Exploring Public Policy Questions with Models: REMI, Bay Area UrbanSim, & the Travel Model

Plan Bay Area 2050 Summer Webinar Series

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September 10, 2019

PLAN BAY AREA 2050

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Today's Webinar

Quick Introduction to Plan Bay Area 2050 → Planning for a major Earthquake → Policy Interventions for Displacement/Gentrification → Planning for Autonomous Vehicles → Q&A + Future Webinars

PLAN BAY AREA 2050

What is Plan Bay Area?

- The regional plan is **a blueprint for growth and infrastructure for the next 30 years.**

- The regional plan is **updated every four years**, with this major update due in 2021.

- The regional plan is a reflection of **the shared priorities of the diverse nine-county San Francisco Bay Area.**

- The regional plan is **fiscally-constrained**, even as it aspires to tackle the Bay Area's big challenges with specific strategies.

- The regional plan is **not an expenditure plan**; it is focused on setting priorities and over the long term and looking holistically across "silos".

Meets federal & state requirements

Identifies local and regional strategies

Establishes a long-range regional vision across multiple topic areas

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Spring 2015 to July 2017

February 2018 to October 2019

September 2019 to June 2021

High-performing strategies and projects from *Horizon* – those that are resilient to uncertainties – **will be recommended for inclusion in the Preferred** Plan Bay Area 2050 (RTP/SCS).

What **Topic Areas** Do These Efforts Tackle?

Horizon and Plan Bay Area 2050 are addressing four core topic areas, as we work to create a long-range integrated regional vision for the next 30 years.

Transportation

Housing

NEW **Economy**

NEW **Environment**

Plan Bay Area 2050: Summertime Webinar Series

Regional Growth Framework Update + Baseline Data Review

- **June 26, July 1 & July 10**
  - New Criteria and Submitting Letters of Interest/Letters of Confirmation
- **September 6**
  - How to Review Baseline Land Use Data with BASIS

Target audience:
Cities, counties, and CTAs

Preparing for Plan Bay Area 2050

- **July 9**
  - Public Engagement Process Overview
- **August 6**
  - Bay Area Spatial Information System (BASIS)
- **September 5**
  - Looking Ahead: The Vision for Plan Bay Area 2050
- **September 10**
  - Exploring Policy Questions with Models
- **September 20**
  - Horizon Perspective Paper 5: Bay Crossings

Target audience:
Stakeholders & interested public

In Case You Missed It! (ICYMI)

- **July 30**
  - ICYMI: Horizon Futures Round 1 Analysis
- **August 14**
  - ICYMI: Horizon Perspective Paper 1 - Autonomous Vehicles

Target audience:
New stakeholders/ public

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Why Forecast & Model?

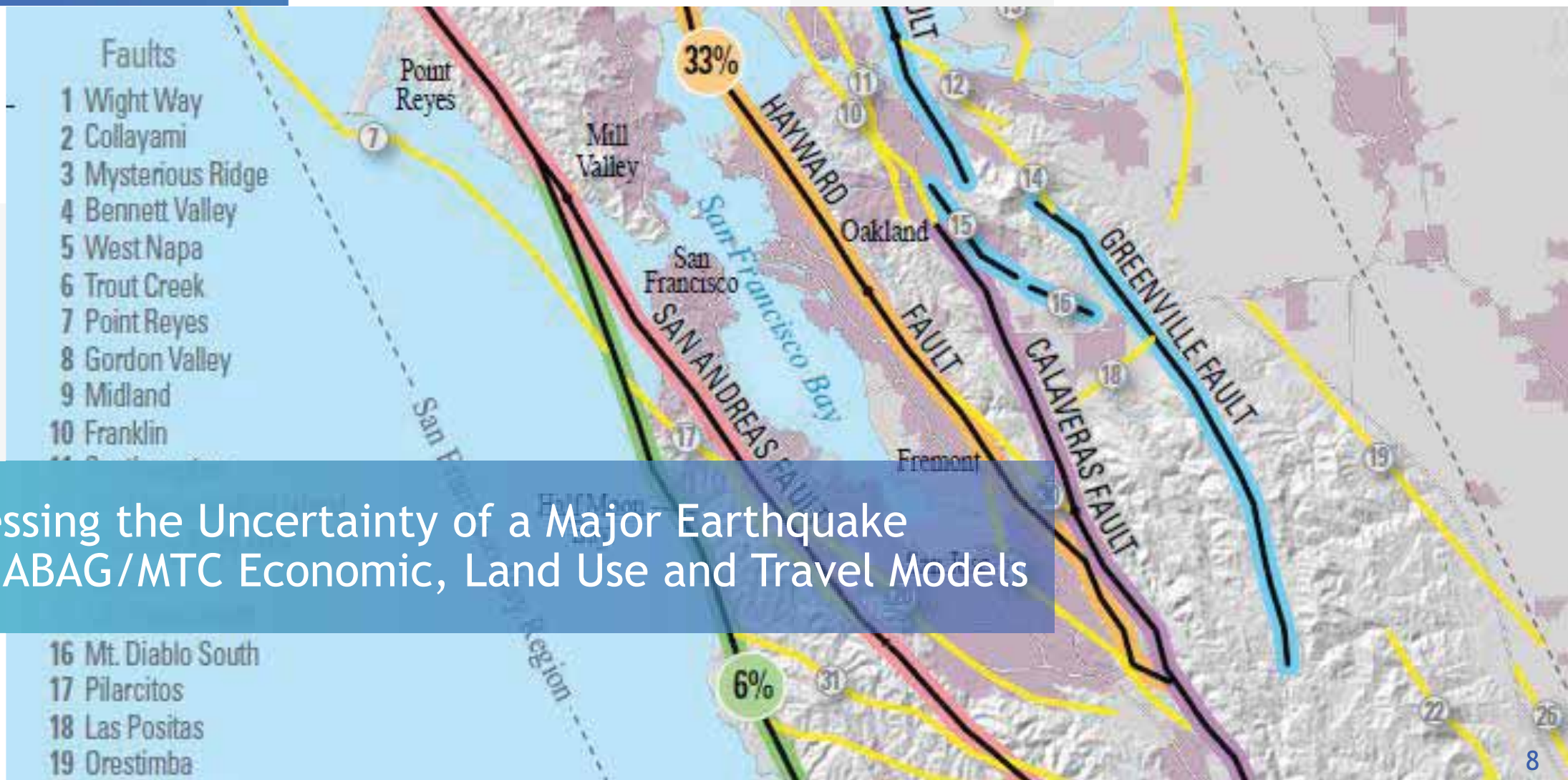To understand and analyze **projects** and

policies

Models help us to answer:

- **How** effective is the project or policy at achieving goals and objectives?

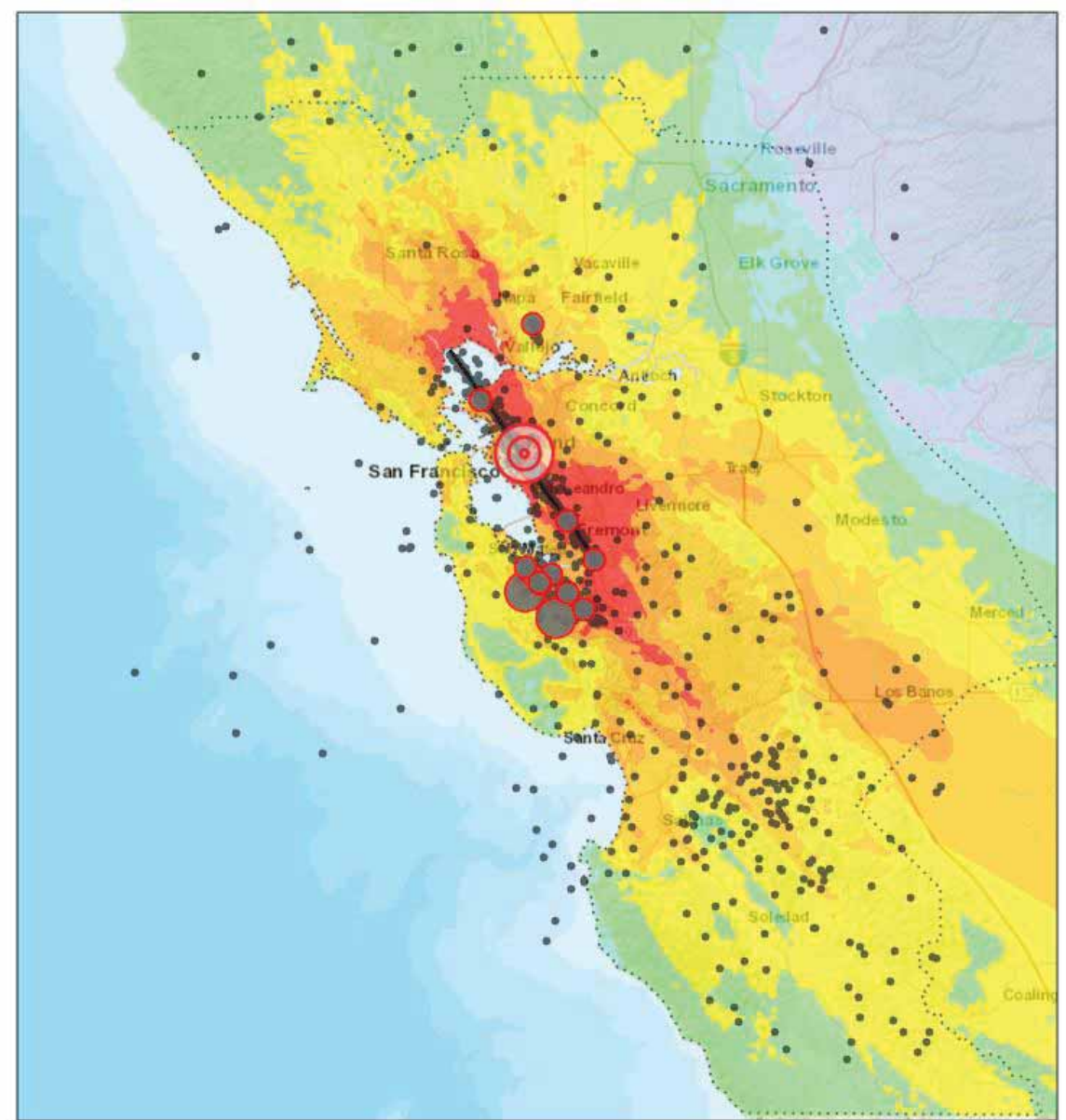- **What** are the benefits and costs?

