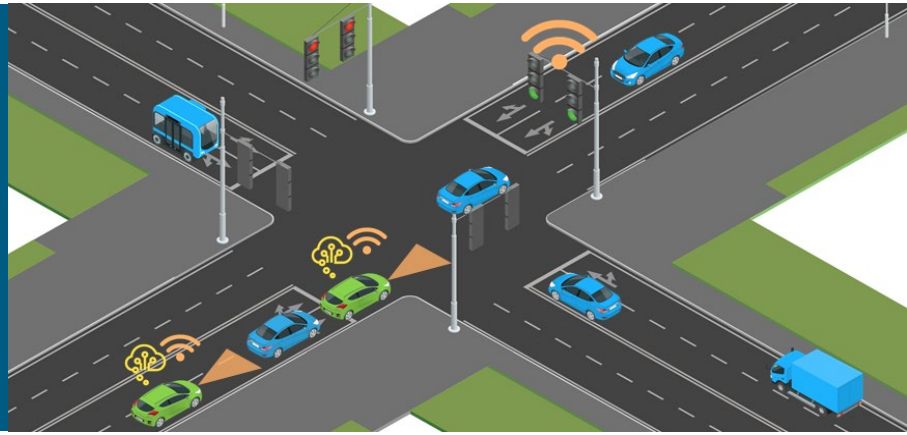
U.S. DEPARTMENT OF ENERGY
SMARTMOBILITY
Systems and Modeling for Accelerated Research in Transportation

MULTIMODAL TRAVEL: TRANSIT AND RIDE HAIL



March 14, 2023

SMART Webinar Series
Webinar #2

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Argonne NATIONAL LABORATORY
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PREVIOUS & UPCOMING WEBINARS

FEBRUARY
OVERVIEW, KEY METRICS AND INSIGHTS SNEAK PEEK

TODAY

MARCH
MULTIMODAL TRAVEL
Transit & Ridehail

APRIL
MULTIMODAL TRAVEL
Micromobility
Drones

MAY
CONNECTED & AUTOMATED VEHICLES (CAVs)
Vehicle and powertrain control
Traffic signal control

JUNE
CAVs and Intelligent Transportation Systems
Transportation system impact, Induced VMT, parking, curb management, land use, policies

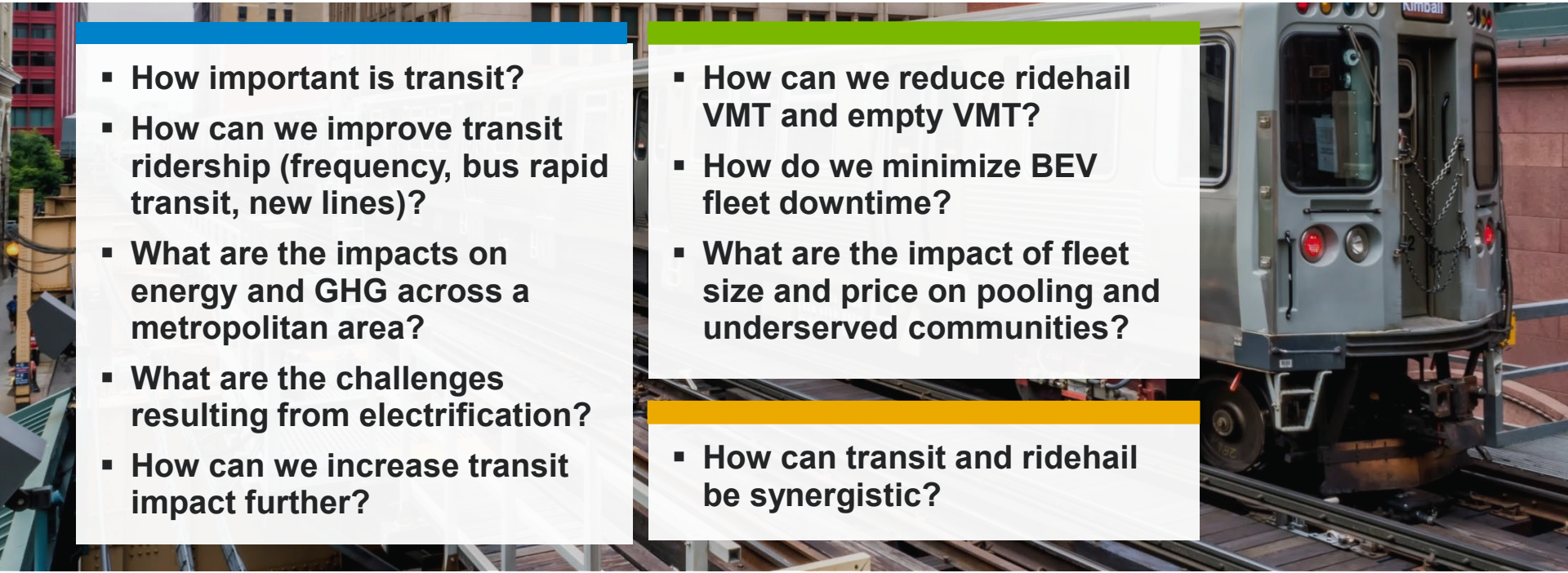
JULY
FREIGHT
Last mile delivery

AUGUST
ELECTRIFICATION
EV charger deployment
Grid impact

2023

Webinar Materials

IMPACT OF TECHNOLOGIES AND POLICIES ON TRANSIT AND RIDE HAILING



- How important is transit?
- How can we improve transit ridership (frequency, bus rapid transit, new lines)?
- What are the impacts on energy and GHG across a metropolitan area?
- What are the challenges resulting from electrification?
- How can we increase transit impact further?

- How can we reduce ridehail VMT and empty VMT?
- How do we minimize BEV fleet downtime?
- What are the impact of fleet size and price on pooling and underserved communities?

- How can transit and ridehail be synergistic?

TRANSIT IS CRITICAL TO THE OVERALL TRANSPORTATION SYSTEM

Drastic reduction in overall activity and travel speeds with no transit

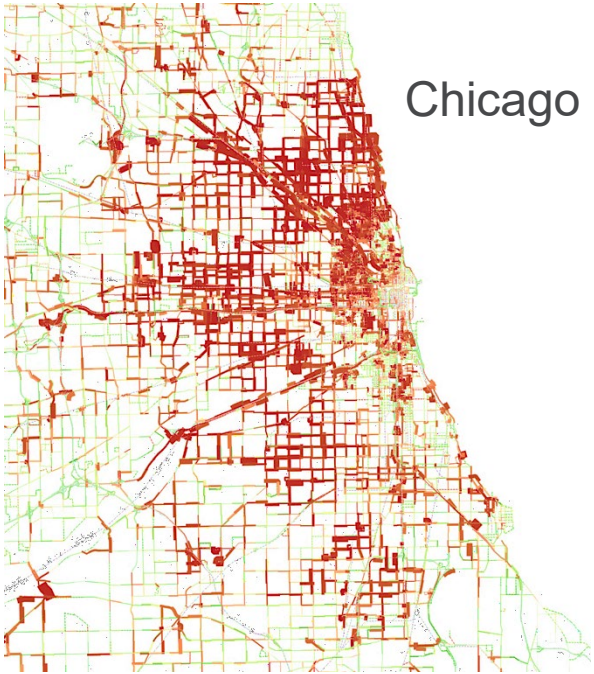
- Baseline transit in Chicago has 6-7% mode share.
- Without transit, 26% of non-work activities (17% of total) would be cancelled.
- Despite fewer overall trips, speeds would reduce by 28% in the city & by 12% in the entire region.

