~ NOTICE OF MEETING ~
CAPITAL METROPOLITAN TRANSPORTATION AUTHORITY
BOARD OF DIRECTORS WORKSESSION

Austin Convention Center, 500 East Cesar Chavez

~ AGENDA ~

Executive Assistant/Board Liaison Gina Estrada
512-389-7458

Friday, September 14, 2018	12:00 PM	Austin Convention Center

I. Presentations:

1. High Capacity Transit Modes and Emerging Technology Overview

ADA Compliance

Reasonable modifications and equal access to communications are provided upon request. Please call (512)389-7458 or email gina.estrada@capmetro.org if you need more information.

BOARD OF DIRECTORS: *Wade Cooper, chairperson; Delia Garza, vice chair; Juli Word, board secretary; Terry MItchell, Pio Renteria, Jeffrey Travillion, Rita Jonse and Ann Kitchen. Board Liaison: Gina Estrada (512)389-7458, email gina.estrada@capmetro.org if you need more information.*

The Board of Directors may go into closed session under the Texas Open Meetings Act. In accordance with Texas Government Code, Section 551.071, consultation with attorney for any legal issues, under Section 551.072 for real property issues; under Section 551.074 for personnel matters, or under Section 551.076, for deliberation regarding the deployment or implementation of security personnel or devices; arising regarding any item listed on this agenda.

Capital Metropolitan Transportation Authority ***MEETING DATE: 09/14/2018***
Board of Directors ***(ID # 4218)***
Project Connect

TITLE: Project Connect

High Capacity Transit Modes and Emerging Technology Overview

projectconnect

New Transit Options for a Greater Austin

September 14, 201

Joint Capital Metro Board / City of Austin City Council Work Session

INTRODUCTION

PROJECT CONNECT OVERVIEW

AUSTIN STRATEGIC MOBILITY PLAN + CORRIDOR OFFICE COORDINATION

DEDICATED PATHWAYS

MODES

NEXT STEPS

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Project Overview

Phased Approach to Project Development

1 BIG IDEAS, BOLD START

With public input, identify and review potential projects for building a high capacity transit system.

2 REAL SOLUTIONS

Study the selected projects and present options to the community that are consistent with regional and local priorities.

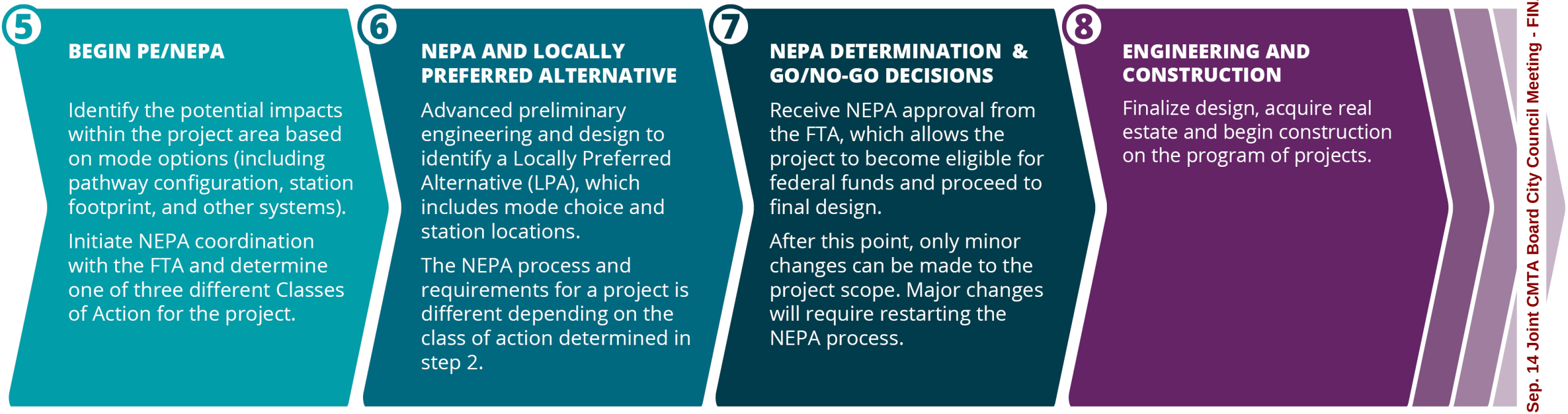
3 PATH TO IMPLEMENTATION

Approval of Project Connect system vision and development of partnerships with stakeholders, agency board and community members.

4 PROJECT DEVELOPMENT

Further study the costs, benefits and ridership of a potential project—all of which are impacted by mode choice—to determine whether the project will be competitive for FTA funding.

Phased Approach to Project Development



Project Connect All High-Capacity Modes

Heavy Rail

Commuter Rail

Bus Rapid Transit (BRT)

Light Rail Transit (LRT)

Autonomous Rapid Transit (ART)

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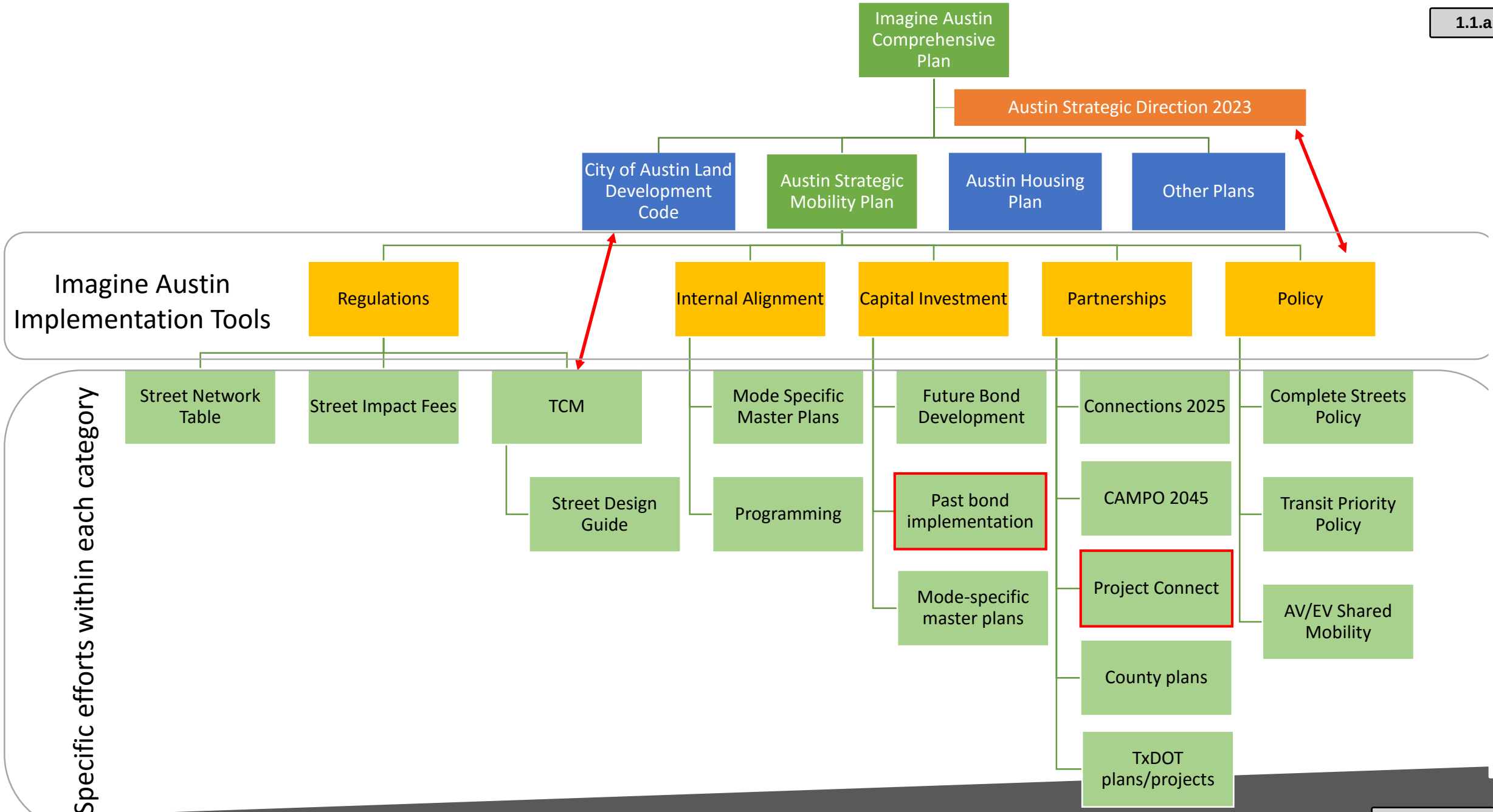
City of Austin and Project Connect: Key Coordination Points

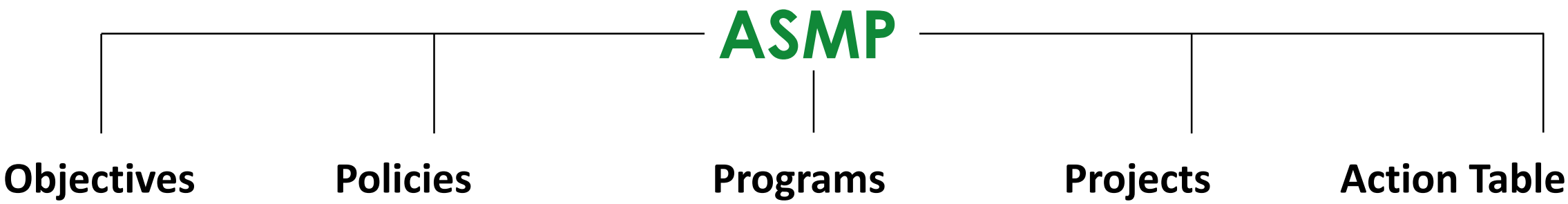


Austin Strategic Mobility Plan

What is the Austin Strategic Mobility Plan?

The ASMP is the City's new transportation plan, covering all the ways we get around Austin. It will:

- Guide our transportation policies, programs, projects, and investments
- Have a 20+ year horizon
- Be presented to City Council for adoption, amending Imagine Austin



+ An Updated, Multimodal Roadway Table

Planning Approach

Technical:

Scenario Planning

Public Engagement:

Targeted to Focus Populations

- Youth (24 and younger)
- Seniors (65 and older)
- People of Color
- People with Mobility Impairments

What did we hear?

