



Regional Forecast for Plan Bay Area 2040

**Association of Bay Area Governments
Planning and Research Department**

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Regional Forecast for Plan Bay Area 2040

Context

As part of the four-year update of *Plan Bay Area*, the Association of Bay Area Governments (ABAG) has modified the regional forecast to 2040. This document describes the regional projections of employment, population, household and housing growth from 2010 through 2040, to be used in *Plan Bay Area 2040*. The forecast presented here was accepted by the ABAG Executive Board in January 2016 and will be the basis for the growth scenarios to be released later this spring and the preferred scenario to be adopted in Fall 2016.

Plan Bay Area, the region's sustainable community strategy adopted in July 2013, was based on a set of projections published as *Projections 2013*. Regional conditions underlying the revised forecast are substantially different from the situation in which *Projections 2013* was developed. Between 2010 and 2015, employment in the region grew by 19 percent, finally surpassing the region's 2000 employment level reached during the dot-com boom. The pace of population growth accelerated from a half percent annually between 2000 and 2010 to over one percent annually between 2010 and 2015, representing a shift from net out-migration of working-aged adults to net in-migration. Housing construction picked up more slowly than employment or population growth, but the nature of new construction also changed, with multifamily permits accounting for 69 percent of units since 2010, compared to 49 percent in the previous decade.

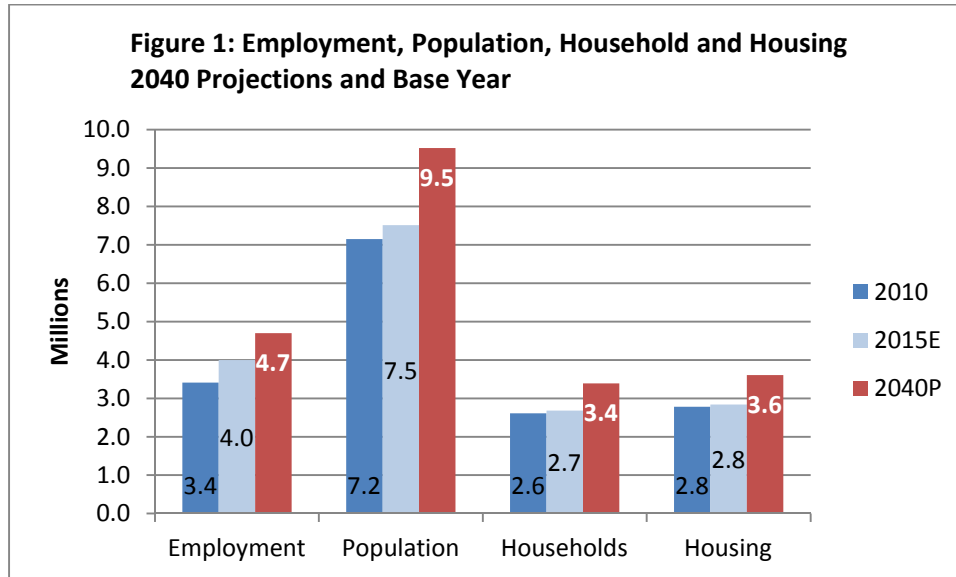
ABAG's updated forecast recognizes the strength of the recent recovery but also takes into account the cyclical nature of growth in the San Francisco Bay Area, generated not only by national economic cycles but also by product cycles of the region's key industrial sectors. The forecast is also to some extent policy based. The employment forecast presented in this document is created under the assumption that the major efforts to expand housing production described in *Plan Bay Area* succeed in restoring regional housing production to levels achieved in earlier decades, while providing housing available to the mix of income ranges expected for the region's workforce. An Appendix to this report summarizes the methodology behind the forecast.

Forecast Summary

Between 2010 and 2040, the region is projected to grow from 3.4 million jobs and 7.2 million people to 4.7 million jobs and a population of 9.5 million. We estimate this will result in almost 3.6 million households and demand for more than 3.6 million housing units. (See Figure 1). The forecast projects:

- Growth of 1.3 million jobs between 2010 and 2040. Almost half of those jobs—over 600,000—were added between 2010 and 2015.
- An increase of 2.4 million people between 2010 and 2040. Almost one fourth of the projected growth occurred between 2010 and 2015.
- An increase of 783,000 households. Only 13 percent of that increase occurred between 2010 and 2015, but the pace of household growth will increase as the population ages.
- 823,000 additional housing units. Only 8 percent of this growth had occurred by 2015, highlighting the need for a focused effort to expand housing production to meet the needs of our broad range of household types. Of the 823,000 projected units, about 39,600 come from

the increment of units added to the Regional Housing Control Total to meet the legal settlement agreement . (See In-Commute Estimates Section, page 8 and Appendix, page A-12)



Source: ABAG from California Department of Finance, California Employment Development Department, US Bureau of the Census, and in-house analysis.

Table 1 shows the numbers associated with this summary.

	2010	2015	2040	Change 2010-40	Change 2015-40	2010-2040%	2015-2040%
Total Employment^[1]	3,422.8	4,025.6	4,698.4	1,275.6	672.8	37.7%	16.7%
Population^[2]	7,150.7	7,609.0	9,522.3	2,371.6	1,913.3	33.2%	25.1%
Households^[3]	2606.3	2,699.3	3,388.6	782.8	689.8	30.0%	25.6%
Regional Housing Control Total^[4]	2784.0	2,839.6	3,606.6	822.6	765.0	29.5%	27.0%

Source: California Department of Finance (DOF) and Employment Development Department [2010], ABAG analysis.
 [1] 2015 is ABAG year to date estimates based on 10 month growth rates estimated from EDD data. [2] 2015 is July 2015 estimate from the DOF; [3] 2015 is ABAG estimate for mid-year, based on 2015 January data and growth estimates; [4] 2015 is DOF estimate for January 2015; later years are calculated as the household number divided by 0.95 to account for 5% vacancy plus the in-commute increment (added in proportionately from 2020 to 2040).

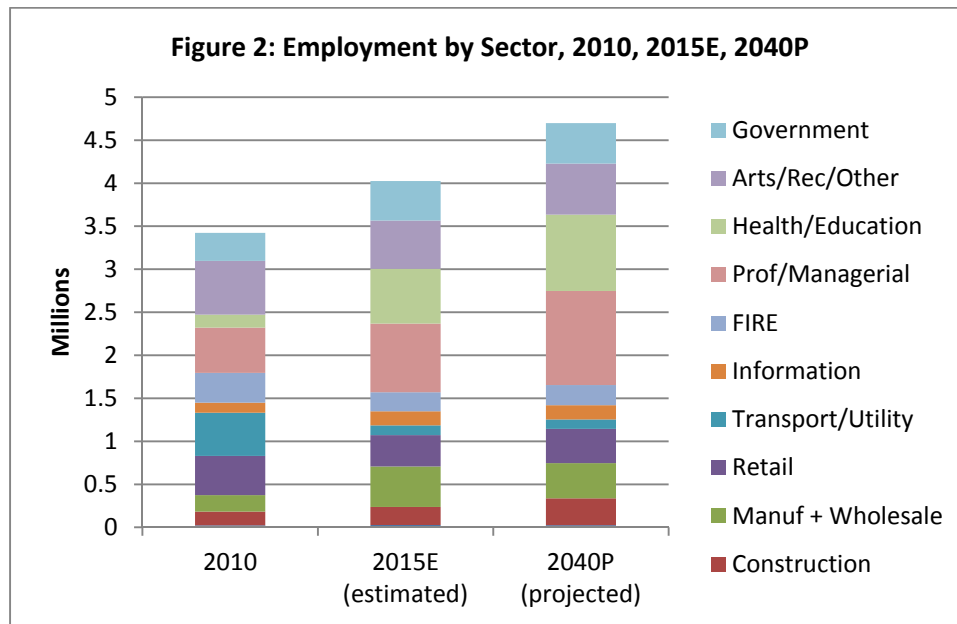
Employment projections suggest an economy even more heavily concentrated in professional services and health and education and less in direct production of goods than currently, in line with changes expected nationwide. Population will become older and more diverse, influencing types of households and their location choices. The following section describes the projections in more detail.

Projection Details

Compared to the 2010 baseline, the projections set an expectation for significant shifts in the economic structure of the Bay Area, the region's demographic base, the composition of households, and the pace of building construction.

Employment Growth and Change

Figure 2 compares the level and distribution of employment in 2010, 2015 (estimated) and 2040 (projected). Table 2 shows 2010, 2015 and 2040 estimates of employment and employment change for aggregate Bay Area employment sectors.



Source: ABAG from US Bureau of Labor Statistics, US Bureau of the Census, American Community Survey, and modeling results from ABAG REMI 1.7.8, NC3RC1.

