Ohio Travel Demand Model Users' Group

Columbus, Ohio, April 2024

A Work-from-Home Retrofit for Tour and Activity-Based Models

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ASSOCIATION OF BAY AREA GOVERNMENTS
METROPOLITAN TRANSPORTATION COMMISSION

IAS
TUM Institute for Advanced Study
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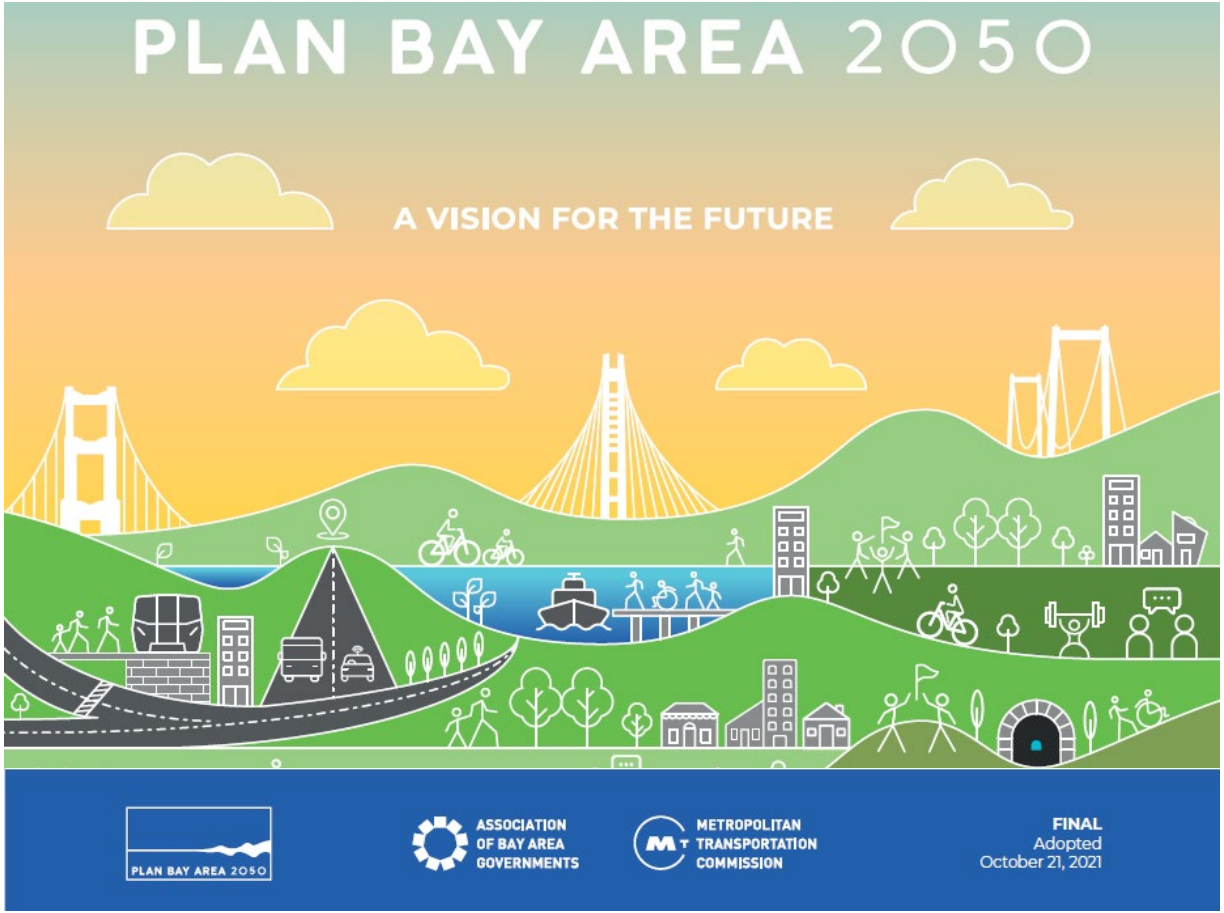
It’s Time for Plan Bay Area 2050+ (PBA 50+)

MTC’s last regional plan was adopted in 2021, and an update must be adopted by 2025.

This will be a “minor update”, but involves updating planning assumptions to a 2023 base year.

To meet planning deadlines, we needed a calibrated and working model by late 2023.



What's in the Plan?

$1.4 Trillion of Investments

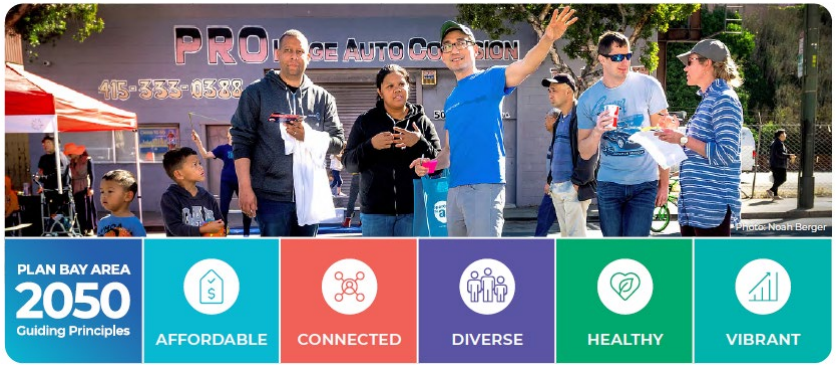
- $468 billion for housing
- $234 billion for economic investments
- $578 billion for transportation
- $103 billion for environmental strategies

Transportation Plan

- Regional Rail
- Complete Streets
- Vision Zero
- Roadway Pricing

Sustainable Community Strategies

- California law requires the plan achieve a 19% reduction in per capita greenhouse gas emissions from passenger vehicles in 2035 relative to 2005 levels.



