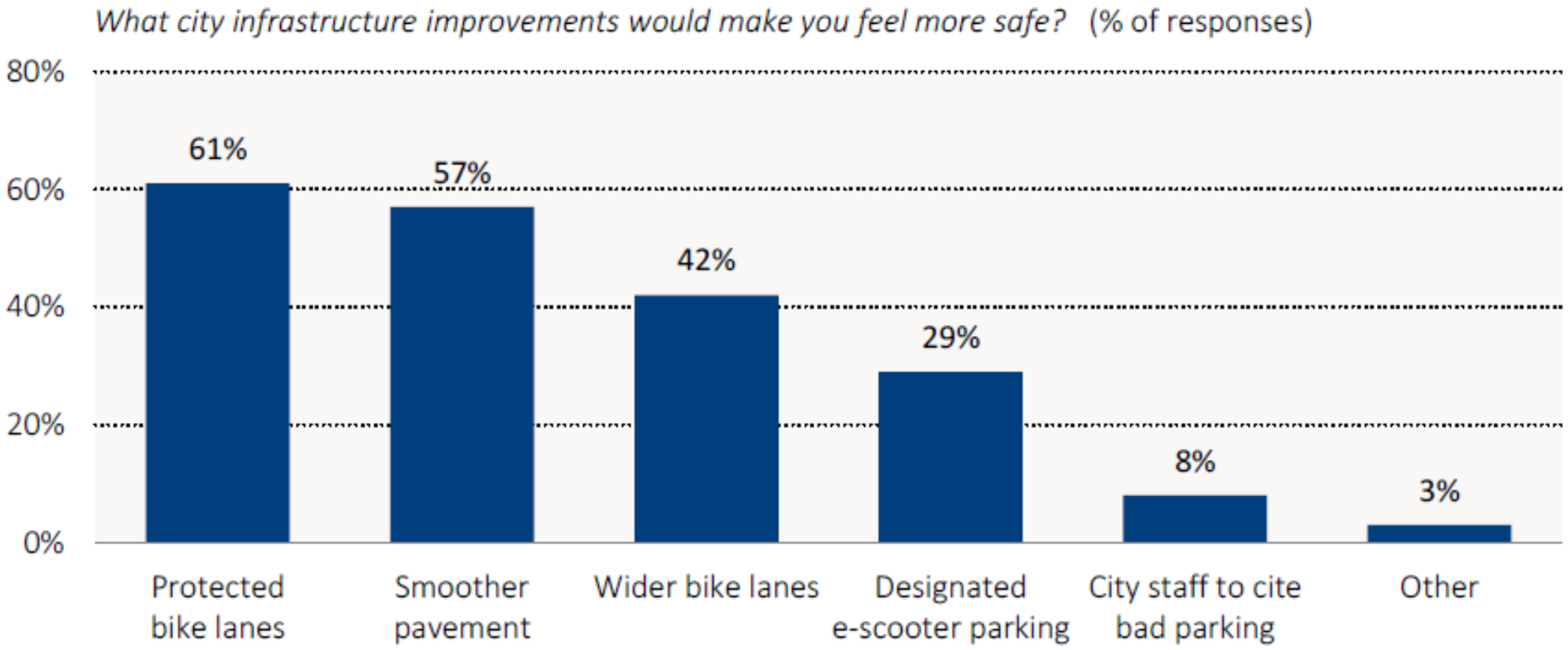
Consider this common case



- 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

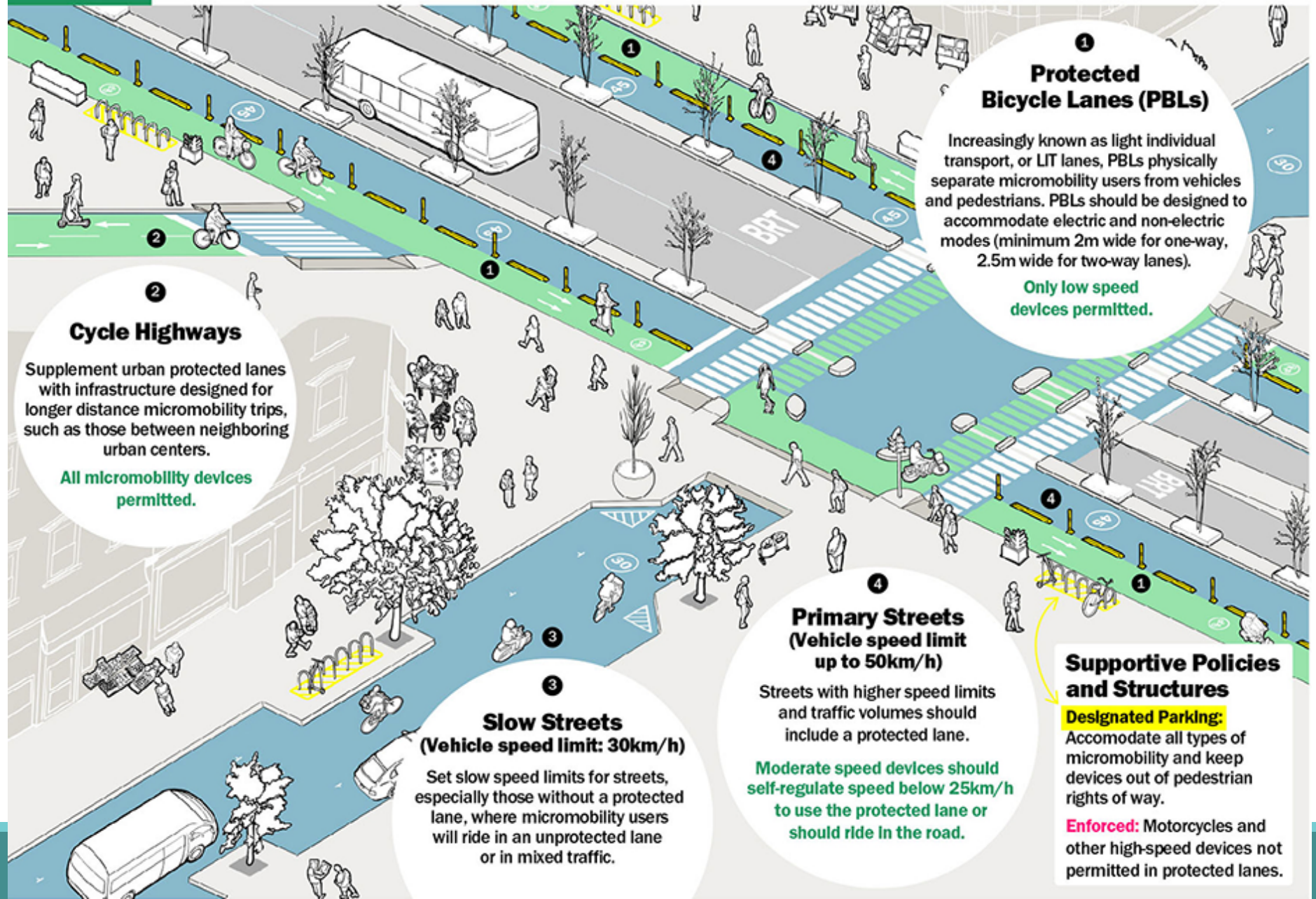


Source: Bird (2019).

ITDP

WHERE CAN MICROMOBILITY GO?

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



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.

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.

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.

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.

