

Automated Mobility
Policy Project

**Municipal Planning for Autonomous
Vehicles**
June 6, 2019

Annie Hudson

MIT's Urban Mobility Lab

- | Led by **Professor Jinhua Zhao**, MIT's Urban Mobility Lab works to examine the impacts of mobility systems and shape travel behavior through insights into planning and policy.



Our current work on autonomous vehicles



Singapore

Transport for London

Chicago Transit Authority

MIT Energy Initiative

MIT Institute for Data, Systems, and Society



JTL's current work on autonomous vehicles

| Behavior

AV preference and demand: Do people want to use AVs? What experiences would encourage them to share AVs with strangers?

| Systems

How will AVs impact transit systems? Is there potential for integrating AV networks with bus and rail systems? Can we predict individual demand?

| Policy

How do AV regulations vary between the US, Canada, and China? What are appropriate regulations with respect to parking, land use, and congestion pricing?



This presentation

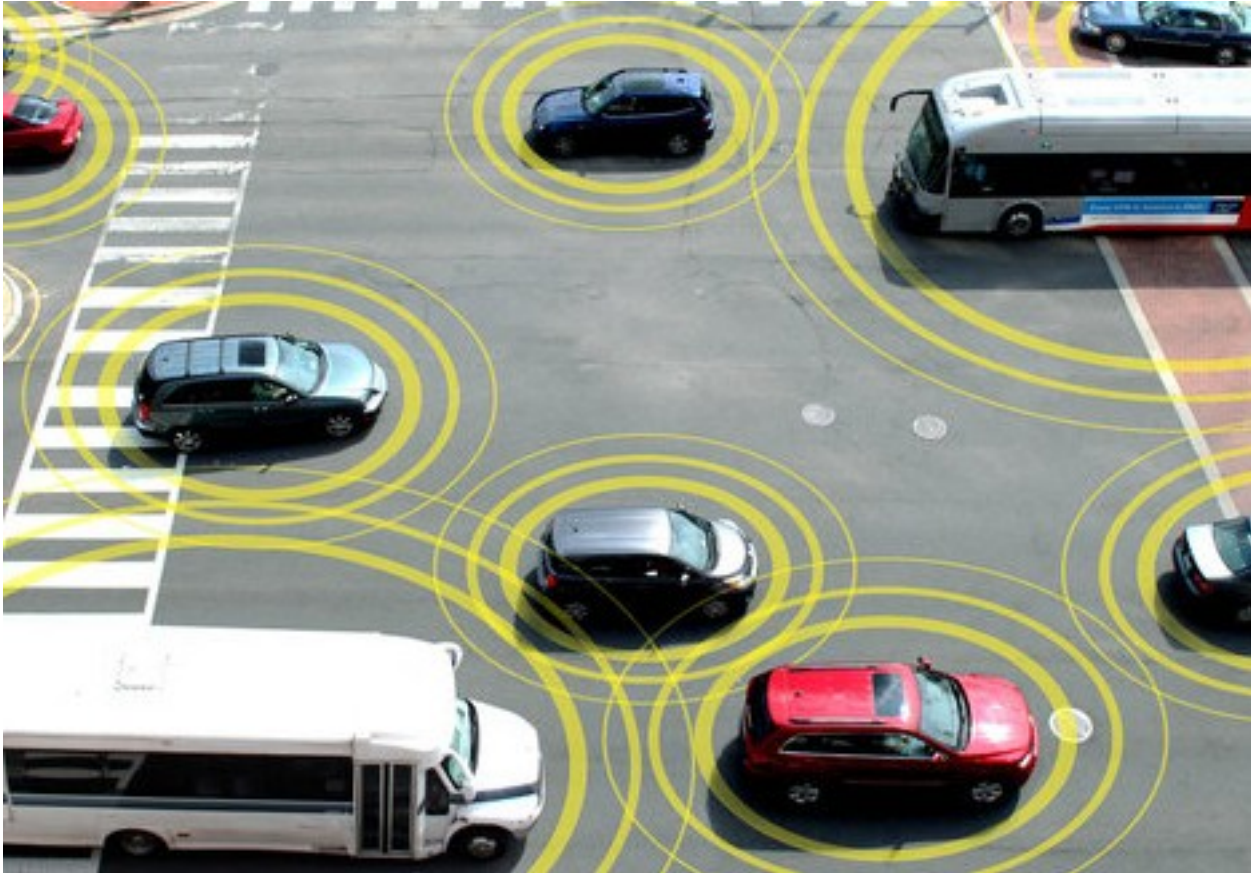
1. Why should we be talking about policy
2. Why should we be talking about cities
3. What are cities doing
4. What should they be thinking about doing



AVs could radically transform the way our cities and their transportation systems work.



Context: The promise of AVs



More **equitable**
access to urban needs

More
**environmentally
sustainable** mobility
More **efficient** urban
transportation systems

More **livable**
neighborhoods



Context: The risks of AVs



- Increased **vehicular travel and congestion**
- Increased **energy use and pollution**
- Increased **segregation by class and race**
- More auto-dependent **land uses**





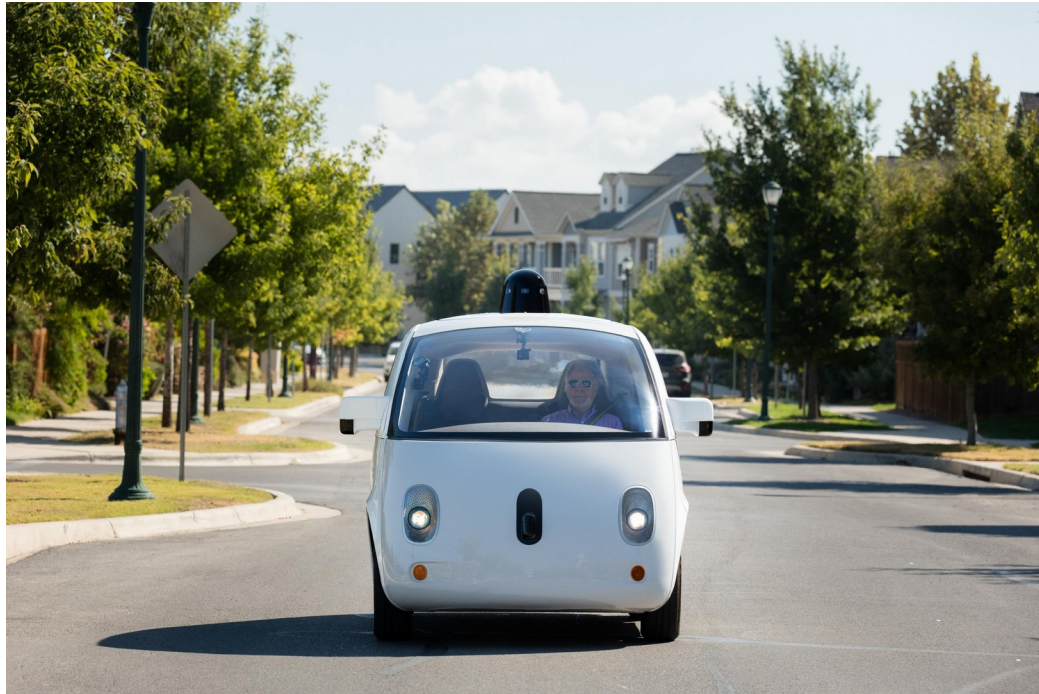
But all of this depends on many things...