OVERALL ACTIVITY

NON-WORK	TOTAL
-26%	-17%

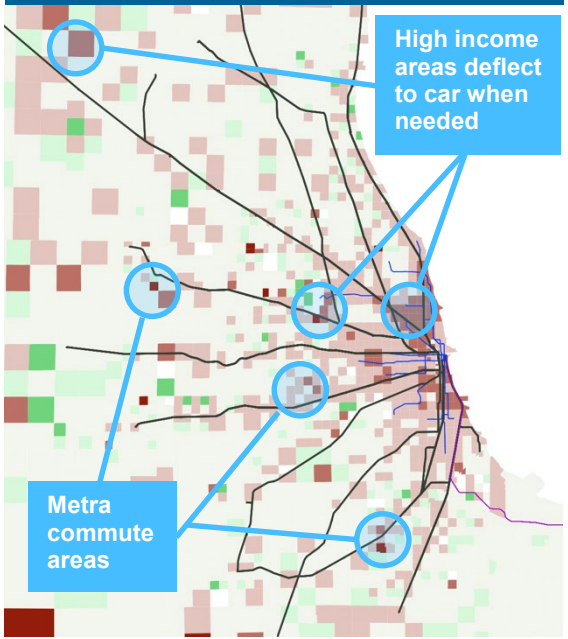
AVERAGE SPEED

CITY	METRO AREA
-28%	-12%

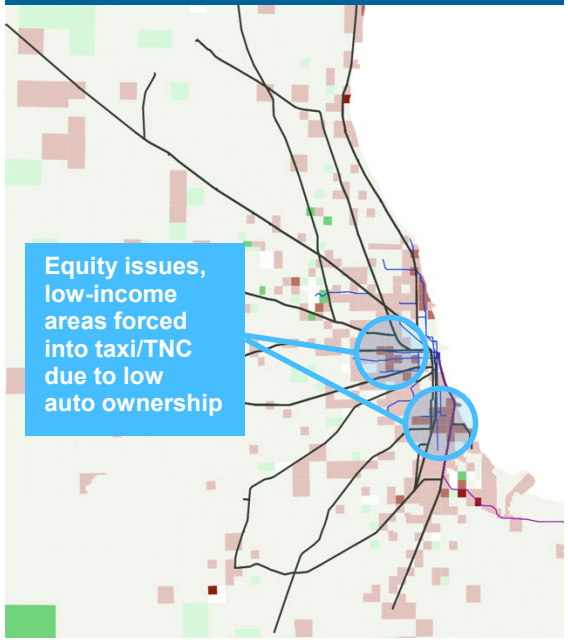


CHANGE IN MODE USAGE PATTERNS WITH NO TRANSIT ILLUSTRATES POTENTIAL EQUITY ISSUES

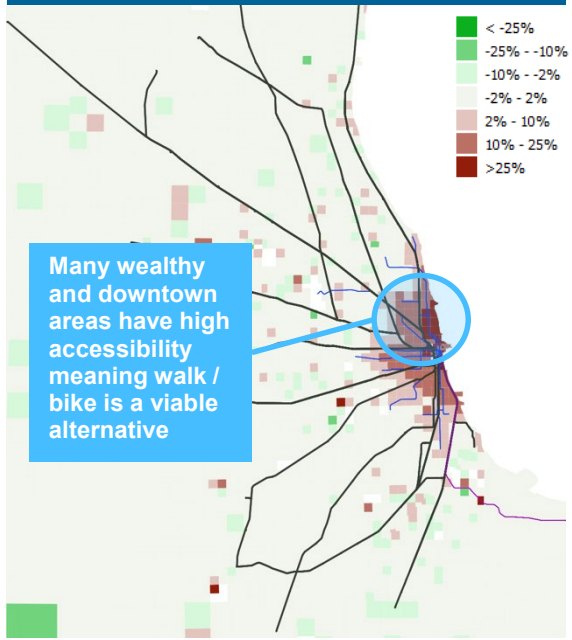
% Δ in Auto Mode Share



% Δ in TNC/Taxi Mode Share



% Δ in Non-motorized Share



PERSISTENT REDUCTION IN TRANSIT HAS MAJOR ECONOMIC IMPACT


October 20, 2022 05:00 AM

The CTA is staring down a financial disaster

The outlook after next year is dire, with federal aid drying up and farebox revenue down by about half.

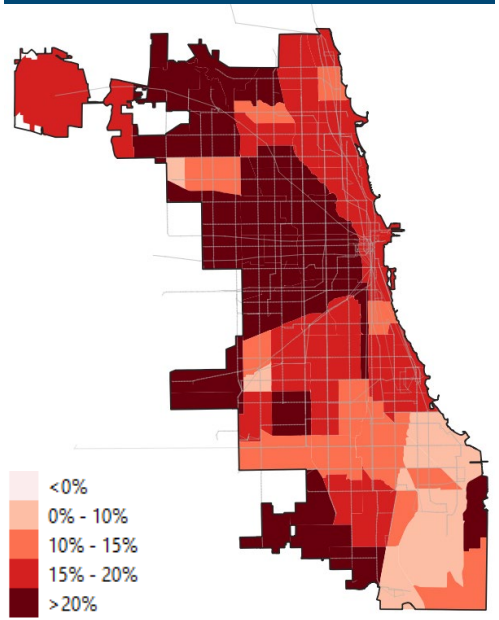
GREG HINZ

Source: Crain's Chicago Business

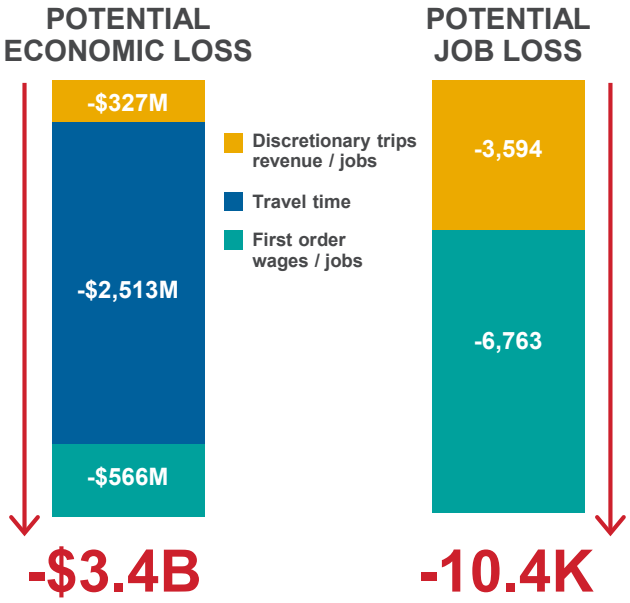
- **Potential service cuts driven by reduced transit ridership during COVID lead to job and wage losses and drop in discretionary trips.**
- **Total impact of $1 Billion to $3.4 Billion economic loss when service is reduced by 20-50%.**

Sources: APTA TRED tool, Argonne Labs Regional Model, Standard Value of time assumption

Δ in Avg Trip Duration (%)

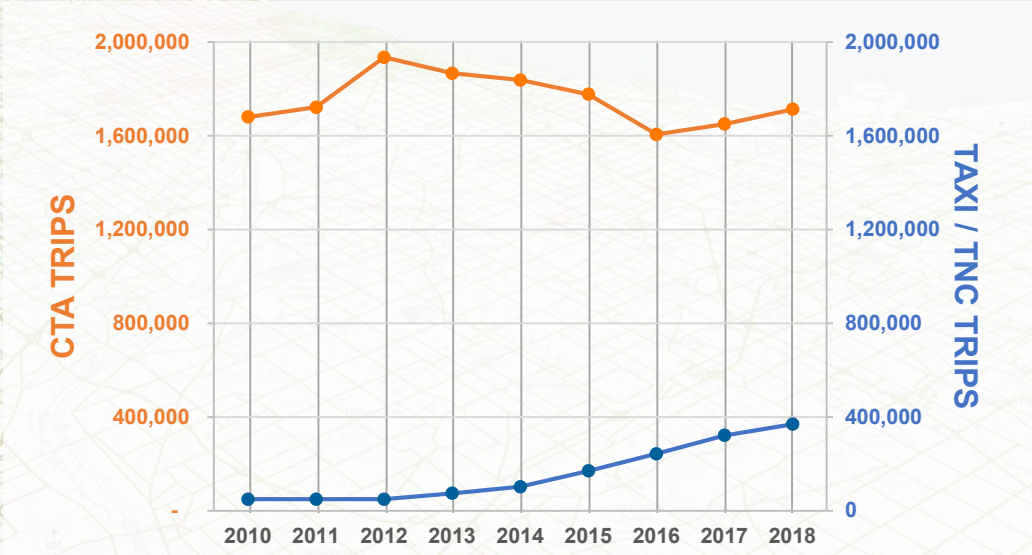


Annual Regional Economic Impact



TNC GROWTH CAN ALSO IMPACT TRANSIT RIDERSHIP, CONGESTION AND EMPTY VEHICLE MILES TRAVELLED (VMT)

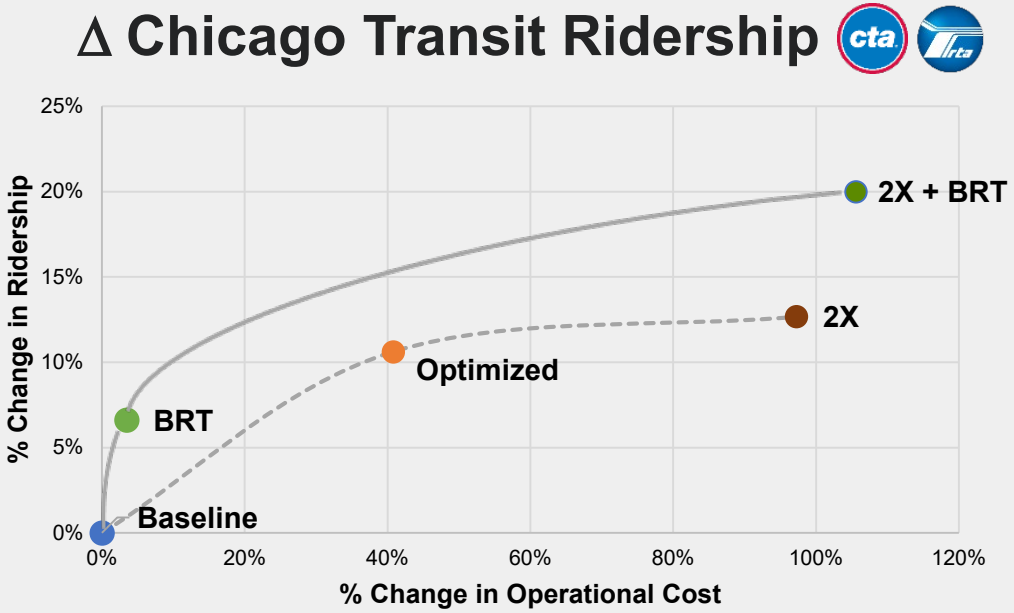
- Drastic growth in ride share trips between 2014 and 2018.
- Potential for increased congestion in dense urban areas and reduction in transit use.
- 360% growth in Taxi/TNC since 2014 while transit has dropped 7%.