Top Strategies Chosen (by total # of votes)

Overall Population

1. Provide **more public transit service** and enhance connections to/from public transit *(Travel Choice - 1,996)*

2. Promote transportation modes that reduce reliance on fossil fuels (such as bicycling, walking, **transit** and electric vehicles*)* *(Sustainability - 1,782)*

3. Improve signal timing and other transportation technologies *(Commuter Delay - 1,765)*

4. Prioritize travel choices, such as taking **public transit**, walking, or bicycling, making them more convenient and efficient *(Commuter Delay - 1,683)*

5. Reduce serious injuries and fatalities by designing streets for appropriate vehicular speed
(Health & Safety - 1,637)

Focus Populations

1. Provide **more public transit service** and enhance connections to/from public transit *(Travel Choice - 674)*

2. Offer more choices in how we travel to **reduce personal costs associated with car ownership** *(Affordability - 581)*

3. (TIE) Improve signal timing and other transportation technologies *(Commuter Delay - 575)*

3. (TIE) Reduce serious injuries and fatalities by designing streets for appropriate vehicular speed *(Health & Safety – 575)*

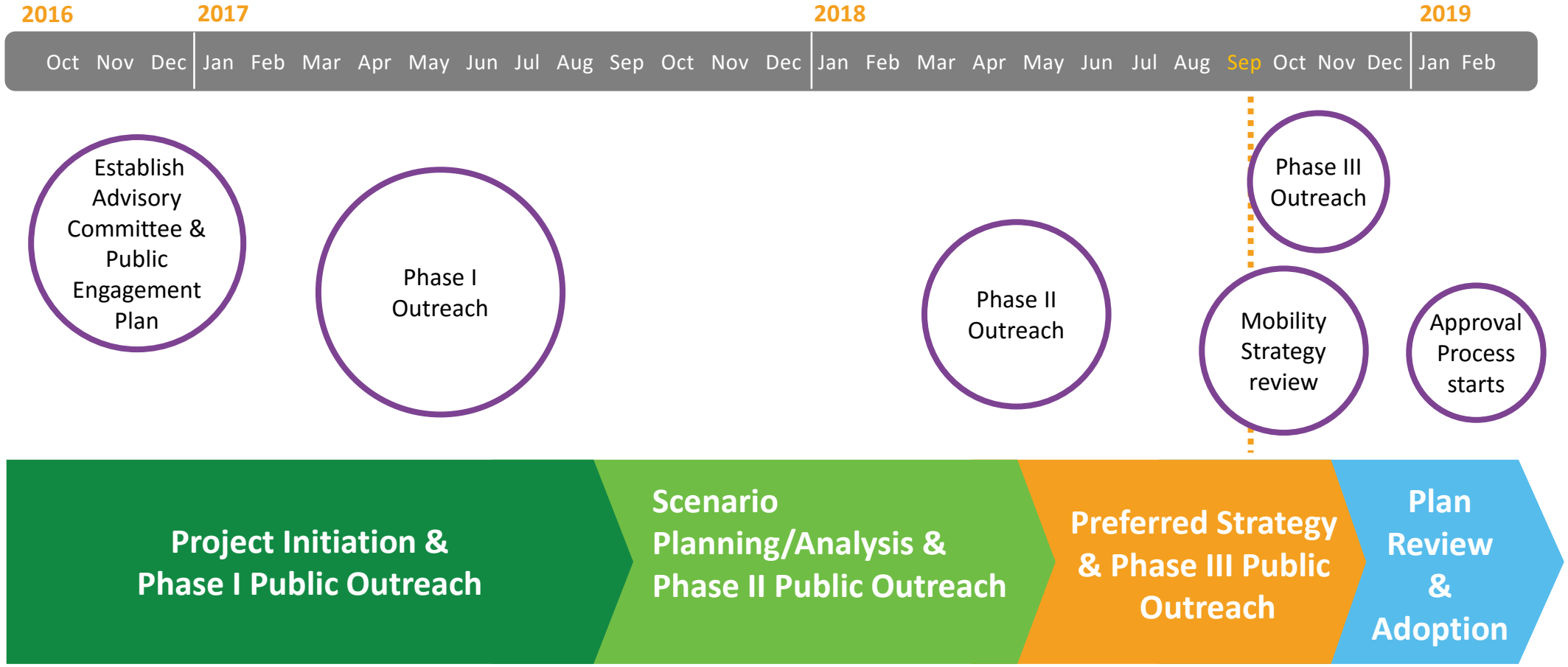
5. Promote transportation modes that reduce reliance on fossil fuels (such as bicycling, walking, **transit** and electric vehicles*)*
(Sustainability - 569)

Total strategies to choose from: **27**

ASMP Coordination with Project Connect & Capital Metro

- Regular coordination meetings at all levels – technical, community engagement and program leaders
- Project Connect and ASMP shared Multimodal Community Advisory Committee (MCAC)
- Updated CAMPO model to reflect Capital Metro transit service
- Multimodal pinch point analysis
- Transit Priority Policy *(Council Resolution No. 20160414-07)*

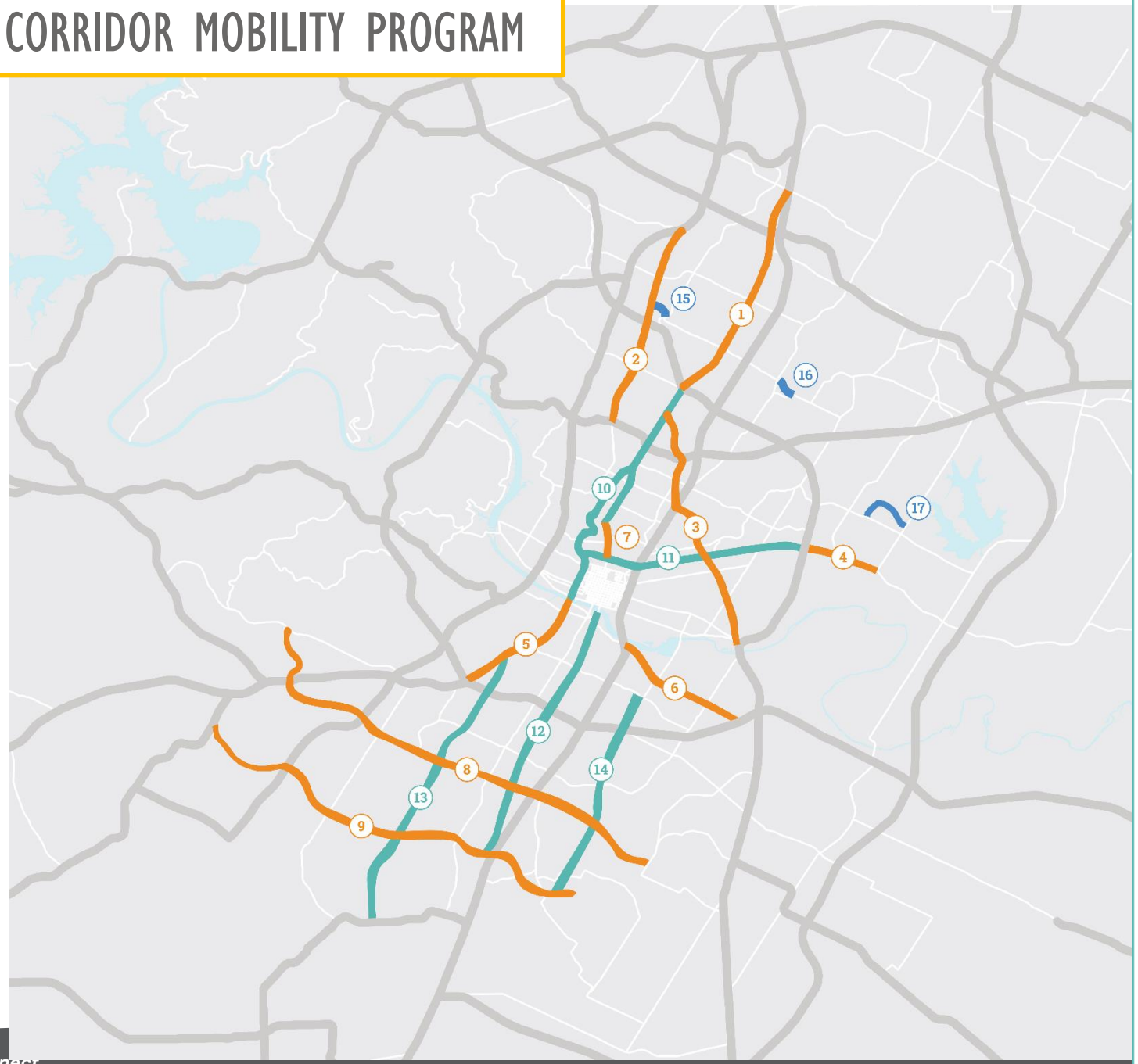
Schedule



austin MOTION
2016 MOBILITY BOND

Corridor Program

CORRIDOR MOBILITY PROGRAM



CORRIDOR CONSTRUCTION PROGRAM:

1. North Lamar Boulevard (US Hwy. 183 to Howard Lane)
2. Burnet Road (Koenig Lane to MoPac Expressway)
3. Airport Boulevard (North Lamar Boulevard to US Hwy. 183)
4. East MLK Jr. Boulevard/FM 969 (US Hwy. 183 to Decker Lane)
5. South Lamar Boulevard (Riverside Drive to Ben White Boulevard/US Hwy. 290 West)
6. East Riverside Drive (I-35 to SH 71)
7. Guadalupe Street (MLK Jr. Boulevard to W. 29th Street)*
8. William Cannon Drive (Southwest Parkway to McKinney Falls Parkway)*
9. Slaughter Lane (FM 1826 to Vertex Boulevard)*

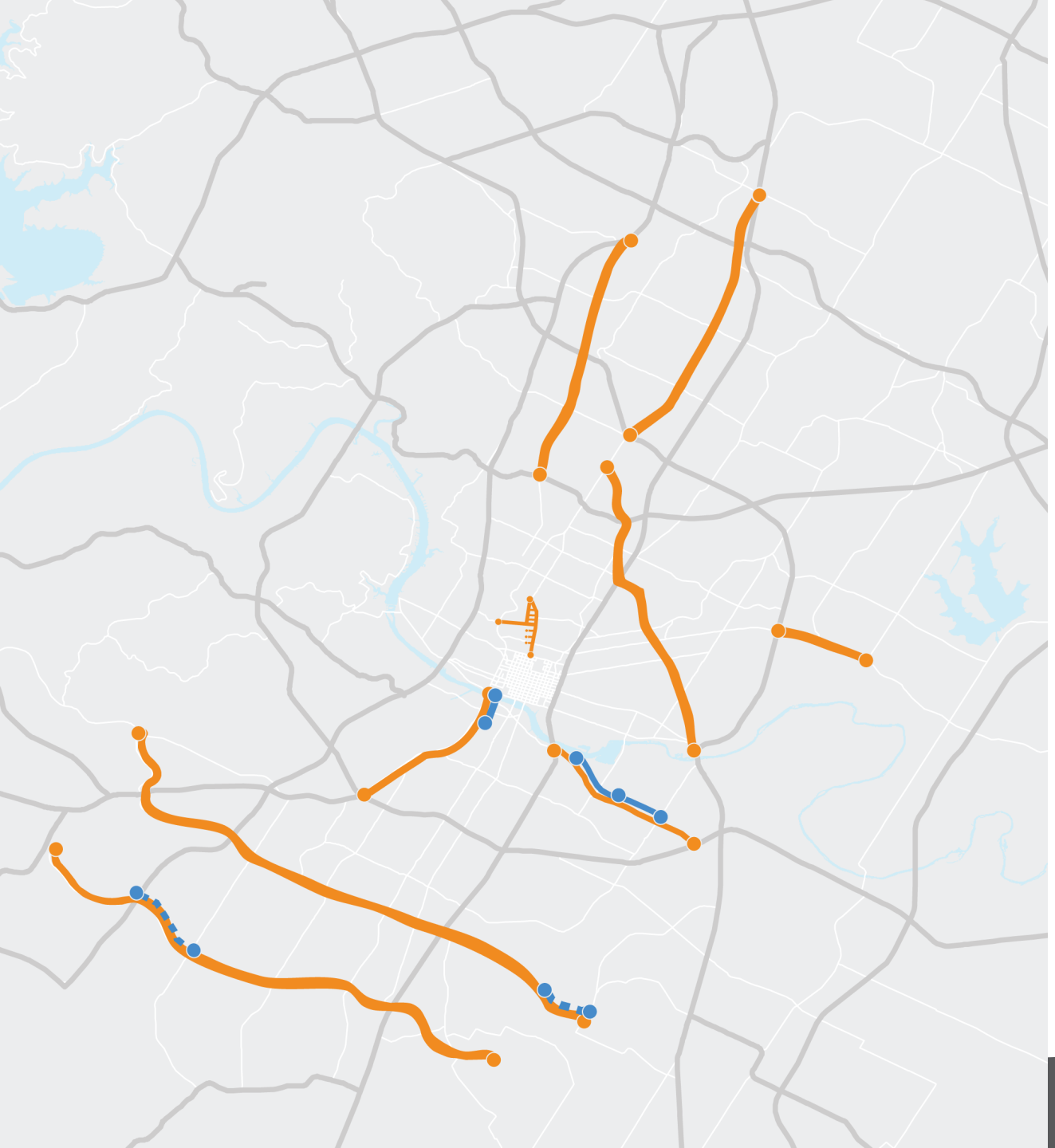
*Report in progress

PRELIMINARY ENGINEERING:

10. North Lamar Boulevard (Lady Bird Lake to US 183) / Guadalupe Street (W. 29th St. to North Lamar Boulevard)
11. E. MLK Jr. Blvd/FM 969 (North Lamar Boulevard to US 183)
12. South Congress Avenue (Lady Bird Lake to Slaughter Lane)
13. Manchaca Road (South Lamar Boulevard to FM 1626)
14. South Pleasant Valley Road (Oltorf Street to Slaughter Lane)

PRELIMINARY AND DESIGN WORK:

15. West Rundberg Lane (Burnet Road to Metric Boulevard)
16. East Rundberg Lane (Cameron Road to Ferguson Lane)
17. Colony Loop Drive (Loyola Lane to Decker Lane)



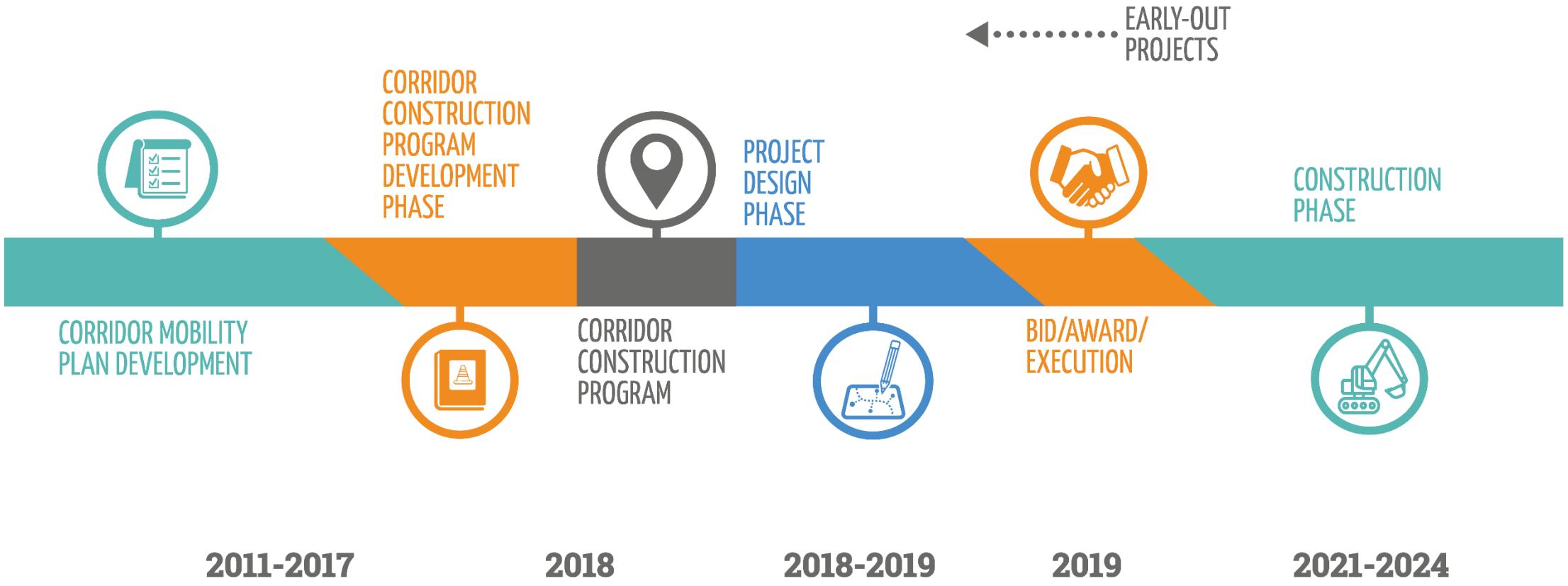
FUNDING CATEGORY:
Full Design and Construction

Corridor-wide Mobility Improvements on all 9 corridors

Enhanced Multimodal Improvements

- East Riverside Dr – Shore District Dr to Montopolis Dr
- South Lamar Blvd –Riverside Dr to Barton Springs Rd
- CAMPO Grant: William Cannon Dr – Running Water Dr to McKinney Falls Pkwy
- CAMPO Grant: Slaughter Lane – MoPac to Brodie Ln

CORRIDOR CONSTRUCTION PROGRAM TIMELINE



Capital Metro Coordination

- Optimization of transit access
- Cap Remap included in conceptual design of Corridor Construction Program
- Ongoing evaluation of how Project Connect outcomes may affect Corridor Mobility Program

Questions?

Annick Beaudet, Assistant Director, Austin Transportation Department

Mike Trimble, Director, Corridor Program Office

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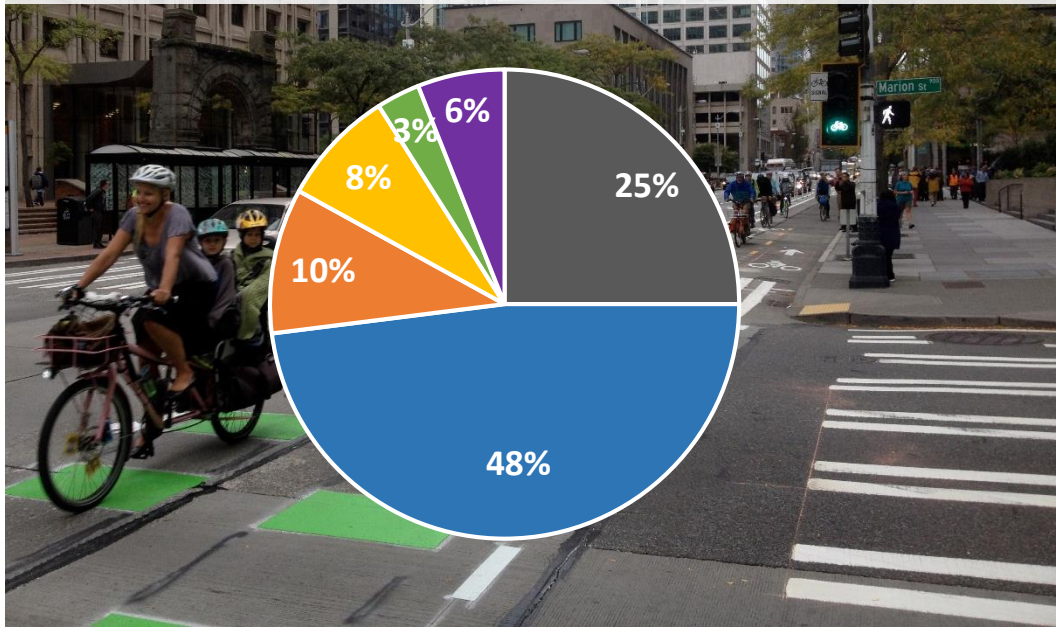
Competitor Cities Outpacing Austin

Mode Split for Commutes into Downtown: Primary Indicator of Mobility System Health

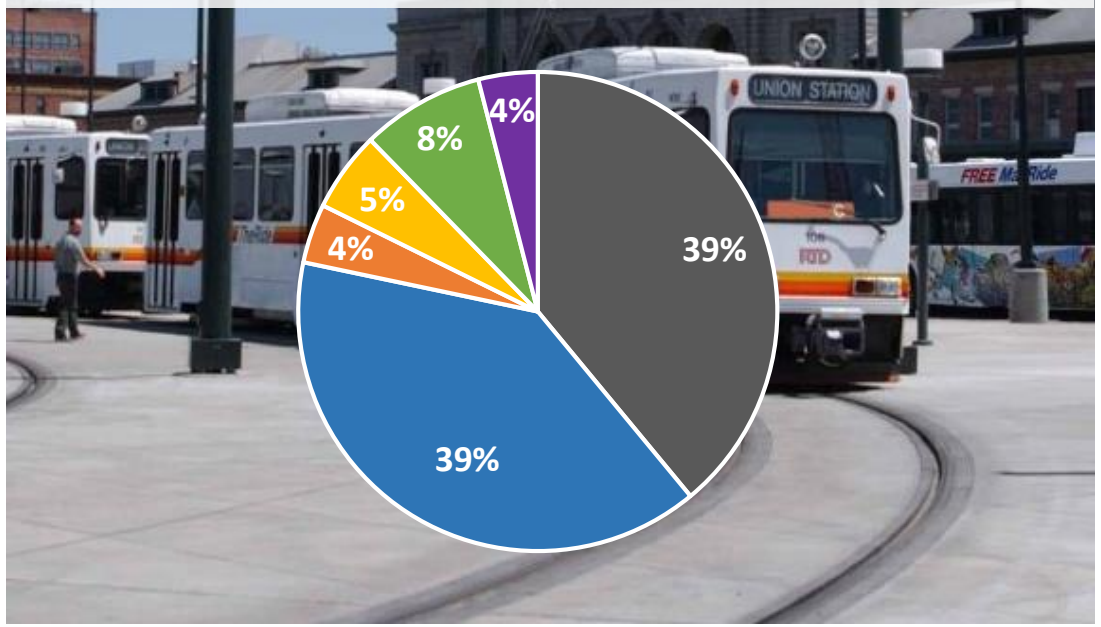
Seattle Downtown Commute

Regional Seattle Population (MSA): 3,870,000
Seattle Population: 725,000



Denver Downtown Commute

Regional Denver Population (MSA): 2,800,000
Denver Population: 705,000



Drive Alone *Transit* *Carpool* *Walk* *Bike* *Other*

Sources: US Census ACS data, Seattle (Commute Seattle), Denver (Den

Meanwhile in Austin

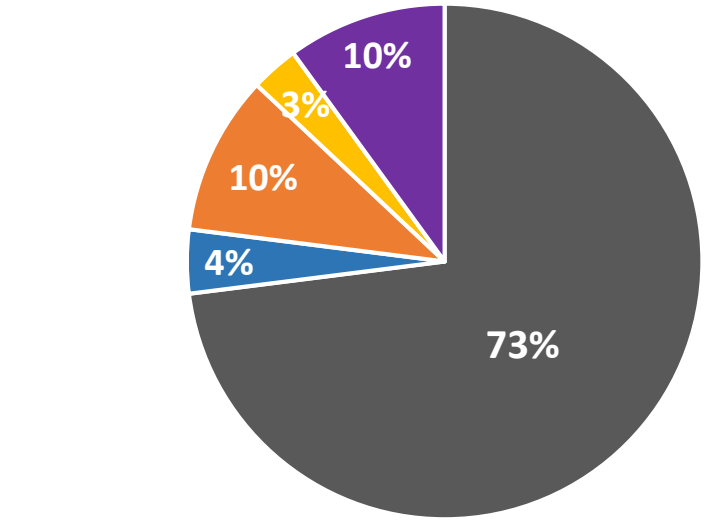
*"..the latest [..] forecast for the five-county Austin-Round Rock metro area is for 83 percent growth over 30 years — from 2,064,000 residents in 2016 to **3,780,000** in 2046."*