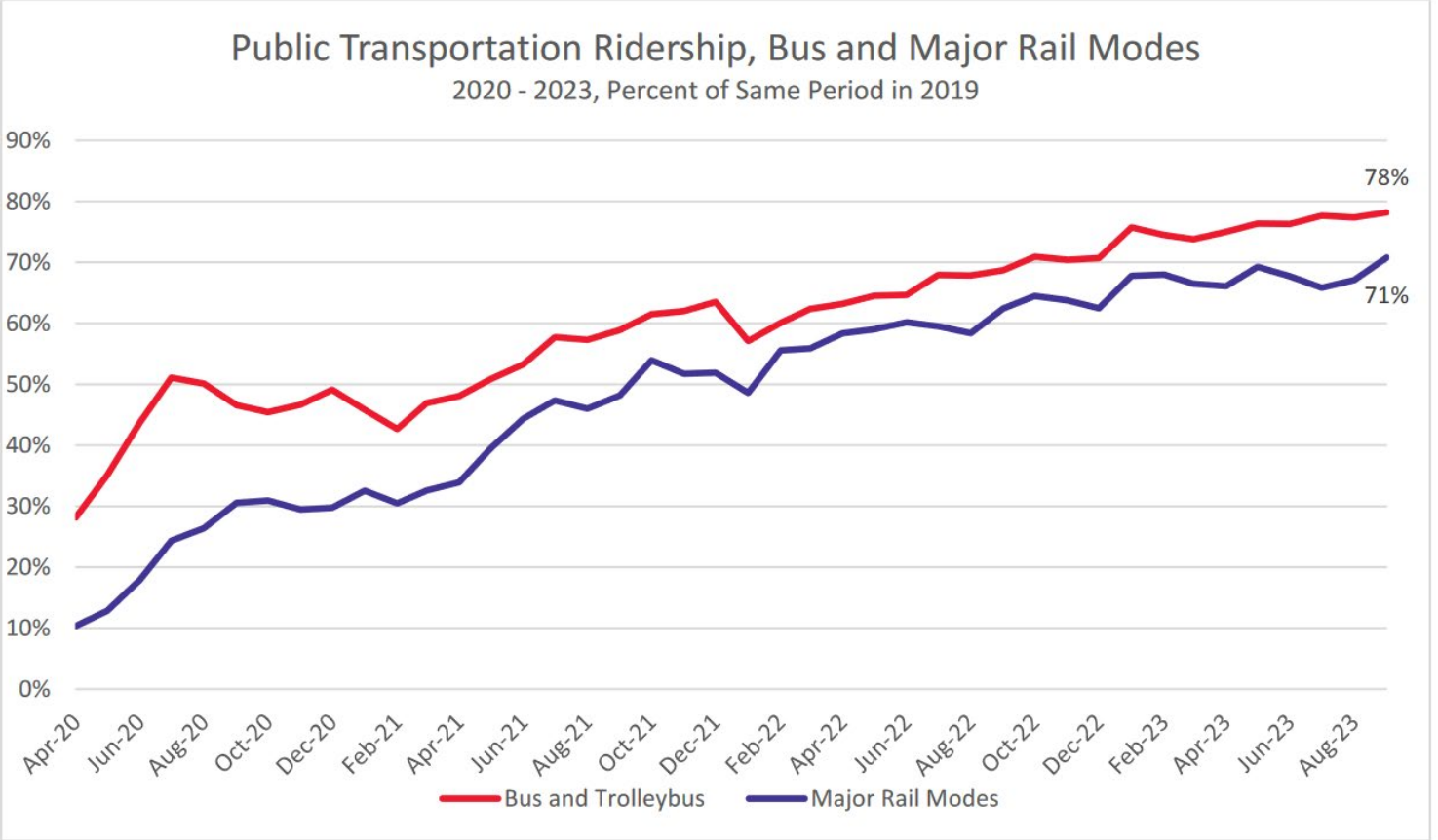
But the world has changed!

Compared to 2019, we have:

- Less transit ridership
- Different traffic patterns
- More work-from-home and hybrid work
- More traffic fatalities
- More electric vehicles

Does the future look more like 2019 or 2023?