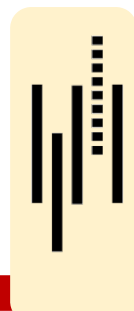
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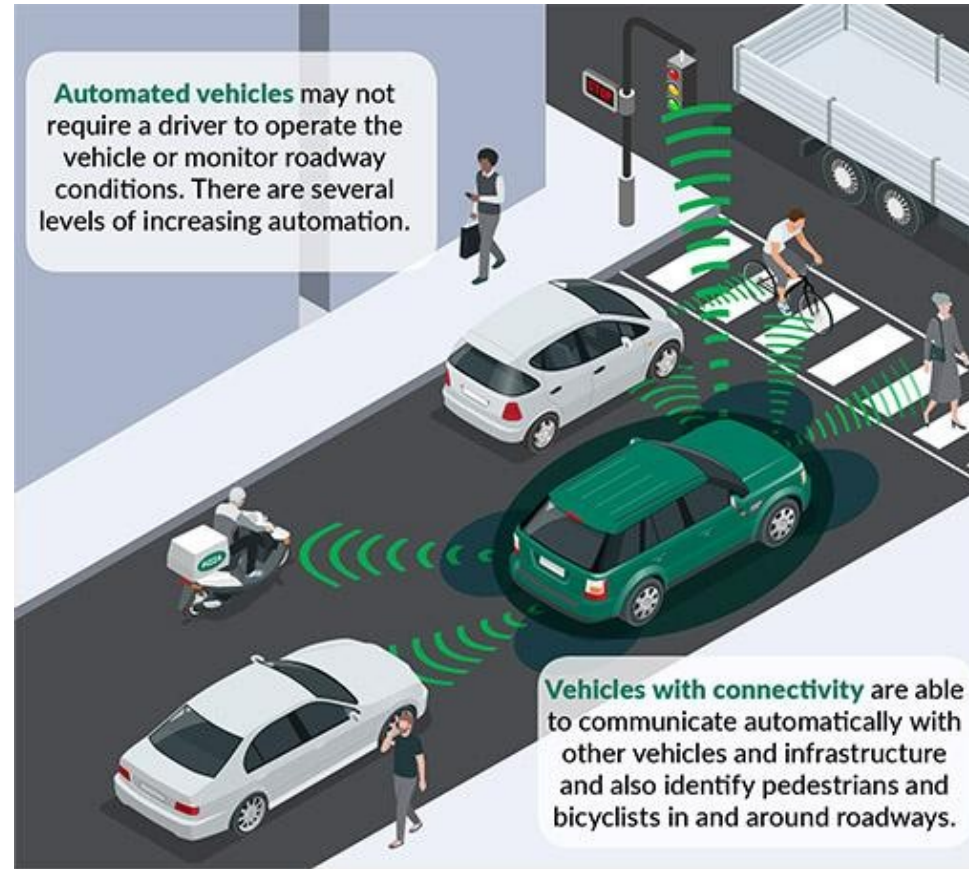
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But all of this depends on many things...



Atelier Parisien D'Urbanisme



Atelier Parisien D'Urbanisme



Atelier Parisien D'Urbanisme


Helsinki

A smart city, emissions-reducing approach



Overview

Well-known for its efforts to establish itself as a leading smart city, Helsinki is well-positioned to be an early AV mover. The city has been experimenting with autonomous shuttles to solve first-mile/last-mile limitations, aiming to increase public transportation use and thus reduce emissions. What sets the city apart in its approach is its openness to EU-wide partnerships, its centralization of integration under a Chief Design Officer and the establishment of clear priorities to be achieved by AV experimentation.

- **Location** ----- Helsinki, Finland
- **Testing dates** ----- 2016 - present
- **AV mode** ----- 

- 6** different areas of experimentation within Helsinki region
- 18 km/h** operating speed for SOHJOA project
- 25+** smart city projects being developed in Kalasatama district
- 2050** target date to phase out use of private cars



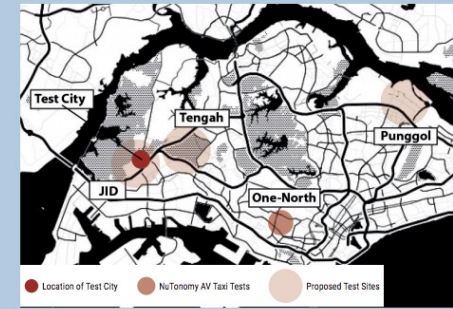
Helsinki Robobus project



SOHJOA project

Singapore

Widespread testing of diverse technologies



Overview

Known as one of the world's most autonomous vehicle-friendly countries, Singapore has allowed testing of autonomous vehicles on its streets since 2015. The city has expressed itself open to experimentation with a wide variety of autonomous vehicle formats ranging from autonomous taxi fleets to buses to shuttles serving both private use and public transportation. Its strong and diverse partnerships and extensive testing offer unique insights into the juxtaposition of a wide variety of potential technologies and system structures.

- **Location** ----- Singapore
- **Testing dates** ----- 2015 - present
- **AV mode** -----    

- 67 km** of trial routes on public roads
- 10+** companies testing vehicles in city
- 15 %** car ownership rate within city
- 2** hectares test city complex dedicated to testing



NuTonomy vehicle



Nanyang Technology University's Centre for Excellence for Testing & Research of Autonomous Vehicles (CETAN)



Preparing for a future with AVs

The form and execution of the **technology**



Preparing for a future with AVs

The form and execution of the **technology**

The form and execution of the **regulations**




Preparing for a future with AVs

The form and execution of the **technology**


The form and execution of the **regulations**





**There is still a lot of uncertainty
surrounding AVs...**





**There is still a lot of uncertainty
surrounding AVs...**

...Why now for regulations?



Why now for regulations?

Endowment Effect



Why now for regulations?

Endowment Effect

**Salience
Effect**



AVs are rolling out

- | Who should be responsible to doing something about it?



Focus on: The local government role

| From a public policy perspective, **cities will impact AV rollout, whether or not they develop regulation related to them.**

Policies that most cities oversee directly.

Local streets

Zoning

Public space

Policies that cities engage with indirectly.