Almost half of the projected job growth from 2010 had already occurred as of 2015. The 2010 to 2015 strength reflects a combination of recovery from the depths of the 2007 to 2009 recession and a strong surge in economic activity related to the technology and social media sectors. In this projection, employment growth slightly outpaces the nation, with the Bay Area share of U.S. employment growing from 2.5 percent in 2010 to 2.69 percent in 2015 and to 2.76 percent in 2040. Despite increases in output and demand in all sectors, employment declines in a few sectors, due to higher productivity from technological advances or production or operations displacement to lower cost sites.

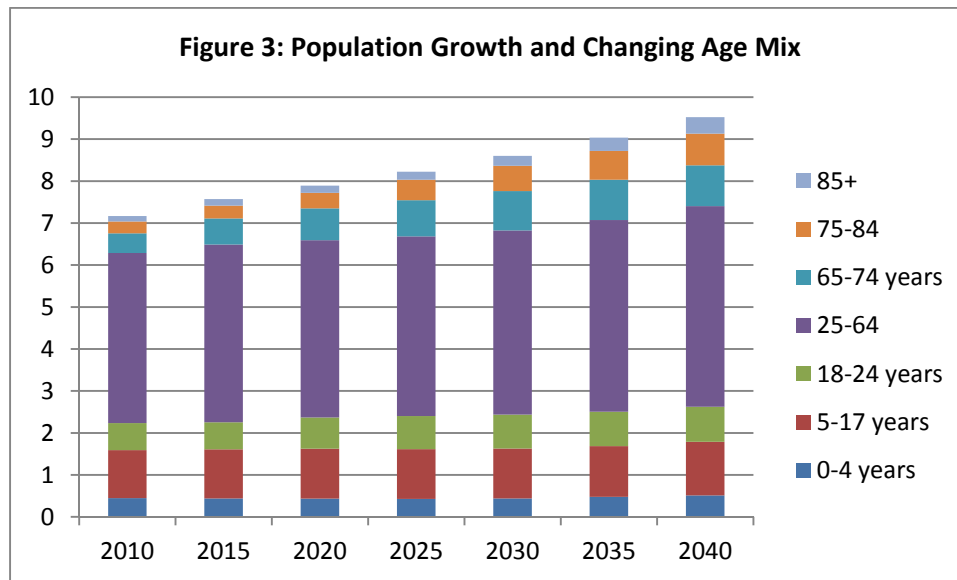
Table 2: Projected Employment by Sector, San Francisco Bay Area 9 County Area, 2010 to 2040

(Thousands)	2015	2020	2025	2030	2035	2040	2010-2040 %	2015-2040%
Total Employment	4,025.6	4,038.5	4,137.5	4,236.9	4,456.5	4,698.4	37.7%	16.7%
Agriculture & Nat Resources	26.6	26.5	26.2	25.4	24.8	24.4	-2.9%	-8.4%
Construction	210.3	216.8	224.3	242.9	276.8	313.4	89.1%	49.0%
Manufacturing & Wholesale	471.1	429.1	426.0	414.4	411.7	408.3	-4.7%	-13.3%
Retail	364.7	360.0	367.5	376.5	387.7	398.2	22.6%	9.2%
Transportation & Utilities	112.2	103.9	102.8	102.6	106.4	110.5	13.7%	-1.5%
Information	164.1	159.3	156.3	158.4	161.9	165.0	39.8%	0.5%
Financial & Leasing	220.8	223.1	222.3	221.0	227.4	234.5	20.3%	6.2%
Prof'l & Managerial Services	799.1	810.0	860.0	914.1	1,000.3	1,093.4	74.9%	36.8%
Health, Educational Services	634.7	682.6	723.0	753.6	816.8	887.6	76.6%	39.8%
Arts, Recreation, Other Serv	562.5	559.0	560.3	557.5	573.4	591.8	24.2%	5.2%
Government	459.5	468.2	468.8	470.4	469.4	471.3	4.2%	2.6%

Source: ABAG forecast based on REMI version 1.7.8, model NC3RC1.

Population Growth and Change

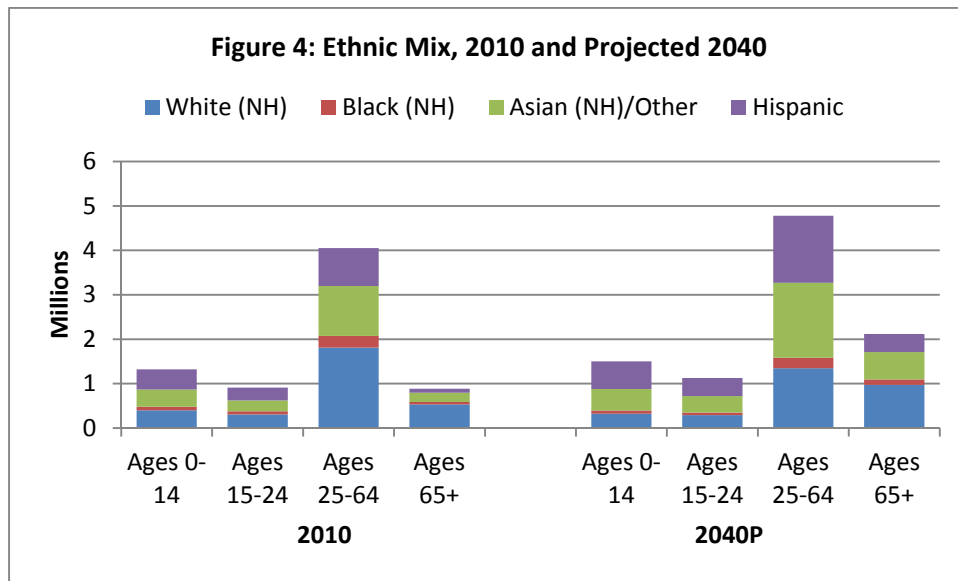
While the 2040 population as a whole is projected to be 33 percent higher than in 2010, growth will differ widely by age group. (See Figure 3). The number of school aged children (5 to 17 years old) is projected to grow by only 11.5 percent, while the number of people 65 and over will increase by 140 percent, accounting for more than half of all growth in the region.



Source: ABAG compilation from US Bureau of the Census and ABAG REMI 1.7.8, NC3RC1.

Between 2015 and 2040, employment is projected to grow faster than the population in prime working years between 25 and 64 (16.7 percent compared to 12.9 percent). The difference will be made up by faster increase of younger workers compared to employment growth (“college-aged” workers, aged 18 to 24, increase by 29.7 percent in that period), by a portion of older workers remaining in the labor force, and possibly by a small increase in the numbers in-commuting.

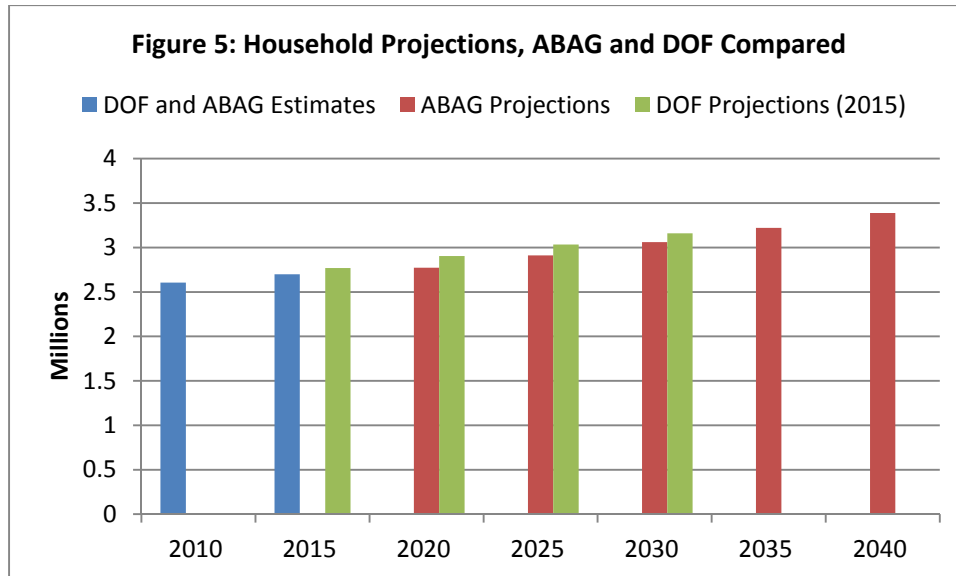
Ethnically, the region continues to diversify over time, as shown in Figure 4. In 2010, only among seniors 65 and older was there an ethnic category (White, Non-Hispanic) with more than half of the population. By 2040, there are no majority ethnic categories for any of the age groupings shown in the figure. (Note that Asian (NH) and other includes multiracial/multiethnic categories).