Nationally, transit ridership is steadily recovering

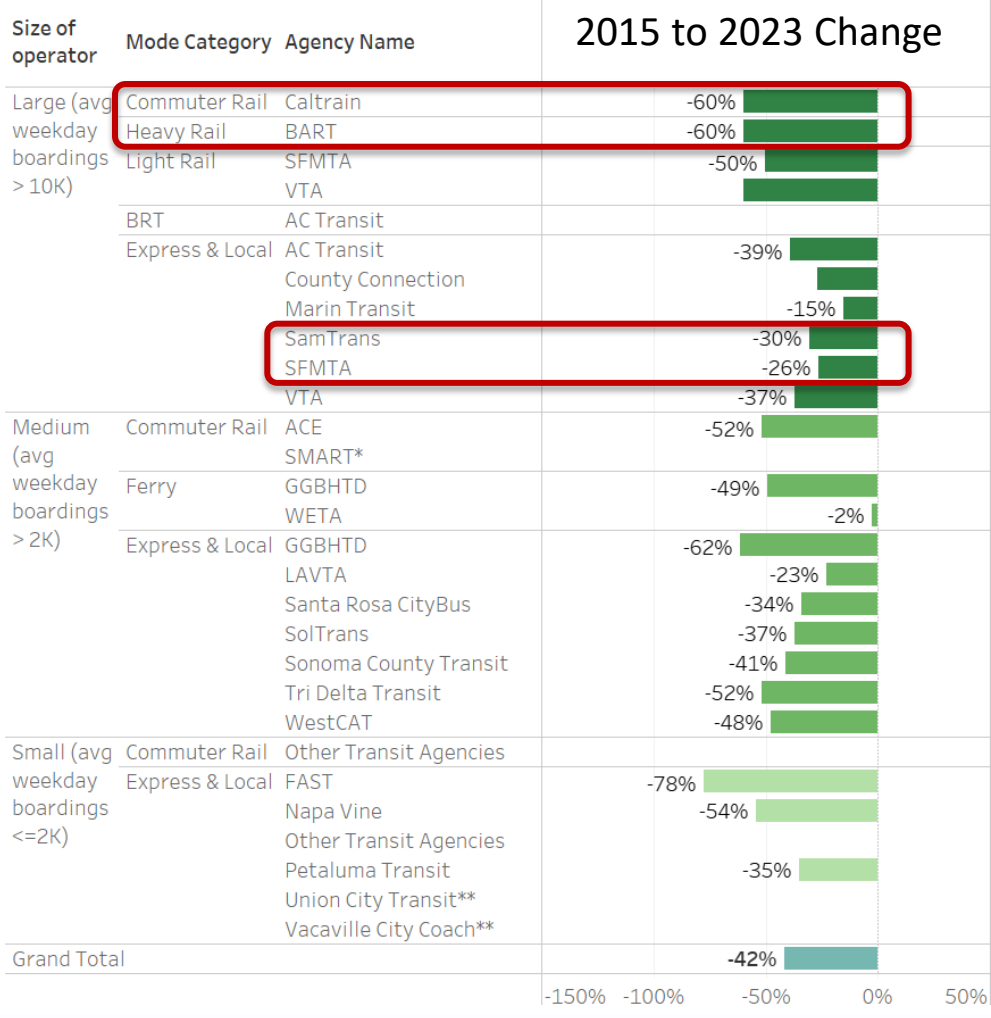


Source: APTA Public Transportation Ridership Update, December 2023

The Bay Area lags national trends

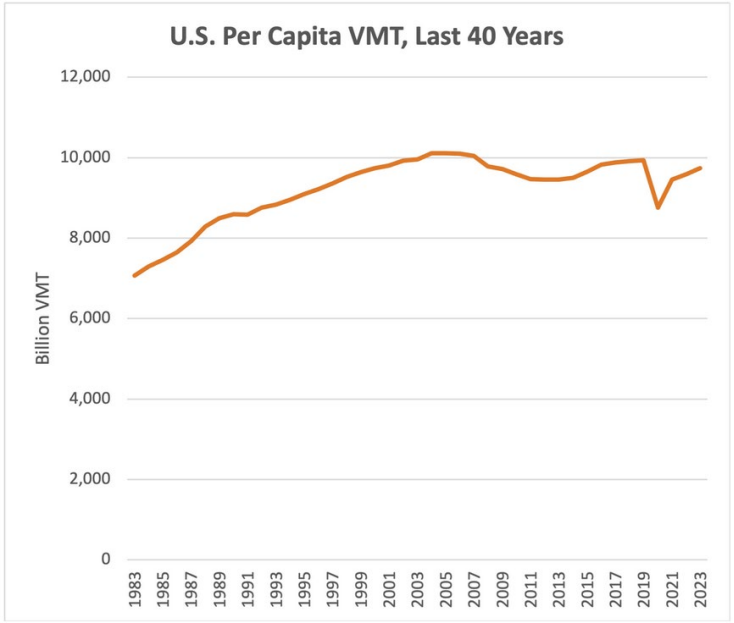
Transit ridership recovery is lower on rail modes and routes serving Central Business Districts

Transit ridership recovery is highest on routes serving low-income and minority areas and on systems serving a high share of “captive” riders.



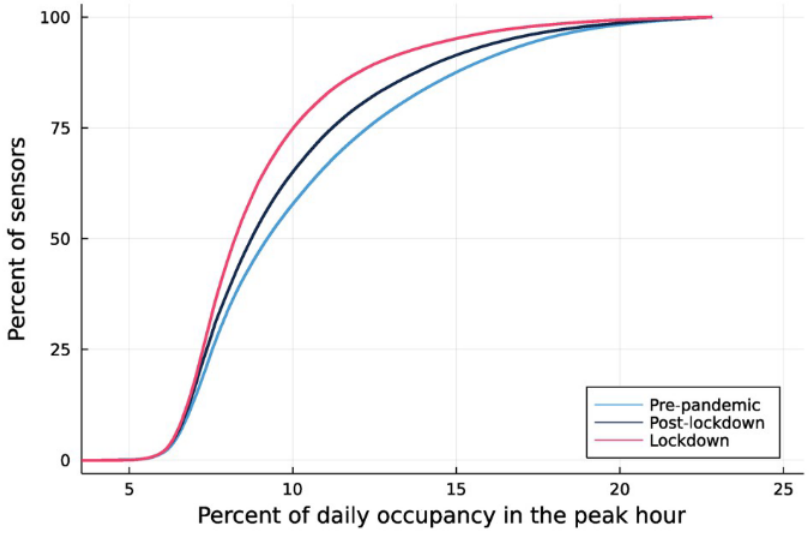
Traffic patterns have changed

VMT is close to 2019 levels.



https://enotrans.org/article/vmt-back-to-pre-covid-level-in-2023-but-still-lags-per-capita/

But more spread out—with a "rebound" effect.



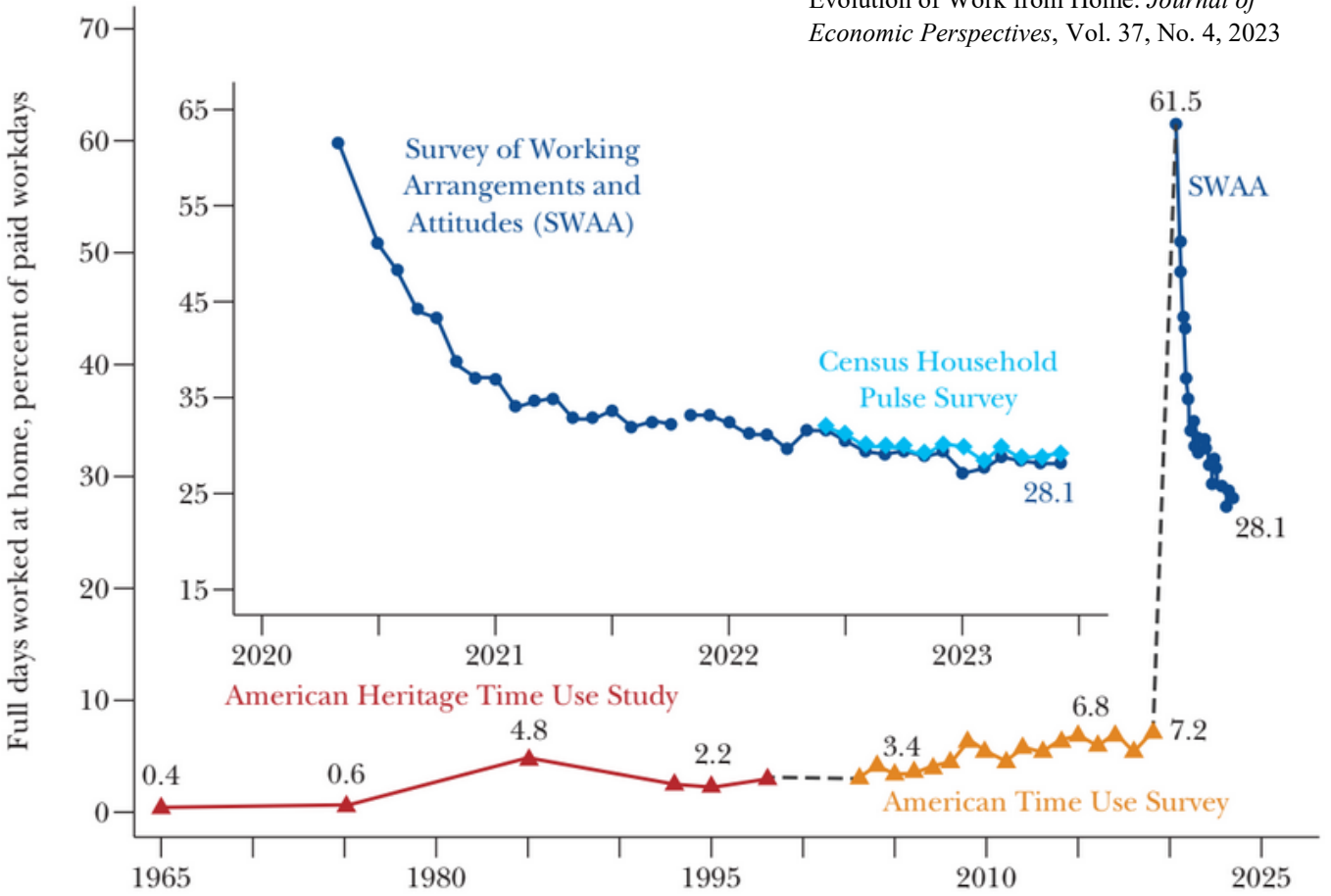
Bhagat-Conway, M. W., and S. Zhang. Rush Hour-and-a-Half: Traffic Is Spreading out Post-Lockdown. PLOS ONE, Vol. 18, No. 9, 2023.