- **Who** wins? (and who loses?)

Model Scenario

Includes problem / Issue

vs

Model Scenario

Includes problem / Issue

Includes policy / project!

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Addressing the Uncertainty of a Major Earthquake
Using ABAG/MTC Economic, Land Use and Travel Models

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Earthquake Modeling in Horizon

- USGS HayWired Scenario...in 2035
- Epicenter in Oakland
- 18 second magnitude 7.0 Hayward Fault rupture
  - <u>Shaking</u>: strongest closest to the fault but felt across the region
  - <u>Liquefaction</u>: Bay Area margins, creeks
  - <u>Landslides</u>: initiation in moderately steep/steep East Bay Hills and rest of Bay Area
  - <u>Aftershocks</u>: 16 x magnitude 5.0 or greater earthquakes
 - <u>Fire</u>: increases damage footprint

October 3, 2018

1:2,311,162

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community
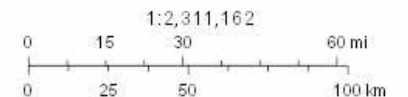
Utility & Transportation Damage

- Electric power: 3-4 weeks
- Fuel: 7-10 days (minimum)
- Voice and data: 7-10 days
- Water: up to 6 months in core damage areas
- Highway bridges: up to 4-10 months
- BART stations: up to 1-3 years
- Longest restoration times in Alameda, Contra Costa (water) counties
- Intermediate restoration times in Contra Costa, San Mateo, Santa Clara, and San Francisco counties
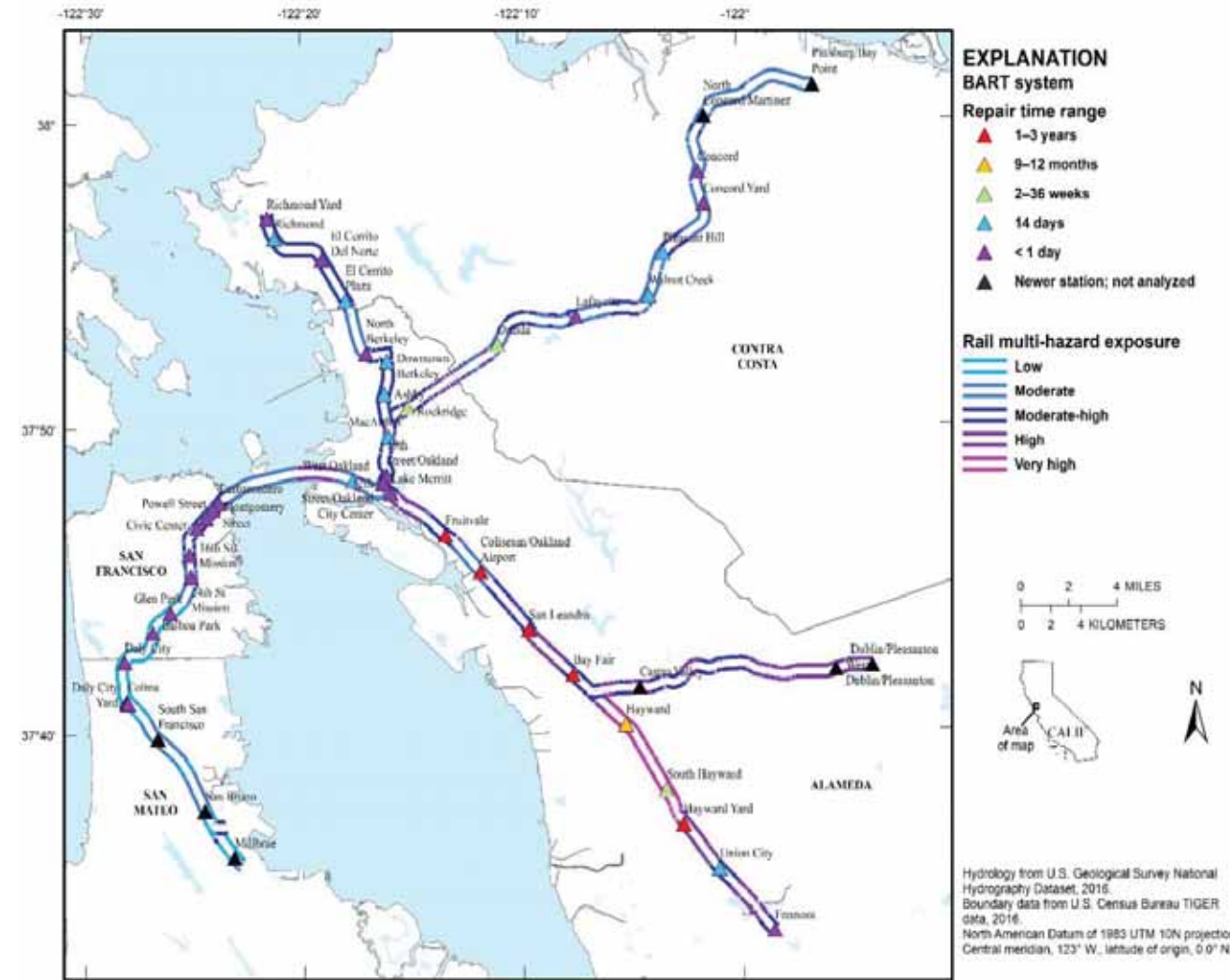
Earthquake Through Three Models
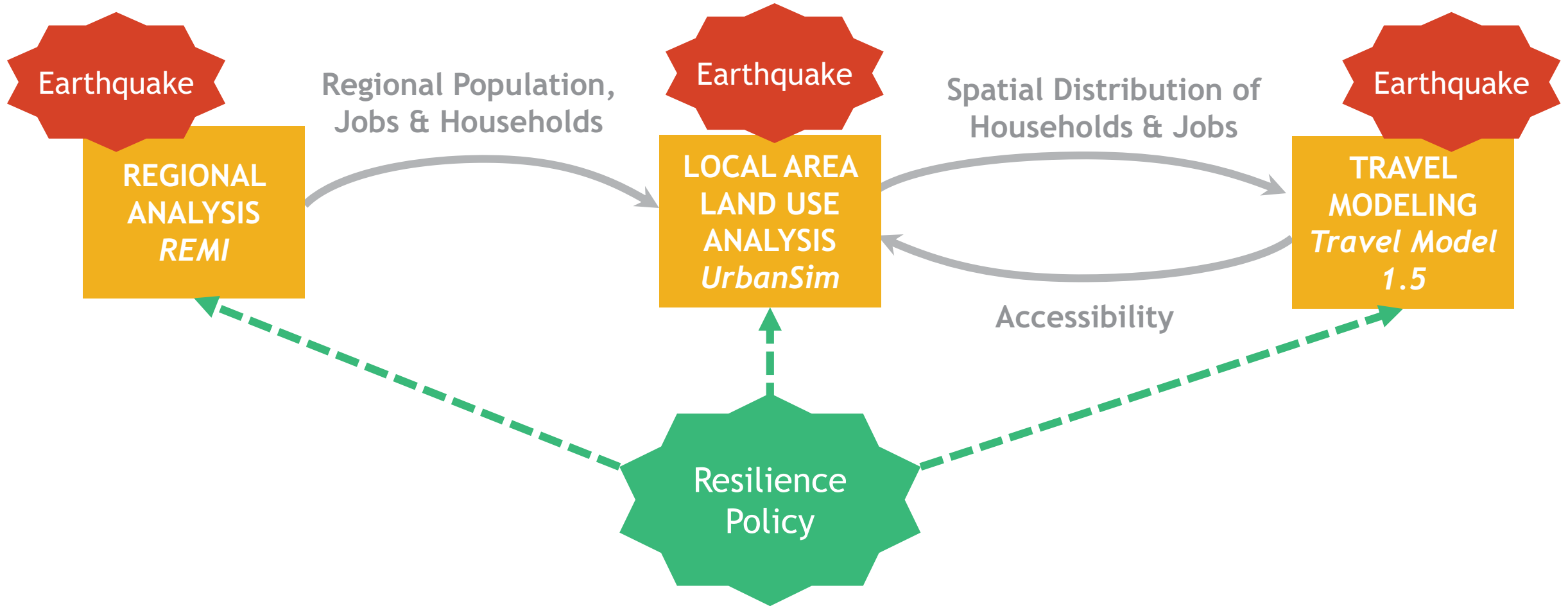
REMI – Regional Economic Analysis

- REMI: Economic model representing jobs, population & trading flows in the region

- For HayWired: Estimate impacts on employment, population and output during the first few years

- Effects of the earthquake on the additional 15-year trajectory of growth in the region (through 2050)

- Interactive effects of damage, travel disruption, population movements, and recovery spending