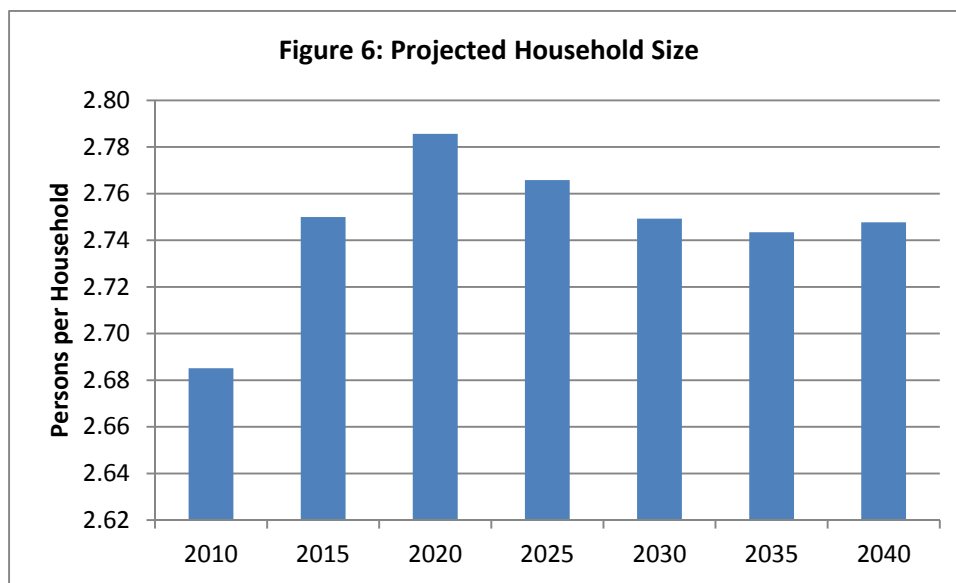
Source: ABAG analysis using Bay Area REMI 1.7.8 model, NC3RC1 results.

Household Growth

The amount of household growth projected (Figure 5) assumes household size continues to be constrained by costs and is also affected by behavioral factors such as increases in the share of multigenerational households and a higher share of two person senior households (due to higher male survival rates). In the short run, household size continues to increase, as it has since 2010, but as new construction also increases, household size drops back to just below 2015 levels. (See Figure 6).

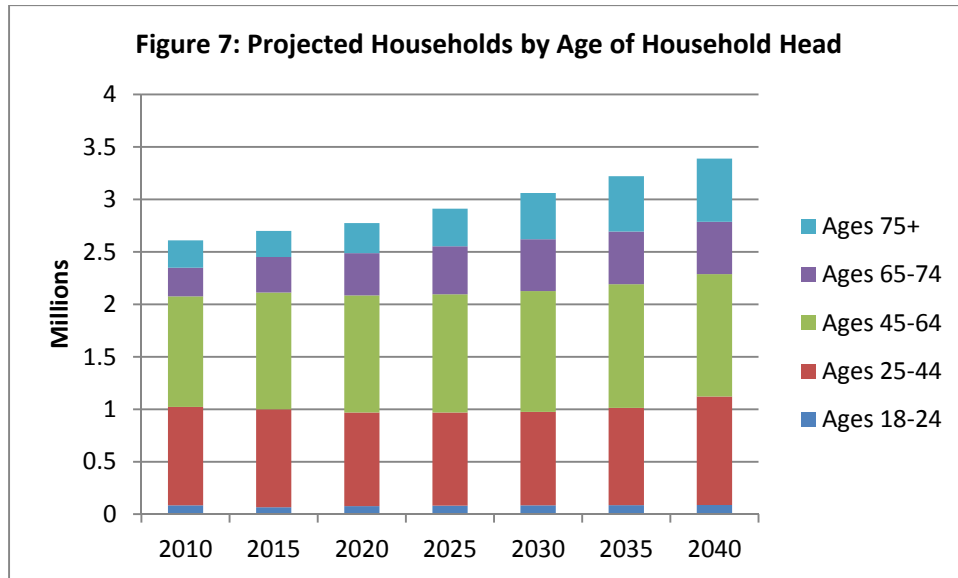


Source: ABAG housing model and estimates; California Department of Finance (DOF) Reports E-5 (May 2015) and P-4 (March 2015).



Source: ABAG REMI 1.7.8, NC3RC1, and California Department of Finance Report E-5, May 2015.

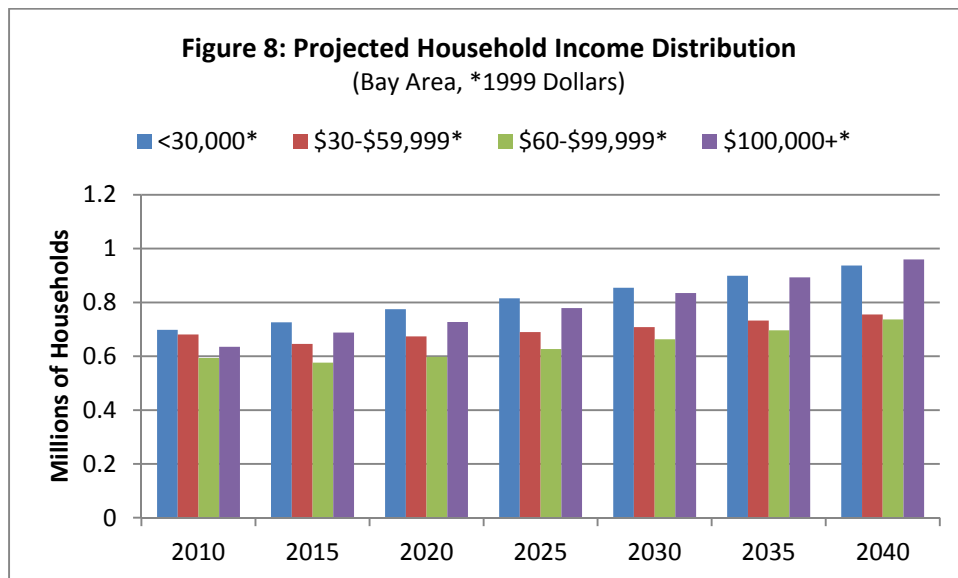
Characteristics of households are very much influenced by the changing age structure. As shown in Figure 7, households headed by people 65 and older account for the bulk of the increase from 2010 to 2040—some 568,000 households, or more than 70 percent of the 780,000 growth in households. Remaining household growth is divided between the 25 to 44 year old age group and the 45 to 64 year old group. This may shift overall demand from suburban single family homes to more urban settings.



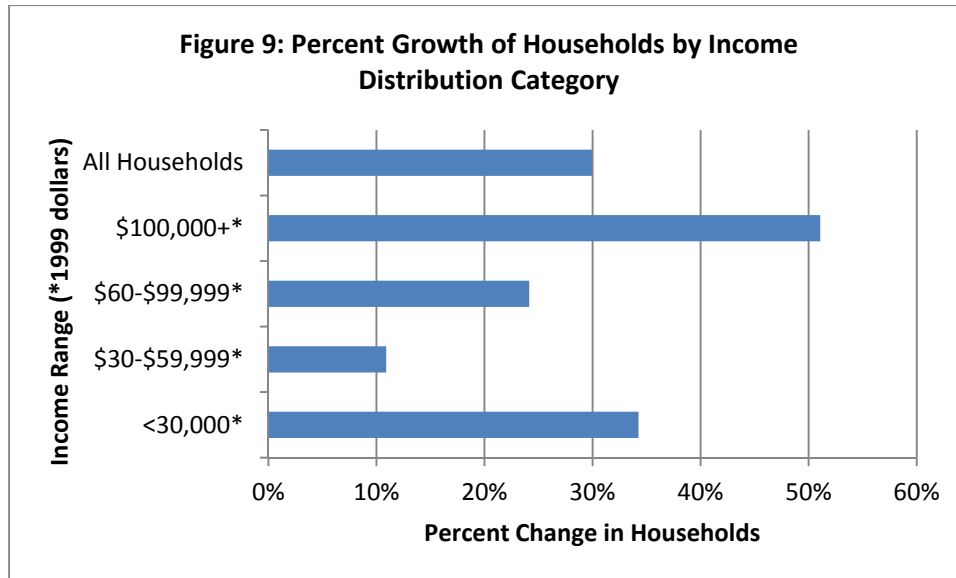
Source: ABAG housing model.

Household Income Distribution

The “hollowing out” of the middle is projected to continue over the next 25 years, as shown in Figure 8. Household growth will be strongest in the highest income category, reflecting the expected strength of growth in high wage sectors combined with non-wage income. Household growth will also be high in the lowest wage category, reflecting wage stagnation, as well as the retirement of seniors without pension assets. Slowest growth will be in the lower middle category, highlighting concerns about advancement opportunities for lower wage workers. (See Figure 9).



Source: ABAG household income distribution analysis.



Source: ABAG income distribution analysis. Note: Categories compared were in 1999 dollars for all years.