Work-from-home rates remain elevated

Rates are measured differently, depending on the survey.

There is a substantial share of hybrid work.

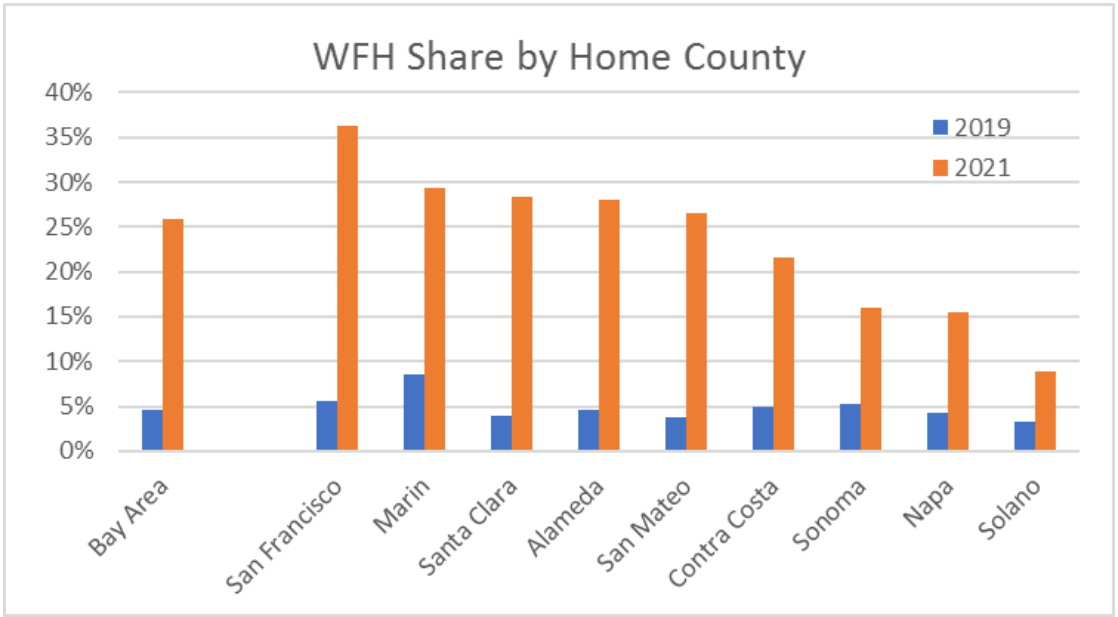
And a share of fully-remote work.



Barrero, J. M., N. Bloom, and S. J. Davis. The Evolution of Work from Home. *Journal of Economic Perspectives*, Vol. 37, No. 4, 2023

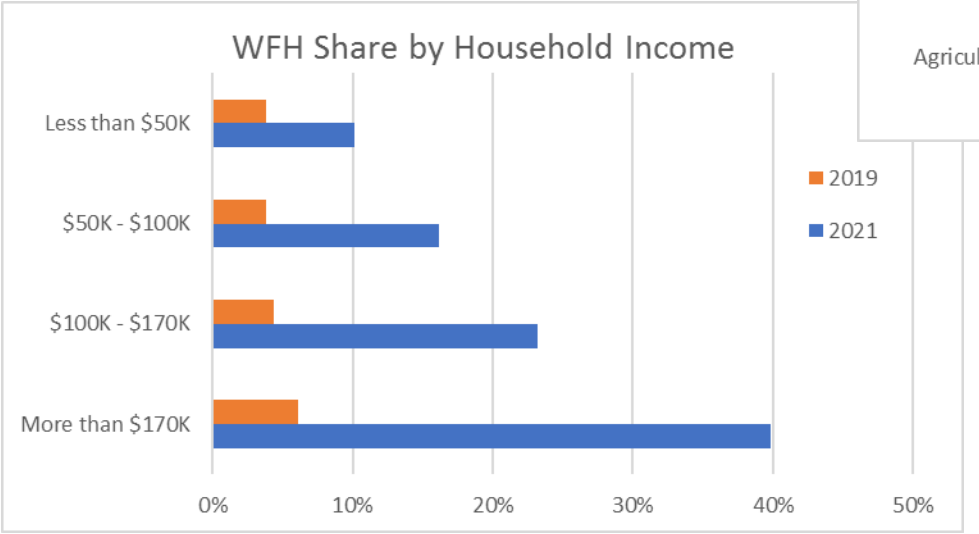
WFH rates vary greatly by location

Which Bay Area county has the highest work-from-home rate? Which has the lowest?