- Statesman Article

Austin Region-Wide Commute

Regional Austin Population (MSA): 2,064,000

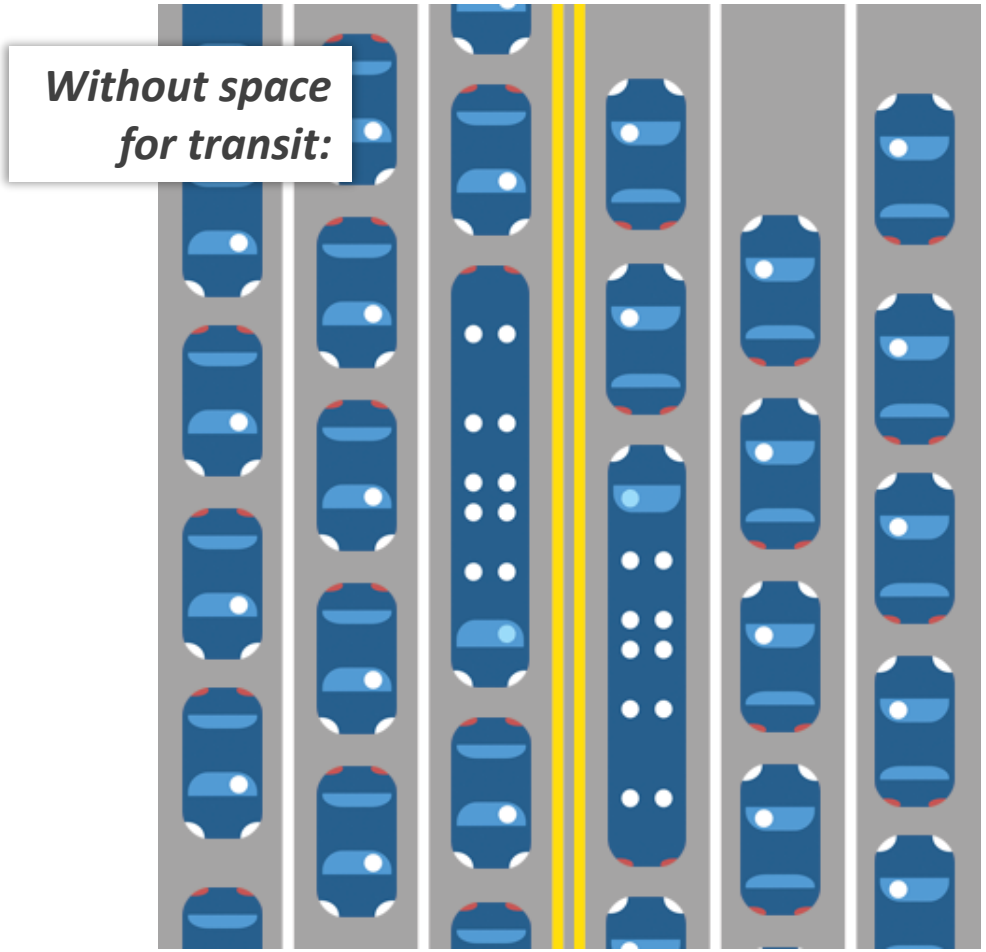
Austin Population: 950,000

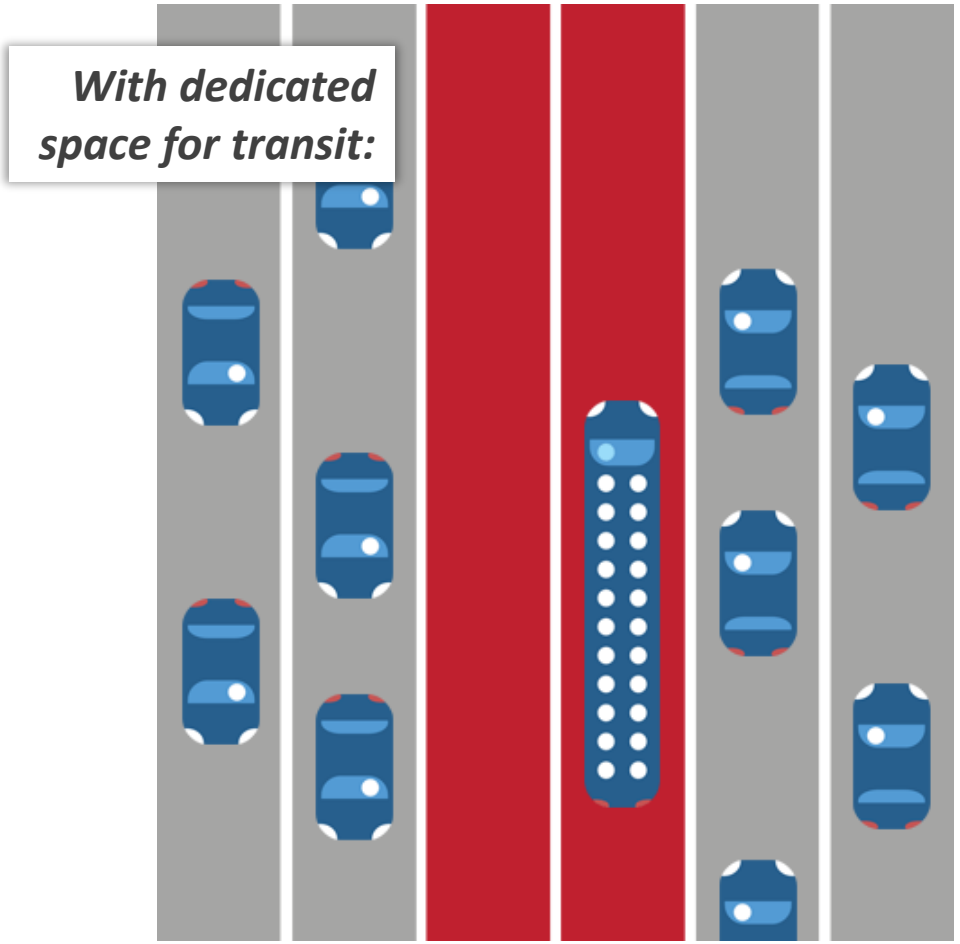


Sources: City of Austin via American Community Survey, State

Must Fix Throughput

How Many People Can We Get Through an Intersection in a Minute?

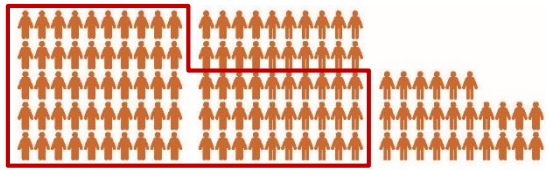




Must Fix Throughput

How Many People Can We Get Through an Intersection in a Minute?

126 People move through this roadway during each light cycle. **80 in transit.**



235 People on a road with transit-only lanes move through this roadway during each light cycle **204 in transit**

Multiple Configurations to accommodate R.O.W. constraints

Primary Options

Center Running

COST: Low

SPEED & RELIABILITY: High

CONSTRUCTION CHALLENGES: Low

Curb Running

COST: Low

SPEED & RELIABILITY: Low

CONSTRUCTION CHALLENGES: Moderate

Multiple Configurations to accommodate R.O.W. constraints

Secondary Options

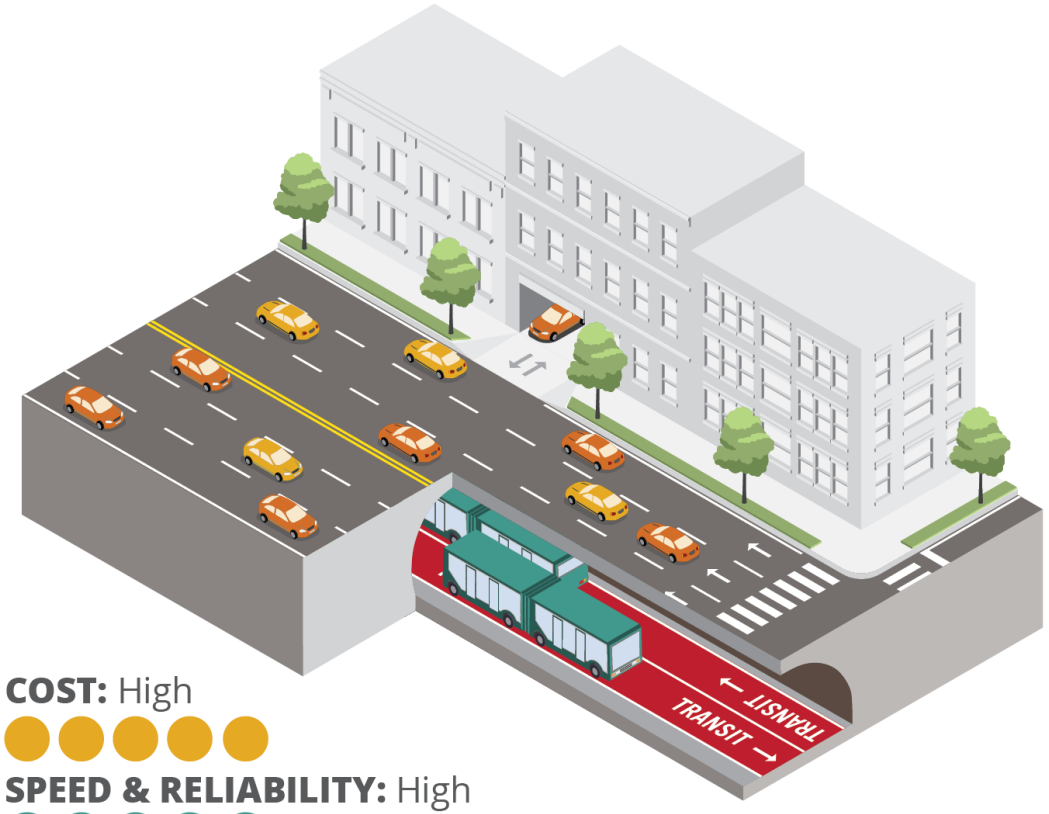
Elevated

COST: High

SPEED & RELIABILITY: High

CONSTRUCTION CHALLENGES: High

Underground



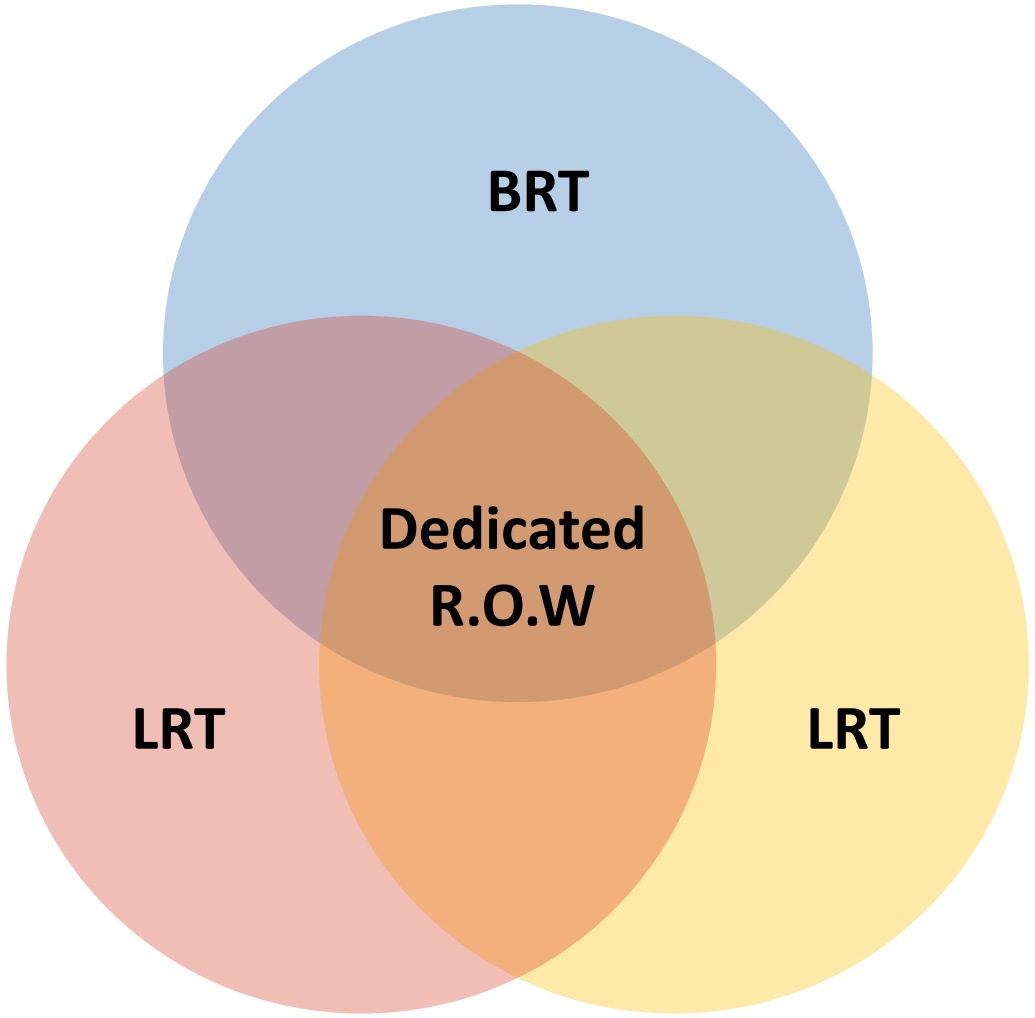
COST: High

SPEED & RELIABILITY: High

CONSTRUCTION CHALLENGES: High

First Hurdle to Overcome: Right-of-Way

Future-Proofing Requires Dedicated R.O.W.