Chicago

TRANSIT OPTIMIZATION IMPROVES RIDERSHIP UP TO 11% AT MODERATE COST

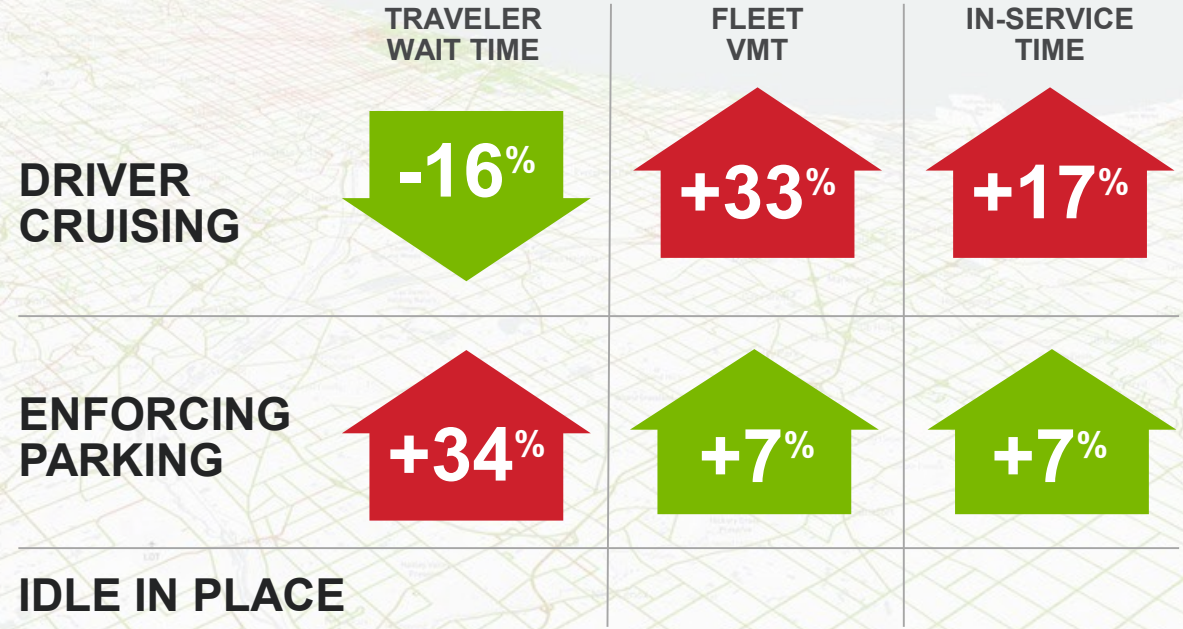
- Increased bus frequencies or new Bus Rapid Transit (BRT) improves transit user experience (less waiting & travel times).
- Suburban agencies could focus on increasing frequency.
- Agencies operating in high density urban areas could implement new routes and BRT.



PARKING BETWEEN RIDEHAILING TRIPS COULD DECREASE EMPTY VMT BY 25%

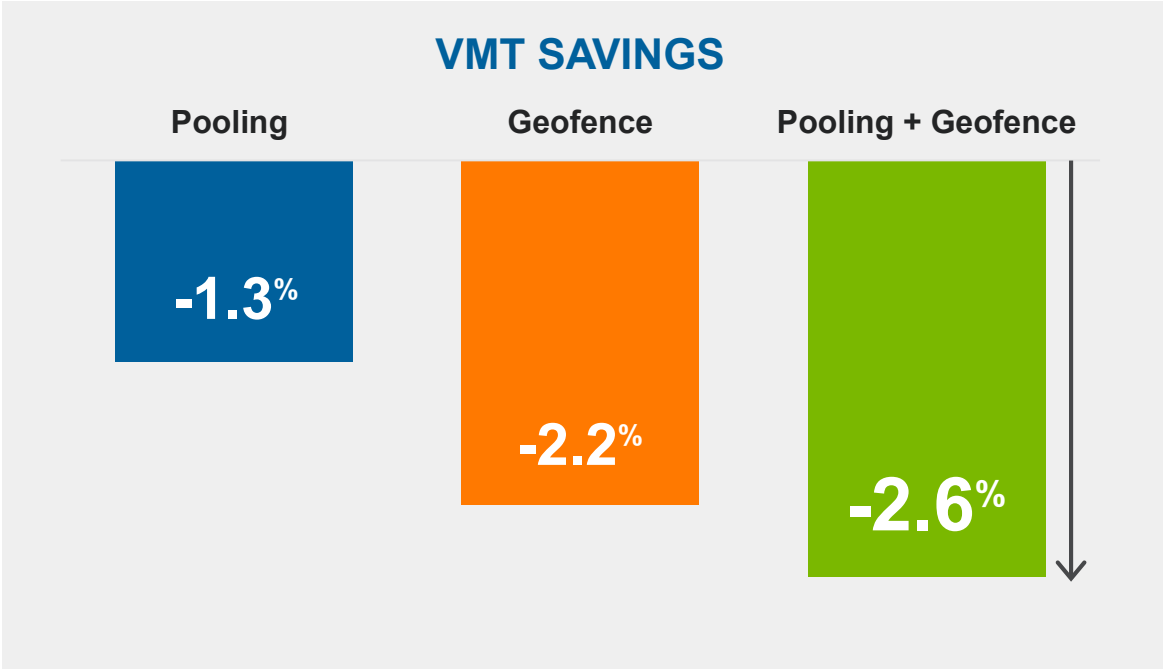
Compared to driver cruising

- Driver cruising lowers traveler wait time at the expense of increased VMT and in-service time.
- Driving to parking between trips would decrease empty VMT by 25% in urban dense areas with 18% increase in traveler wait time.
- Cities could start tracking parking and improve use of limited resource through curb management.



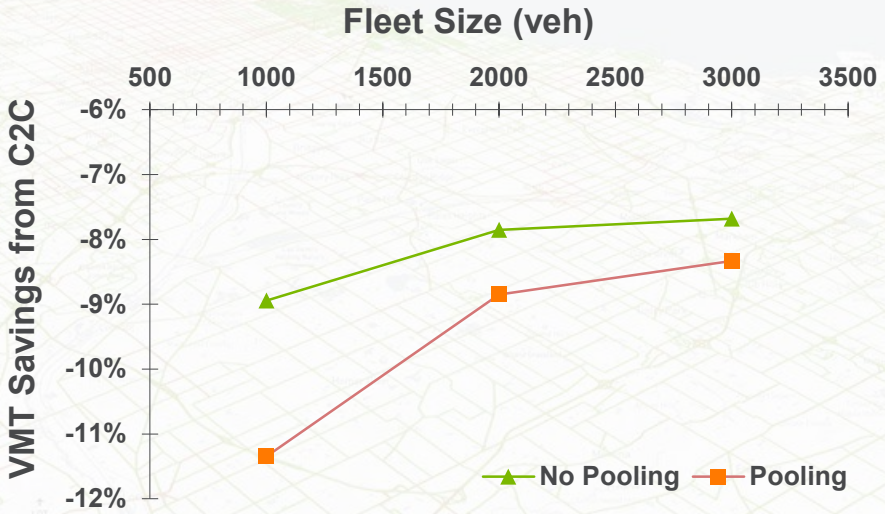
POOLING AND GEOFENCING CAN HELP REDUCE RIDESHARE VMT BY 3%

- Pooling trips can help lower regional VMT for those that opt in.
- Geofencing reduces operating area, making trip-matching more efficient.
- Up to 3% savings observable when combined.
- Fleet operators could consider a variety of policies with synergistic benefits.



TNC CORNER-TO-CORNER (C2C) ROUTING CAN SAVE UP TO 11% VMT

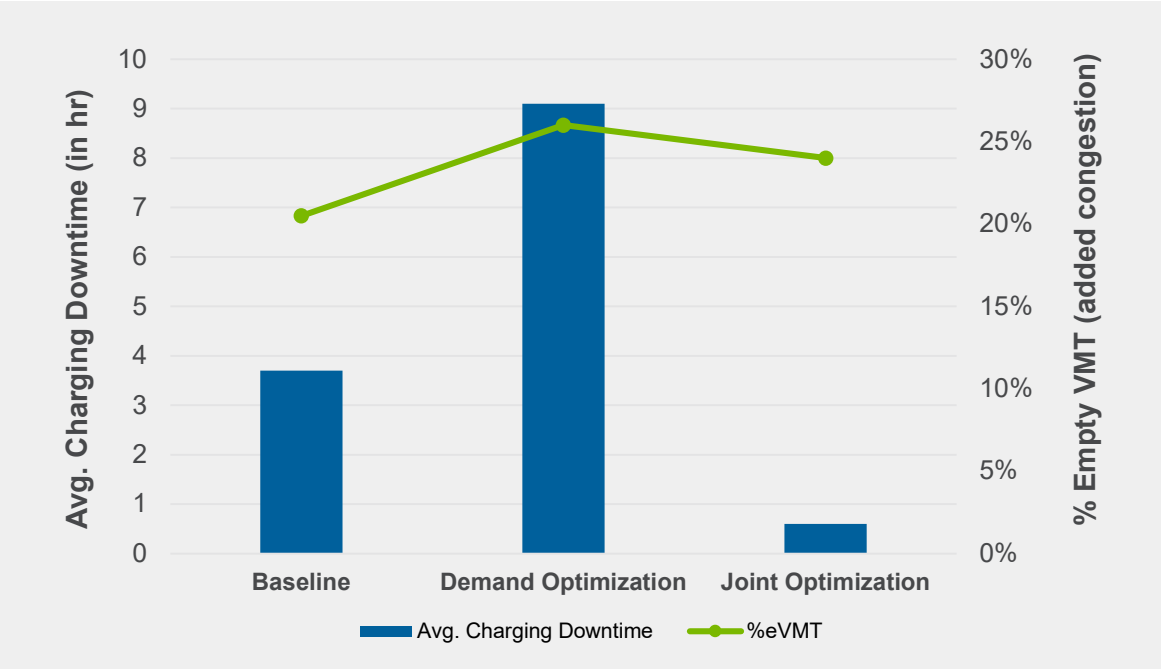
- TNC vehicles stay on more direct routes, saving time & lowering congestion.
- C2C is more effective at low supply & high demand levels.
- Sharing rides boosts benefit compared to solo travel by an additional 3%.
- Rideshare providers could incentivize use of C2C where applicable to improve performance and user experience.