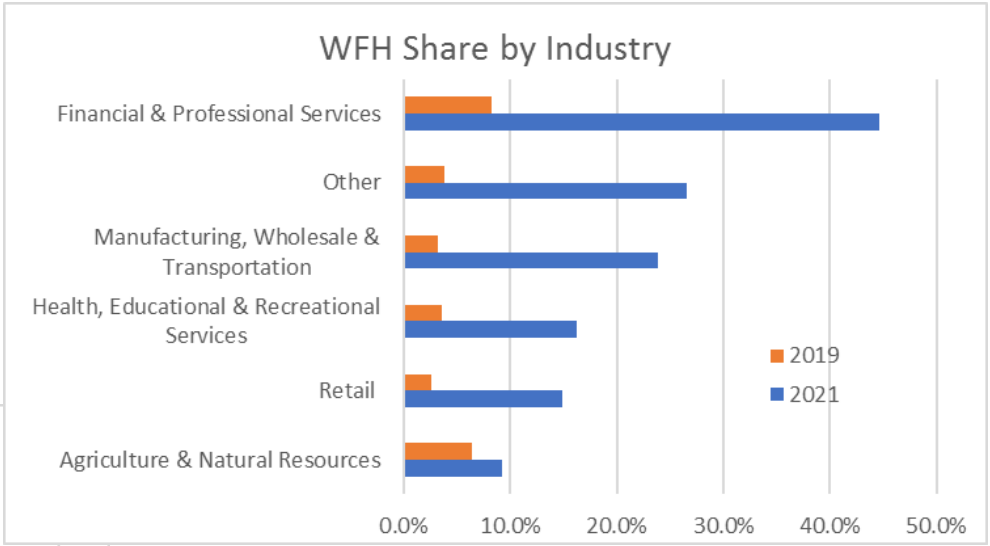


Source: ACS

WFH rates vary greatly by income and industry



Source: ACS

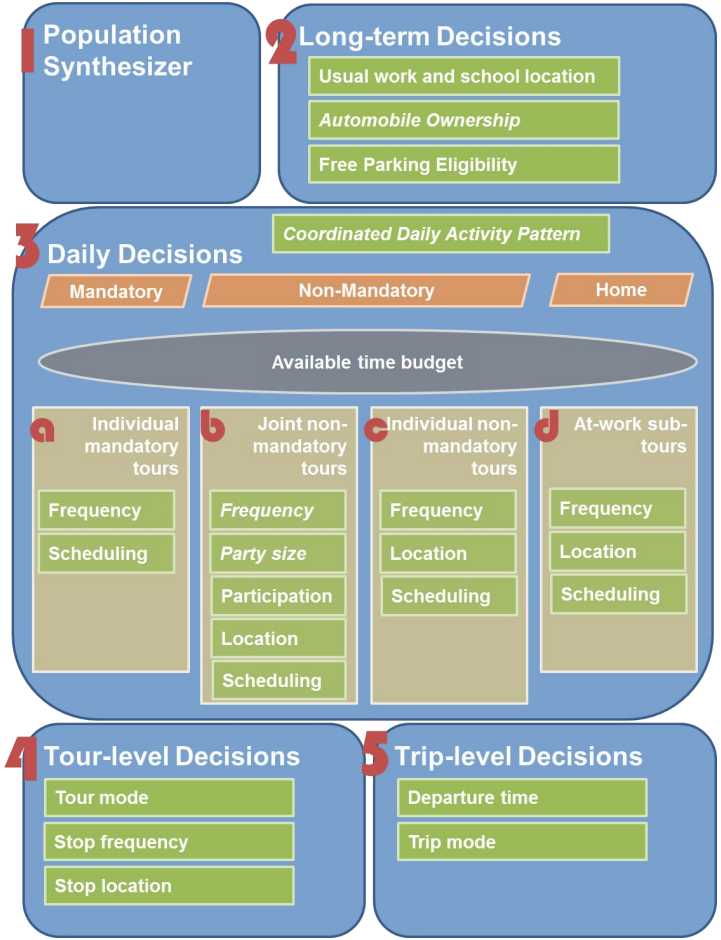


Source: ACS

What we want in a model

- Reasonably captures the most important dimensions of WFH
- Calibrates to 2023 transit ridership and traffic counts
- Parameterized to allow for different forecast assumptions
- Based on data that we have in-hand

- **Is done in time for updating the plan!!!**
  - **Doesn't break what works now!!!**



Starting Point

We start from a tour-based travel model (TM 1.5) in the CT-RAMP family of models.

Work-location choice is doubly constrained.

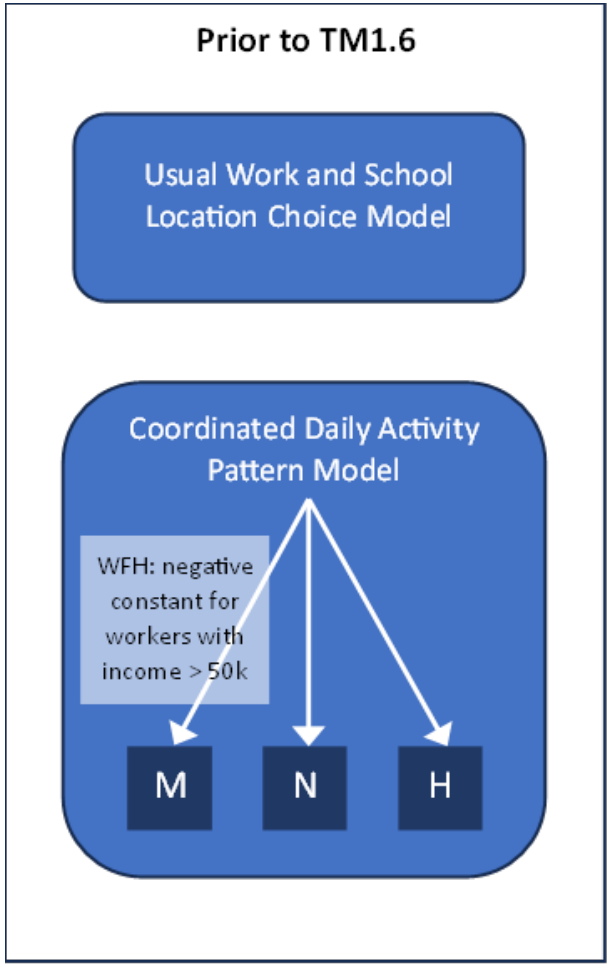
There is no explicit distinction between WFH and not going to work for other reasons.

Workplace location choice

For a doubly-constrained model, we ideally want to distinguish:

- **In-person workers** are assigned a usual workplace location outside the home.
- **Hybrid workers** are assigned a usual workplace location outside the home and "consume" a job at that location even if they rarely travel to that location. This category includes most workers who are employed by a firm that maintains offices, stores or factories.
- Fully remote **workers who do not have a workplace location outside the home.** This may include people who are self-employed, run in-home child cares, or drive for ride-hailing companies.

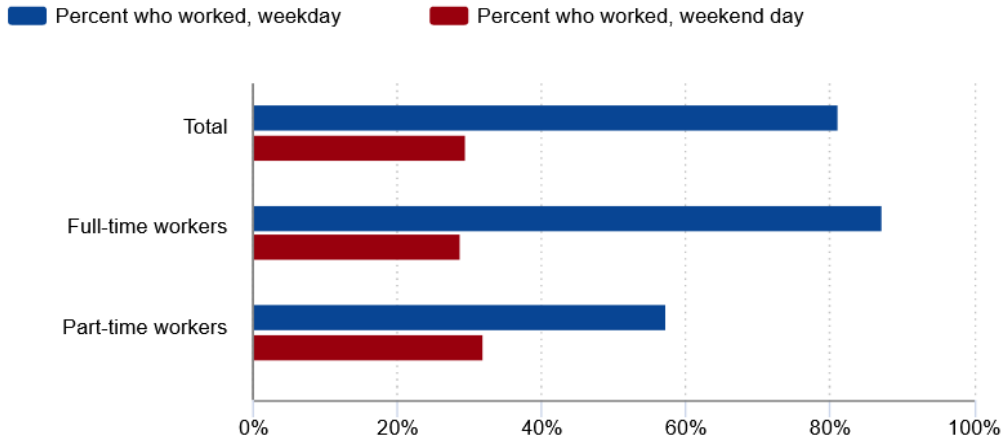
In the United States, most employment statistics are derived from unemployment insurance records or tax records, so often the company address is reported, even if the person works in a different state.