- Sensitivity analysis on changing construction costs, insurance spending, population displacement levels, and commute disruption levels
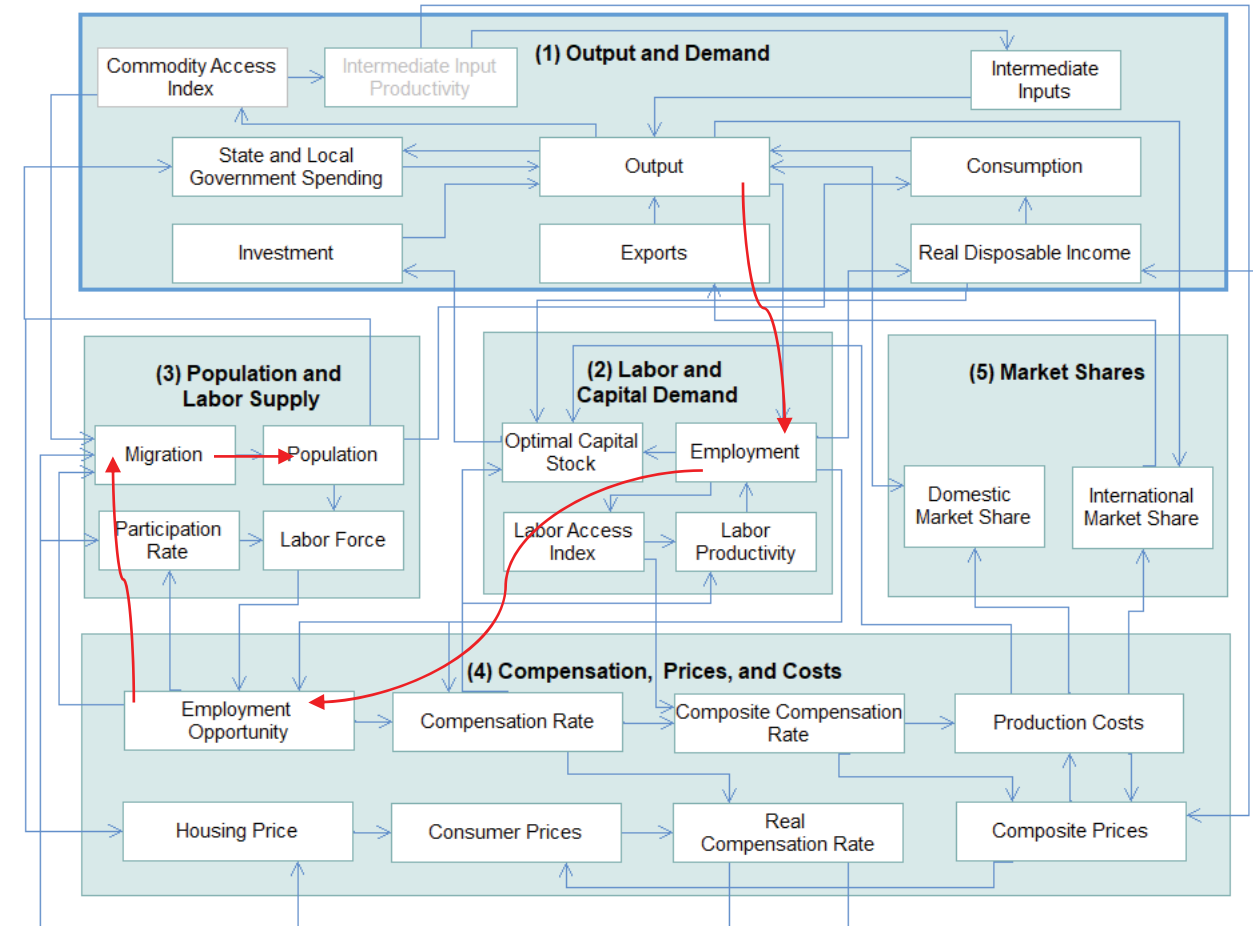
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Economic Analysis Summary

Range of Job Forecasts – Plan Bay Area 2040 versus Horizon Futures
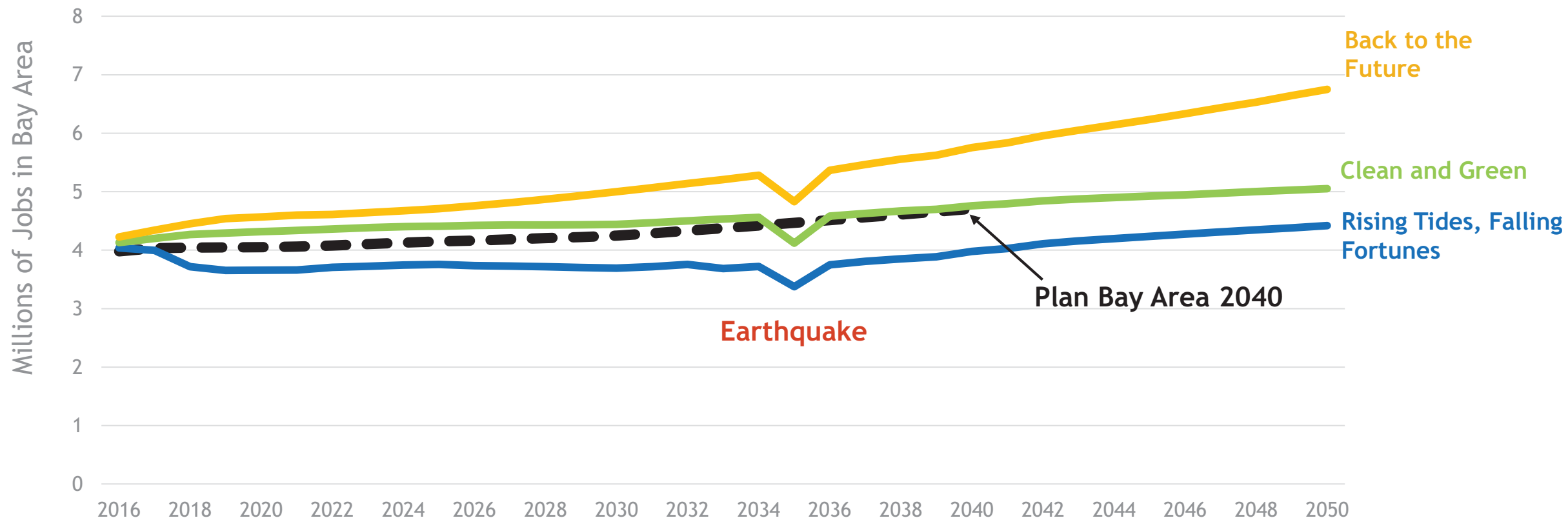
Economic Analysis Summary (cont.)

- **Lessons Learned**
  - Damage very concentrated: Worst effects in the East Bay
  - It's not just the shaking: Travel disruption and fires can spread impacts further
  - Rebuilding will offer risks and opportunities
    - Risks--displacement pressures at the lower end of the income scale
    - Opportunities--Replacing what is lost can also open new avenues for growth.
- **Critical policies can affect the level of impact and recovery**
  - Getting to resilience pre-quake is critical:
    - Investing and retrofitting by building owners
    - Transportation and infrastructure resilience and retrofit
  - Getting ready to respond post-quake:
    - Financial resilience: Individuals, firms/businesses and public sector (utilities)
    - Addressing construction costs and worker availability

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# Forecasting the Damage to Buildings

- Start with a database of all buildings in the region

  - Includes type, size, age, some construction information

- Combine with the probabilities the Hayward quake would damage particular types of structures in particular neighborhoods (from USGS Hazus Model)

- Simulate removal of some buildings and displace the households or jobs within

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# Detailed Building Database