In-Commute Estimates

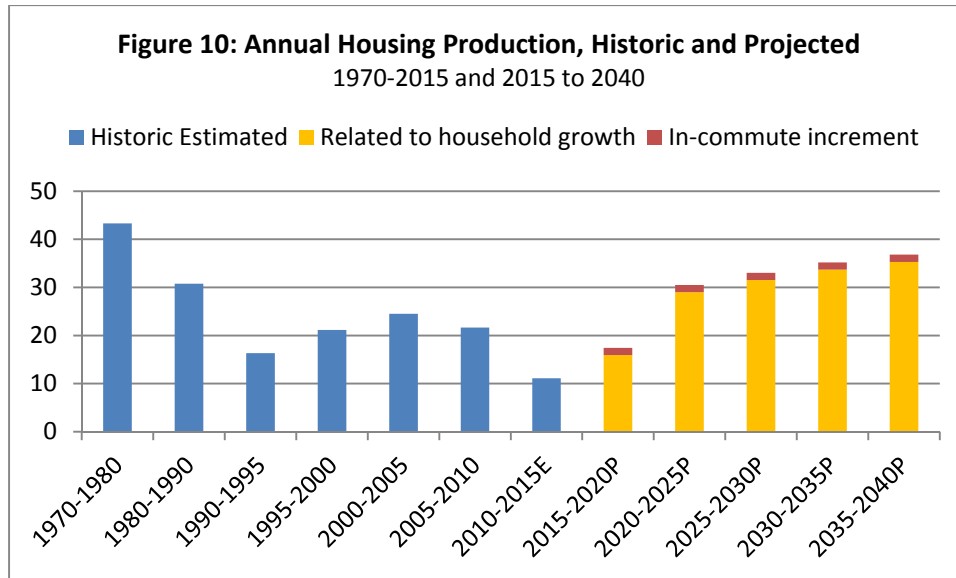
Our estimate of net commuting between Bay Area counties and other areas shows that net in-commuting would be expected to grow by up to 53,000 between 2010 and 2040. The greater amount of this increase may have already occurred over the past 5 years.

Using a ratio of approximately 1.41 workers per household, we include an estimated additional 37,600 households related to the in-commute change leading to an additional 39,600 housing units in calculating the Regional Housing Control Total, to fulfill the requirements of the legal settlement of ABAG and MTC with the Building Industry Association Bay Area.

Housing Production

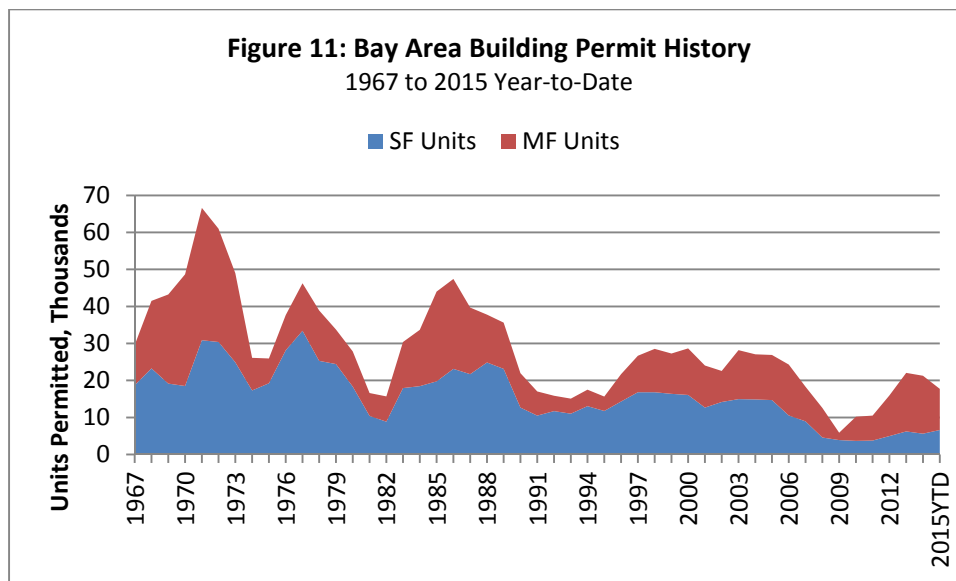
ABAG assumes a five percent vacancy rate to estimate housing units from projected household growth.¹ The vacancy rate is incorporated within the region as a whole. The projected increase of 822,600 new housing units includes 39,600 units associated with the growth in the projected number of in-commuters between 2010 and 2040. The Regional Housing Control Total of 3.607 million housing units includes units for all projected households plus the much smaller number of units associated with the in-commute. From the January 2015 base provided by the California Department of Finance, this implies an annual average rate of increase of between 17,000 and 37,000 units, depending on the time period (the level of demand for new housing units increases over the projection time period, as shown in Figure 10), and assuming the in-commute related increment of housing is added gradually over the full 25 year period. The great majority of the new housing units projected would be to fill the needs of projected household growth within the region. The portion of the projected bars shown in red is the added increment related to the projected growth of in-commuting.

¹ California Department of Finance estimates of Bay Area vacancies have varied from 3.4-6.4 percent since 2000.



Source: US Bureau of the Census, California Department of Finance, and ABAG analysis.

The housing unit growth projected through 2040 would require a major jump in production beginning in 2020, returning to levels of sustained production not seen since the 1980s. In addition, because of changing demographics and requirements to reduce greenhouse gas production, we can expect multifamily to be at least as large a share of this as was the case in most of the 1980s, and possibly close to the share experienced in recent years (see Figure 11).



Source: Compiled by ABAG from Construction Industry Research Board and California Housing Foundation data. Note: 2015 permits are through November only.

Is This the “Right” Forecast?

There is no “right” forecast, given the level of uncertainties in the future about economic trends, innovation and entrepreneurialism, technological change, demographic characteristics and behavioral changes. A credible forecast needs to take account of two broad considerations. The projections need to be built on a realistic assessment of the national outlook and regional competitiveness relative to the nation (a “top down” economy requirement), but at the same time are expected to reflect the cumulative effects of local land use policies (a “bottom up” land use requirement), as well as the conditions aspired to by the regional plan and state policy.

A “business as usual” set of projections based on existing patterns of housing development would likely be driven by a continuing increase in housing prices, a tightening of vacancies, and an increase in household size, with a consequent redistribution of a portion of economic activity outside of the region as well as increasing in-commuting into the region. ABAG has for about a decade produced “policy-based” projections. The current set of projections is expected to move beyond current land use policies to reflect the requirements and spirit of SB375 to reduce GHG emissions and also to anticipate housing commensurate with the growth in the economy. At the same time, recognizing that growth is a complex process, the projection used for future regional planning must still be anchored in realistic expectations so that the numbers produced are useful for planning long term investments in transportation and other infrastructure. Depending on how much emphasis is placed on the constraints versus opportunities in the economy and assumptions regarding infrastructure and institutional capacity, different groups come up with different projections. There are lower population projections that have been released by credible groups, as there are higher employment projections also released by different credible groups.

Compared to Lower Projections

ABAG retained John Pitkin and Dowell Myers, nationally renowned demographic experts, to provide regional projections for the Bay Area out to 2040. Pitkin-Myers provided a base projection, as well as the model code allowing ABAG staff to adjust key components, like migration assumptions. The updated population projection is higher than the baseline version of the Pitkin-Myers Bay Area projections and higher than the California Department of Finance (DOF) 2040 projection. The Pitkin-Myers base projection (8.95 million in 2040) assumes that migration continues as it did in 2000 to 2010, a period of high net domestic outmigration. This pattern of migration has *not* continued in the past 5 years. A version of the Pitkin-Myers projection assuming a migration pattern similar to an average over earlier decades (a 15% increase in in-migration over 2000 to 2010 levels compared to the base) instead gives a population level of 9.49 million in 2040, much closer to the ABAG update. For comparison, the Department of Finance population projection completed in 2015 does not reach 9.5 million people until 2045. (However, the DOF household projection from March 2015, which goes only through 2030, is conversely slightly *higher* than the ABAG final household projection through 2030, because of different assumptions on changes over time in household headship rates. Those who prefer the lower DOF forecast would also be faced, for consistency, with a higher household forecast.)

Compared to Higher Projections

The updated employment projection is lower than the Center for Continuing Study of the California Economy projection released December 2015. At the level of total employment, the major difference is a slower rate of growth between 2015 and 2020 in the ABAG projection as compared to CCSCE

December 2015. This reflects a difference in interpretation of the observed 2010 to 2015 surge, which was triggered mainly by growth in the information, professional and business services and construction sectors. ABAG interprets the surge as driven by general cyclical and product cycle forces more so than a long term structural adjustment. Its effect on the long term base of growth would be modest, consistent with the pattern of highly volatile expansions and contractions during the past few decades, with strong build-up in employment during upswings followed by substantial losses during downturns. (Because a correction is likely by 2020, the projection shows little growth between 2015 and 2020). Treating the recent job surge as growth in the *long term* employment 2015 base could raise the 2040 employment by between 150,000 and 300,000 jobs, depending on other assumptions. To get the labor force commensurate with such job demand would entail either a population of over 10 million by 2040 or much higher in-commute levels (or both).