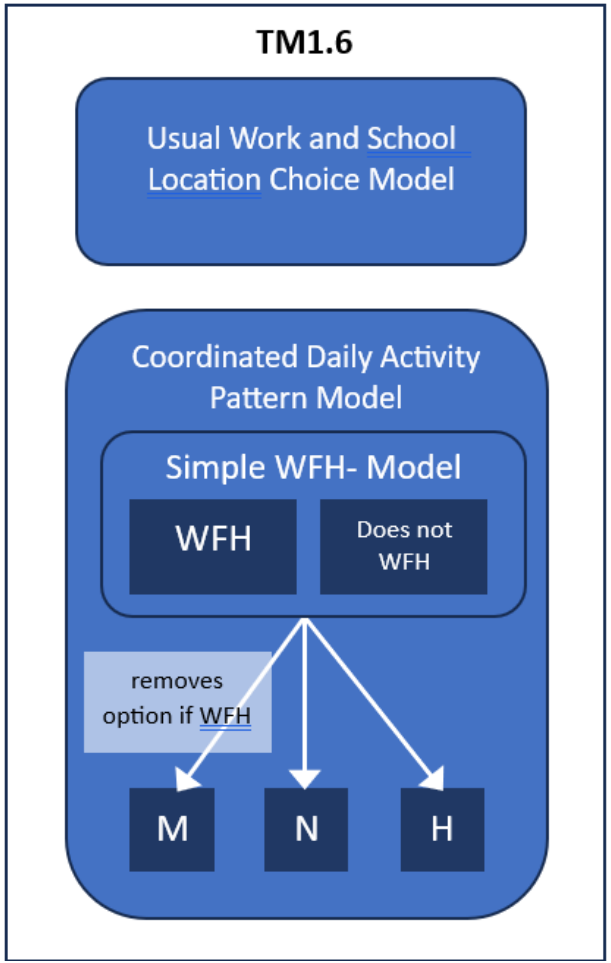


Even without WFH, only 85% of full-time workers and 60% of part-time workers work on an average weekday.

This makes it important to distinguish between WFH and not working—something we haven't always observed in our travel surveys and we don't capture in TM 1.5.

Percent of employed people who worked by day of week, 2022 annual averages





Proposed Model

Runs after workplace location choice and before CDAP → double constraint remains unchanged.

Offers a simple binary choice of WFH or not → a stand-alone model means only adding 1 more column to the person table.

Removes mandatory tour option from CDAP if someone works from home → incorporates rebound effect where drivers can travel in mid-day.

Adds an exogenous WFH scaling factor → calibrate for 2015 and 2023 calibration and exploration of future differences.

Available Data Sources

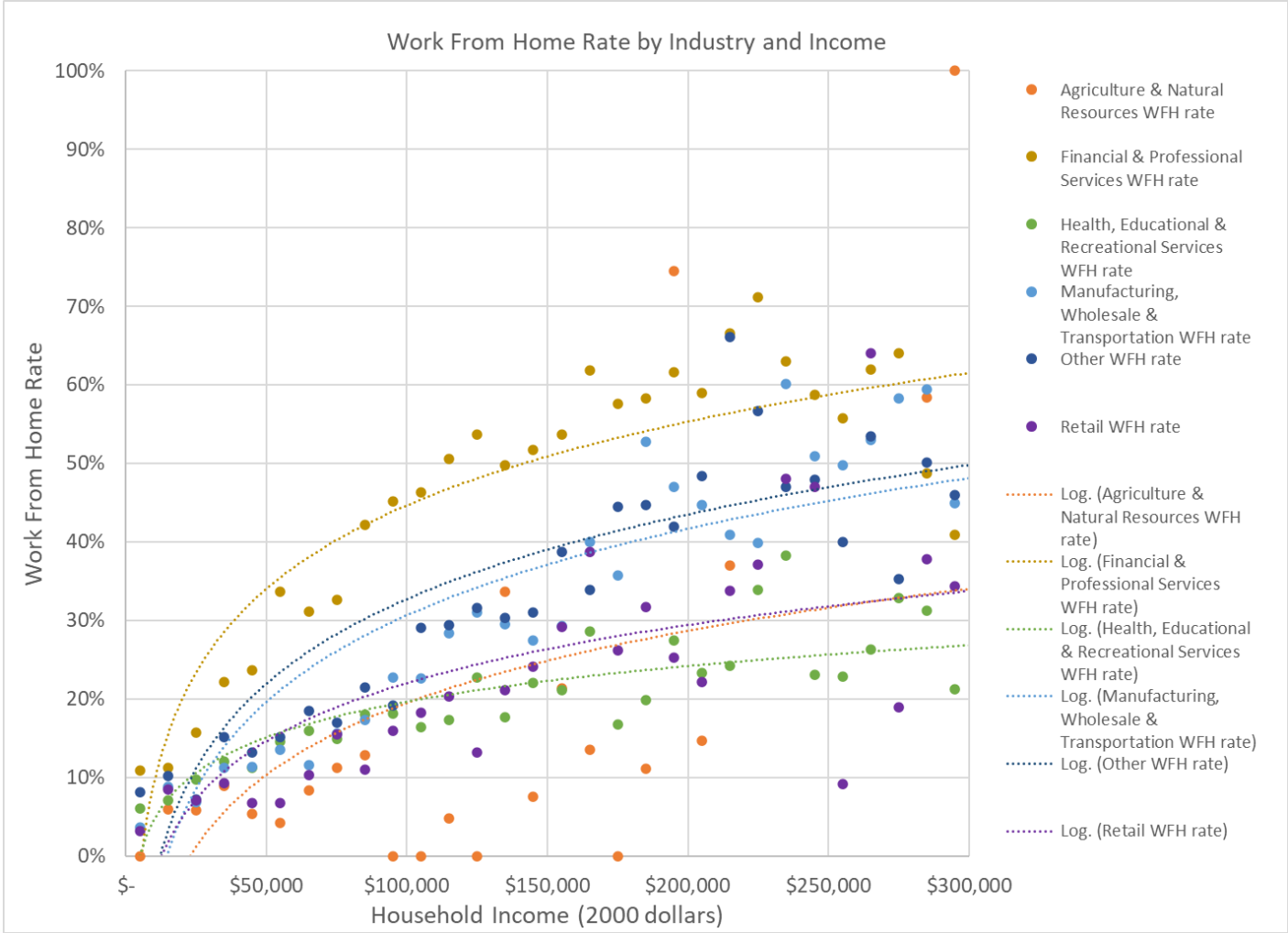
Data Source	Telecommute Estimate	Notes	Date of Most Recent Available Data
Census American Community (ACS) Survey Means of Transportation to Work	33.0% Worked at home as primary "mode" in the reference week (2021); 24.9% Worked at home as primary "mode" in the reference week (2022).	From ACS 2021 Subject Definitions: "Means of transportation to work refers to the principal mode of travel or type of conveyance that the worker usually used to get from home to work during the reference week." Universe: Workers 16 years and over filtered to Bay Area counties who worked in the reference week.	2021 at time of estimation; 2022 released at the time of writing.
American Time Use Survey (ATUS)	(2022) 33.8% of Employed persons who worked on an average day responded that they worked at home on an average day.	From the June 22, 2023 News Release on ATUS 2022: "Employed persons working at home, workplace, and time spent working at each location by full- and part-time status and sex, jobholding status, and educational attainment, 2022 annual averages". Universe: US workers, 15 years and over. (34.8% of Full-time workers and 28.1% of Part-Time workers.)	2022
U.S. Survey of Working Arrangements and Attitudes (SWAA) time series data	Betweeen 32.6%-33.7% for March, April and May 2023.	From the workbook's README: "Time series of the amount of working from home (percent of full paid days) for: the top 10 largest cities; cities 11 to 50; other small cities and towns; and select top cities. All are 6 month centered moving averages subject to data availability." (Barrero et al., 2021)	June 2023
Census Household Pulse Survey	Only 13%-22% of respondents who answered the question said no.	Survey question (TWDAYS_RESP): "In the last 7 days, have you teleworked or worked from home?" The survey is administered frequently in phases, with about 500-1,000 people answering this question in each survey week. Universe: Workers in San Francisco-Oakland-Berkeley, CA Metro Area (5 Bay Area counties).	June 2023