PLAN BAY AREA 2050
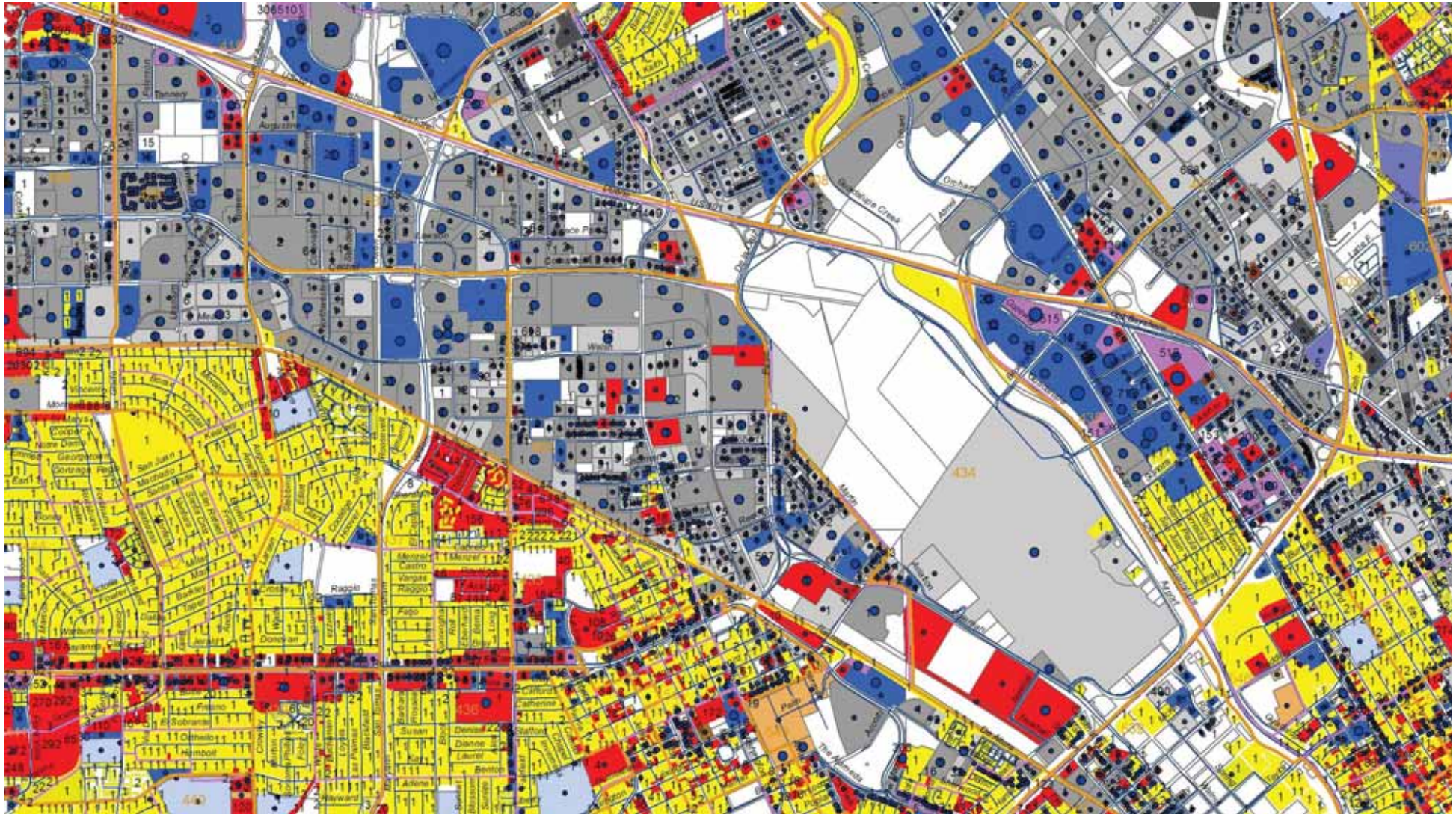
# Probability of Structural Damage

PLAN BAY AREA 2050
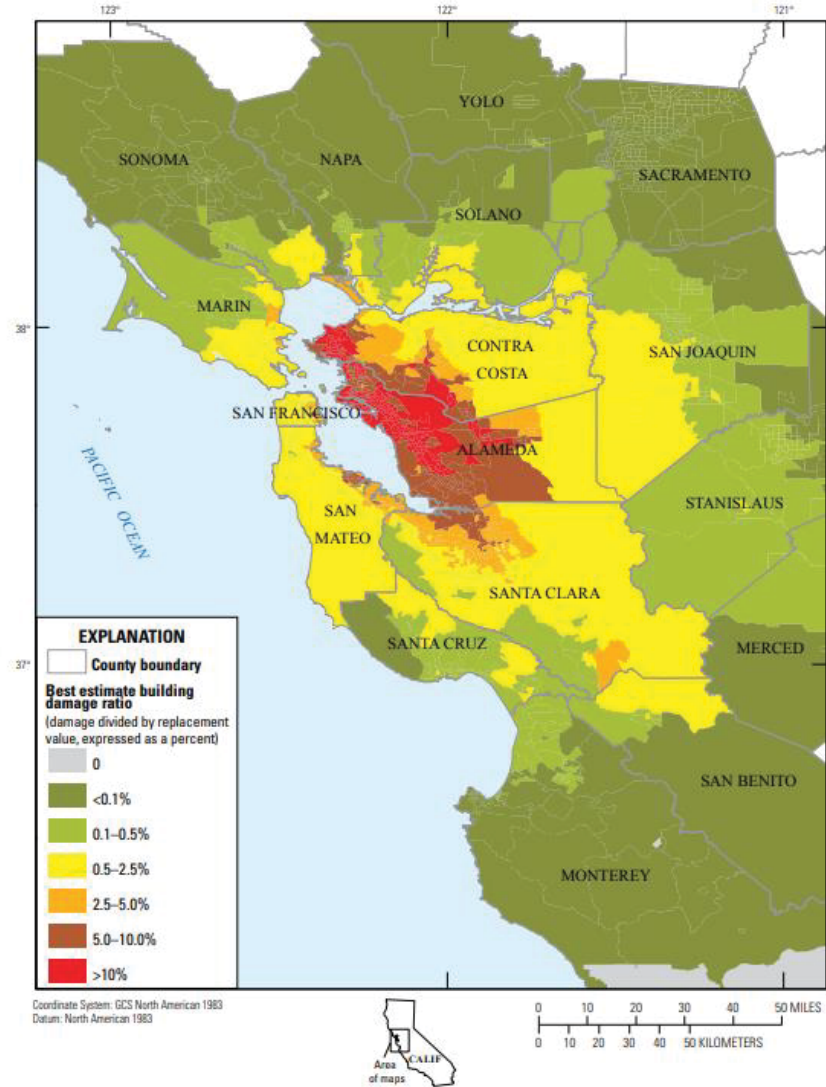
Forecasting Post-Quake Urban Change

- Then use UrbanSim to forecast local growth with these destroyed buildings and the modified regional growth trajectory

- UrbanSim uses statistics to predict the locations that different types of households and companies tend to locate

- Can estimate which locations are likely to see spillover growth and what areas don't fully recover by 2050

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Quake

No Quake

PLAN BAY AREA 2050
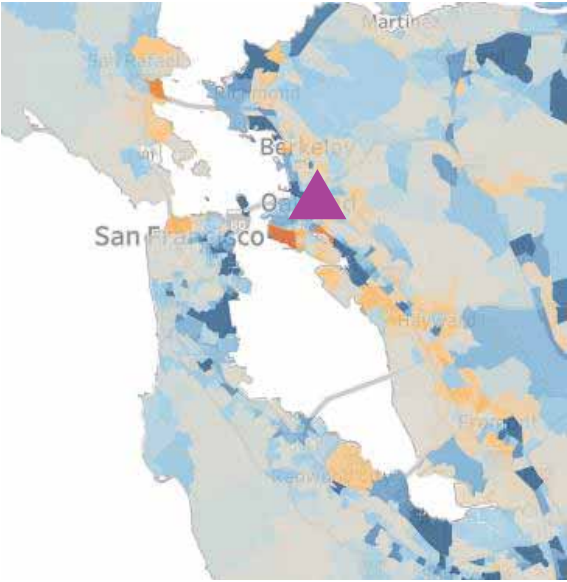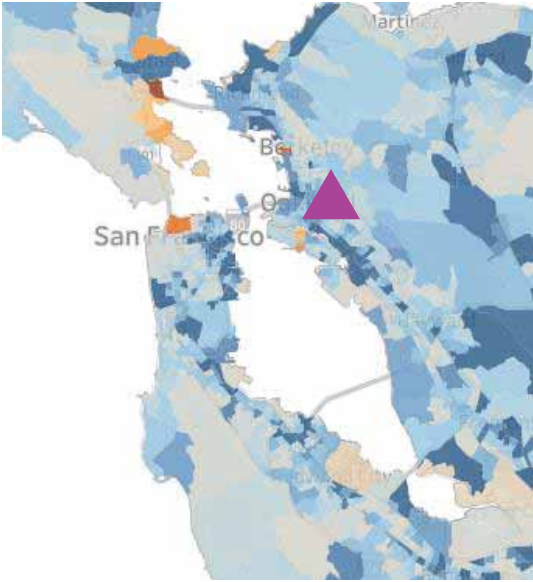
Incorporating an earthquake event in the Travel Model

- The earthquake event primarily impacted highway overpasses and elevated BART facilities e.g. stations and tracks

- If a facility is closed for more than 90 days in the HayWired study, it is impacted in the travel model

- In Horizon Futures Round 1:

Rising Tides, Falling Fortunes — Local/state funding is **not** available for repairing the structures impacted
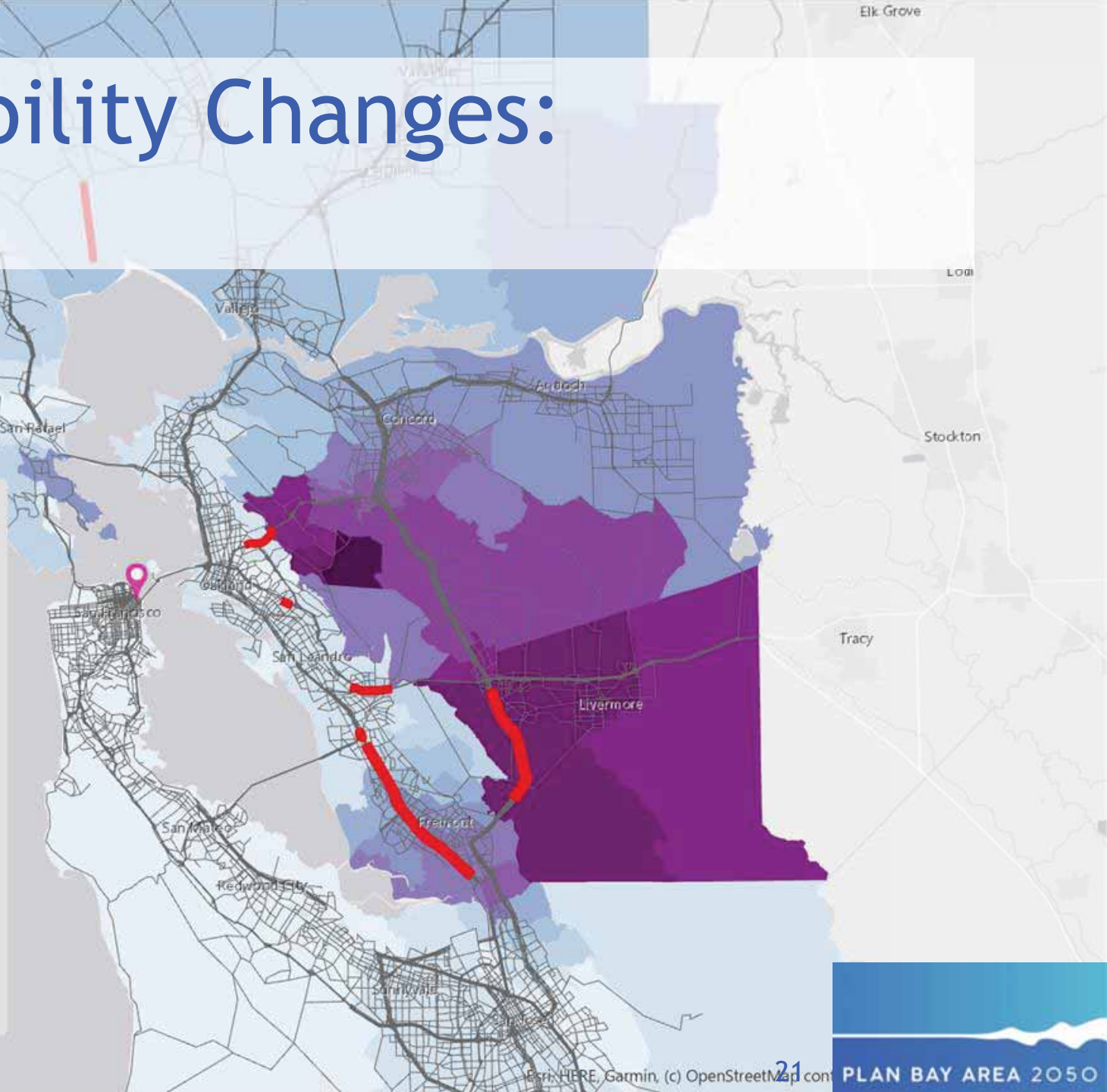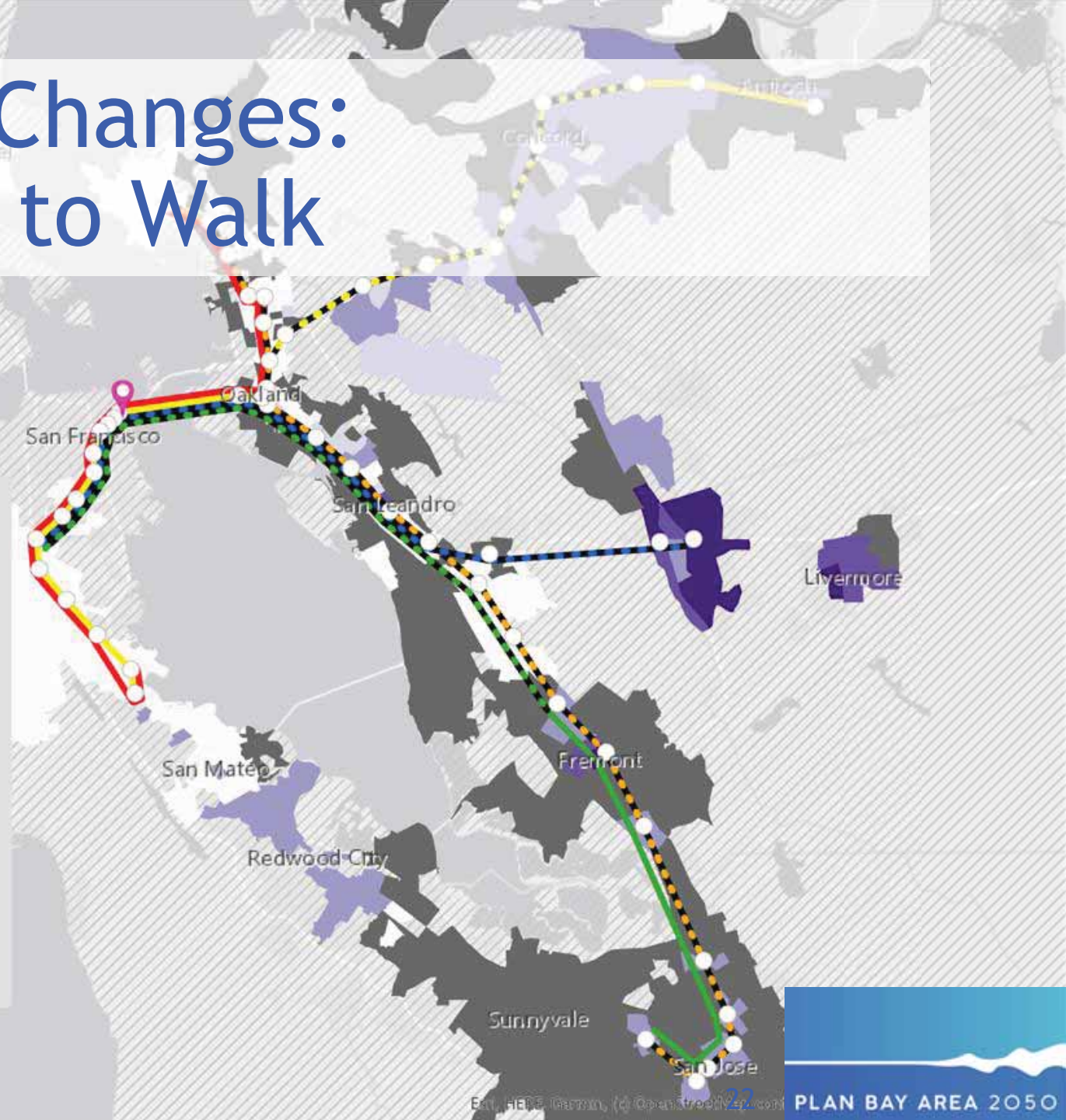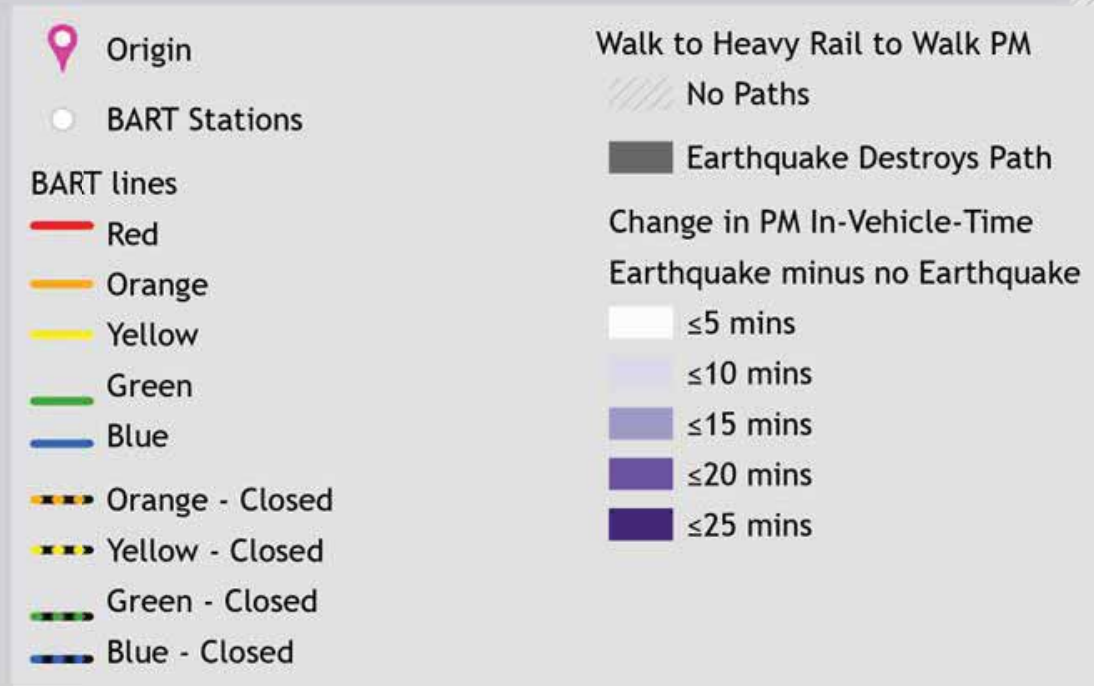
Clean and Green

Back to the Future — Local/state funding is available; none are still damaged 5 years later

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Roadway Accessibility Changes: Drive Alone

Legend:
- Origin
- Roadways Destroyed
- Roadways

Change in PM Drive Alone Time
Earthquake minus no Earthquake
- ≤5 mins
- ≤10 mins
- ≤15 mins
- ≤20 mins
- ≤25 mins
- ≤30 mins
- ≤35 mins
- ≤40 mins
- ≤45 mins
- ≤50 mins
- ≤55 mins
- ≤60 mins

Esri, HERE, Garmin, (c) OpenStreetMap cont

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BART Accessibility Changes: Walk to Heavy Rail to Walk

Legend:

- **Origin**
- ○ BART Stations

BART lines
- ▬ Red
- ▬ Orange
- ▬ Yellow
- ▬ Green
- ▬ Blue
- ▬ Orange - Closed
- ▬ Yellow - Closed
- ▬ Green - Closed
- ▬ Blue - Closed

Walk to Heavy Rail to Walk PM
- No Paths
- Earthquake Destroys Path

Change in PM In-Vehicle-Time
Earthquake minus no Earthquake
- ≤5 mins
- ≤10 mins
- ≤15 mins
- ≤20 mins
- ≤25 mins