Supportive Policies and Structures

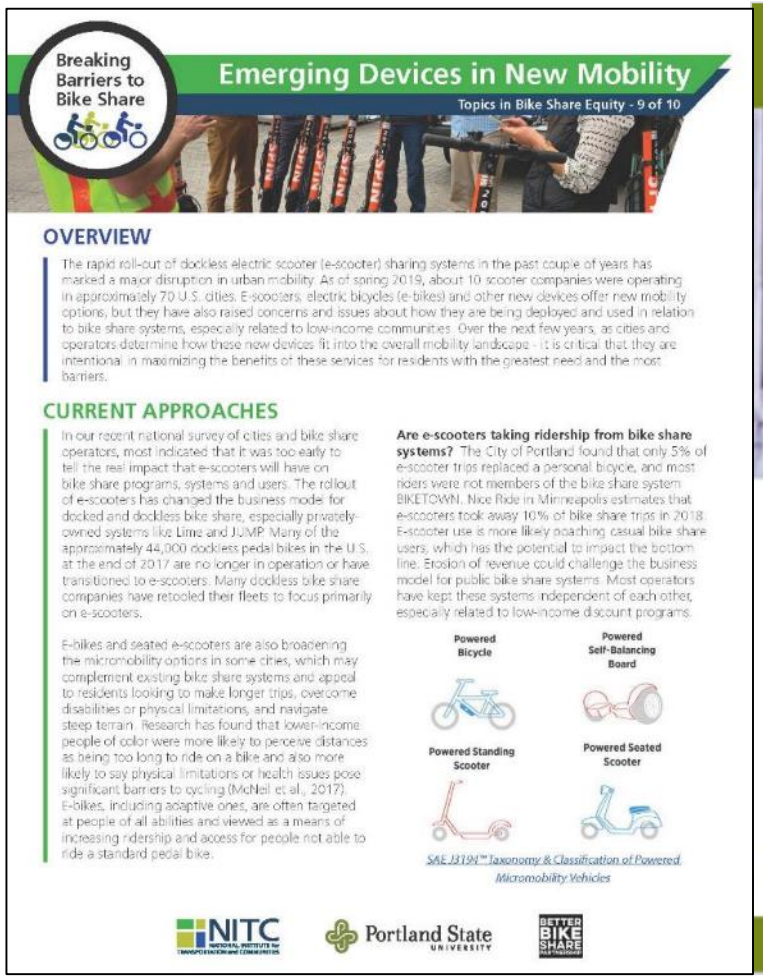
Designated Parking: Accomodate all types of micromobility and keep devices out of pedestrian rights of way.

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



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

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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
@LEVEResearch

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