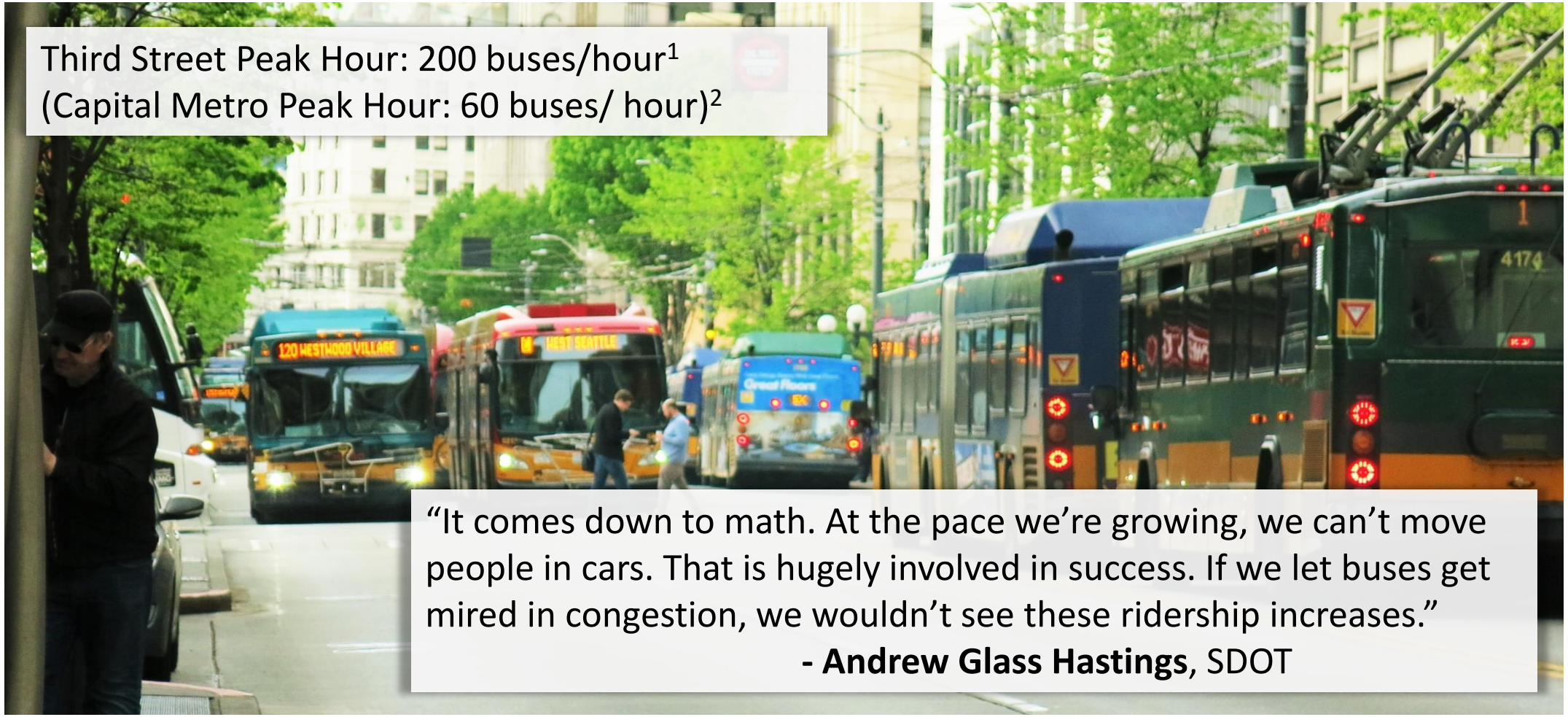
Dedicated R.O.W. = future proofing

Travel times and reliability suitable for Project Connect high capacity transit ridership projections will require dedicated R.O.W.

Dedicated R.O.W. Case Study: Seattle's Third Ave

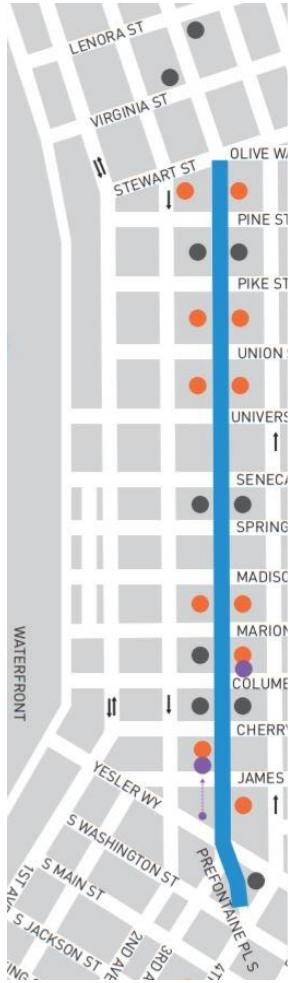
Dedicated for Buses and Bikes Only as of August 21, 2018

Third Street Peak Hour: 200 buses/hour[1]
(Capital Metro Peak Hour: 60 buses/ hour)[2]



"It comes down to math. At the pace we're growing, we can't move people in cars. That is hugely involved in success. If we let buses get mired in congestion, we wouldn't see these ridership increases."

- Andrew Glass Hastings, SDOT



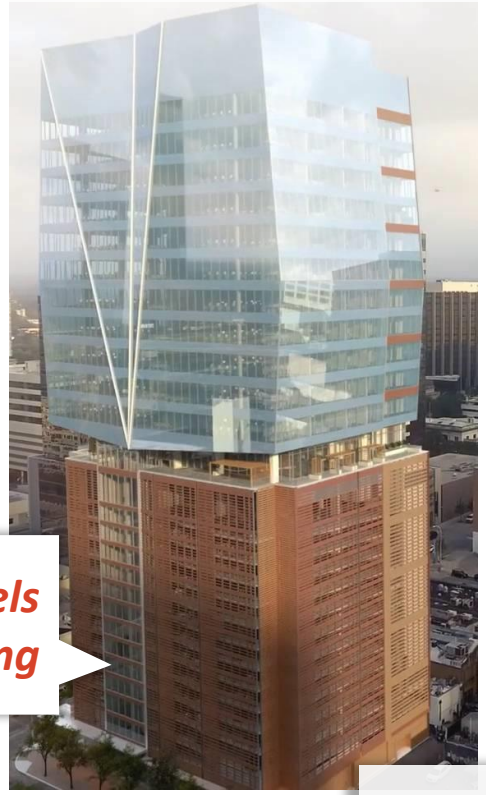
[1] King County News 5

[2] Capital Me

Austin Hurdles to Overcome:

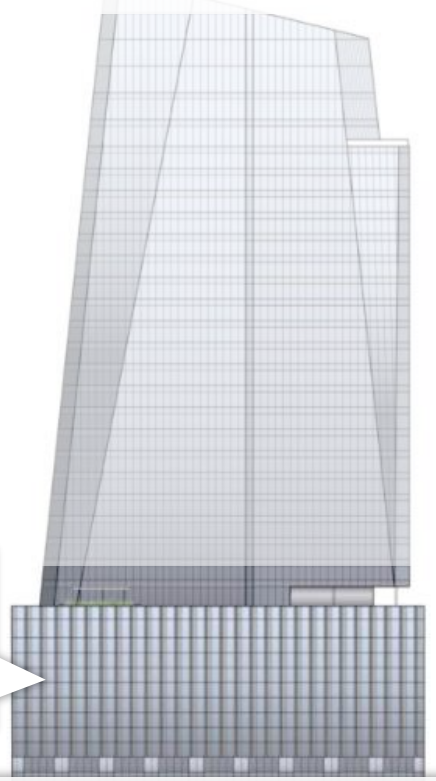
1 Actively building towers with lots of parking and driveways