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BART Accessibility Changes: Walk to Heavy Rail to Drive

Origin

BART Stations

BART lines
— Red
— Orange
— Yellow
— Green
— Blue
▪▪▪ Orange - Closed
▪▪▪ Yellow - Closed
▪▪▪ Green - Closed
▪▪▪ Blue - Closed

Walk to Heavy Rail to Drive PM
No Paths
Earthquake Destroys Path

Change in PM In-Vehicle-Time
Earthquake minus no Earthquake
≤5 mins
≤10 mins
≤15 mins
≤20 mins
≤25 mins
≤30 mins
≤35 mins
≤40 mins

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Accessibility is fed back into UrbanSim

Earthquake

Earthquake

Earthquake

REGIONAL ANALYSIS *REMI*

Regional Population, Jobs & Households

LOCAL AREA LAND USE ANALYSIS *UrbanSim*

Spatial Distribution of Households & Jobs

TRAVEL MODELING *Travel Model 1.5*
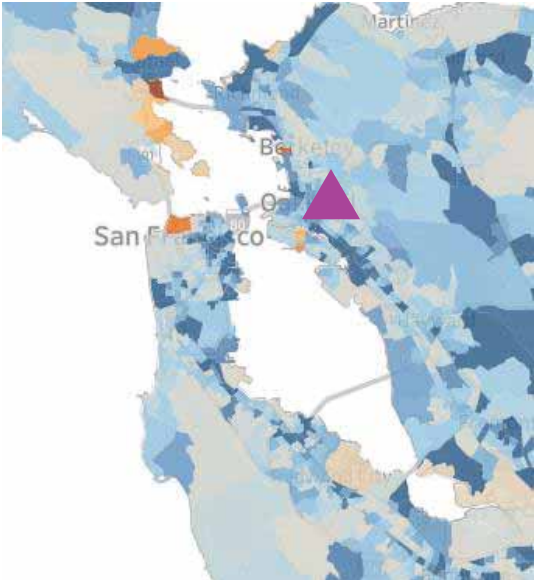
Accessibility

Resilience Policy

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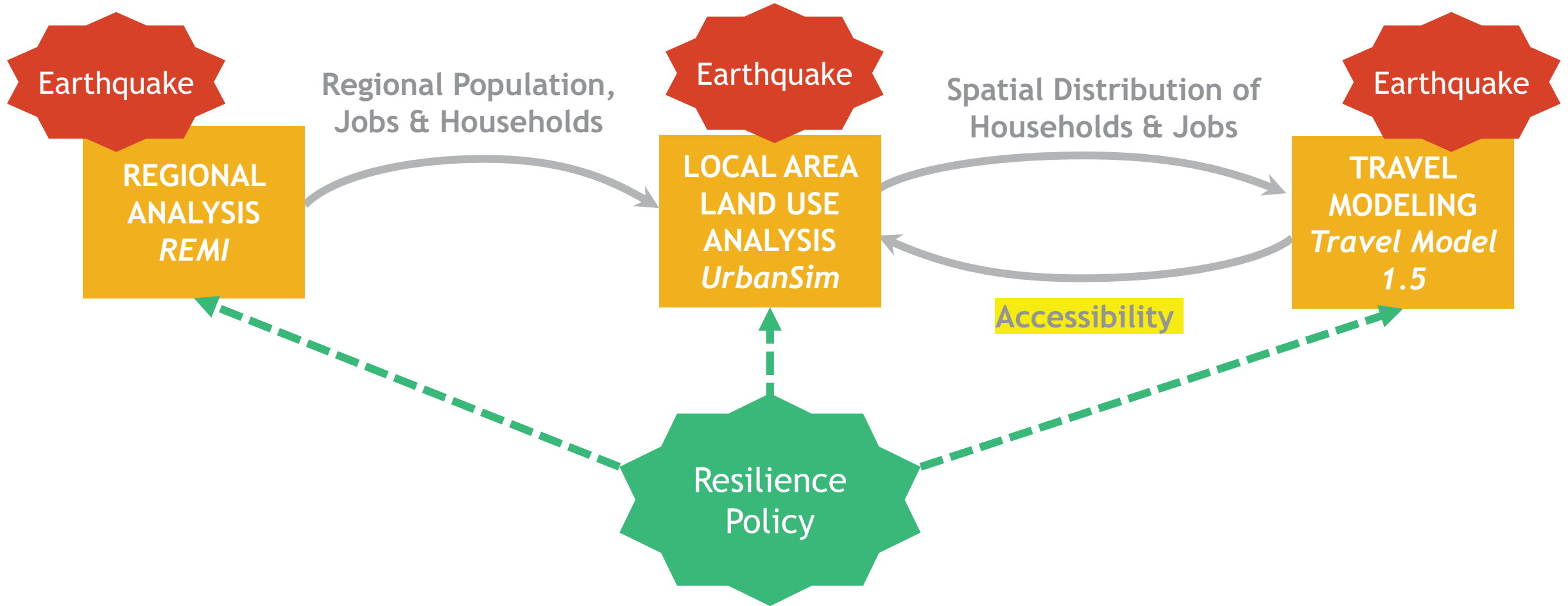
Testing an Earthquake Retrofit Policy

- Defined a potential policy that provided funding to add features to existing buildings to make them more resistant to an earthquake

- Calculated how many buildings would be retrofitted and lowered the likelihood those buildings would be destroyed

- Re-ran the simulation and re-forecast the urban changes in order to see how effective this policy is
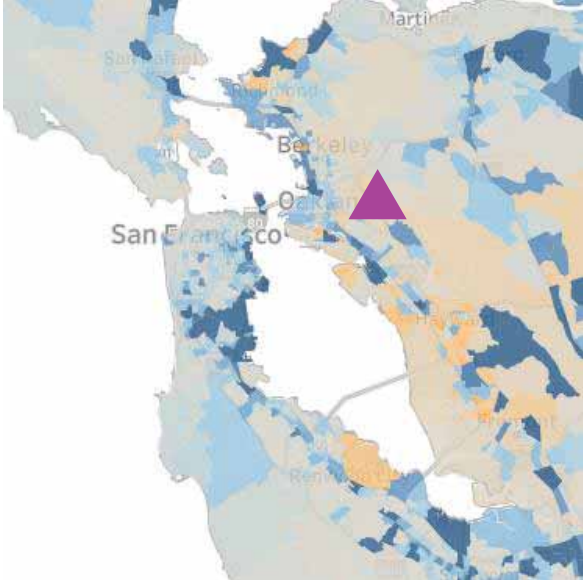
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Quake

No Quake

Quake w/Retrofit

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Displacement and Gentrification

Analyzing Policies with UrbanSim

Bay Area Gentrification and Displacement

- While Bay Area housing is expensive generally, some neighborhoods have lower prices and more lower income households

- The strong economy combined with very limited new housing construction has led to wealthier households moving into some poorer areas

- This can lead to *gentrification*, a snowball effect where the presence of wealthier households and their newly improved housing causes neighboring rents to rise, *displacing* the poorer households

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Modeling Households Moving with UrbanSim

- As we saw in the earthquake example, UrbanSim forecasts the movement of households at detailed level

- We establish the current types of households in a given neighborhood today by looking at US Census data

- Then we simulate the movement each household using statistics on typical relocation rates and location characteristics for households in each income quartile

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Modeling Changes in Neighborhood Prices

- Each year UrbanSim also calculates new prices for housing in each area

- This is based on factors including access to jobs, amenities, and demand for that location

- In this way, prices rise in high demand areas and the model can be used to forecast neighborhood gentrification and low income household displacement

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Simulating Building Construction in UrbanSim
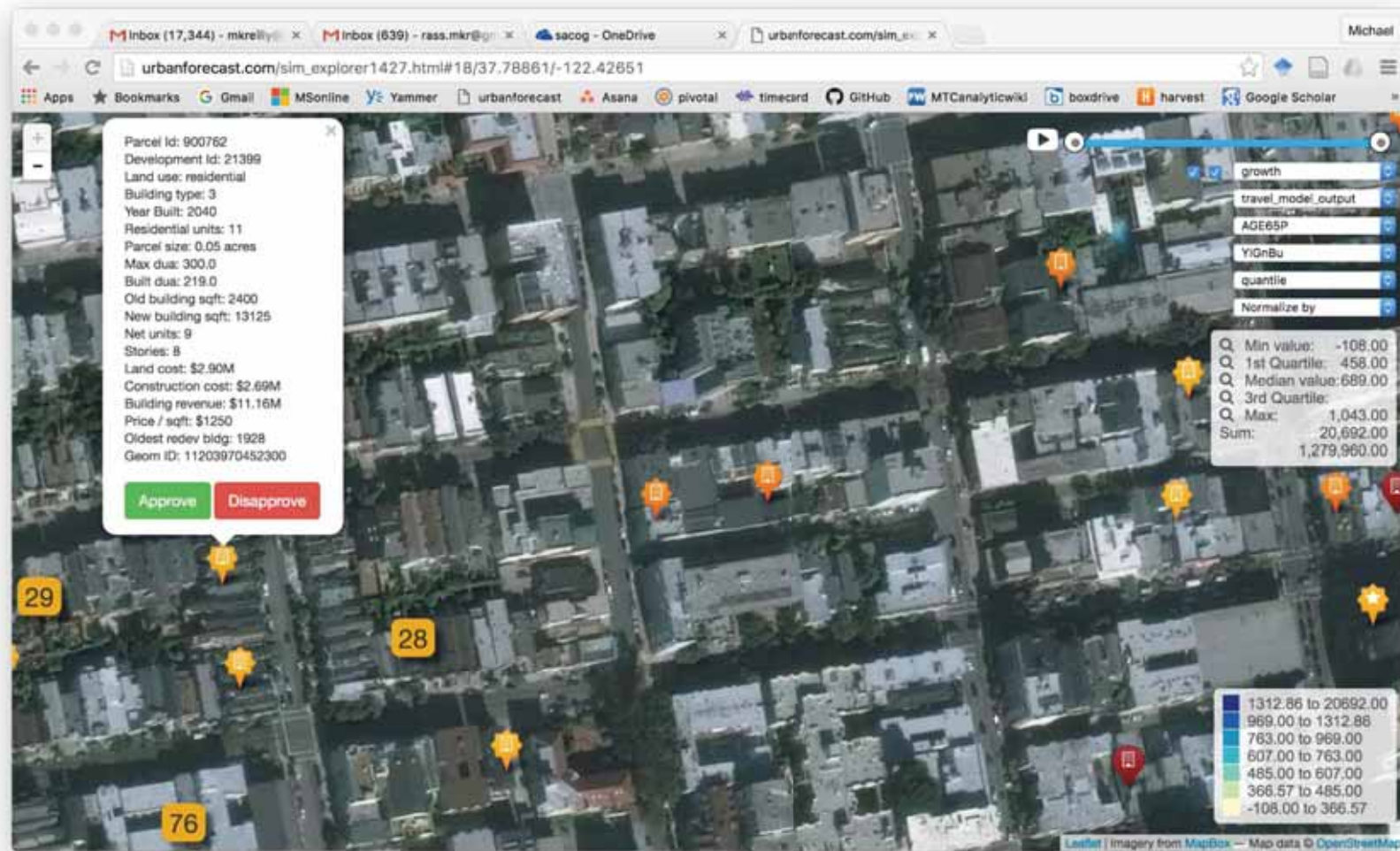
Shifting Neighborhood Prices

