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

Plan Bay Area 2050 Summer Webinar Series
Cynthia Kroll, Bobby Lu, Mike Reilly, Lisa Zorn, Flavia Tsang
September 10, 2019
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
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”.

Overview
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
- Economy
- 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

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

More information available at:
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?)
Addressing the Uncertainty of a Major Earthquake Using ABAG/MTC Economic, Land Use and Travel Models
Earthquake Modeling in Horizon

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

Regional Population, Jobs & Households

Spatial Distribution of Households & Jobs

Accessibility

Resilience Policy
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
Economic Analysis Summary

Range of Job Forecasts - Plan Bay Area 2040 versus Horizon Futures

- Back to the Future
- Clean and Green
- Rising Tides, Falling Fortunes
- Plan Bay Area 2040
- Earthquake
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
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
Detailed Building Database
Probability of Structural Damage
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.
Quake

No Quake
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]
  Local/state funding is available; none are still damaged 5 years later

  ![Back to the Future]

(PLAN BAY AREA 2050)
Roadway Accessibility Changes: Drive Alone
BART Accessibility Changes: Walk to Heavy Rail to Walk
BART Accessibility Changes: Walk to Heavy Rail to Drive
Accessibility is fed back into UrbanSim

Earthquake

Regional Population, Jobs & Households

REGIONAL ANALYSIS REMI

Earthquake

Spatial Distribution of Households & Jobs

LOCAL AREA LAND USE ANALYSIS UrbanSim

Travel Model 1.5

TRAVEL MODELING

Accessibility

Resilience Policy

Earthquake

Earthquake

Regional Population, Jobs & Households
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
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
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
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.
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
Displacement Across Three Scenarios

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.
Modeling Autonomous Vehicles with the Travel Model
Planning for autonomous vehicles (AV) is fraught with uncertainty

Source: Horizon Perspective Paper: Autonomous Vehicles
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:
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.

- 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.

- For every one mile driven with a passenger, an AV will drive 0.7 miles without a passenger.
Potential Impacts of AVs

Interim Results: Vehicle Miles Travelled (VMT) Per Capita Per Day

- **2015 Baseline**
  - AV Share: 0%
  - Cost to drive one mile: $0.20
  - With passengers: 15
  - Without passengers: 15

- **Rising Tides, Falling Fortunes**
  - AV share: 10%
  - Cost to drive one mile: $0.20
  - With passengers: 16
  - Without passengers: 1

- **Clean and Green**
  - AV share: 95%
  - Cost to drive one mile: $0.40
  - With passengers: 12
  - Without passengers: 6

- **Back to the Future**
  - AV share: 75%
  - Cost to drive one mile: $0.10
  - With passengers: 17
  - Without passengers: 8
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)
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

<table>
<thead>
<tr>
<th>Future Name</th>
<th>Immigration and Trade</th>
<th>National Taxes and Funding</th>
<th>National Growth</th>
<th>Land Use Preferences</th>
<th>National Environmental Policy</th>
<th>New Technologies</th>
<th>Natural Disasters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rising Tides, Falling Fortunes</td>
<td>Reduced</td>
<td>Lower funding due to tax cuts</td>
<td>Limited</td>
<td>Housing: more urban</td>
<td>Relaxed regulations (3’ SLR)</td>
<td>More limited</td>
<td>Magnitude 70 Hayward Fault earthquake</td>
</tr>
<tr>
<td>Clean and Green</td>
<td>Similar to today</td>
<td>Higher funding via carbon tax</td>
<td>Similar to today</td>
<td>Housing: more urban</td>
<td>Stricter regulations (1’ SLR)</td>
<td>Widespread</td>
<td>Magnitude 70 Hayward Fault earthquake</td>
</tr>
<tr>
<td>Back to the Future</td>
<td>Increased</td>
<td>Similar to today</td>
<td>Rapid</td>
<td>Housing: more dispersed</td>
<td>Similar to today (2’ SLR)</td>
<td>Widespread</td>
<td>Magnitude 70 Hayward Fault earthquake</td>
</tr>
</tbody>
</table>

- Trend **reduced, lower, limited** than today.
- Trend **similar** to today.
- Trend **increased, higher, more rapid** than today.