Taxation

Transit



Potential for municipal involvement

Transportation concerns about AVs:

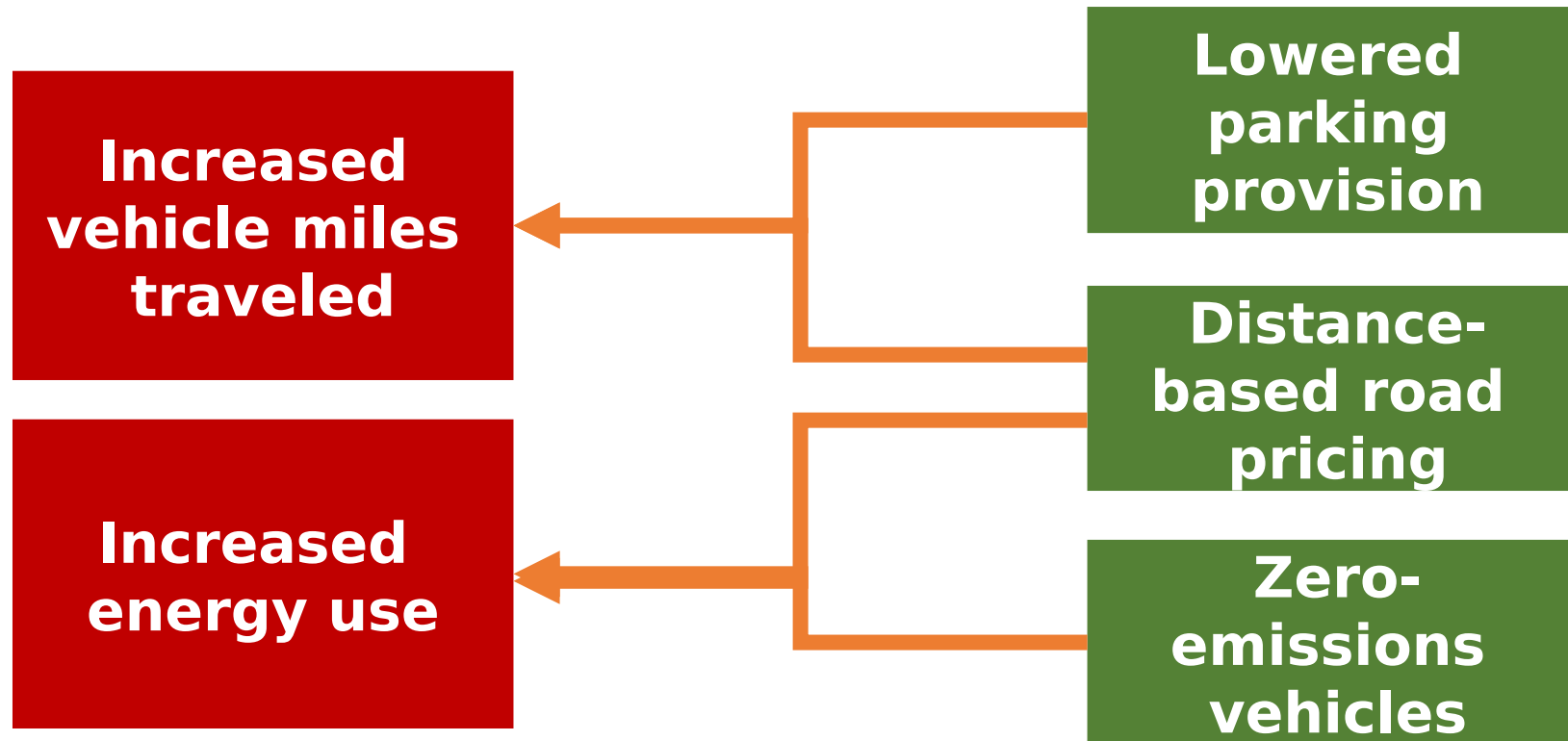
Increased
vehicle miles
traveled

Increased
energy use



Potential for municipal involvement

Potential solutions:





Potential for municipal involvement

Land use concerns about AVs:

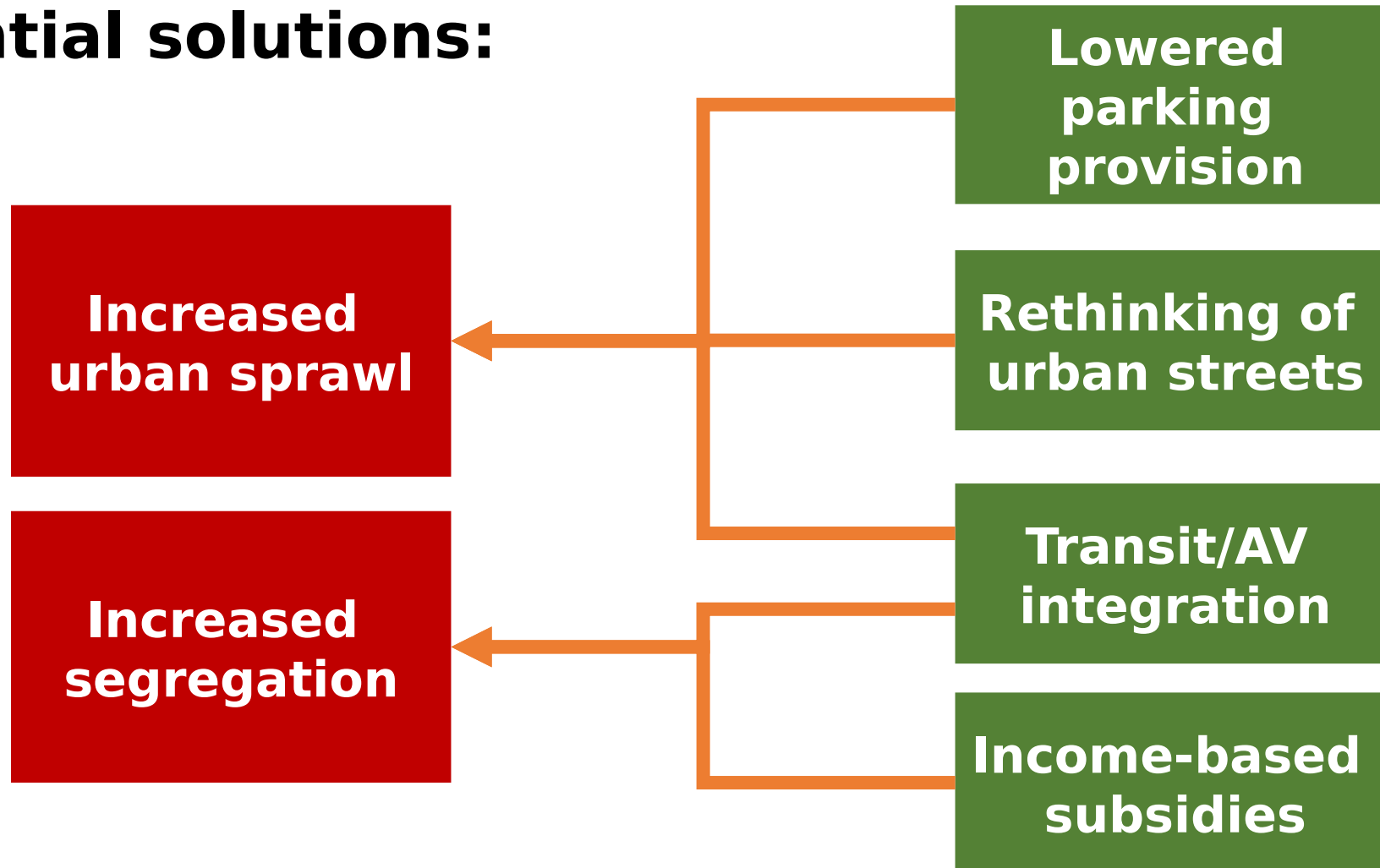
**Increased
urban sprawl**

**Increased
segregation**



Potential for municipal involvement

Potential solutions:



Setting a path forward

Cities need to identify which **key powers** they are granted by the state, and then use those to coordinate their response to AV implementation.