WFH Model

1. Use ACS PUMS to estimate WFH model based on usual commute mode.
2. Segment by industry.
3. Continuous function of income.

Estimated Models

Models were also segmented by home county.



We don’t know the worker’s industry

- We do know their work location and their income.
- The size terms in our workplace location model are segmented by income, and specific to industry.
- Therefore, we take a weighted average of the industries in the work zone for that income group.

Even with these changes, transit ridership remained too high in 2023 calibration

- BART was especially challenging to match.
- We introduced a “post-COVID mode preference” constant.
- We do not know how much this will stick in the future.

Post-COVID mode preference

With the rise of working-from-home, infrequent commuters may choose transit less often when they do commute

The prevalence of work from home arrangements has increased the number of infrequent commuters, who, anecdotally, tend to be less likely to use transit on their commute days compared to frequent commuters. This can be attributed to various factors, including, but not limited to:

- Less regular commuting leads people to not buy a transit pass which pushes up the marginal cost of riding transit.
- Less overall commuting may lead to less peak direction congestion in certain areas, inadvertently lowering the effective cost of driving.
- Even though the per trip/tour costs of driving commute and transit commute stay the same, the overall cost of driving (may include toll, parking fee, congestion, etc.) feels much lower when people commute fewer days; therefore, transit has become less attractive as its advantage over driving is less significant.
- Hybrid work leads to more trip chaining, and therefore more substituting transit with driving.
- Change in habits: once people get out of the habit of transit, they might also use it less for non-commute trips.

Calibrated WFH Rates

Table 3-1: Summary of the work-from-home rate in ACS, Bay Area Transportation Study, and the Travel Model

	ACS	*Modeled*	*Bay Area Transportation Study (2018/2019)*
2015	5.6%	12.4%	
2019	6.5%		12.4%
2022	24.9%		
2023		31.3%	