405 Colorado – breaking ground on 4th and Colorado



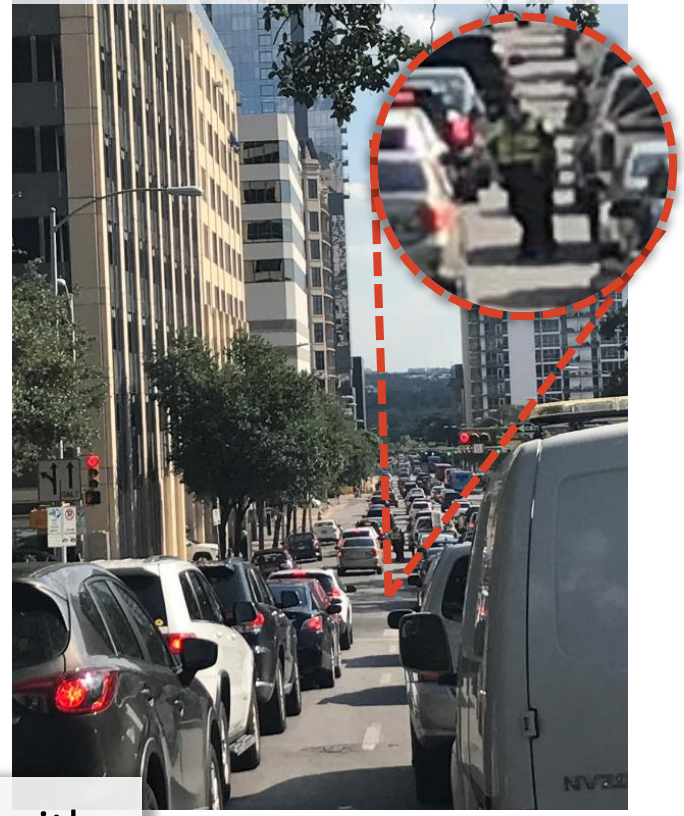
12 Levels of parking

The Republic – Proposed for 308 Guadalupe



13 Levels of parking

Situation on Guadalupe Today



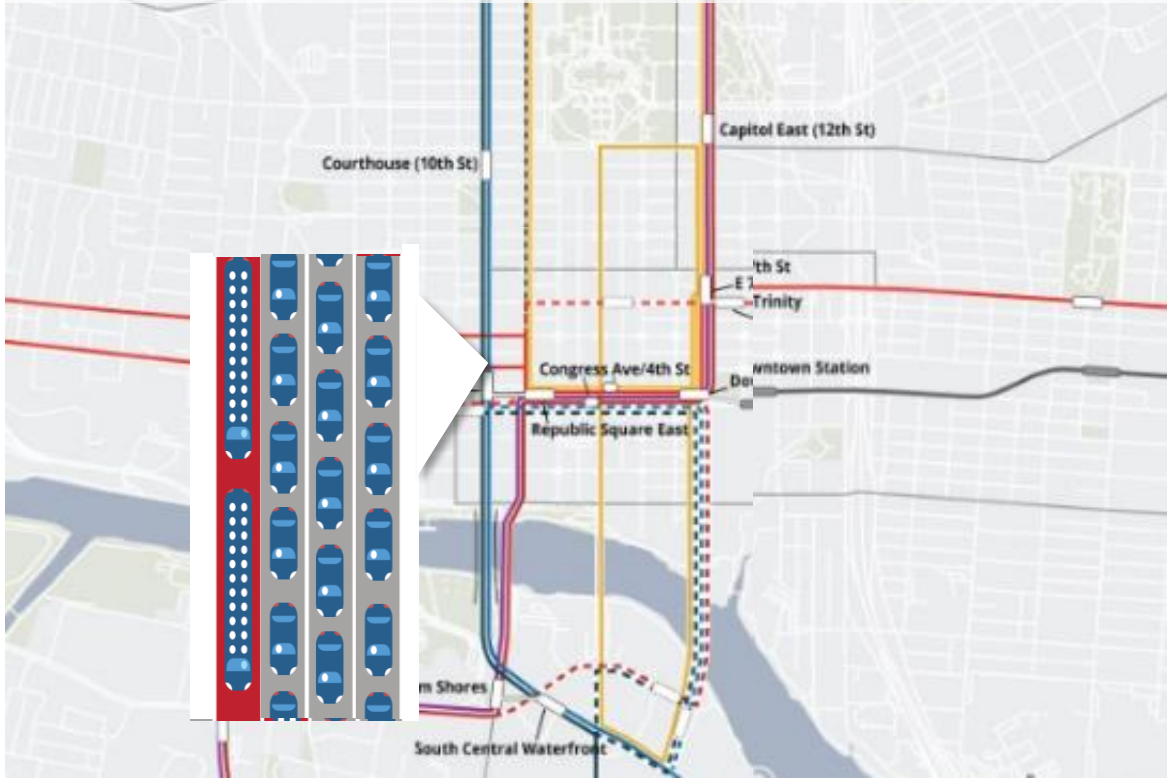
An invitation for single occupancy gridlock: towers with 25-50% of the structure parking are STILL being built

Austin Hurdles to Overcome:

2 Optics of “not enough buses” to justify dedicated lane

Guadalupe: Currently 60 buses per hour during rush hour, with competitive travel speeds due to dedicated transit lanes

Project Connect network: high frequency trunk lines allowing more transit routes to leverage speed advantage in dedicated ROW



Austin Hurdles to Overcome:

3 Concern of Mode Shift: However, Reliability and Faster Travel Times WORK

- The Los Angeles Metro Orange Line is a BRT route that operates in dedicated lanes with stations spaces approximately every 1 mile
- A 2007 study observes a **mode shift of 18%** from car drivers to Orange Line riders[1]
- This agrees with a 2005 study that observes a **17% reduction in congestion** on CA highway 101 as a result of new Orange Line service[2]

[1] Transportation
[2] LA Times

Case Study: Boston, MA and Everett, MA

Crawl, Walk, Run: Piloting to Permanence

After years of talk, the City of Boston finally "tested" a one-day pop-up lane of its own on a chronically jammed high ridership route[1]

Findings showed that travel times decreased by 34% and variability decreased by 35% during the morning peak. [2]

[1] Transit Center
[2] Everett's Transportation P

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Heavy Rail

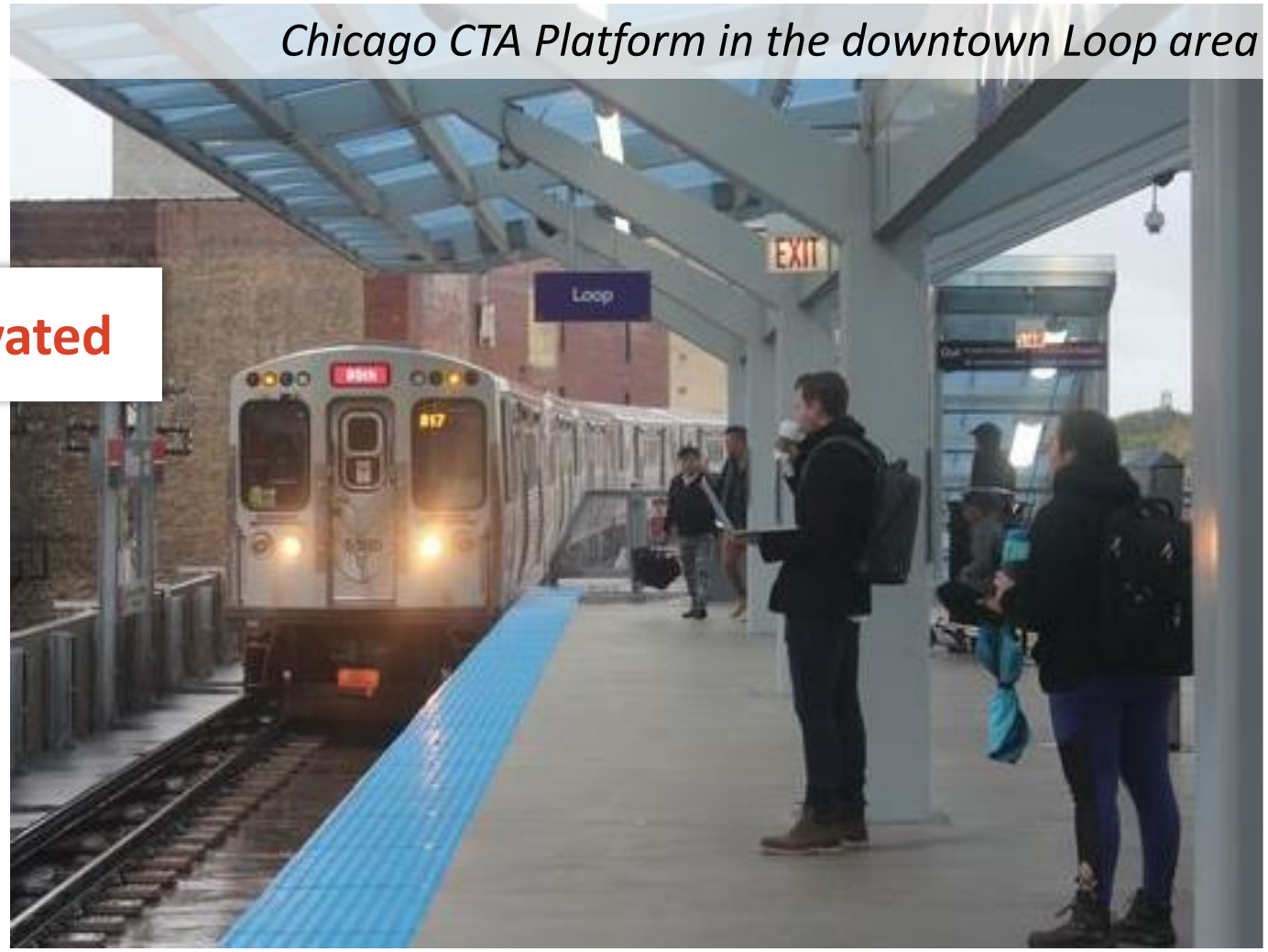
Heavy Rail At-A-Glance	
Defined as	Train operating in exclusive right of way with high frequencies to carry many people to destinations in and around the downtown core
Frequency[1]	Every 2 - 9 minutes during rush hour
Typical Daily Passengers Per Route[2]	250,000 – 275,000 per route
Cost to build[3]	$200M - $1B/mile
Distance between stations[4]	Stops ½ to 1 mile apart
Per Vehicle Capacity[5]	150-200 passengers par car, with 2-8 cars in a train

[1] WMATA + MBTA
[2] NTD for CTA and MBTA
[3] Connect Greater Washington Report
[4] Connect Greater Washington Report
[5] National Transit
All costs inflated to 2018 $

Heavy Rail Case Study: Chicago CTA

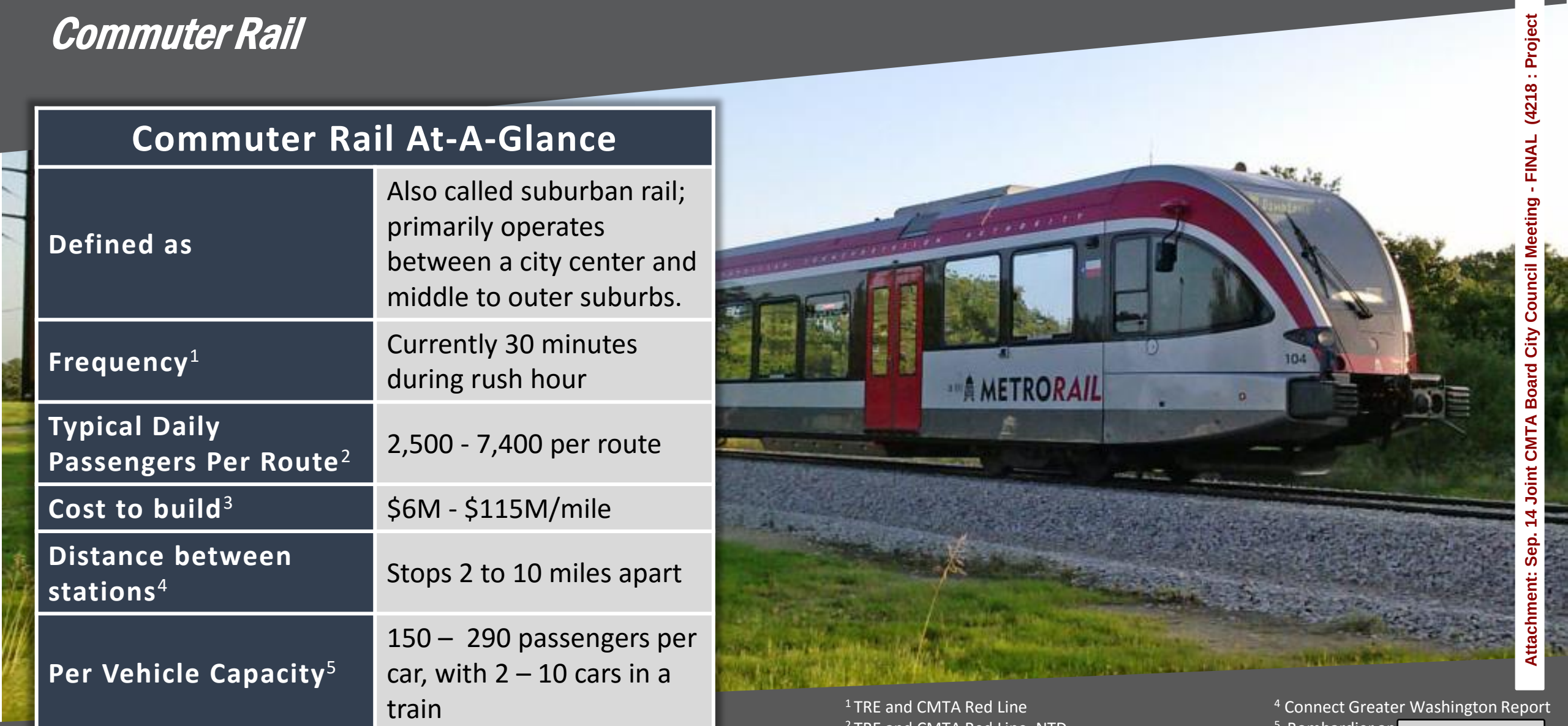
Chicago CTA Platform

Chicago CTA Platform in the downtown Loop area



Commuter Rail

Commuter Rail At-A-Glance	
Defined as	Also called suburban rail; primarily operates between a city center and middle to outer suburbs.
Frequency[1]	Currently 30 minutes during rush hour
Typical Daily Passengers Per Route[2]	2,500 - 7,400 per route
Cost to build[3]	$6M - $115M/mile
Distance between stations[4]	Stops 2 to 10 miles apart
Per Vehicle Capacity[5]	150 – 290 passengers per car, with 2 – 10 cars in a train