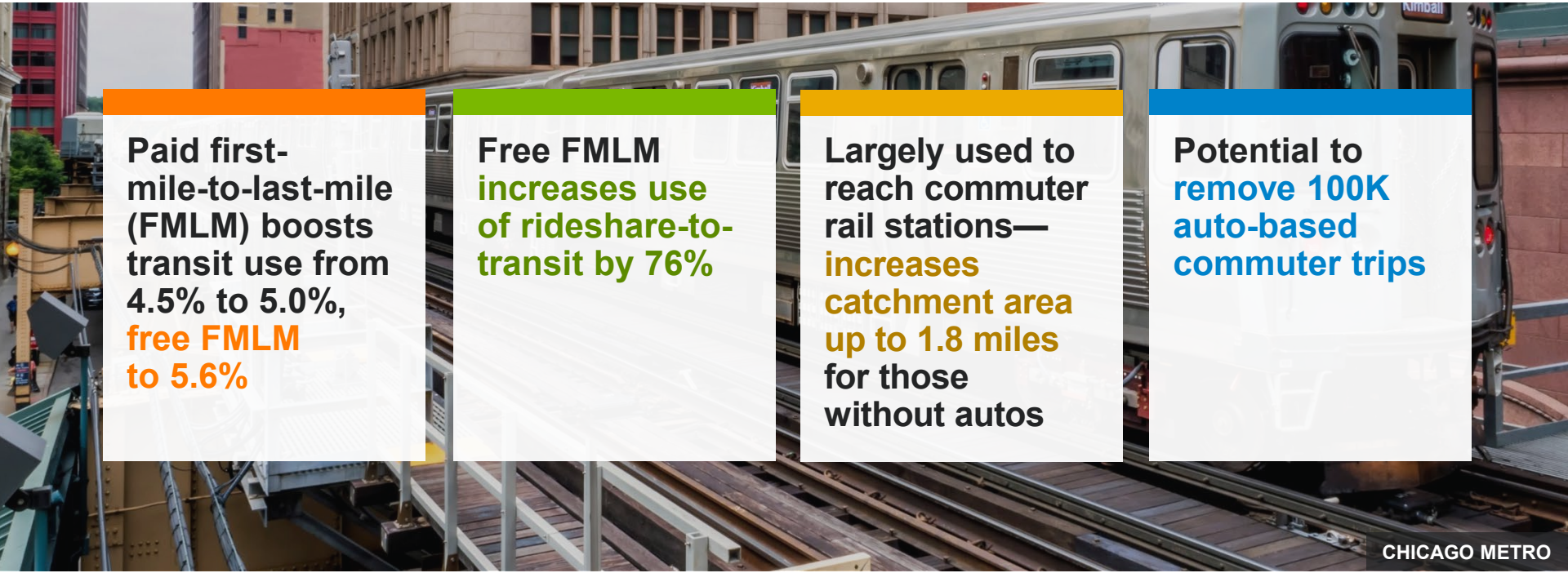
COORDINATED REPOSITIONING AND CHARGING REDUCE EV TNC FLEET DOWNTIME BY UP TO 84%

While also decreasing empty VMT by 8%

- Electrified fleets need dedicated management to improve service for daily operation.
- Focusing on charging only increase traveler wait time up to 15%.
- Fleet operators could simultaneously consider wait time and charging needs to minimize downtime and empty VMT.



SUBSIDIZED FMLM HAS STRONG POTENTIAL TO INCREASE TRANSIT USE AND REMOVE AUTO COMMUTING TRIPS



Paid first-mile-to-last-mile (FMLM) boosts transit use from 4.5% to 5.0%, free FMLM to 5.6%

Free FMLM increases use of rideshare-to-transit by 76%

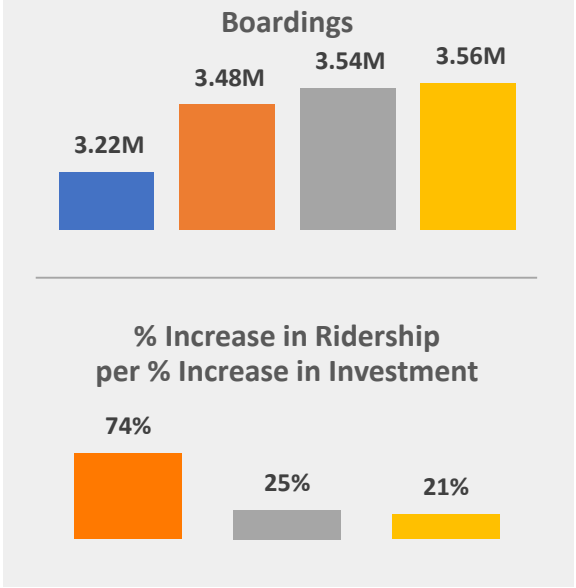
Largely used to reach commuter rail stations—increases catchment area up to 1.8 miles for those without autos

Potential to remove 100K auto-based commuter trips

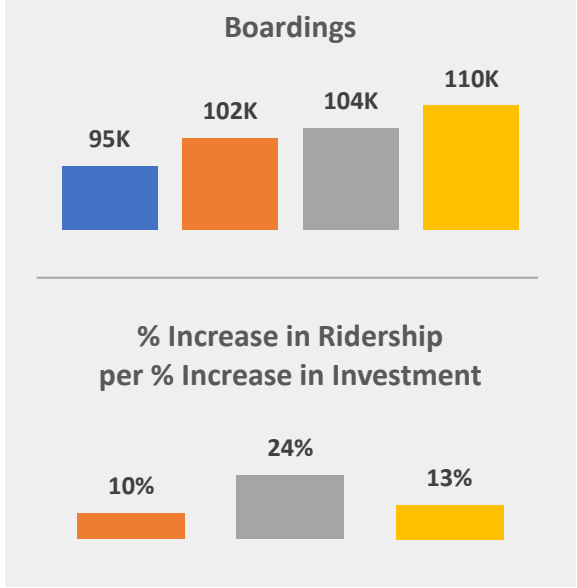
INVESTING IN TRANSIT OR FMLM SUBSIDIES CAN IMPROVE RIDERSHIP UP TO 15%

- Subsidized FMLM increases boardings by 7–8%.
- 40% higher budget increases ridership by 10%.
- Combined effect of FMLM and transit investment is 11% in Chicago and 15% in Austin.
- FMLM subsidization has a much higher return on investment in Chicago, while in Austin frequency increase is more efficient.
- Agencies could target specific solutions for their areas.

CHICAGO – 2035



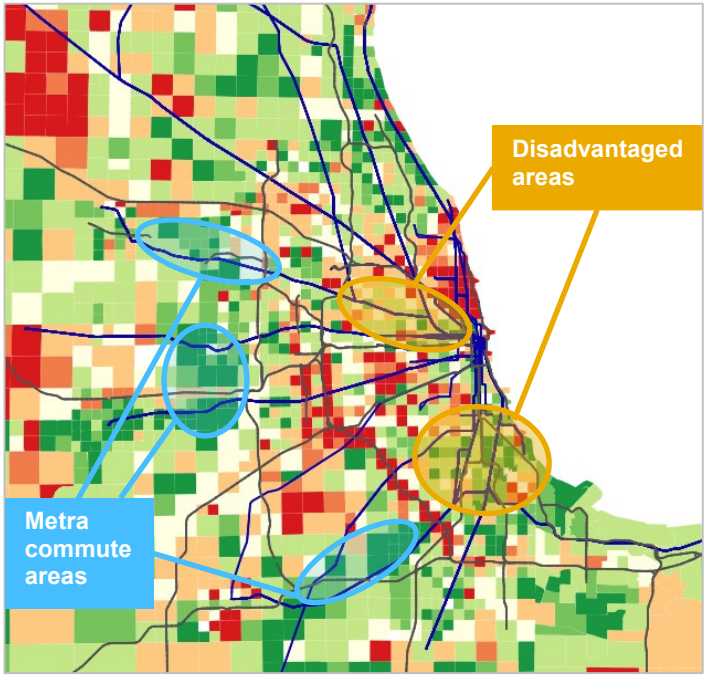
AUSTIN – 2035



Transit: False - FMLM: False | Transit: False - FMLM: True | Transit: True - FMLM: False | Transit: True - FMLM: True

INCREASED TRANSIT SERVICE CAN HAVE SIGNIFICANT IMPACT ON ENERGY AND GHG IN TARGETED AREAS

- Modest reduction in overall regional energy use and GHG for Chicago of 1% with subsidized TNC and increased transit budget.
- Significant improvements centered in disadvantaged communities and outlying areas along commuter rail.
- Energy increases along circumferential highways not served by rail and wealthier areas.
- Agencies could consider local impact and unintended consequences.