Testing Policies to Slow Change

- In recent planning work, we have added various policies to UrbanSim to test their efficacy in slowing displacement

  - Rent control slows rate of household relocation

  - We model the existence and construction of deed restricted low units that only allow lower income households

  - Inclusionary zoning requires that a percentage of new units in market-rate construction be set aside as deed restricted low income

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Displacement Across Three Scenarios

Performance Assessment Report_PBA2040_7-2017_0
PDF - 7.6 MB

Performance Target #6: Equitable Access (Affordable Housing)
- 🔴 No Project: -0%
- 🟡 Main Streets: +2%
- 🟡 Big Cities: +1%
- 🟡 **Preferred: +3%**
- 🟡 Equity, Environment, and Jobs 2.0: +3%

Similar to some targets discussed above, the goal of doubling the share of affordable housing in identified locations was remarkably ambitious given limited resources on the housing front. That being said, all scenarios except for No Project made progress towards the target – which means the number of affordable units grew faster than housing growth overall. Main Streets, Big Cities, and Preferred all boosted the number of deed-restricted units in PDAs, TPAs, and HOAs – but Equity, Environment, and Jobs 2.0 resulted in 40,000 additional units more than the runner-up (Main Streets with 119,000 units). However, in terms of naturally-affordable units, Preferred performs the strongest of the scenarios evaluated, with Equity, Environment, and Jobs 2.0 only outperforming No Project. Ultimately, Preferred and Equity, Environment, and Jobs 2.0 tied for strongest performance on this target. Additional affordable housing production policies and subsidies would be required to achieve stronger performance on this target.

Performance Target #7: Equitable Access (Displacement Risk)
- 🔴 No Project: +18%
- 🔴 Main Streets: +6%
- 🔴 Big Cities: +9%
- 🔴 **Preferred: +5%**
- 🔴 Equity, Environment, and Jobs 2.0: +5%

Displacement risk was highest in the No Project scenario as it lacked any substantive policies – such as inclusionary zoning – to help mitigate the displacement crisis. Furthermore, it produces more housing at the periphery and less in the region's core, where housing is most needed to alleviate the imbalance between supply and demand. Preferred and Equity, Environment, and Jobs 2.0 performed the best on this target. While neither achieved the goal of mitigating all growth in displacement risk, they performed better than the Big Cities scenario which funneled a greater level of growth into the urban core with a more limited inclusionary zoning policy.

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Modeling Autonomous Vehicles with the Travel Model

HORIZON

Planning for autonomous vehicles (AV) is fraught with uncertainty
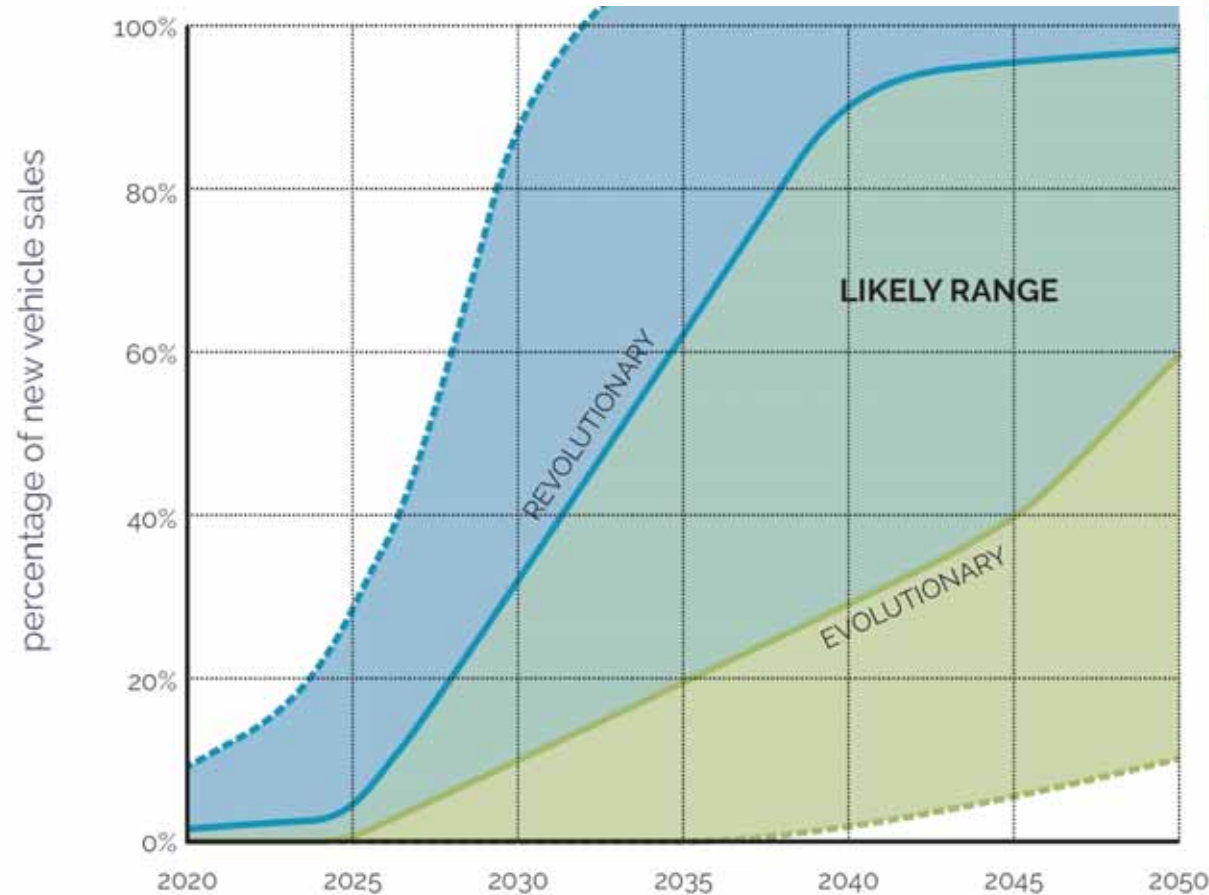
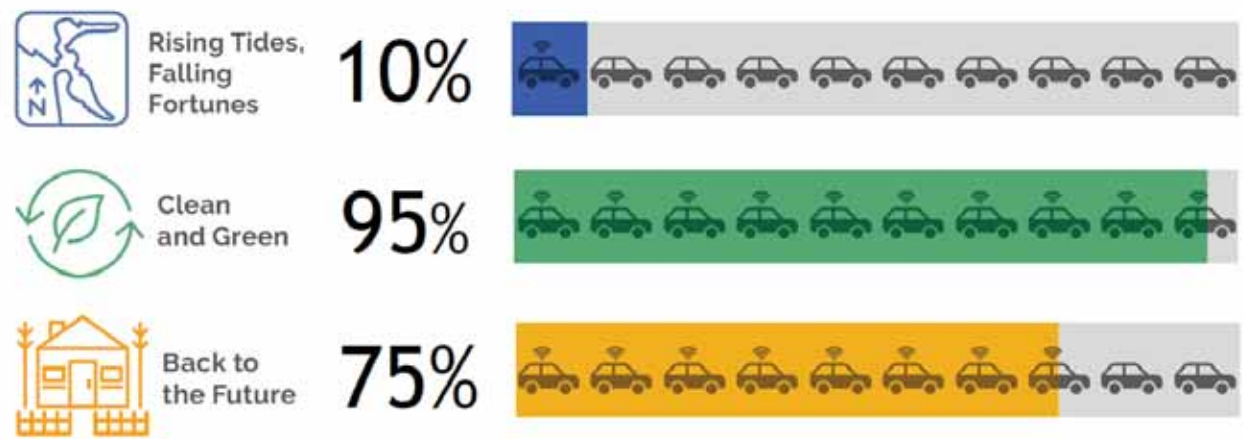**REVOLUTIONARY**
- Technology breakthroughs
- Regulatory resolutions
- Shared model, at much lower cost than ownership
- Rapid adoption