**Zoning
powers**

Police powers

**Control over
local streets**

**Taxi and ride-
hailing
regulations**

**Data
management**

**Influence over
transit
provision**



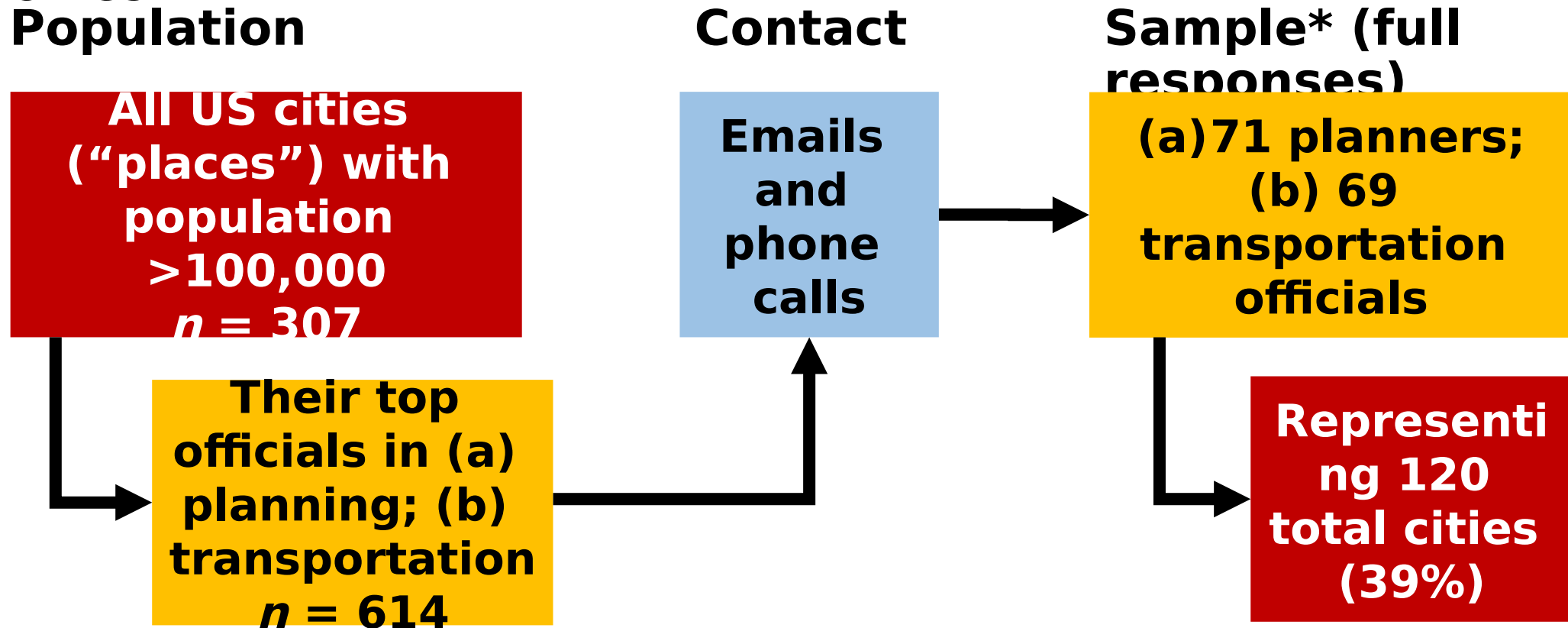
Research questions we're currently pursuing

- | How are large US municipalities planning for AVs?
- | What expectations do municipal officials have about AV impacts?
- | What city characteristics impact officials' views with regards to AVs?



Methods

- Survey of a representative sample of officials in large American cities.



* No significant difference ($p < 0.05$) on covariates between sample and population.



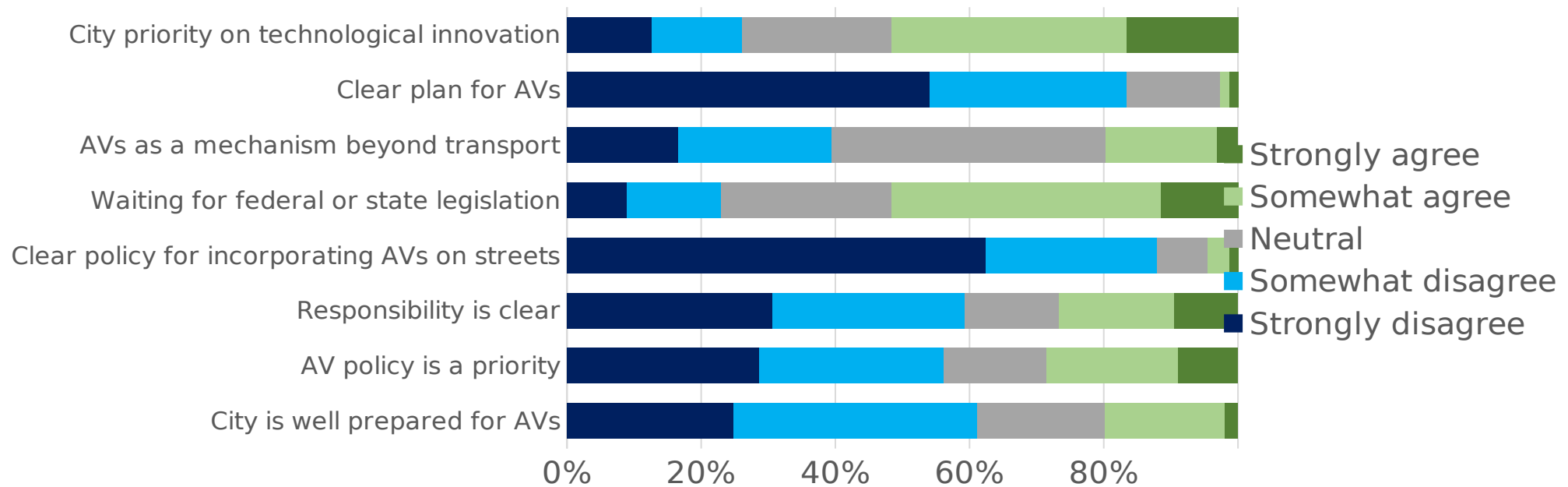
Few cities are prepared for AVs

- | Of comprehensive plans, only 24 percent mention AVs in any way. Only 20 percent of these 25 largest cities have a “new mobility” plan relevant to AVs.
- | 80.9% of officials noted that there had been little to no staff time yet committed to AVs.
- | Several officials pointed out that state preemption was likely to serve as a major barrier to local involvement on the issue.