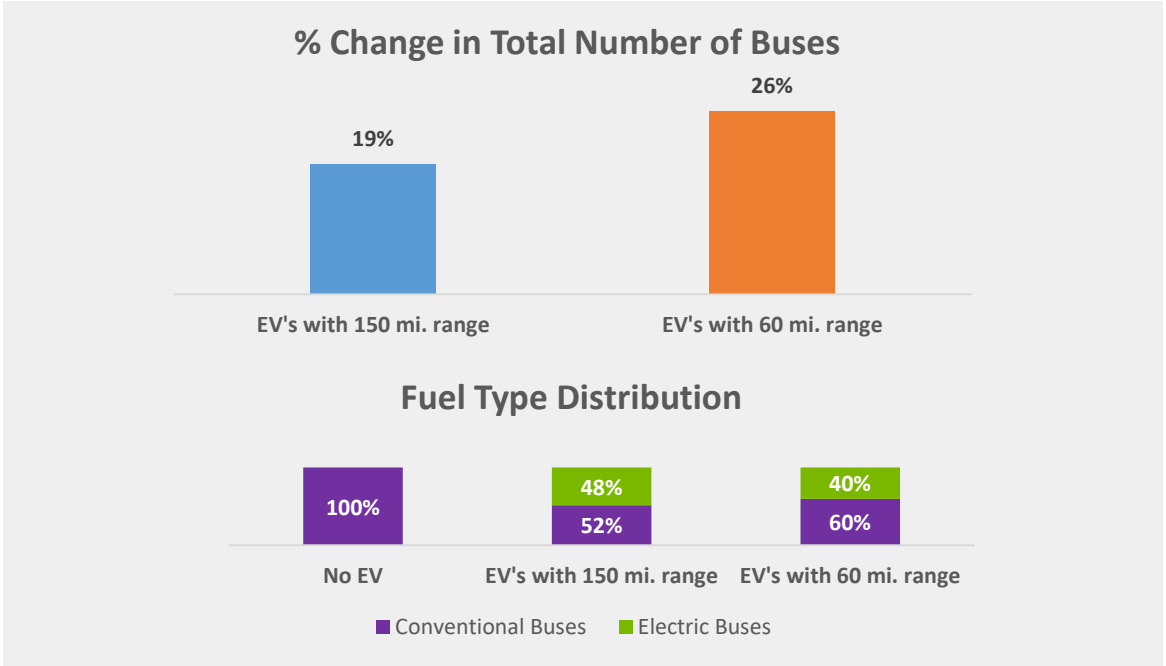
1% reduction in energy / GHG

% change in energy vs base

- <-15%
- -15 - -10%
- -10 - -2%
- -2 - 2%
- 2-10%
- 10 - 15%
- >15%

~50% TRANSIT ELECTRIFICATION REQUIRES ~20% FLEET INCREASE TO MAINTAIN SCHEDULES

- Conventional buses can be mostly driven as long as labor regulations allow.
- Electric buses have limited range and need to return to their depots to recharge every ~2 to ~5 hours.
- Electrification beyond 50% is very challenging under current ranges and charging times.
- Transit agencies could consider electrification impact on number of vehicles, depots and operations.



TECHNOLOGY IMPACTS ARE UNIQUE TO EACH METROPOLITAN AREA

FMLM has no impact in Austin, but helps in Chicago with priced cordon

- In Austin, transit frequency alone is ineffective, but works well with a cordon.
- In Chicago, transit frequency, FMLM subsidies and cordon pricing work together to reduce travel times 2.4%.
- Teleworking negates some of this benefit.
- Agencies should not assume existing deployed policies will have similar impact.

% Change in regional travel time given investment in:

	Austin	Chicago
Transit	0.0%	-0.8%
FMLM	0.3%	-0.3%
Transit + Cordon	-1.2%	-0.5%
FMLM + Cordon	0.0%	-1.1%

And for different demand scenarios:

	Austin	Chicago
Transit + Teleworking	0.7%	0.6%
FMLM + Teleworking	-0.1%	0.2%
Transit + CACC/EV	0.1%	-0.5%

A HOLISTIC APPROACH IS REQUIRED TO INCREASE TRANSIT IMPACT FURTHER

- Car owners will continue to use them, except for some shift to commuter rail.
- Non-auto household shift trips largely from active modes, with some reduction in shared-auto.
- When auto ownership stays the same, transit growth is limited.
- New policies needed to reduce auto ownership and influence long-term decisions.

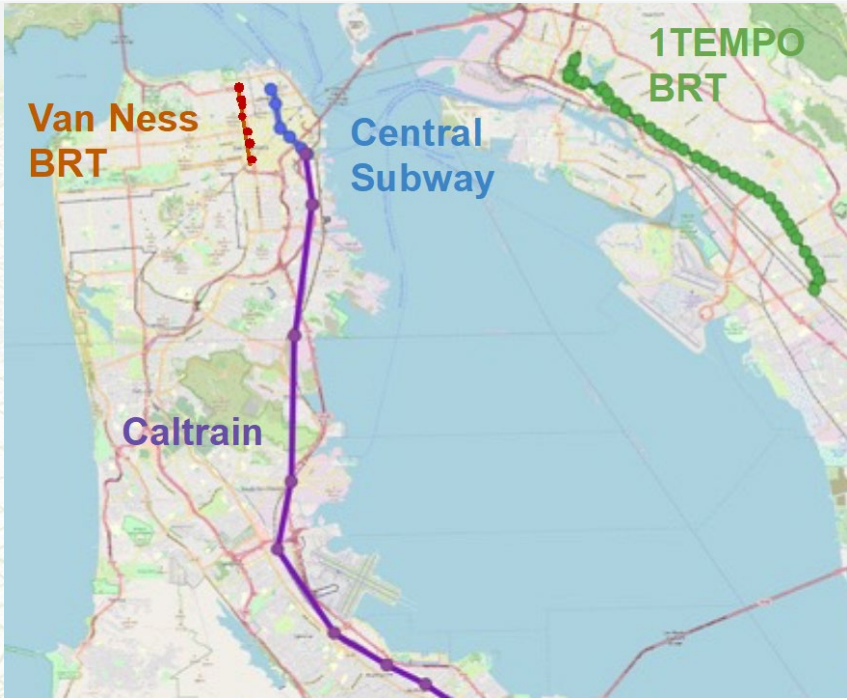
		% of miles traveled by mode:			
SCENARIO	AUTO-OWNERSHIP	TRANSIT	SOV	ACTIVE	OTHER
Baseline	Auto owners	4.6%	81.5%	3.7%	10.2%
	Non-owners	52.3%	–	23.2%	24.5%
Transit and FMLM	Auto owners	5.3%	81.1%	3.3%	10.3%
	Non-owners	55.9%	–	20.2%	23.9%
% point change	Auto owners	0.6%	-0.4%	-0.3%	0.1%
	Non-owners	3.6%	–	-3.0%	-0.6%

INCREASING PUBLIC TRANSIT SYSTEM CAPACITY CAN IMPROVE MOBILITY

Some projects increase service quality; others expand access

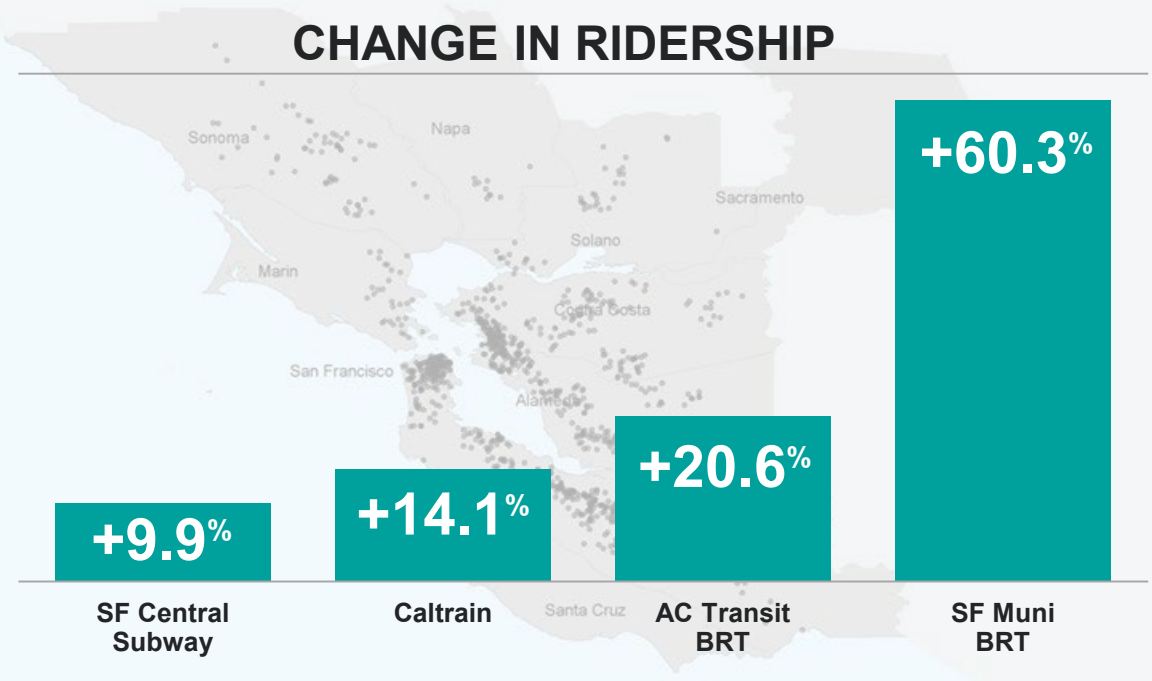
Four new transit projects considered:

- **SF Muni Central Subway Project**
  - New underground light rail route: 4 stations, 1.7 miles
- **SF Muni Van Ness Avenue Bus Rapid Transit "light" line**
  - Improvements cut travel times 32%
- **Electrify Caltrain**
  - 20% increase in service frequency reduces travel times 15%
- **AC Transit 1TEMPO Bus Rapid Transit "Light" line**
  - Operational changes increase speed 18%



FINDING 1: IMPROVEMENTS RESULT IN MEANINGFUL INCREASES IN TRANSIT USE

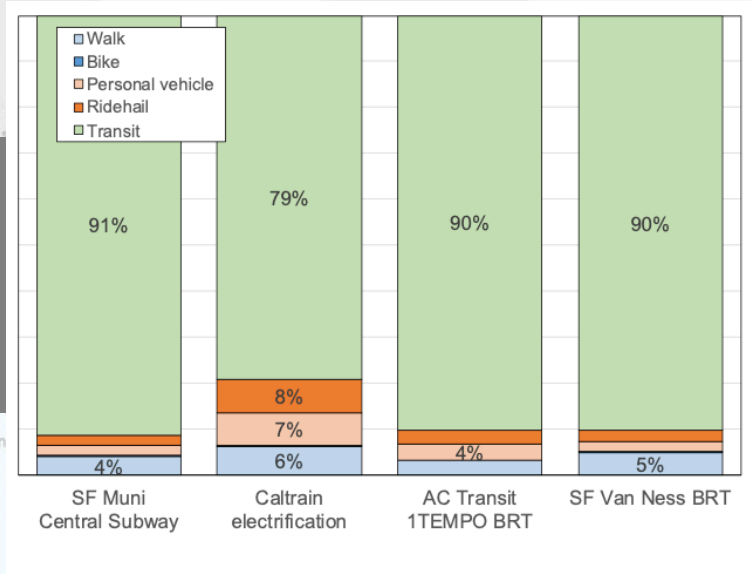
- Central Subway increases Muni light rail ridership 10%.
- Increased travel speed and run frequency from Caltrain electrification and the planned frequency of AC Transit BRT increase ridership 14% and 21%.
- SF Muni BRT line increases ridership 60%.



FINDING 2: NEW PROJECTS ALLOW RIDERS TO BOTH SHIFT FROM OTHER MODES AND REOPTIMIZE WITHIN TRANSIT

- 90% of users on new projects in dense urban areas come from other transit lines, 5% from personal and ridehail vehicles.
- Electrification of Caltrain (less dense areas, fewer transit options) resulted in 15% of new users coming from personal and ridehail vehicles. Fewer come from pre-existing transit service.

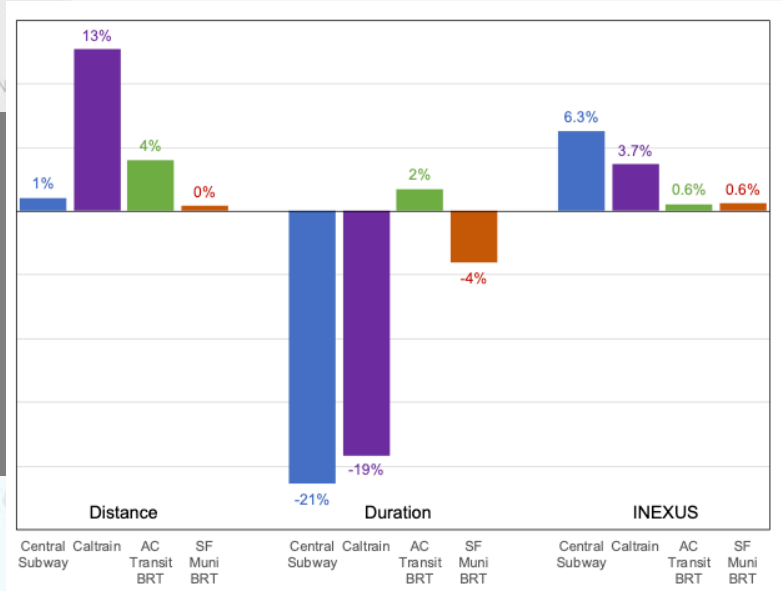
PREVIOUS MODES USED BY NEW TRANSIT USERS DUE TO TRANSIT EXPANSIONS



FINDING 3: THE IMPROVEMENTS IN TRAVEL EXPERIENCE AND OPTIONS FOR USERS VARY BY NEW PROJECT

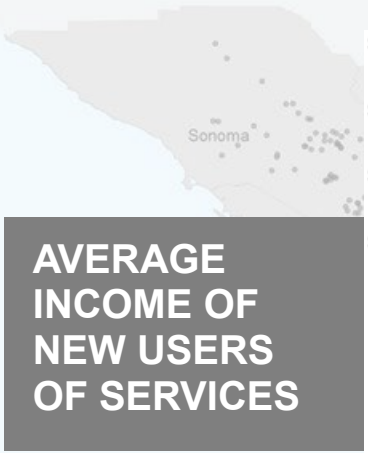
- Central Subway, which saw the largest increase in ridership, increased Potential INEXUS (person-trip based accessibility measure) the most (6%), driven in part by a 21% reduction in trip duration.
- Caltrain electrification enabled longer distance and much faster trips for users, increasing Potential INEXUS 4%.
- For the BRT projects, while there was relatively little change in trip distances, durations and Potential INEXUS. The opportunities riders were able to access increased ridership 20% to 60%.