[1] TRE and CMTA Red Line
[2] TRE and CMTA Red Line, NTD
[3] Connect Greater Washington Report
[4] Connect Greater Washington Report
[5] Bombardier an
All costs inflated to 2018 $

Commuter Rail Case Study: CMTA Red Line

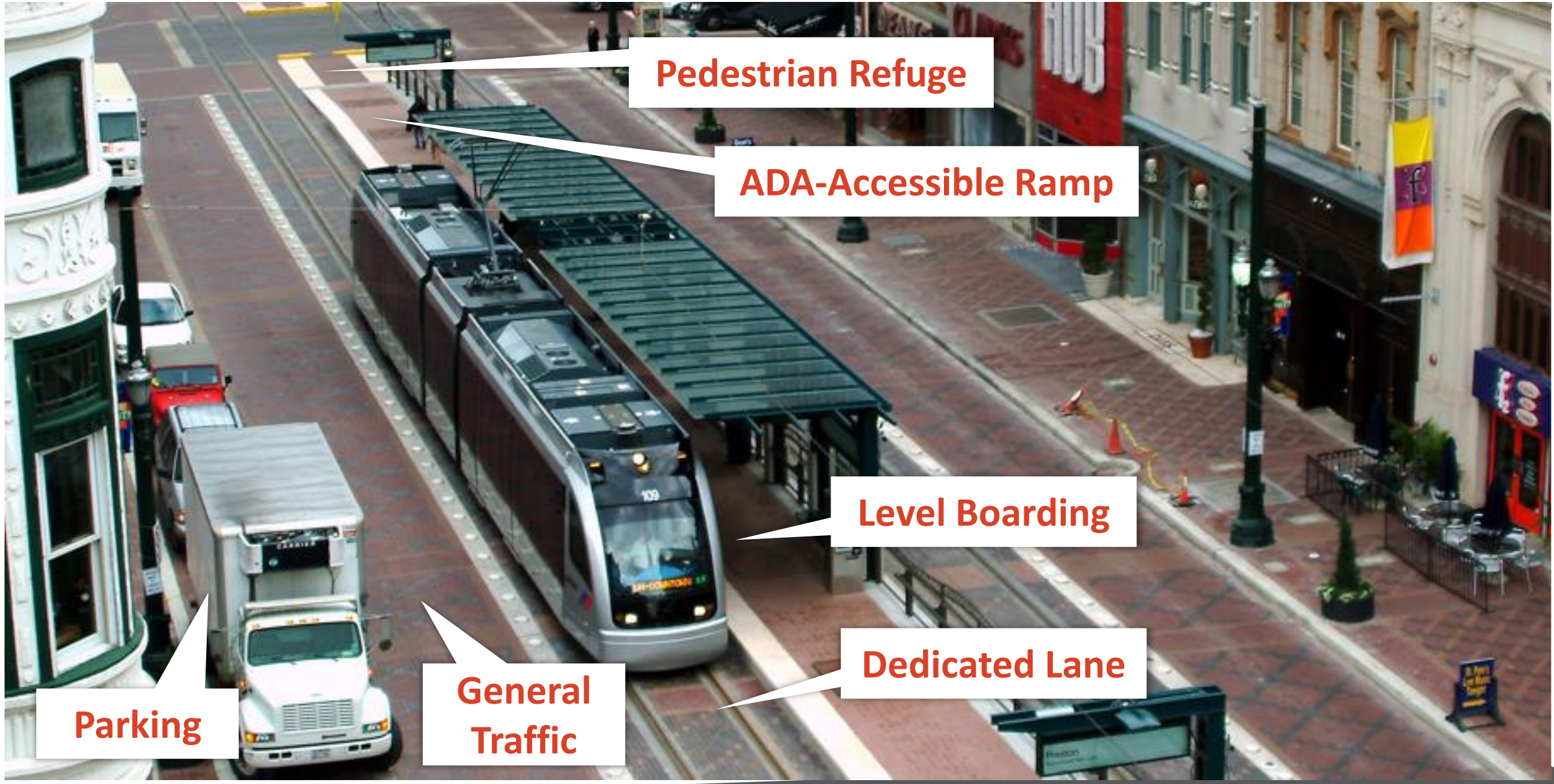
METRO | projectconnect

Light Rail Transit (LRT)

LRT At-A-Glance	
Defined as	Rail service that operates in a dedicated lane, providing rapid service to connect local activity centers.
Frequency[1]	Every 5 minutes during rush hour
Typical Daily Passengers Per Route[2]	Typically 30,000 – 55,000 per route
Cost to build[3]	$60M - $170M per mile
Distance between stations[4]	Stops every 3/4 – 1.5 miles
Per Vehicle Capacity[5]	140 - 240 passengers per car, with 2 - 3 cars in a train

[1] DART and King County Metro
[2] Average of NTD Sources
[3] Connect Greater Washington Report
[4] Connect Greater Washington Report
[5] Siemens
All costs inflated to 2018 $

LRT Case Study: Houston Metro



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Bus Rapid Transit (BRT)

BRT At-A-Glance	
Defined as	Bus routes that operate in dedicated lanes and provide rapid service to connect local activity centers.
Frequency[1]	Every 5 -10 minutes during rush hour
Typical Daily Passengers Per Route[2]	15,000 – 20,000
Cost to build[3]	$35 - $75M / mile
Distance between stations[4]	Stops 1/2 mile apart
Per Vehicle Capacity[5]	50 - 100 passengers per vehicle

[1] RVA Health Line and Silverline
[2] Metro Planning
[3] Connect Greater Washington Report
[4] Connect Greater Washington Report
[5] New Flyer
All costs inflated to 2018 $

BRT Case Study: Cleveland Health Line

Return on Investment = $114 for every $1 spent

Fast, Reliable Service
Operates 24/7, with 5-minute bus frequency during peak periods

High-Quality Investments
63-foot hybrid-electric vehicles with doors on both sides

Smart System Design
Replaced 108 bus stops with 36 conveniently spaced stations

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Bus Rapid Transit Light (BRT Light)

BRT Light At-A-Glance	
Defined as	Bus routes that operate in mixed traffic and transit priority lanes and provide rapid service to connect local activity centers.
Frequency[1]	Every 10 minutes during rush hour
Typical Daily Passengers Per Route[2]	3,500 – 10,000
Cost to build[3]	$1M - $2.5M/ mile
Distance between stations[4]	Stops 1/4 – 1/2 mile apart
Per Vehicle Capacity[5]	50 - 100 passengers per vehicle

[1] San Antonio Primo Rt. 100, San Diego MTS Rt. 215
[2] KPBS and Capital Metro
[3] Connect Greater Washington Report
[4] Connect Greater Washington Report
[5] New Flyer
All costs inflated to 2018 $

BRT Light Case Study: MetroRapid

Transit Priority Lanes – only *some* of the benefits of dedicated lanes

Curb-Level Boarding

One-Door Boarding

Shorter Platforms

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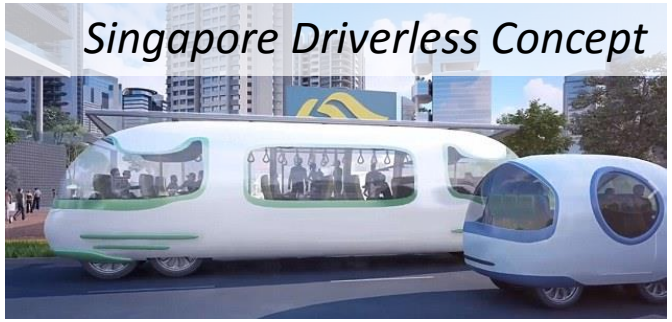
Autonomous Rapid Transit (ART)

What is Autonomous Rapid Transit (ART)?

- Emerging train/bus mode that will operate using driverless technology
- Currently being developed in Singapore, France, Germany, and China
- Will optimize vehicle-to-vehicle (V2V) technology
- Holds huge potential to optimize routes and roadspace through platooning
- Four key components to this technology: Autonomous, Connected, Electric, Shared (ACES)

Zhuzhou Concept

Singapore Driverless Concept



Mercedes Future Bus

Volvo ART Bus Concept

Dresden Autotram

Automation in Transit

A short history

DRAFT

System	Year Opened	Type of System	Capacity
 DFW Airport	1974	Automatic Train Operation - airport	Low
 Miami Metro Mover	1996	Automated Guideway Transit	Medium
 Paris Metro Line D	1993	Automatic Rubber Tire	High
 Singapore, NE Line	2002	Automatic Train Operation	High

Source: *Vuchic, 2002 (abridged)*

Autonomous Rail Case Study: Honolulu Driverless Train

- 20-mile elevated rail line between downtown and outlying communities with a planned opening in **2020.**
- Can carry **800 riders per train,** with racks for both bicycles and surfboards.
- **First fully automated wide-scale urban transit system in the U.S.** Instead of human drivers, a centrally-located computer system will control stops, departures, and speed, and even open and close doors.

A rendering of a rail canopy at a new HART station, which is scheduled to begin operations in 2017. // Honolulu Authority for Rapid Transportation

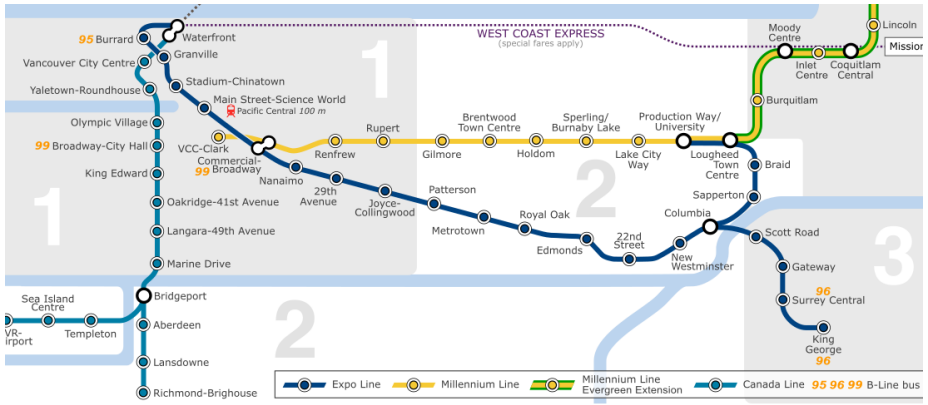
Honolulu Is Building America's First Fully Driverless Transit System

AMY CRAWFORD SEP 17, 2014

Autonomous Rail Case Study: Vancouver SkyTrain

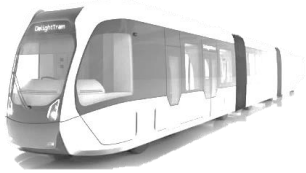
- SkyTrain is the oldest and one of the longest automated driverless light rapid transit systems in the world (opened in 1986)
- 49.5 miles
- uses fully automated trains on grade-separated tracks running on underground and elevated guideways
- Service levels of 2- 10 minute headways made viable by lower operating costs
- Daily Ridership: 477,500

SkyTrain Station Platform in Vancouver, British Columbia



Automation in Transit

Development of Autonomous Technology

	No Autonomy	Driver Assistance	Partial Autonomy	Conditional Autonomy	High Autonomy	Full Autonomy
Medium Occupancy						
High Occupancy						

ART Case Study: Mercedes Future Bus City Pilot

- The technology of the CityPilot in the Mercedes-Benz Future Bus is based on that of the autonomously driving Mercedes-Benz Actros truck with Highway Pilot **presented in 2014.**
- The CityPilot is able to **recognize traffic lights**, communicate with them and safely negotiate junctions controlled by them. It can also **recognize obstacles**, especially pedestrians on the road, and brake autonomously.
- It **approaches bus stops automatically**, where it opens and closes its doors.