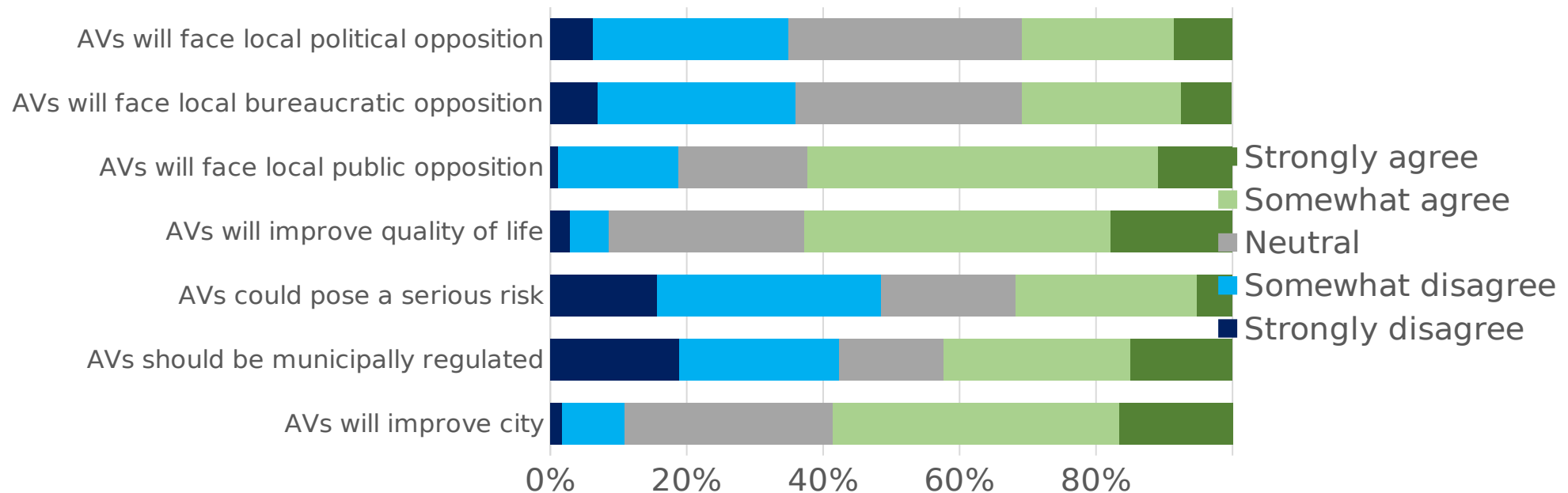
City officials haven't developed AV policies

Survey results across a range of questions show general lack of preparation; a majority are waiting for federal or state legislation, and most have no clear plan for AVs or clear responsibility.



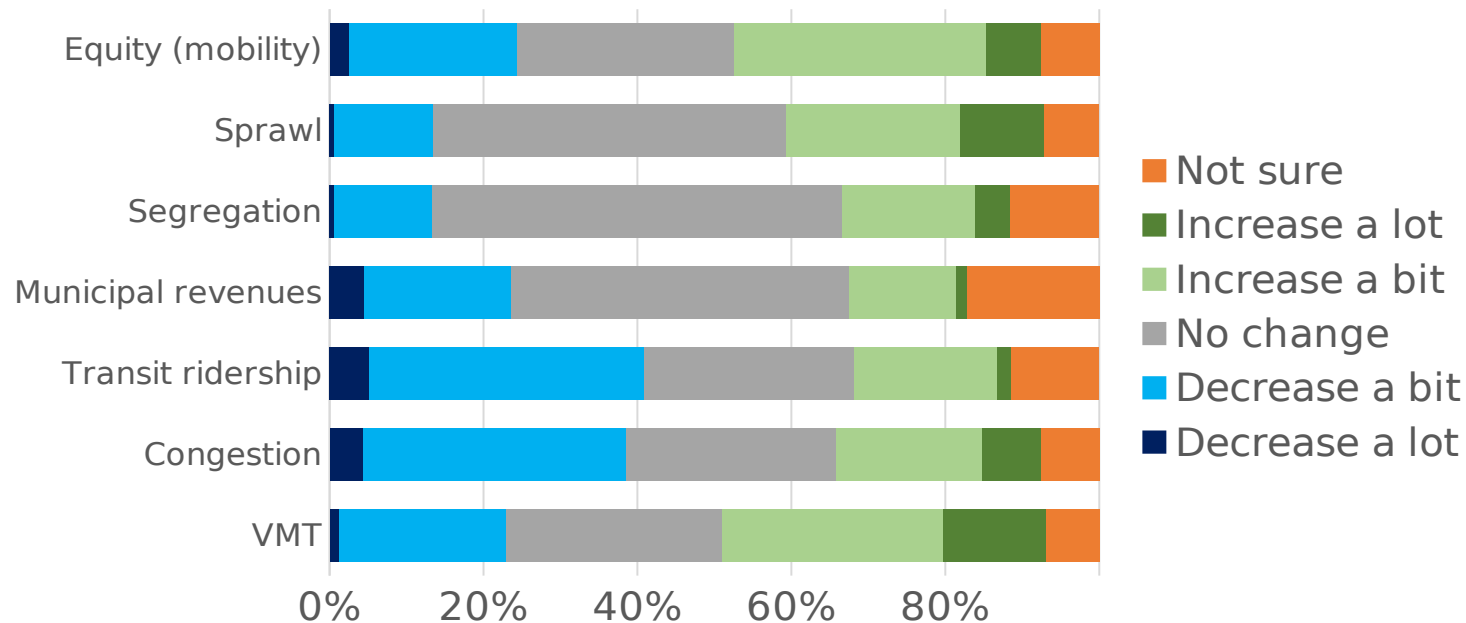
Officials have mixed views about AV impacts

Officials generally see AVs as likely to benefit their respective cities and local inhabitants. However, a significant cohort believes that AVs will present risks and that they should be regulated.



City concerns: Sprawl, vehicular travel, transit

A significant share of officials are concerned that AVs could increase sprawl and VMT, while reducing transit use and municipal revenues.



What kinds of policies can cities undertake?

- | National and state governments need to allow cities the freedom to adopt new regulations that address their concerns. AVs may serve as a **motivating** technological change.
E.g., Cities concerned with sprawl could...

**Enforce
congestion
pricing**

**Enact growth
controls**

**Expand access to
alternatives**



Conclusions

- | Cities are **unprepared** for AV rollout.
- | But they have **key legal powers** that will make them influential actors in impacting how AVs impact society.
- | Their leadership is **concerned**—probably rightly—about many potential impacts of AVs.
- | National and state governments need to **allow local governments** to develop appropriate regulations.