CHANGE IN DISTANCE, DURATION AND ACCESSIBILITY OF USERS OF NEW SERVICE OPTIONS

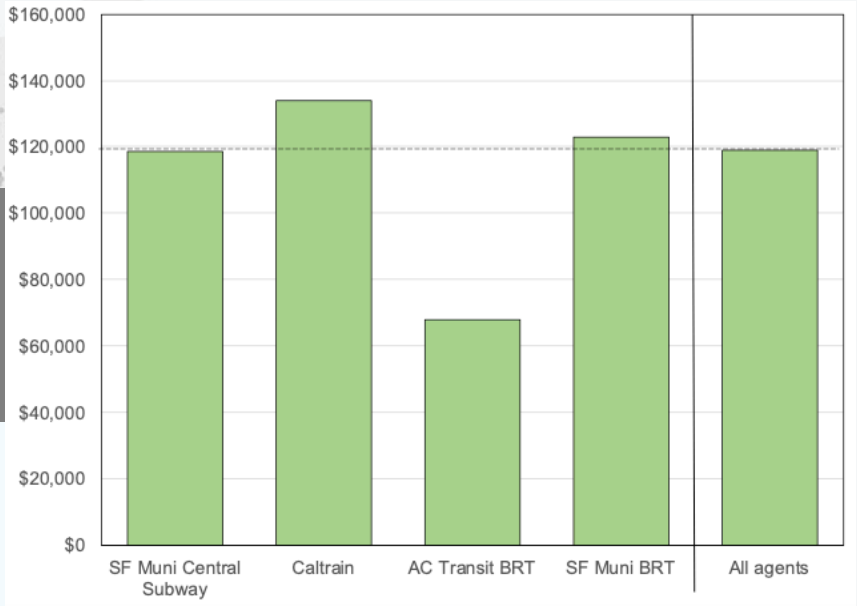


FINDING 4: NEW SERVICE EXPANSIONS SERVED DIFFERENT SUBPOPULATIONS IN THE REGION

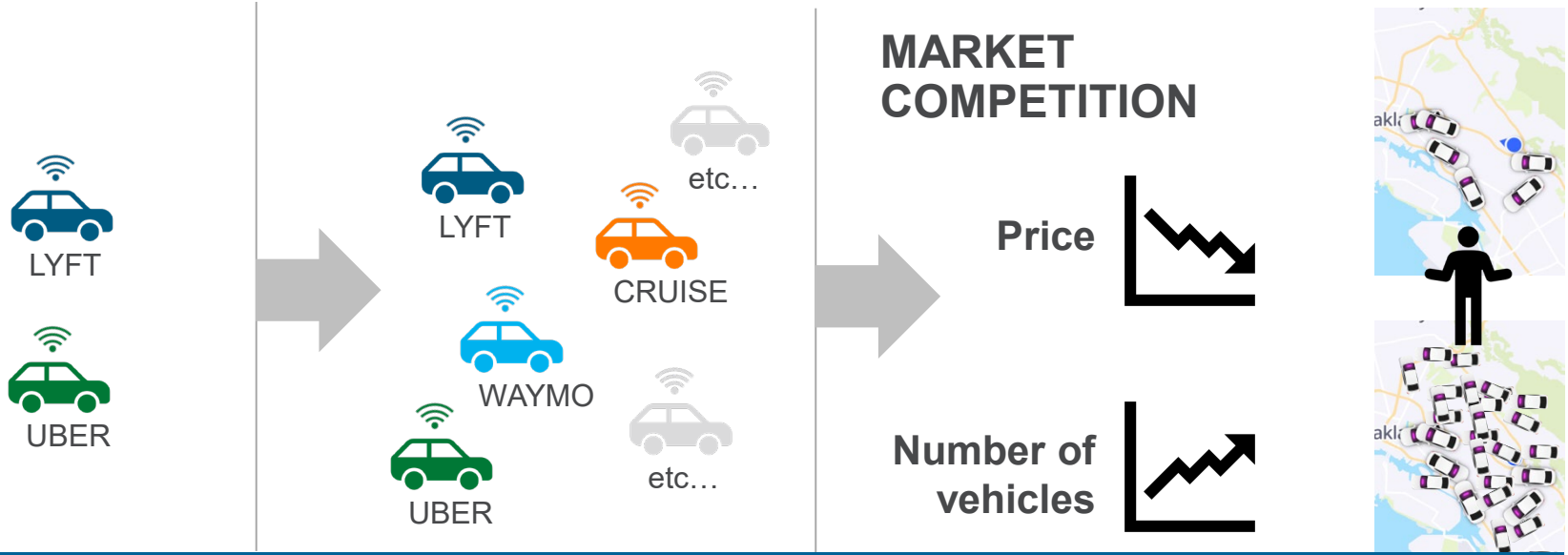
- The SF Muni projects and the Caltrain project served users with incomes at or above the average of regional travelers.
- The AC Transit BRT project in Oakland increased options for users with incomes on average or almost half of the region average.



AVERAGE INCOME OF NEW USERS OF SERVICES



RIDEHAIL SERVICE EXPANSION, PRICE CHANGES HAVE IMPORTANT IMPACTS

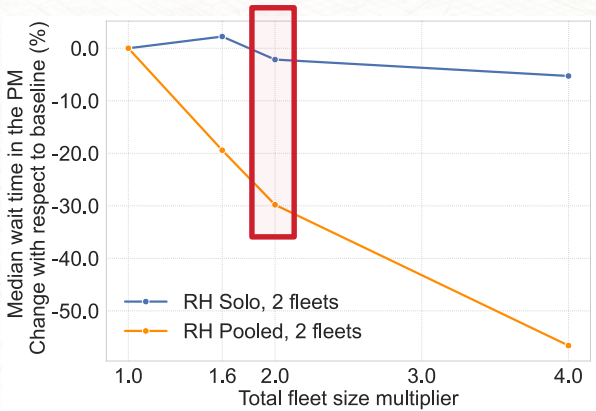


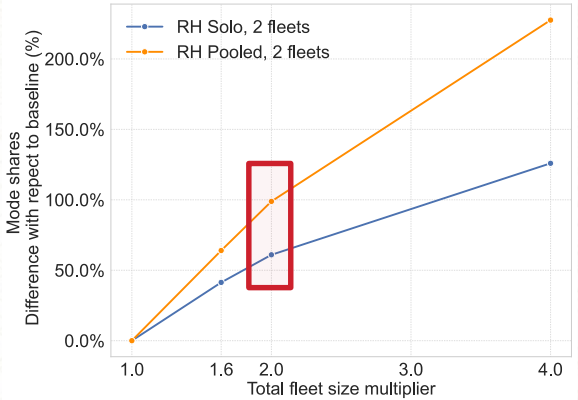
Can pooling mitigate negative outcomes?

FINDING 1: OPERATING MORE RIDEHAIL VEHICLES INCREASES SERVICE QUALITY AND MODE SHARE, BUT ALSO ENERGY AND DEADHEADING

Doubling size of existing Uber and Lyft fleets:

- **30%** Pooled ridehail wait times
- **2x** Pooled ridehail share
- **>50%** Solo ridehail share
- **63%** Deadheading VMT
- **1%** System transportation energy



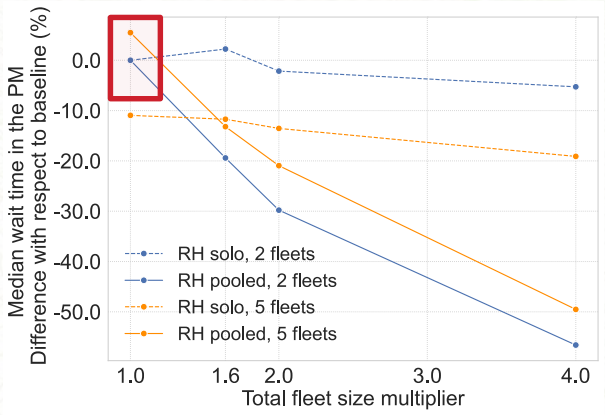


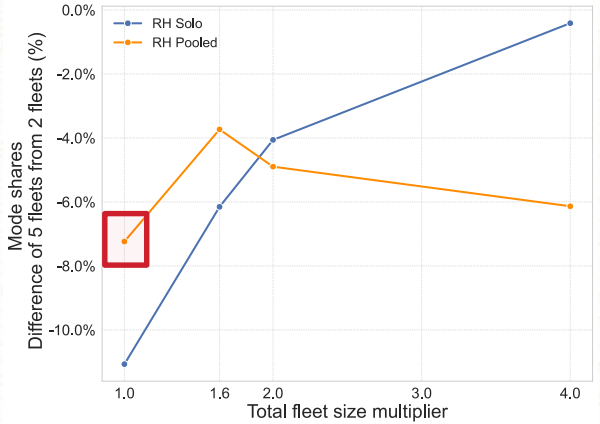
FINDING 2: MORE SEPARATE RIDEHAIL SERVICES ADD INEFFICIENCIES

Fracturing fleet → coordinating pooling becomes more difficult

Increasing number of fleets from 2 to 5:

- **5-10%** Pooled ridehail wait times
- **7%** Pooled ridehail share





FINDING 3: LOWER PRICES INCREASE SOLO RIDEHAIL BUT CAN DECREASE POOLING

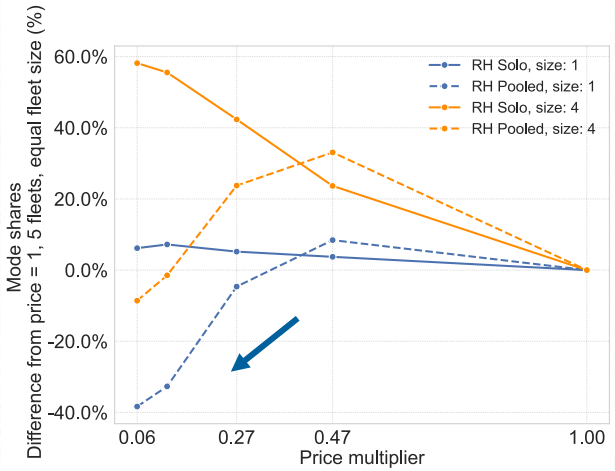
There are limits to how much pooling can mitigate inefficiency of expanding ridehail service

Reducing ridehail prices:

- Initially increases mode share of both solo and pooled ridehail.
- But eventually pooling will decrease as demand strains the system.

*Likely underestimates magnitude due to differences in pooling algorithm and simulation limitations.

**Assumes same vehicle technology mix as today.



Pooling hits limits even when free

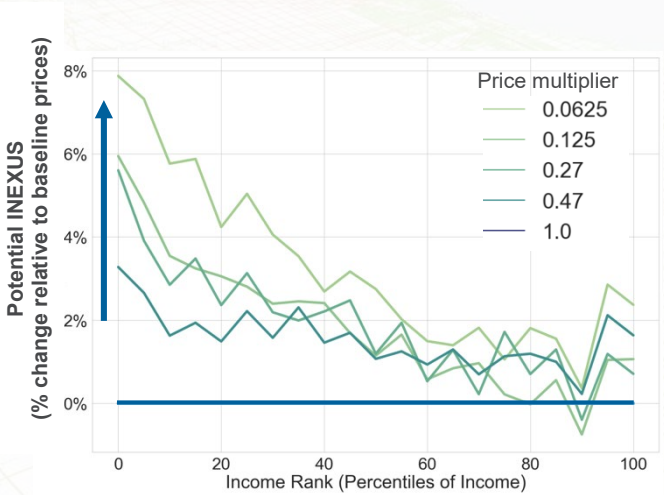
	5 fleets, baseline no. vehicles	5 fleets, 4X no. vehicles
RH Pooled: mode share when same prices as today*	0.2%	0.6%
RH Pooled: mode share when only pooling is free*	0.7%	3.1%
Total System Energy (% change relative to today) when only pooling is free**	-0.6%	2.6%