Finding a Middle Ground

ABAG projects higher population and employment growth levels than would occur were housing production to continue at the very slow pace of 2008 through 2012 or even the quickening pace of 2013-2015. In that sense, it is an optimistic projection assuming local and regional Plan Bay Area policies will lead to greater housing production and a housing market that serves the needs of a wider range of employees than is currently the case. After 2020, for the ABAG projected level of employment growth to occur, the rate of housing production will need to meet and eventually exceed that experienced in the 1980s.

Geographic Distribution of the Forecast

The data presented in this white paper describes projections at the regional level. Distribution of the forecast geographically depends in part on market factors and in part on local and regional policy, including decisions regarding transportation investments. As different scenarios are explored for local policy and regional transportation investments, patterns will emerge on where growth may concentrate or disperse, and the type of jobs and housing that may locate in different parts of the region. The regional data presented here will underlie each of the scenarios to be analyzed.

Acknowledgments and Appendix Summarizing the Forecast Methodology Follow

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Clint Daniels, Principal Analyst, SANDAG

Ted Egan, Chief Economist, Controller's Office of Economic Analysis, City of San Francisco

Robert Eyler, Professor of Economics and Director, Center for Regional Economic Analysis, Sonoma State University

Gordon Garry, Director of Research and Analysis, Sacramento Area Council of Governments

Tracy Grose, Bay Area Council Economic Institute

Subhro Guhathakurta, Professor, Georgia Tech University, Department of City and Regional Planning

Hans Johnson, Senior Fellow, Public Policy Institute of California

Jed Kolko (Economist, jedkolko.com, former Chief Economist, Trulia)

Walter Schwarm, Demographic Research Unit, California Department of Finance

Michael Teitz, UC Berkeley and PPIC, Retired

Daniel Van Dyke, Rosen Consulting Group

And ex-officio Technical Advisory Committee members

Sean Randolph, Bay Area Council Economic Institute

David Ory, Metropolitan Transportation Commission

Michael Reilly, Metropolitan Transportation Commission

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Chris Brown and many other staff from REMI worked extensively with us to develop a model that reflected the unique characteristics of the Bay Area economy, while helping us to maintain the integrity of the REMI model.

Appendix

Summary of Technical Approach Underlying ABAG Final Regional Forecast 2010-2040

This Appendix summarizes the methods used to calculate the regional forecast released January 19, 2016.¹

The memo describes the methods underlying:

- Employment projections
- Population projections
- Household projections (number and income distribution)
- In-commute projection
- Regional Housing Control Total projection

Employment

ABAG built the employment projection using the Bay Area REMI PI+ model², version 1.7.8, with the adjustments described here. Regional Economic Modeling, Inc. (REMI) for more than 25 years has produced custom regional models for use in making projections and for impact analysis. We made several adjustments to the “out of the box” model at both the national and local level.

Adjustments include:

- 1) Modifying the rate of employment growth at the *national* level for construction, information, retail, wholesale and transportation and warehousing sectors.
- 2) At the *regional* level modifying residential and nonresidential investment and the relative housing price, and replacing the first two years of forecast employment with estimates based on reported Bureau of Labor Statistics employment growth rates.
- 3) At the *regional* level, translating employment results from the US Bureau of Economic Analysis (BEA) employment definition to a measure equivalent to the US Bureau of Labor Statistics (BLS) measure of jobs by place of work plus the US Bureau of the Census measure of self-employed workers.

Table A-1 compares the National Standard Control (NSC) employment results with the modified national control (we have identified this version by the code NC3). Sector adjustments for NC3 were as follows:

- a) Construction: REMI shows construction investment and jobs expanding far faster than historic trends. The high jobs come from an overestimate of growth from 2013 to 2015, while the investment issue appears to be a weakness of the model. We applied actual BLS rates of growth for 2014 and 2015 to the 2013 BEA employment number given in REMI (this rate of growth is lower than the REMI projected rate of growth). From 2016 to 2019, the 2015 rate of growth is interpolated to reach the REMI estimated rate of growth by 2020. After 2020, employment grows at the REMI calculated rate, but from the new (lower) 2020 employment level. It is not

¹ For a comparison to the methodology in ABAG’s preliminary forecast, see “Summary of Technical Approach Underlying ABAG Final Regional Forecast 2010-2040,” Attachment A to “Final Regional Forecast 2010-2040” Memo to the Executive Board, January 19, 2016.

² See Regional Economic Models, Inc., *Bay Area Economic Forecasting: PI+/HD and County Control Forecasting*, March 2014. Further documentation available on model updates at <http://www.remi.com/resources/documentation>.

possible to adjust residential and nonresidential investment in the model at the national level. ABAG's regional level adjustment is explained below.

Category	2010	NSC 2040	NC3 2040	Difference
Forestry, Fishing, and Related Activities	855.4	699.3	699.3	0
Mining	1268	2126.9	2126.9	0
Utilities	582.2	350.1	350.1	0
Construction	8793.7	18206.6	17397.6	-809.0
Manufacturing	12102.9	10382.5	10382.5	0
Wholesale Trade	6024	6343.7	7032.2	688.5
Retail Trade	17591.6	18428.9	20619.1	2190.2
Transportation and Warehousing	5474.2	5955.8	6410.2	454.4
Information	3222.6	2450.0	3200.3	750.3
Finance and Insurance	9202.4	10328.4	10328.4	0
Real Estate and Rental and Leasing	7697	9107.2	9107.2	0
Professional, Scientific, and Technical Services	11755.8	18847.4	18847.4	0
Management of Companies and Enterprises	2019.4	1835.0	1835.0	0
Administrative and Waste Management Services	10402.2	15367.1	15367.1	0
Educational Services	4089.9	5027.7	5027.7	0
Health Care and Social Assistance	19089.9	31162.8	31162.8	0
Arts, Entertainment, and Recreation	3788.4	4569.8	4569.8	0
Accommodation and Food Services	11986.3	14608.8	14608.8	0
Other Services, except Public Administration	9780.8	10396.8	10396.8	0
Government	24672	23164.1	23164.1	0
Farm	2646	1502.1	1502.1	0
Total	173044.7	210860.9	214135.3	3274.4

Source: ABAG analysis using Bay Area REMI 1.7.8

- b) Information: REMI's national forecast for information is far less optimistic than most other forecasts and also underestimates recent growth. We built our adjustment on BLS 2012 to 2022 projections.³ Specifically, we used measured BLS growth rates to adjust 2013, 2014 and 2015 numbers for subsectors publishing, internet, motion pictures and telecommunications (only 2014 and 2015). For subsequent years we used BLS 2012-2022 projected rates of growth (publishing, telecommunications), adjusted BLS 2012-2022 projected rates of growth (internet and other—decreased by 2/3 from 2021 to 2030, decreased forecast rates of growth by half from 2031 to 2040), or reverted back to the REMI rate (motion pictures). The relevant BLS projections are shown in Table A-2.
- c) Retail, Wholesale, Transportation and Warehousing: These sectors all dropped sharply over the 30 year period in REMI's National Standard Control (NSC). We compared this to historic relations

³ Bureau of Labor Statistics, Economic Forecast 2012 to 2022, BLS Detailed Industry, Table 2.7 Employment and Output by industry; <http://www.bls.gov/opub/mlr/2013/article/industry-employment-and-output-projections-to-2022.htm>.

to factors such as population and manufacturing and adjusted the levels over time. To make these adjustments, we calculated log/log relationships with relevant factors (retail—population; wholesale—manufacturing and population; transportation and warehousing—population, manufacturing, and professional and scientific). We used these relationships to adjust growth rate either directly or in a tapered way (retail, wholesale) assuming effects of technological change. (See Table A-3 for regression results).

This adjustment to the national control raised the employment forecast at the national level by about 1.6 percent compared to the REMI NSC. These minor adjustments allowed us to adjust the forecast to better reflect regional characteristics reflected in alternative forecasts while still accounting for the 2010 to 2015 surge in employment.

	Actual	Forecast	Percent Change
Industry	2012	2022	2012 - 2022
Publishing industries	737.8	705.9	-0.4%
Motion picture, video, and sound recording industries	372.3	350	-0.6%
Broadcasting (except internet)	285.4	296.7	0.4%
Telecommunications	858	807	-0.6%
Data processing, hosting, related services, and other information services	424.1	452.8	0.7%

Source: ABAG from US Bureau of Labor Statistics Economic Forecast , Detailed Industry, Table 2.7.