Uncertainty...



Transportation policy	Scholarly mentions			AV-related policy guidance	
	Google Scholar references	Examples	Sperling (2018)	National Association of City Transportation Officials (2017) mentions	Regional Plan Association (2017) mentions
1. Reduction in <i>minimum parking requirements</i> for new developments	1,550	Loader and Stanley (2009)	Yes (pg. 73)	Yes (pg. 17)	Yes (pg. 4)
2. Reduction in level of <i>curbside parking</i>	1,600	Arnott (2014)	Yes (pg. 83)	Yes (pg. 16)	Yes (pg. 26)
3. Transformation of <i>traffic lanes</i> for pedestrian, bike, transit use	23,700	Huang and <u>Cynecki</u> (2000)	Yes (pg. 83)	Yes (pg. 16)	Yes (pg. 3)
4. <i>Income-based subsidies</i> for TNC service	83	Schweitzer and Taylor (2008)	Yes (pg. 75)	No	Yes (pg. 3)
5. Require <i>zero-emissions vehicles</i>	940	<u>Barkenbus</u> (2009)	Partially (pg. 53)	Partially (pg. 17)	Partially (pg. 4)
6. <i>Single fare system</i> for transit and TNC	79	Shen et al. (2018)	Yes (pg. 142)	Yes (pg. 16)	Yes (pg. 4)
7. Redesign <i>transit system</i> to account for TNC service	73,200	<u>Iacobucci</u> et al. (2017)	Yes (pg. 129)	Yes (pg. 17)	Yes (pg. 3)
8. <i>Minimum level of service</i> for TNCs throughout city	2,460	<u>Hensher</u> et al. (2003)	Yes (pg. 147)	Implied (pg. 48)	Implied (pg. 5)
9. Require TNCs to be <i>shared vehicles</i>	1,800	Meyer and <u>Shaheen</u> (2017)	Yes (pg. 18)	Partially (pg. 26)	Partially (pg. 4)
10. Public <i>data clearinghouse</i> to collect TNC data	2,120	Kuhn (2011)	Yes (pg. 147)	Yes (pg. 16)	Yes (pg. 4)
11. Distance and <i>congestion charging</i> for all drivers	10,300	Small (1992)	Yes (pg. 19)	Yes (pg. 48)	Yes (pg. 3)
12. Ban <i>single-occupancy vehicles</i> from portion or all of city	2,290	<u>Nieuwenhuijsen</u> and <u>Khreis</u> (2016)	Partially (pg. 108)	No	Yes (pg. 3)
13. <i>Increase road capacity</i>	772	<u>Mogridge</u> (1997)	The inverse (pg. 83)	The inverse (pg. 16)	No



Should municipal governments develop regulations for AVs to address these issues?

	Yes	Maybe	No		
			This isn't an important policy	Private actors should intervene	Other governments should intervene
Land use and public right-of-way					
A. Reduce sprawling land uses	51.3%	29.2%	7.8%	1.3%	10.4%
B. Increase street space for pedestrians	70.5%	21.8%	4.5%	0.0%	3.2%
Equity and environment					
C. Increase access to mobility for low-income people	51.6%	21.9%	1.9%	7.1%	17.4%
D. Increase access to mobility for disabled people	58.8%	20.3%	1.3%	1.3%	18.3%
E. Reduce pollution	31.2%	17.5%	1.9%	2.6%	46.8%
The transportation system					
F. Reduce vehicle miles traveled	26.5%	23.2%	12.9%	4.5%	32.9%
G. Increase public transportation ridership	47.7%	23.9%	3.9%	3.9%	20.6%
H. Reduce private car ownership	16.2%	14.3%	30.5%	14.9%	24.0%



Depends on the issue

Majority support among interviewees for AV-related municipal policies that would **reduce sprawling land uses; increase street space for pedestrians; and increase access to mobility for low-income and disabled people.**

Considerable support for local regulations that would **increase transit ridership.**

Officials were far more **skeptical** of local involvement in **reducing pollution and reducing VMT**, with a plurality in each case suggesting that other governments should intervene instead.

Policies related to reducing **private car ownership** attracted far less support from officials, with almost a third suggesting that such an effort should not be in the realm of government intervention at all.

The broader picture

- | Most policies (and potential policy changes) related to urban transportation have little to do with AVs specifically...



The broader picture

- | Most policies (and potential policy changes) related to urban transportation have little to do with AVs
- | specifically...
- | ...how do policymakers feel about the feasibility of these policies today **without AVs**?



The broader picture

- | Most policies (and potential policy changes) related to urban transportation have little to do with AVs
- | specifically...
 - | ...how do policymakers feel about the feasibility of these policies today **without AVs**?
 - | ...and how do they think that **might change** in a future with AVs?



Understanding policymaking

| Bureaucrats: opinion



Understanding policymaking

- | Bureaucrats: opinion
- | Bureaucrats: capacity



Understanding policymaking


- | Bureaucrats: opinion
- | Bureaucrats: capacity
- | Bureaucrats: legal feasibility



Understanding policymaking

- | Bureaucrats: opinion
- | Bureaucrats: capacity
- | Bureaucrats: legal feasibility
- | Political support





How do local-government officials feel about pursuing certain transportation policies today? How does the present political, legal, and bureaucratic environment impact support for such policies?



	I personally think this is a good idea	My agency has the capacity and resources to pursue this idea	It is legally feasible for my city to pursue this idea		There is political support in my city for this idea	
	Yes	Yes	Yes	Not sure	Yes	Not sure
Land use and public right-of-way						
1. Reducing minimum parking required for new developments	87.2%	73.8%	83.8%	14.8%	36.2%	42.6%
2. Reducing curbside parking	74.1%	66.2%	73.4%	22.4%	19.7%	44.4%
3. Transforming car lanes into space for pedestrians and bicyclists	79.9%	71.1%	76.8%	20.4%	31.2%	38.3%
Equity and environment						
4. Providing subsidies for low-income riders to use AV services	81.0%	28.1%	27.7%	68.1%	30.5%	61.0%
5. Requiring AVs to be zero-emissions vehicles	79.3%	26.4%	13.4%	73.9%	26.8%	64.1%
The transportation system						
6. Implementing a single payment system for both transit and AV service	86.4%	26.8%	27.5%	64.8%	28.9%	61.3%
7. Redesigning transit system to account for AV service options	88.4%	30.2%	35.0%	54.5%	23.8%	63.6%
8. Requiring a minimum level of service for AV operators	70.5%	27.5%	11.3%	76.6%	17.0%	74.5%
9. Requiring AVs to be shared, not privately owned	40.9%	15.4%	7.0%	73.9%	5.6%	71.8%
10. Implementing a public data clearinghouse that collects and releases data about AV trips	85.0%	26.4%	19.7%	72.5%	23.9%	64.1%
11. Implementing distance- and congestion-based road pricing	74.1%	18.1%	11.4%	70.0%	9.3%	68.6%



Depends on the issue

For all but one policy we asked officials to consider, we find majority personal support. One exception: only 40.9% of officials agreed that AVs should be shared

From the perspective of bureaucratic and legal capacity, local officials pointed to very **significant roadblocks** to implementing new policies—regardless of their personal support of the policies

Officials were far **less confident** in their cities' ability to address issues related **to equity, the environment, and the transportation system** as a whole

Officials expressed **broad skepticism** about the level of local **political support** for the policies



What city characteristics matter?