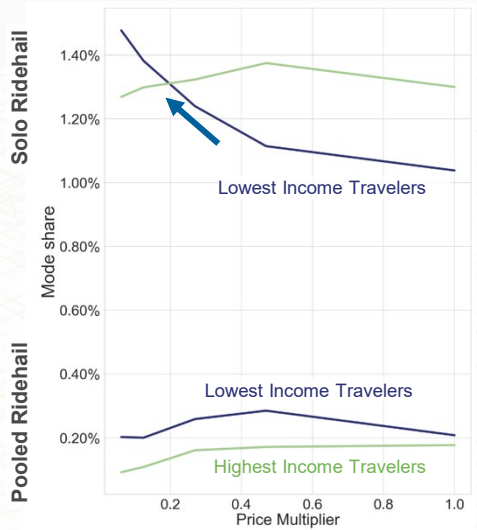
FINDING 4: EQUITY BENEFITS ACCOMPANY INEFFICIENCIES FROM INCREASED COMPETITION

Lowest income travelers benefit the most when ridehail fleets compete and reduce prices

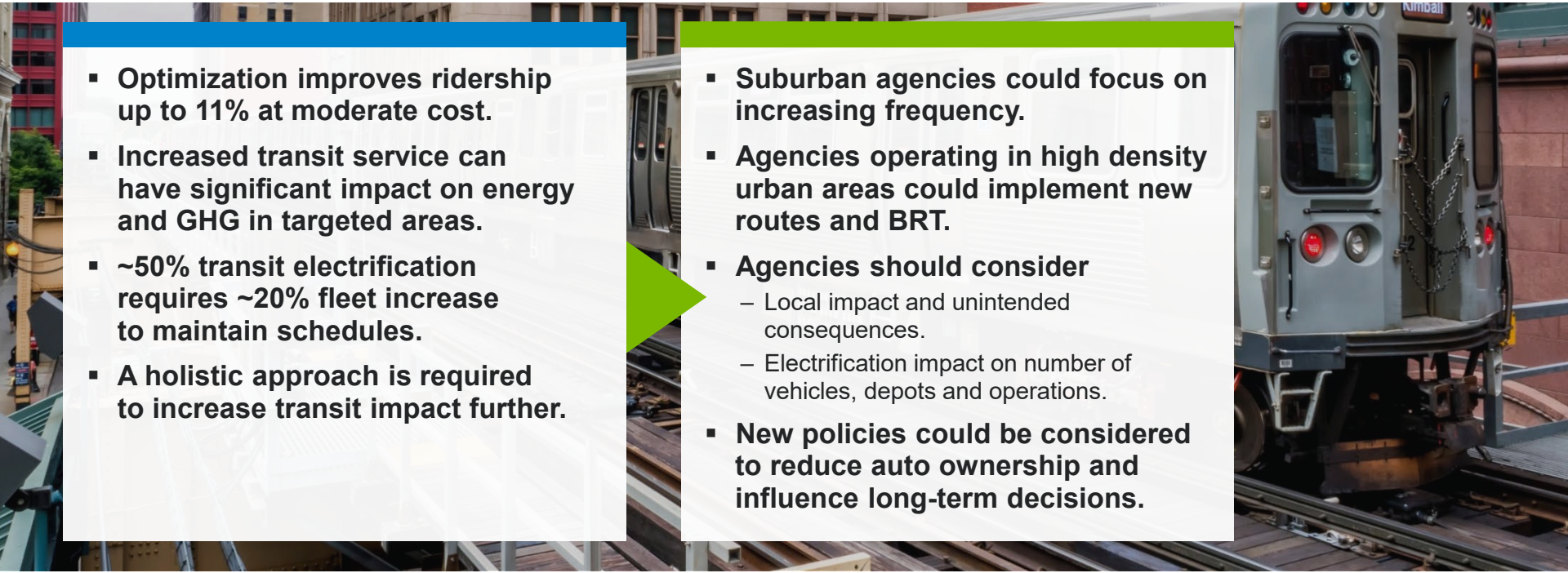
If ridehail prices reduce:

- **INEXUS accessibility (especially lowest income group)**
- **Solo ridehail mode share for lowest Income group**





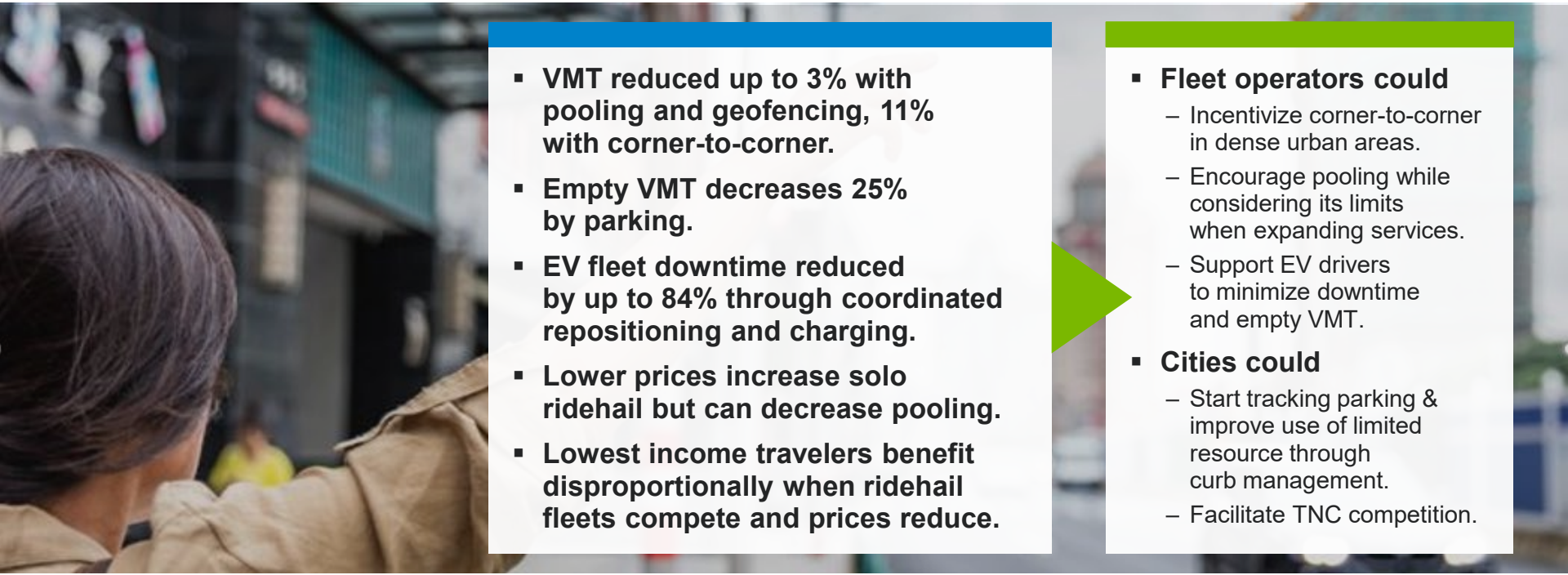
SUMMARY OF KEY INSIGHTS AND ACTIONS: TRANSIT



- **Optimization improves ridership up to 11% at moderate cost.**
- **Increased transit service can have significant impact on energy and GHG in targeted areas.**
- **~50% transit electrification requires ~20% fleet increase to maintain schedules.**
- **A holistic approach is required to increase transit impact further.**

- **Suburban agencies could focus on increasing frequency.**
- **Agencies operating in high density urban areas could implement new routes and BRT.**
- **Agencies should consider**
  - Local impact and unintended consequences.
  - Electrification impact on number of vehicles, depots and operations.
- **New policies could be considered to reduce auto ownership and influence long-term decisions.**

SUMMARY OF KEY INSIGHTS AND ACTIONS: RIDEHAILING



- **VMT reduced up to 3% with pooling and geofencing, 11% with corner-to-corner.**
- **Empty VMT decreases 25% by parking.**
- **EV fleet downtime reduced by up to 84% through coordinated repositioning and charging.**
- **Lower prices increase solo ridehail but can decrease pooling.**
- **Lowest income travelers benefit disproportionally when ridehail fleets compete and prices reduce.**

- **Fleet operators could**
  - Incentivize corner-to-corner in dense urban areas.
  - Encourage pooling while considering its limits when expanding services.
  - Support EV drivers to minimize downtime and empty VMT.
- **Cities could**
  - Start tracking parking & improve use of limited resource through curb management.
  - Facilitate TNC competition.

CLOSING THOUGHTS

- **Transit and ridehailing can be complementary.**
  - Investing in transit or FMLM subsidies can improve ridership up to 15%.
- **Technology impacts are unique to each metropolitan area.**

- **Agencies should**
  - Target specific solutions for their areas.
  - Not assume existing deployed policies will have similar impacts.

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FEBRUARY
OVERVIEW, KEY METRICS AND INSIGHTS SNEAK PEEK

MARCH
MULTIMODAL TRAVEL
Transit & Ridehail

APRIL
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Micromobility
Drones

MAY
CONNECTED & AUTOMATED VEHICLES (CAVs)
Vehicle and powertrain control
Traffic signal control

JUNE
CAVs and Intelligent Transportation Systems
Transportation system impact, Induced travel, parking, curb management, land use, policies

JULY
FREIGHT
Last mile delivery

AUGUST
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EV charger deployment
Grid impact

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