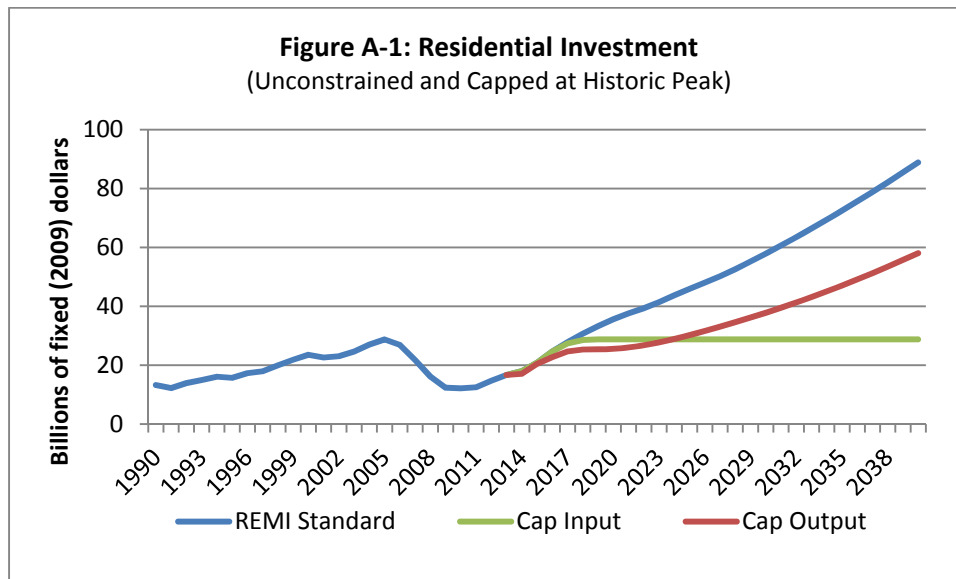
	Dependent variables (log form)				
	retail employment	wholesale employment	air transportation	transit	warehousing
Independent variables (log form; t value in parentheses)					
Population	0.6180171 (6.19)	1.147926 (8.79)		1.949733 (21.44)	3.351744 (35.02)
manufacturing employment		0.3184065 (4.77)	0.9150349 (8.72)		
professional, technical and scientific emp.			0.5055651 (6.34)		
Adjusted R-Squared	0.6185	0.8358	0.7713	0.9523	0.9816

Source: ABAG Analysis

We created a new *regional* control based on our REMI NC3 national control with three additional adjustments (labeled NC3RC1). These include:

- 1) A reduction of levels of residential and nonresidential investment to temper the degree to which this expands. For those familiar with REMI, this is done by entering new investment numbers by

subregion in the policy section of the regional control.⁴ The new investment numbers were calculated to be no larger than the previous peak. Once entered into REMI, this does not actually cap investment to the previous level, but it does reduce the rate at which investment expands to a level more consistent with actual growth. Figure A-1 illustrates the relationship between the residential investment level in the standard regional control based on national control NC3, the input to the revised regional control for the final forecast (NC3RC1) and the output of the model for residential investment in NC3RC1. The relative positions of the lines also indicate the reason for the adjustment. Construction investment is generally a flow rather than a stock variable, and thus grows with the level of change, not the absolute level. Thus, the pace of growth in the standard control is much higher than would be expected from the economic growth observed.

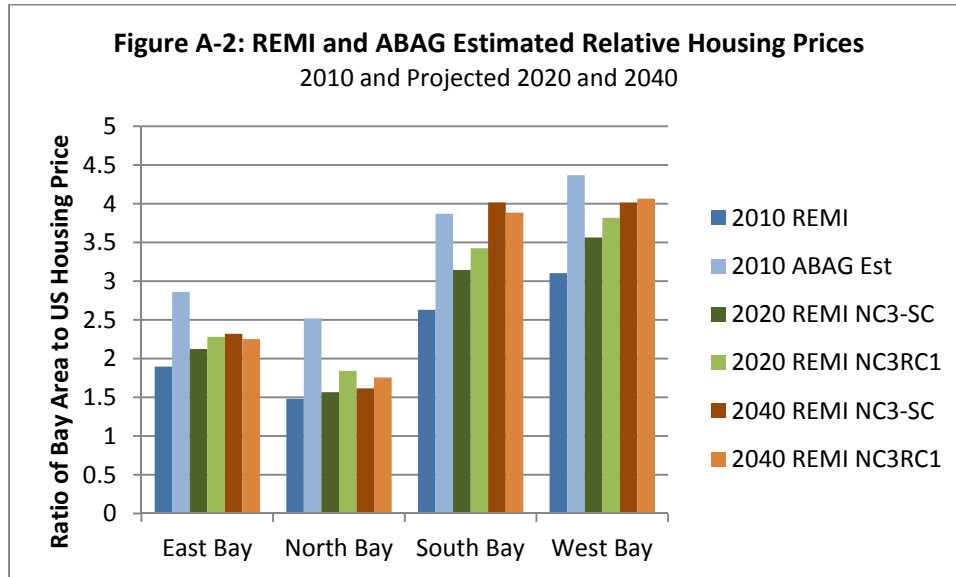


Source: ABAG from Bay Area REMI version 1.7.8, NC3 standard regional output and NC3RC1 capped input and output.

- 2) *An adjustment to the ratio of Bay Area relative to national housing prices.* This policy variable has a bearing on economic migration levels as these are a function of the attractiveness of the Bay Area amenities and job opportunities, but tempered by the cost of housing. We found that REMI’s account of the cost of housing relative to the US as a whole is substantially lower than what we calculate from other sources, leading to overly optimistic economic migration flows. Our adjustment was created using 2013 5-year ACS data for the US and the MSAs relative to our analysis and the FHFA index adjusted to a 2011 base (to be consistent with the 5 year ACS data). We used this data to create a series for price by MSA relative to the US. In looking back to 1975, it leaves only a small advantage for the Bay Area relative to the US, consistent with historic estimates. We then averaged the relative price from 2005 to 2014. We applied 50 percent of the difference between our calculations and the REMI levels to the forecast. As with construction investment, REMI still recalculates the relative price. The effect is insignificant by 2040 but raises

⁴ ABAG’s version of the REMI model has 4 subregions within the Bay Area—the East Bay (Alameda and Contra Costa counties), North Bay (Napa, Solano and Sonoma counties), South Bay (Santa Clara County) and West Bay (Marin, San Francisco, and San Mateo counties).

prices midway through the forecast, relative to REMI’s unadjusted relative prices, as shown in Figure A-2.



Source: ABAG analysis from Census American Community Survey and Federal Housing Finance Agency data; REMI model output (NC3 unadjusted regional control, NC3RC1).

- 3) *An adjustment of employment levels in 2014 and 2015 to actual measured rate of growth by sector from BLS. For those familiar with REMI, we made this adjustment in the Policy section rather than in the Update section. This treats the higher employment levels as a short term exogenous shock which the model can then respond to, and adjust to (e.g. short term labor scarcity drives up costs and reduces demand). This is distinct from other possible treatments. We could also have treated the high recent growth as an accounting change through the update function, setting the baseline higher, which would have more long term effects in an upwards direction (the magnitude of the long term effect of this sort of adjustment is between 150,000 and 300,000 additional jobs by 2040). We chose this approach (exogenous rather than baseline accounting adjustment) because it is consistent with the region’s historic experience with the sectors that have driven the current surge, marked by not insignificant volatility.*

After running the model, we then present the results in Bureau of Labor Statistics measures of employment rather than Bureau of Economic Analysis measures of employment.⁵ These result in an average annual figure, rather than a count of all jobs that are offered at some time during the year. (Note that both definitions are different from the ABAG definition used prior to Projections 2013. Prior definitions were based on a count of one job per person, rather than jobs per workplace).

⁵ The BEA measure accounts all jobs held at all firms by all individuals during a year (as well as self-employment), and thus is likely to double count individuals and even positions in a company (where there has been turnover in a position during the year or a shift in duties from one employee category to another). In contrast BLS reports monthly employment which is then averaged for an annual count. The BEA count is related to the agency’s major responsibility of tracking income and output. The BLS estimate is more useful for regional planning purposes, because it is closer to identifying likely housing and travel demand. BLS does not report self-employment, so ABAG adds this estimate to the employment count using US Bureau of the Census ACS data.

Table A-4 compares the 1.7.8 REMI control with the final forecast, using the Bureau of Labor Statistics plus self-employment definition of employment. Table A-5 shows the ratios used to adjust BEA to BLS plus self-employment counts, estimated from an average of 2007, 2010 and 2013.

(Employment in Thousands)	2010	2040	2040	Percent Change 2010-2040	
	EDD+SE	REMI SC	Final Forecast	REMI SC	Final Forecast
Agriculture & Natural Resources	25.1	24.8	24.4	-1.3%	-2.9%
Construction	165.7	411.0	313.4	148.0%	89.1%
Manufacturing & Wholesale	428.5	395.7	408.3	-7.7%	-4.7%
Retail	324.8	353.4	398.2	8.8%	22.6%
Transportation & Utilities	97.1	97.1	110.5	-0.1%	13.7%
Information	118.0	114.5	165.0	-2.9%	39.8%
Financial & Leasing	194.9	234.1	234.5	20.1%	20.3%
Professional & Managerial Services	625.2	1062.4	1093.4	69.9%	74.9%
Health & Educational Services	502.7	883.3	887.6	75.7%	76.6%
Arts, Recreation & Other Services	476.5	577.9	591.8	21.3%	24.2%
Government	452.2	474.9	471.3	5.0%	4.2%
Total Jobs	3410.9	4629.0	4698.4	35.7%	37.7%

Source: ABAG analysis from Bay Area REMI Model version 1.7.8, standard regional control and NC3RC1.