Officials are likely to feel more prepared from cities with...

- Higher per-capita expenditures,
- Bigger population size, and
- More population growth.

Officials are more concerned about AVs from cities with...

- Lower household incomes,
- More left-wing residents,
- Higher per-capita expenditures, and
- Lower population growth.

Personal and political support for AV policies is linked with...

- More left-wing residents and
- Higher population size.

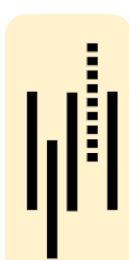
Bureaucratic capacity for policy is linked with...

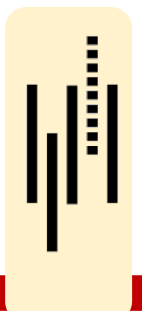
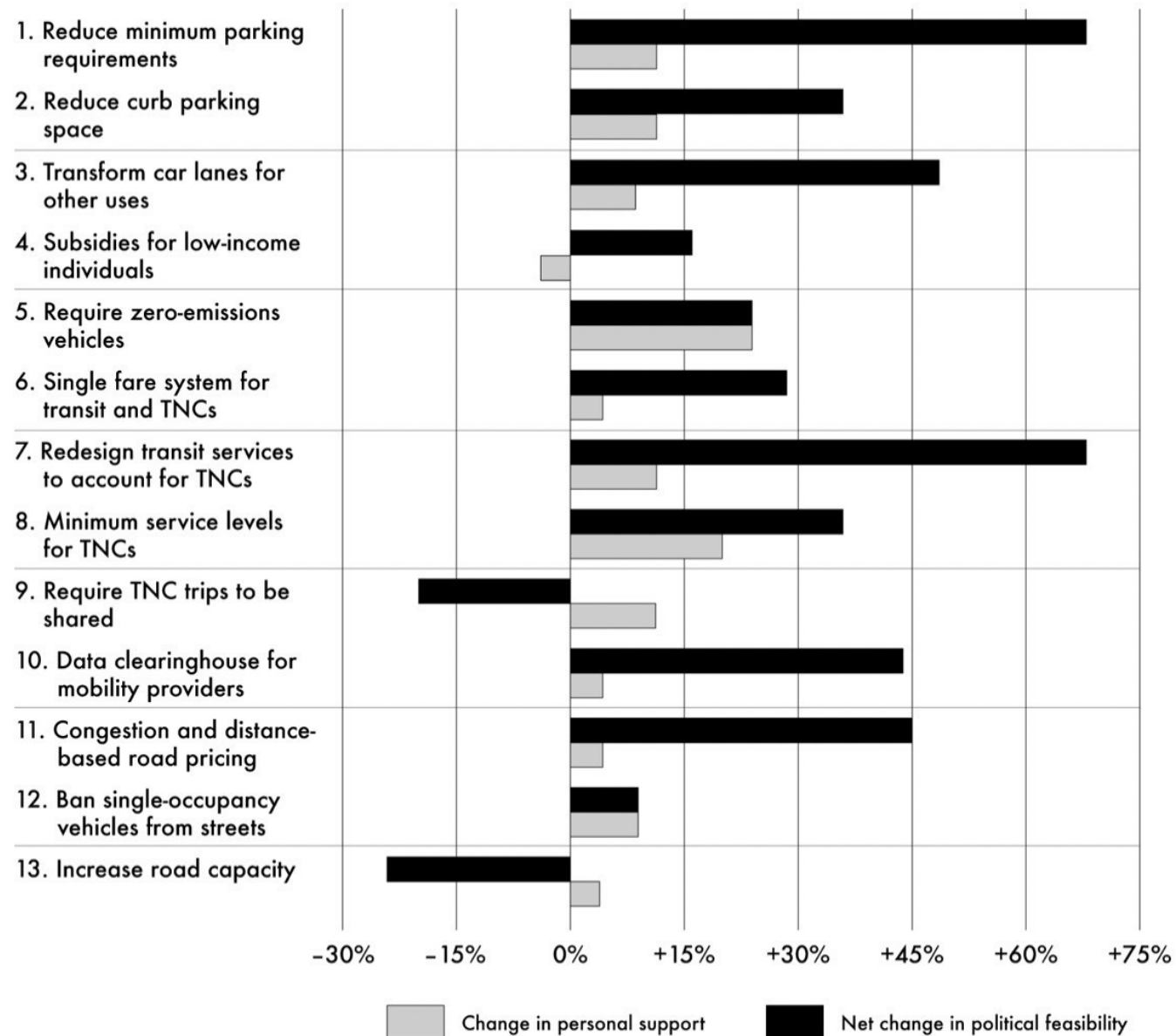
- Higher population growth and
- Higher housing values.

Do autonomous vehicles alter officials' views of these regulations?