Source: *Daimler*

ART Case Study: Automation in Parking

- Automated Bus Parking demonstrates the capability of an autonomous-equipped vehicle to execute precise maneuvers within a bus depot
- Cameras, sensors and image processing technologies precisely guide the vehicle within very tight spatial tolerances

Source: *RATP Group, European Union's Horizon 2020 Program*

ART Case Study: Singapore

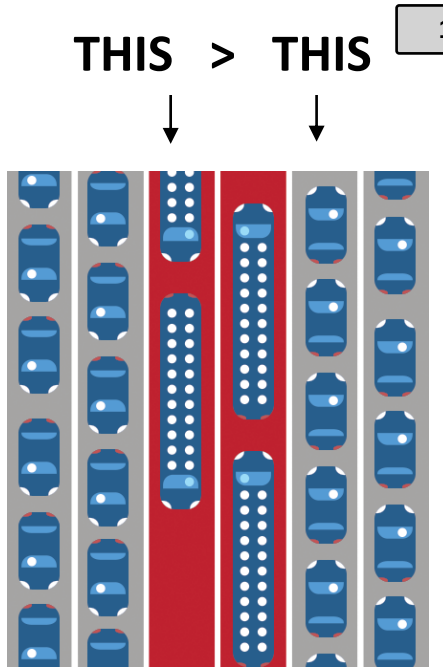
- Volvo Buses and Nanyang Technological University (NTU) in Singapore have signed a cooperation agreement on a research and development program for **autonomous electric buses.**

- NTU's vice-president for research, Professor Lam Khin Yong, said the development of a driverless bus will dovetail with the Government's vision to have autonomous vehicles in Punggol, Tengah and the Jurong Innovation District in **2019 for testing 2022 for commuter use.**

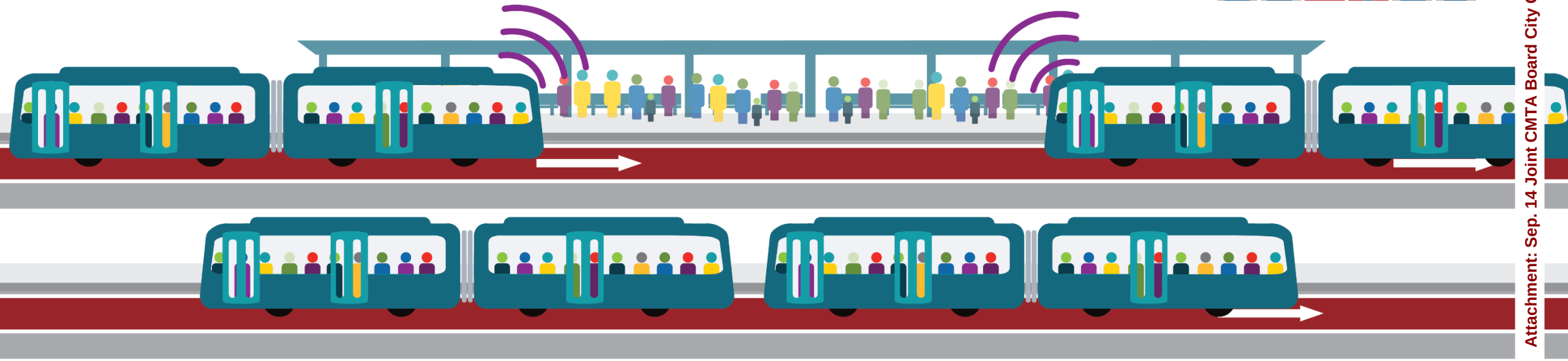
Source: *Volvo, Straits Times*

Emerging Transportation Technology

Platooning and V2V Communication

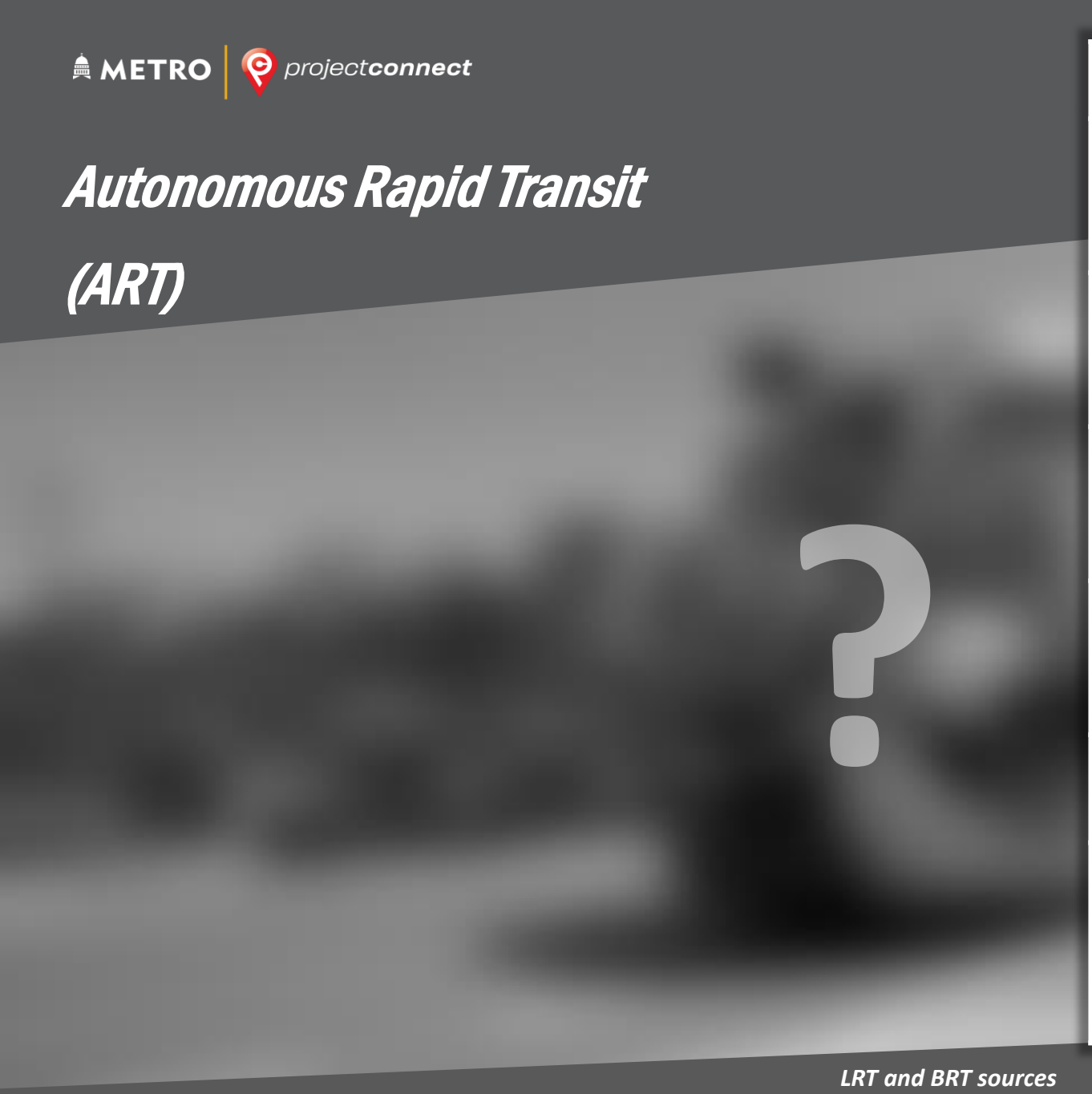


- Transit vehicles share current locations and speeds in real time, allowing for the safe operation of very short headways (less than 2 minutes)
- Vehicle to Vehicle (v2v) communication – allows for optimal allocation of street space (similar to platooning)



METRO | projectconnect

Autonomous Rapid Transit (ART)



ART At-A-Glance

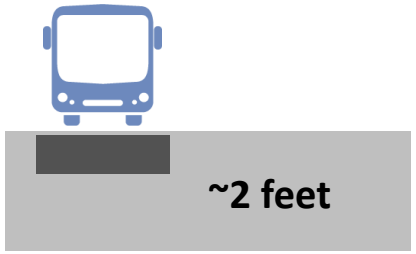
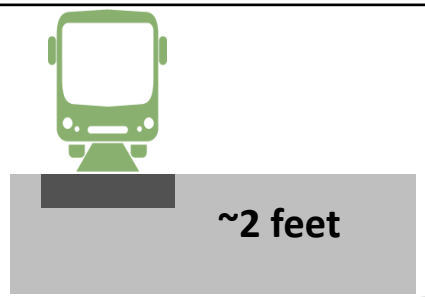
Defined as	Emerging train/bus mode that will operate using driverless technology
Frequency[1]	Comparable to LRT: Every 5 - 10 minutes during rush hour
Typical Daily Passengers Per Route[2]	Under development; likely comparable to BRT/LRT: 20,000 – 40,000
Cost to build[3]	Under development; likely comparable to BRT: $35 - $75M per mile
Distance between stations[4]	Comparable to LRT: Stops 1/2 - 1 mile apart
Per Vehicle Capacity[5]	Under development; likely comparable to LRT/BRT (100 - 200 passengers per vehicle)

LRT and BRT sources

[1] DART and King Country Metro
[2] Metro Planning; Average of NTD Sources
[3] Connect Greater Washington Report
[4] Connect Greater Washington Report
[5] New Flyer, Sier
All costs inflated to 2018 $

Mode Considerations

Building the System

Mode	Infrastructure Costs	Construction Timeline and Impacts (after funding secured)	Repaving/ Utility Relocation Impacts	Vehicle Cost
LRT	$60M - $170M per mile	5 - 10 years construction; moderate disruption		$3M - $5M per vehicle
BRT	$35M - $75M per mile	3 - 5 years; minimal disruption		$500K – $1M per vehicle
ART	TBD but likely comparable to **BRT**	TBD but likely comparable to **BRT**		Less than **LRT** and more than **BRT**

Mode Considerations

Keeping the System Working

Mode	Operational Costs	Maintenance Costs	Repair and Replacement Costs	Other Supporting System Costs
 **LRT**	$$$ Moves the most people for the lowest operational cost	$$$ Tracks and power system carry high maintenance costs	$$$ Vehicle and track replacement costs are high	$$$ Most expensive maintenance and support facilities; power supply system
 **BRT**	$$$ Needs more fuel or charge and operators per passenger than LRT	$$$ Maintenance costs limited to vehicles and stations	$$$ Vehicle costs are lower, but vehicle lifetimes are shorter	$$$ Minimal supporting system costs beyond maintenance facility
 **ART**	$$$ Fewer operators, but needs support personnel	$$$ Costs unknown, but likely between BRT and LRT due to cost of technology maintenance	$$$ Costs unknown; likely higher between BRT and LRT due to cost of technology components	$$$ Costs unknown, but moderate supporting system costs for IT system and AV components

INTRODUCTION

PROJECT CONNECT OVERVIEW

AUSTIN STRATEGIC MOBILITY PLAN + CORRIDOR OFFICE COORDINATION

DEDICATED PATHWAYS

MODES

NEXT STEPS

Next Steps

October 1: Austin Chamber of Commerce Regional Mobility Summit

October-November: Community Engagement, District Town Halls

October 22: Capital Metro Board of Directors Meeting- Staff Presentation of Recommended System Plan

December 17: Capital Metro Board of Directors Meeting- adoption of Project Connect Vision Plan