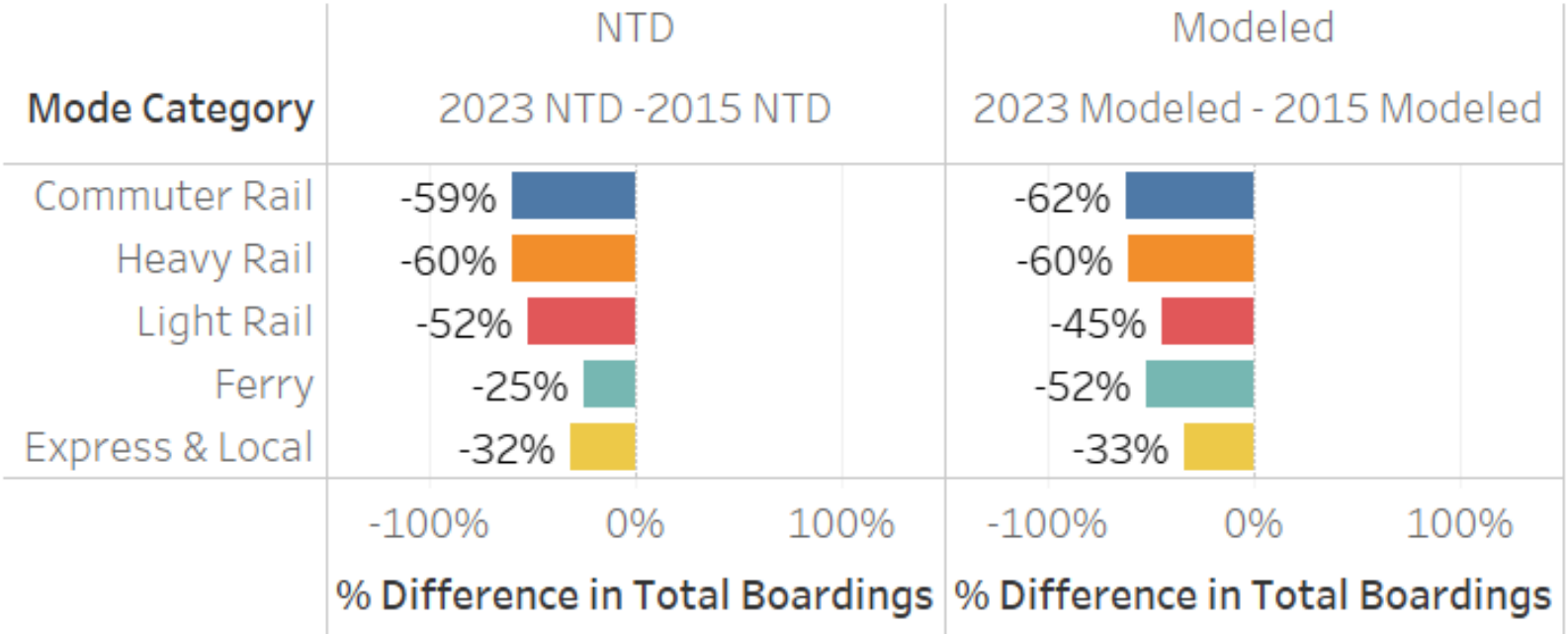
Calibrated WFH Scaling Factor

The WFH rate in ACS 2015 is 5.6%, whereas that of the Travel Model 12.4%. Their difference can be attributed to two main factors:

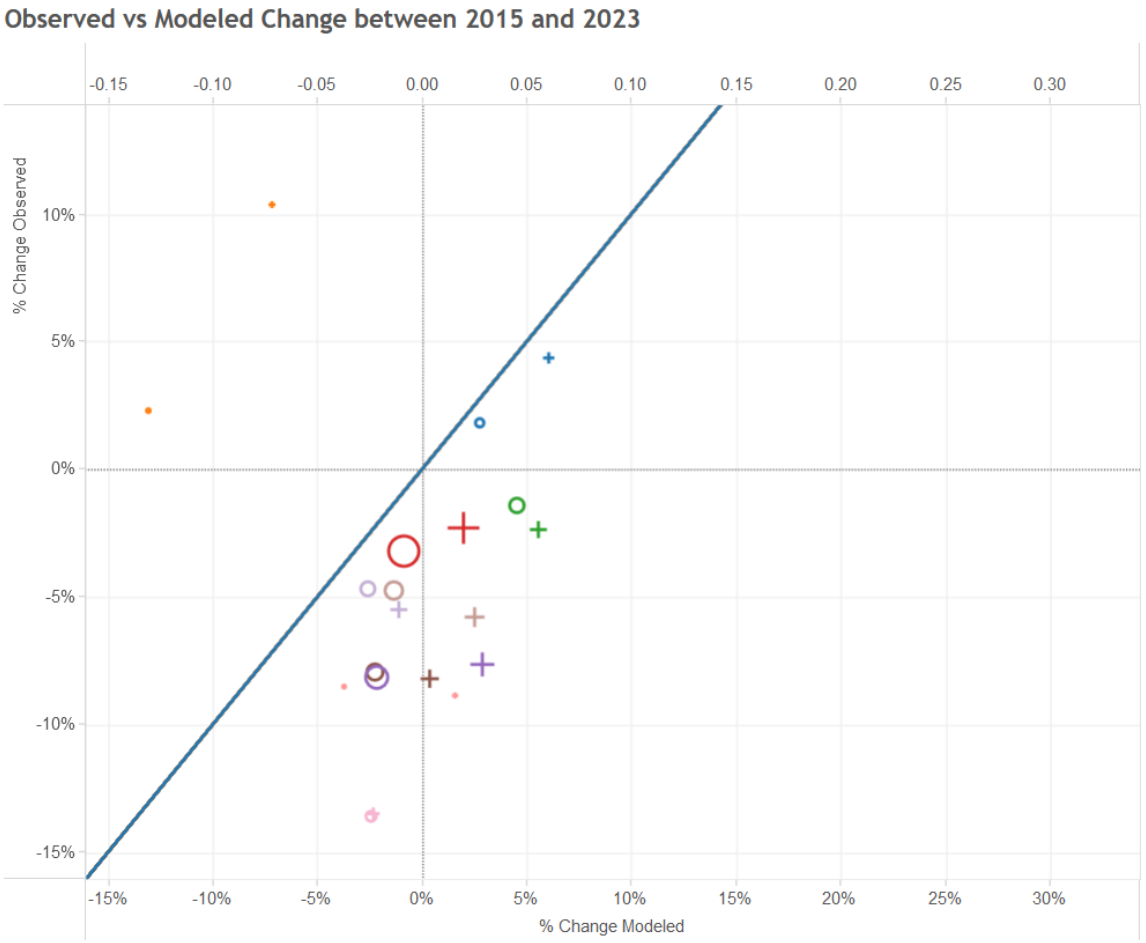
Nuances in definitions: In the ACS, the journey to work question (which also captures working from home) is phrased as follows: "**How did this person usually get to work LAST WEEK?**" Thus, the workers who work from home 1 or 2 (or even 3 in some cases) days a week would not mark the "Worked from home" option even if they frequently work from home. In contrast, the Travel Model represents the Bay Area residents' travel on **a typical weekday**. Some portions of the workers who work from home 1 or 2 days a week are included. Because of this definitional difference, the WFH rate in the model is expected to be higher than that reported by the ACS.

Potential underestimation by ACS: There is evidence indicating that ACS tends to underestimate actual WFH rates. Staff analyzed the results of the Bay Area Transportation Study -- a comprehensive week-long travel diary survey conducted in the fall of 2018 and spring of 2019. This survey asked respondents whether they traveled to work and/or teleworked on each day of survey participation. This survey question is more aligned with the Travel Model's definitions than the ACS's question. Using weighted data representing a "typical" weekday (Monday through Thursday), the survey revealed substantially higher WFH rates (12.4%) in 2018/2019 than in the 6.5% reported by the ACS.

Calibrated transit change: 2015 to 2023



Calibrated traffic count: 2015 to 2023



Notes about the validation data:
For 2015, average observed includes PeMS data from 2014, 2015 and 2016 (where available); for 2023, average observed includes PeMS data from 2022 and 2023 (where available).

Current work & targeted improvements

- Use the model!

- Monitor & update with ongoing trends
- 2023/2024 HH travel survey
  - Relate usual mode to simulation day WFH
  - Calibrate non-mandatory tour participation for people who work from home
  - Estimate with more complete attributes
- Update land-use model assumptions about square feet of office space per employee

Some lessons

- Start by understanding the world around us, before attempting to model it.
  - The most compelling arguments rely on more than one form of evidence, combined with a coherent story.
- We build models to predict change, and should evaluate them on their ability to do so.
- Good definitions are aligned both with an intuitive understanding and the available data.
- A disaggregate simulation model makes it really easy to add one more variable.

Questions & Discussion