EVOLUTIONARY
- Slower technology development and rollout
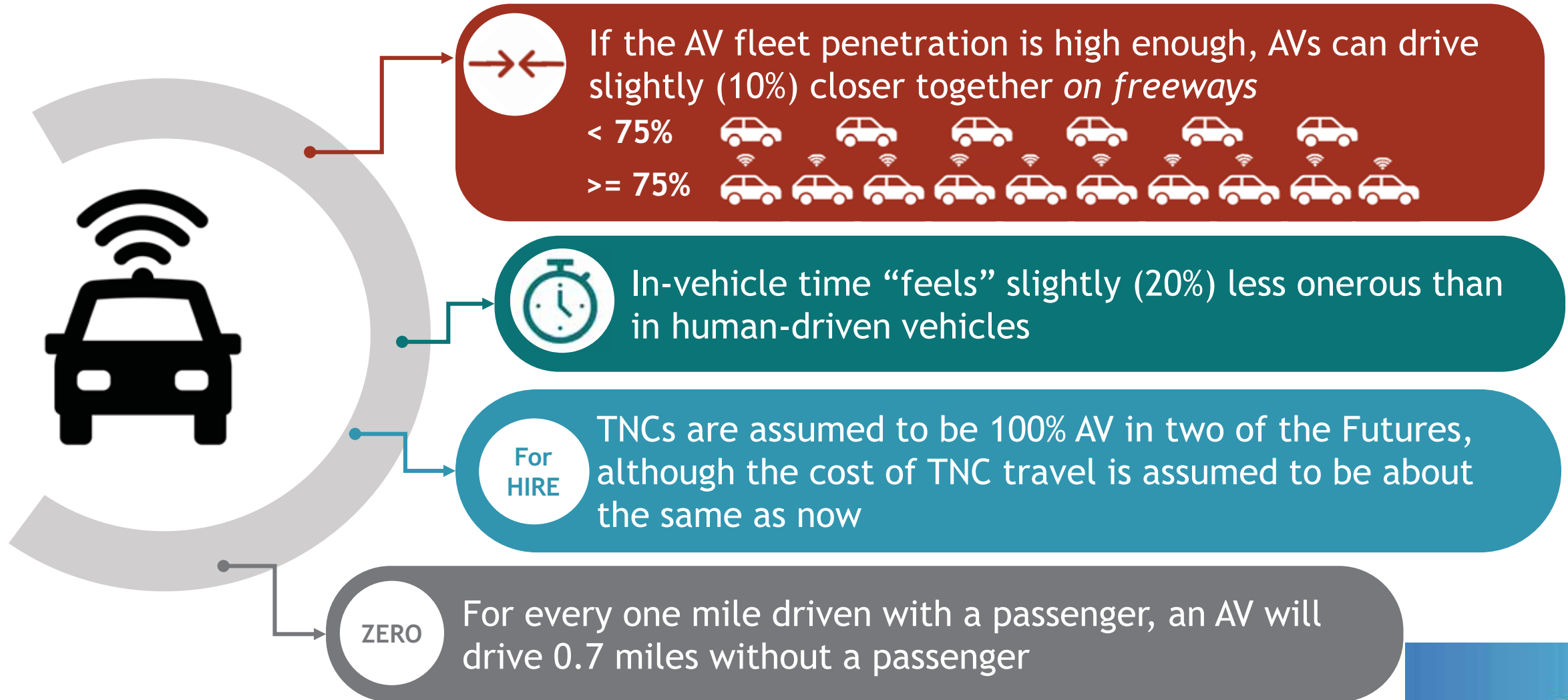- Owned AV model with cost premium
- Slower adoption

Source: Horizon Perspective Paper: Autonomous Vehicles

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Decision-making under uncertainty can be informed by scenarios

- The goal of modeling is not to predict the *single* most likely future, but to understand the effectiveness of proposed policies under *a range of possible futures*

- In Horizon and Plan Bay Area 2050, we run scenarios with different levels of AV market penetration:
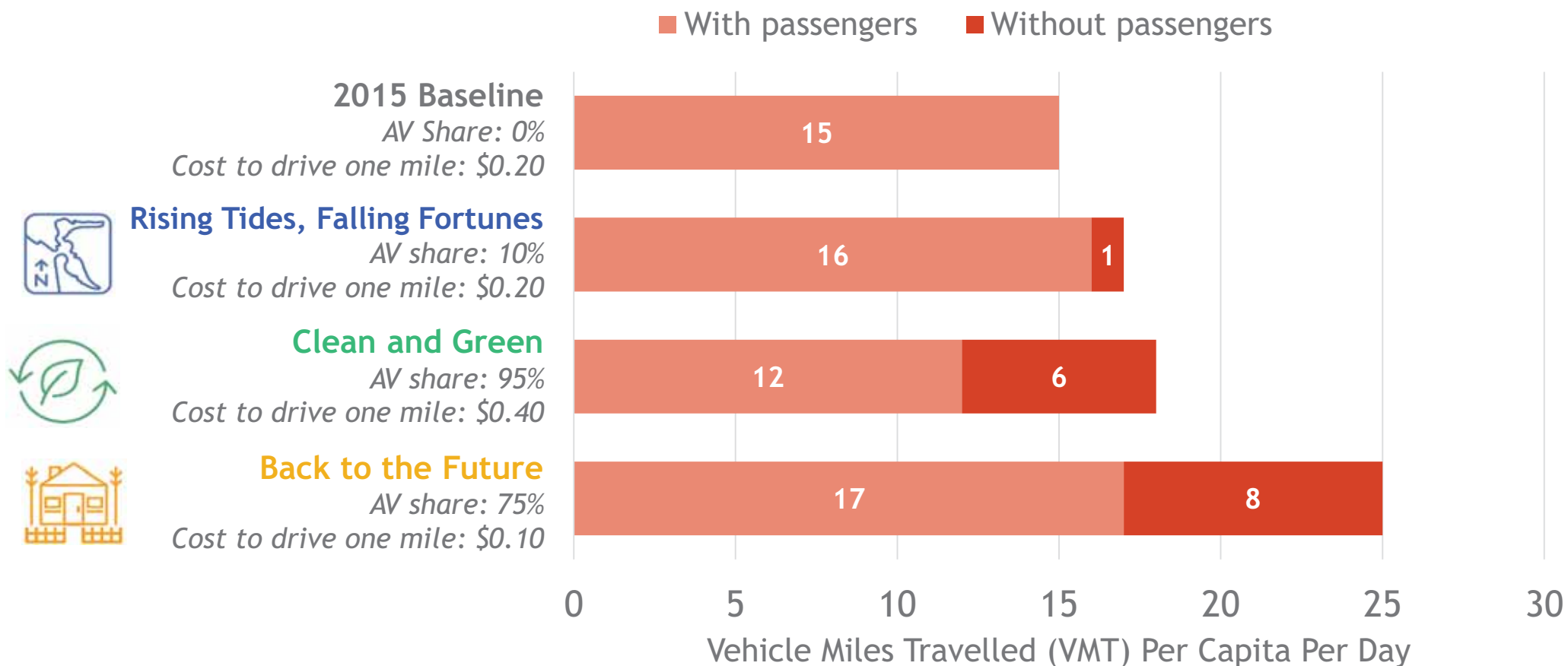

Rising Tides, Falling Fortunes — 10%

Clean and Green — 95%

Back to the Future — 75%

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Careful attention to model assumptions is key

If the AV fleet penetration is high enough, AVs can drive slightly (10%) closer together *on freeways*

< 75%

>= 75%

In-vehicle time "feels" slightly (20%) less onerous than in human-driven vehicles

For HIRE
TNCs are assumed to be 100% AV in two of the Futures, although the cost of TNC travel is assumed to be about the same as now

ZERO
For every one mile driven with a passenger, an AV will drive 0.7 miles without a passenger

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Exploring policy questions

- In Horizon and Plan Bay Area 2050, the Travel Model is being used to investigate the effectiveness of:

  - Pricing: Time-of-Day Tolls on All Highways

  - Lower Speed Limits

  - Creating competitive options to AVs (e.g. free transit for low income households, and free bikes and scooters for short trips)

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Thanks for attending today's webinar!

- Cynthia Kroll (ckroll@bayareametro.gov)
- Bobby Lu (blu@bayareametro.gov)
- Mike Reilly (mkreilly@bayareametro.gov)
- Lisa Zorn (lzorn@bayareametro.gov)
- Flavia Tsang (ftsang@bayareametro.gov)

External Forces

FUTURE NAME	IMMIGRATION AND TRADE	NATIONAL TAXES AND FUNDING	NATIONAL GROWTH	LAND USE PREFERENCES	NATIONAL ENVIRONMENTAL POLICY	NEW TECHNOLOGIES	NATURAL DISASTERS
Rising Tides, Falling Fortunes	Reduced	Lower funding due to tax cuts	Limited	Housing: more **urban** / Similar to today	Relaxed regulations (3' SLR)	More **limited**	Magnitude 7.0 Hayward Fault earthquake
Clean and Green	Similar to today	Higher funding via carbon tax	Similar to today	Housing: more **urban** / Jobs: more **dispersed**	Stricter regulations (1' SLR)	Widespread	Magnitude 7.0 Hayward Fault earthquake
Back to the Future	Increased	Similar to today	Rapid	Housing: more **dispersed** / Jobs: more **urban**	Similar to today (2' SLR)	Widespread	Magnitude 7.0 Hayward Fault earthquake

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