BEA employment numbers are divided by the factors in Table A-5 to give estimates of the Bureau of Labor Statistics (employment by place of work) plus self-employment equivalent.

Employment Sector	Adjustment Factor
Agriculture & Natural Resources	1.402484
Construction	1.158725
Manufacturing & Wholesale	1.084723
Retail	1.168494
Transportation & Utilities	1.239593
Information	1.12953
Financial & Leasing	2.377468
Professional & Managerial Services	1.342899
Health & Educational Services	1.091576
Arts, Recreation & Other Services	1.374565
Government	1.035506

Source: ABAG analysis using BEA, BLS and American Community Survey data.

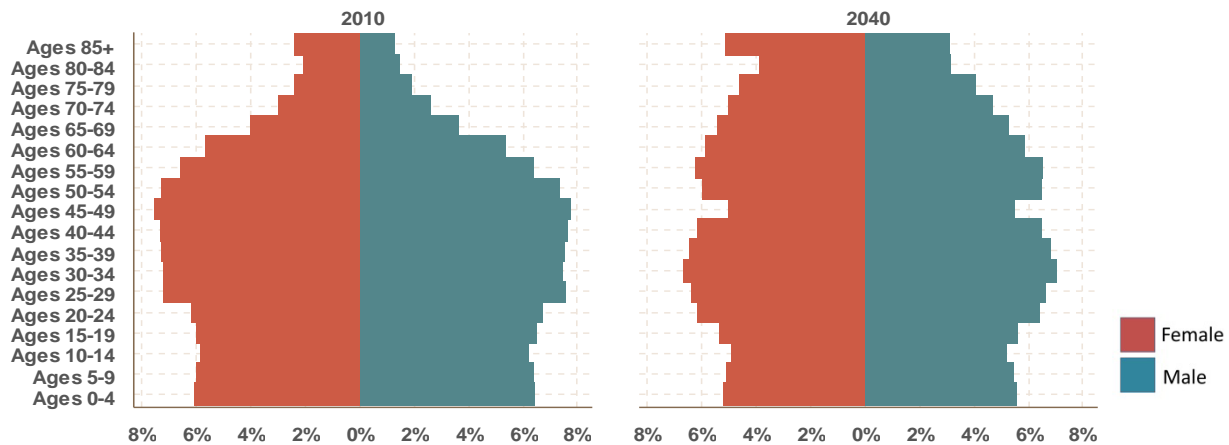
Population

In developing the preliminary forecast, staff used two separate but similar population modeling approaches. The Pitkin-Myers population model for the Bay Area uses a cohort survival model, with careful attention to immigrant status, including generation since immigrating.⁶ The REMI model uses a simpler cohort survival model, which also recognizes differences by ethnic group, but assumes once immigration has happened, the immigrant takes on the characteristics of the ethnic group. We compared the results of the different models in terms of age and ethnicity and found, especially for age categories, results were very similar. For consistency with the employment data, we used the REMI population forecast in both the preliminary and final forecast. Table A-6 compares results from four population projections, the REMI standard regional control, ABAG’s preliminary and final population projections, and the output of the Pitkin-Myers higher migration scenario. Figure A-3 shows population pyramids for 2010 and the 2040 population in the final forecast.

Age Category	2010	2040 Projections		
		Standard Control	Final Forecast	Pitkin-Myers In-Migration up 15%
Ages 0-14	1,320,200	1,532,900	1,499,300	1,524,500
Ages 15-24	909,800	1,160,900	1,126,200	1,054,900
Ages 25-64	4,051,500	4,908,200	4,779,000	4,786,500
Ages 65+	885,100	2,149,500	2,117,700	2,127,300
Total	7,166,700	9,751,400	9,522,300	9,493,100
Share of Total				
Ages 0-14	18.4%	15.7%	15.7%	16.1%
Ages 15-24	12.7%	11.9%	11.8%	11.1%
Ages 25-64	56.5%	50.3%	50.2%	50.4%
Ages 65+	12.4%	22.0%	22.2%	22.4%

Source: ABAG analysis using Bay Area REMI model version 1.7.8, regional standard and NC3RC1, and Pitkin 2015.

Figure A-3: Final Forecast Population Age Distributions, 2010 and 2040



Source: ABAG from US Census and REMI model version 1.7.8, NC3RC1.

⁶ See John Pitkin, *Summary and Analysis of Pitkin-Myers Generational Projections of the Population of the Bay Area to 2040*, Cambridge: June 30, 2015.

Household Estimates

Household estimates are computed by applying headship rates, or the number of householders relative to the population calculated from the American Community Survey to the REMI population output by age and ethnicity. The headship rate is applied to age/race/gender bins: Two genders, four race / ethnic groups and 15 age groups, or a total of 120 distinct groups. Rates are pooled from ACS 1-year PUMS samples 2006-2014, with an exponentially weighted smoothing average applied to avoid spikes in particular in the thinner slices of the PUMS sample.

While not adjusting headship rates secularly across the board, we did two specific rate adjustments:

- 1) We marginally reduced headship rates for Black and White, non-Hispanic households, age groups 25-34 and 65-74 by 5 percentage points to reflect expected changes in household sizes for those groups, due to changing cultural and financial conditions.
- 2) We reduced headship rates for Black and White, non-Hispanic households age groups 75+ by 10 percentage points to reflect expected increases in male survival rates.

We did not adjust headship rates for other ethnic groups related to increased "survival" of older age groups because headship rates were already so low for those ethnicities. Headship rates are summarized for the final forecast in Table A-7.

Table A-7: Headship Rates by Age, Gender and Ethnicity								
gender	Females				Males			
Race/ethnicity	Black-NonHisp	Hispanic	Other-NonHisp	White-NonHisp	Black-NonHisp	Hispanic	Other-NonHisp	White-NonHisp
Final Forecast Rates								
Age								
5-19	0.0079	0.0041	0.0032	0.0063	0.0027	0.0038	0.0038	0.0040
20-24	0.2145	0.1410	0.1333	0.1854	0.1250	0.1051	0.1300	0.1652
25-29	0.4264	0.2917	0.2526	0.3297	0.1976	0.2525	0.3072	0.3195
30-34	0.4996	0.3938	0.3227	0.4241	0.3377	0.3705	0.5099	0.4652
35-39	0.6182	0.4092	0.3304	0.4864	0.4361	0.4514	0.5973	0.5432
40-44	0.6583	0.4296	0.3730	0.5316	0.4815	0.5020	0.6176	0.5557
45-49	0.6676	0.4290	0.3765	0.5238	0.5152	0.5207	0.6094	0.5897
50-54	0.6335	0.4319	0.3626	0.5296	0.5969	0.5389	0.6401	0.6182
55-59	0.6230	0.4450	0.3517	0.5317	0.5985	0.5511	0.6068	0.6427
60-64	0.6590	0.4260	0.3202	0.5450	0.6333	0.5852	0.6062	0.6817
65-69	0.6345	0.3922	0.3161	0.4986	0.6408	0.6314	0.5732	0.6829
70-74	0.6592	0.4589	0.2982	0.5161	0.6724	0.5735	0.5436	0.6862
75-79	0.6206	0.4298	0.3448	0.5016	0.6361	0.6103	0.5636	0.6629
80-84	0.6313	0.5203	0.4176	0.5485	0.6558	0.5400	0.5557	0.6491
85+	0.6118	0.4394	0.4458	0.6338	0.5327	0.5425	0.5632	0.6622

Income Distribution

The income distribution analysis is designed to take into account structural characteristics of the region including demographic factors such as the age profile and ethnic mix, and economic factors such as the predominant industries and occupations in which people work, as well as the various sources of income (retirement income, public assistance income, wage and salary income). An earlier methodology used for Projections 2013, considered the effects of industry and occupational structure on income mix. The methodology created for this analysis includes additional factors, such as all income (including non-wage income).

Other aspects of Bay Area regional forecasting rely on estimates of the distribution of income among four income bins originally defined using 1989 incomes and later updated using 1999 incomes. The categories, originally, were:

- 1) Below \$25,000 (1989 dollars, updated to \$30,000 for 1999 dollars)
- 2) Between \$25,000 and \$45,000 (1989 dollars, upper break point updated to \$60,000 for 1999)
- 3) Between \$45,000 and \$75,000 (1989 dollars, upper break point updated to \$100,000 for 1999), and
- 4) Above \$75,000 (1989 dollars, updated to \$100,000 for 1999).

ABAG specified four regression models (using American Community Survey, Census 2000 data) on the relationship between demographic and economic variables and share of households in each of the four income quartiles defined above.