Policy	Response summary	Key quotes
Land use and public right-of-way		
1. Reducing minimum parking required for new developments	<ul style="list-style-type: none"> • <i>Today:</i> Relatively strong personal, mixed political support. • <i>Future:</i> More optimistic. • Concerned about implications on businesses and spillover problems in neighborhoods. 	<ul style="list-style-type: none"> • "Well I think it would certainly be supported... if we had people use the AVs as kind of a taxi or as ride-hailing." • "Businesses are... going want to see that by removing parking in front of their building, that it doesn't affect their bottom-line." • "We plan for—or think—we can reduce parking supply, but the reality is that people haven't changed their habits..."
2. Reducing curbside parking	<ul style="list-style-type: none"> • <i>Today:</i> Mixed personal, political support. • <i>Future:</i> More optimistic. • Many view curbside parking as unnecessary for AVs, except for loading, but it is associated with street safety. 	<ul style="list-style-type: none"> • "We haven't viewed street parking as much as a negative as say off-street parking... [but if AVs] go off somewhere to park... there will be... support for reclaiming the curbside." • "We're going to be looking at wanting to have more curb space for loading and unloading." • "We're not kind of rethinking management of the curb just because of AVs. But the way that we're thinking of it will... help... when they come."
3. Transforming car lanes into space for pedestrians and bicyclists	<ul style="list-style-type: none"> • <i>Today:</i> Relatively strong personal, mixed political support. • <i>Future:</i> More optimistic. • Several cities are implementing these changes already without AVs. 	<ul style="list-style-type: none"> • "I anticipate that with autonomous vehicles, we would have more ability to narrow streets and turn them into either for other modes of transportation or to turn it into greenspace." • "Before we give up any car lanes, people would want to see if we're really needing the capacity... some people may think that we would see more congestion because we've got all of these autonomous vehicles on the streets during the day time."
12. Ban single-occupancy automobiles from all or parts of city	<ul style="list-style-type: none"> • <i>Today:</i> Poor personal and political support. • <i>Future:</i> Little change. • Some bigger cities were more supportive of implementing in at least a portion of the city. 	<ul style="list-style-type: none"> • "I don't support that... a lot of things will disappear on their own nobody had to tell people to stop using horses." • "As the cost of gasoline goes up, the cost of maintenance, the cost of insurance [...] they start shedding the cars on their own." • "Yeah, I fully support... I would continue to support it with AVs, and I think it will be more politically feasible."
Equity and environment		
4. Providing subsidies for low-income riders to use AV services	<ul style="list-style-type: none"> • <i>Today:</i> Relatively strong personal, mixed political support. • <i>Future:</i> More optimistic. • Many cities already implement subsidy for low-income riders. 	<ul style="list-style-type: none"> • "How do you administer that? Politically, I think there's going to be an overwhelming amount of support." • "That idea is good on its face for equity but it increases... congestion, because now people who would normally take transit are going to be taking [cars]... we can't throw out greenhouse gas emissions and traffic under the bus to do it."
5. Requiring AVs to be zero-emissions vehicles	<ul style="list-style-type: none"> • <i>Today:</i> Poor personal and political support. • <i>Future:</i> More optimistic. • Few cities have discussed. • Concerns about preemption. 	<ul style="list-style-type: none"> • "If it's an AV, I think they could be open to having more restrictions. You're not changing what people own today—you're changing what people are going to acquire." • "It is not going to happen... before it happens at the federal level." • "People hang on to cars for a very long time... but we will continue to have 20- and 30-year old cars on the street for the foreseeable future."
The transportation system		
6. Implementing a single payment system for transit and AV service	<ul style="list-style-type: none"> • <i>Today:</i> Very strong personal support, mixed political support. • <i>Future:</i> More optimistic. • Cities are concerned about how this will be implemented in practice, given separate transit agencies. 	<ul style="list-style-type: none"> • "That does seem like a highly desirable thing to do... It's mostly what it's going to take to get there, and do we have the resources right now to invest in making that happen?" • "Having ease and flexibility of payment for all of your modes is really attractive and I think the best way to incentivize transit users." • "TNCs as they exist today are working against our city policies in terms of transit safety, accessibility, equity, congestion... So providing any kind of easier pathway... would be working against our... goals."
7. Redesigning transit system to account for AV service options	<ul style="list-style-type: none"> • <i>Today:</i> Poor personal and political support. • <i>Future:</i> More optimistic. • Some see benefit of using AVs to improve transit. Concern is lack of control. 	<ul style="list-style-type: none"> • "No transit system that we can currently have will be able to compete in the same sense... no rail system, no bus system." • "The future will still have a place for a transit system that carries volumes of people... but it doesn't mean it will be the exactly same transit system it is now." • "We have these buses that go by that hold 40 people that have two on it. And maybe an AV is a way to go."
8. Requiring a minimum level of service for TNC operators	<ul style="list-style-type: none"> • <i>Today:</i> Poor personal and political support. • <i>Future:</i> More optimistic. • Suburban cities weary about this given sprawl. 	<ul style="list-style-type: none"> • "Taxicabs refused to provide service to certain neighborhoods... This is where driverless cars take away that problem." • "There are outliers that live in areas that are private roads, or you know, rural roads. I wouldn't support requiring anybody to service them. They chose to live out there." • "Finding a way to deliver mobility in an equitable way is likely going to be associated with time or cost at some point... I think it gets easier with AVs."
9. Requiring TNCs to be shared, not privately owned	<ul style="list-style-type: none"> • <i>Today:</i> Poor personal and political support. • <i>Future:</i> Little change. • Concerns about safety. 	<ul style="list-style-type: none"> • "I would love this for everybody else, but not me." • "The industry hasn't really addressed the kind of safety and security concerns of what it means to get into a vehicle with a stranger." • "Probably no political support because people don't want to tell people that they have to share a ride."
10. Implementing a public data clearinghouse	<ul style="list-style-type: none"> • <i>Today:</i> Very strong personal support, strong political support. • <i>Future:</i> More optimistic. • Concern: user privacy 	<ul style="list-style-type: none"> • "There are a variety of questions that I can see people will want to have answered, including: is there broad coverage: is it equitable; is there nevertheless congestion anyway or would it be assumed it would all go away?... that kind of information would help us answer that question." • "I don't think that there is going to be a lot of political support for that currently. [Our city] is a little bit technology shy and/or privacy shy. We've got some concerns around body cameras or traffic cameras or things like that."
11. Implementing distance- and congestion-based road pricing	<ul style="list-style-type: none"> • <i>Today:</i> Relatively strong personal support, poor political support. • <i>Future:</i> More optimistic. • Many cities see benefits of implementing but worried about political perceptions. 	<ul style="list-style-type: none"> • "If it's an AV, they make that choice on a cost-benefit basis to decide whether to stop there, so there is a completely different decision-making framework in some of the pricing things." • "I do think it becomes more politically feasible with AVs, but I do think there's not [political] support today." • "Road pricing is really a regional deal and all of the rich people in the suburbs don't want any pricing on them and they vote so that will be a hard one."
13. Increase road capacity	<ul style="list-style-type: none"> • <i>Today:</i> Poor personal, political support. • <i>Future:</i> More pessimistic. • Some cities want to keep this option. • Almost all expect AVs will eliminate need. 	<ul style="list-style-type: none"> • "Most of the time, you could play tennis on a lot of the roads, they're so empty... during that peak period, even if you triple the number of lanes, the system would still fill up." • "With AVs, we'd be able to maximize the use of the pavement that we've got." • "When we have AVs operating alongside vehicles [...] that may actually make things worse initially... we could end up with some dead trips." • "There probably still is political support in the Midwest to add road capacity."





Findings

Officials said they **were more optimistic** about the chances for advancement among almost all policies except requiring shared TNCs, banning cars from certain parts of the city, and increasing road capacity. The new technology does indeed appear to be encouraging local officials to think differently about the potential for rethinking the urban transportation system.

Nonetheless, officials **remain skeptical** of certain aspects of most policies that we presented to them—with or without AV rollout. (ie parking needs or preemption)

Respondents pointed to **potential safety and privacy concerns** when it came to agreeing about requiring TNCs to be shared & implementing a data clearinghouse



Findings

- | Cities will have the most ease adapting their **land uses and public rights-of-way** in the context of AVs
- | This is in **strong contrast to** the policies we examined related to **equity, the environment, and the transportation system** in general.
- | We find evidence for **clear differences between cities** that may well determine which ones take steps to respond to AVs through regulations, if they are given the opportunity to do so
- | Officials from cities with larger populations, higher per-capita expenditures, and higher levels of population increases are more likely to support both regulatory strategies related to AVs in general, and many of the specific policies we propose





Thank you!



MIT's Urban Mobility Lab
mobility@mit.edu