The results of these regressions are shown in Tables A-8 to A-11.

Table A-8: Regression Results for Income Category 1 (Households below \$30,000, 1999 dollars)				
	params	pvals	std	test_stats
Adjusted R-Squared	0	0	0	0.669211
R-Squared	0	0	0	0.672062
Intercept	0.741601	4.37E-41	0.052547	
Share of population, White (not Hispanic)	-0.17261	3.65E-39	0.012572	
Wharton Residential Land Use Regulation Index	-0.01799	1.35E-10	0.00277	
Share of population, 65 and over	0.997485	6.22E-50	0.063133	
county housing price median relative to US	-0.05317	1.32E-56	0.003127	
more than 1 million people in MSA	-0.04618	5.23E-27	0.004156	
public assistance income, log	0.040692	5.37E-38	0.003015	
retirement income, log	-0.04888	1.25E-33	0.003884	
Share employed in nat resources, const, and maintenance occ	0.427559	1.18E-22	0.042505	
F Test	235.6765	9.2E-217	0	

**Table A-9: Regression Results for Income Category 2
(Households \$30,000-\$59,999, 1999 dollars)**

	params	pvals	Std	test_stats
Adjusted R-Squared	0	0	0	0.414723
R-Squared	0	0	0	0.419768
Intercept	0.530093	4.16E-89	0.023653	
Share of population 16 and over in labor force	0.090489	4.74E-05	0.022137	
Share of population, Hispanic	-0.05252	1E-13	0.00695	
Wharton Residential Land Use Regulation Index	-0.00256	0.055326	0.001336	
Share of population, 25-64	-0.35542	1.14E-14	0.045264	
county housing price median relative to US	-0.02176	9.58E-35	0.001697	
County falls in Census Region 9	0.013903	3.67E-06	0.002985	
Share employed in education services	-0.32121	1.62E-20	0.033779	
Share employed in health care services	-0.23159	2.98E-10	0.036355	
F Test	83.19669	2.2E-103	0	

**Table A-10: Regression Results for Income Category 3
(Households \$60,000-\$99,999, 1999 dollars)**

	params	pvals	Std	test_stats
Adjusted R-Squared	0	0	0	0.647393
R-Squared	0	0	0	0.650053
Intercept	-1.08725	1.94E-61	0.060906	
Share of population 16 and over in labor force	0.290893	2.05E-35	0.022443	
Share of population, Black (Not Hispanic)	-0.03842	7.73E-06	0.008541	
Wharton Residential Land Use Regulation Index	0.007572	7.76E-08	0.001398	
Share employed in health care services	-0.32454	1.88E-17	0.037421	
Share employed in professional and scientific services	-0.49631	4.73E-26	0.045586	
more than 1 million people in MSA	0.019135	2.35E-18	0.002144	
per capita income, log	0.115644	3.85E-60	0.006561	
F Test	244.4039	4.9E-205	0	

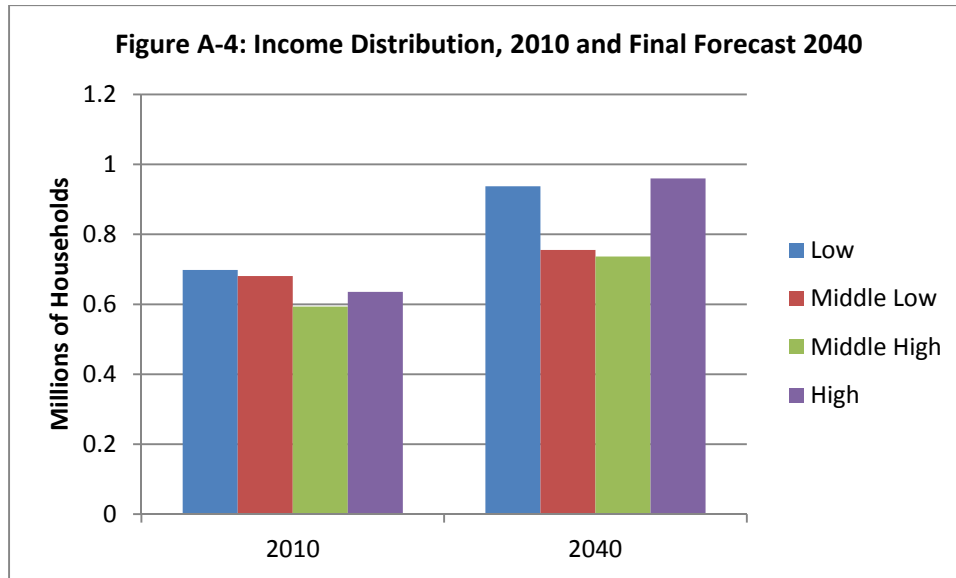
	params	pvals	Std	test_stats
Adjusted R-Squared	0	0	0	0.798193
r2	0	0	0	0.799035
Intercept	-1.2822	8.17E-55	0.078061	0
county housing price median relative to US	0.028745	1.37E-45	0.001943	0
more than 1 million people in MSA	0.016216	1.72E-16	0.00194	0
per capita income, log	0.134153	1.56E-58	0.007866	0
Share employed in management occupations	0.112038	1.4E-08	0.019613	0
Share employed in services occupations	-0.26406	1.23E-13	0.035204	0
F Test	948.6722	0	0	0

The parameters estimated in these regressions are applied to the subregional results of the REMI-based forecast to estimate future shares of households in each income group. (REMI results are estimated for four subregions within the Bay Area, including the East Bay—Alameda and Contra Costa counties, North Bay—Napa, Solano and Sonoma counties, South Bay—Santa Clara County, and West Bay—Marin, San Francisco and San Mateo Counties.)

Applying regression model coefficients to the projected REMI data for each subregion, we estimate a time series of future shares in each bin. In reaching these shares, we make a number of normalizing adjustments:

- 1) Predicted shares come from four separate regressions that are not constrained to fall in any particular range. The sum of the shares predicted by the four regressions is then normalized to 1.
- 2) These shares are indexed to the base year, with regression results expressed as changes over time according to the future state of the region as provided by REMI.
- 3) The indexed amounts are then applied to the base 2010 numbers to reach a growth in households in each income bin over time.

Figure A-4 compares the 2010 income distribution with the distribution in 2040 in the final forecast. The final forecast has somewhat higher growth in the highest income category, at the expense of growth in the two middle categories. The lowest income group grows more quickly than either of the two middle groups, while the slowest growth is in the lower middle group.



Source: ABAG analysis using projections from REMI model 1.7.8, NC3RC1.

In-Commute and Employed Residents

To calculate the change in in-commute, ABAG estimates the change in employed residents and compares this to the projected growth of employment by place of work. REMI reports “residence adjusted employment” (RAE), which is the number of BEA defined jobs held by residents. This number is not a count of people holding jobs. To adjust this number to something closer to persons holding jobs, we divide the REMI projected RAE by the overall ratio of BEA to BLS plus self-employment jobs (BLS+SE) in the year. Our net commute estimate for one year is the difference between BLS+SE and RAE. The change in commute, then, is the change in this estimate. Between 2010 and 2040, in our REMI based forecast, this difference increases by 53,000. (We also used an alternate calculation method, where we compared the projected labor force growth to employment growth, assuming a steady level of unemployment of around 5 to 5.5 percent during the forecast period. This method gave more representative net commute numbers in the early years, but showed a decrease in net commuting over the 30 year period. We have chosen to include the higher number that comes from the RAE approach in estimating the Regional Housing Control Total, to ensure that the concern about considering the in-commute is met).

Compared to the preliminary forecast, higher employment in the region led to a slightly higher increase in the net in-commute, from 33,000 in the preliminary forecast.

Regional Housing Control Total

To compute the regional housing control total, we make a fairly simple calculation of housing associated with the projected number of households, and add to that the housing that would be associated with the net increase in the in-commute. The number of households projected is almost identical in the two forecasts, preliminary and final. We use a vacancy rate of 5 percent to translate the 3,389,000 households in 2040 (final forecast) to 3,567,000 housing units. We then translate the change in commute number first into households and then into units. We use the ratio of 1.41 workers per household to translate commuters into households. This is the ratio of workers in Bay Area households that i) have workers and ii) have household incomes below the region’s median. This is a slightly higher

ratio than we used in the preliminary forecast, which was based on employees by place of work per household and included households with no workers and jobs whose workers may have commuted from outside. In the final forecast, this revised approach gives 37,600 households. Applying the same 5 percent vacancy rate, we then estimate a need for 39,600 housing units to satisfy the requirement that the Regional Housing Control Total include housing for the net increase in in-commuting. The Regional Housing Control Total becomes 3,606,600 housing units (the sum of 3,567,000 and 39,600), an increase of 822,600 units from 2010, or 767,000 from 2015. In comparison, the preliminary forecast projected 808,000 additional units compared to 2010, and Plan Bay Area 2013 estimated an addition of 660,000 units.