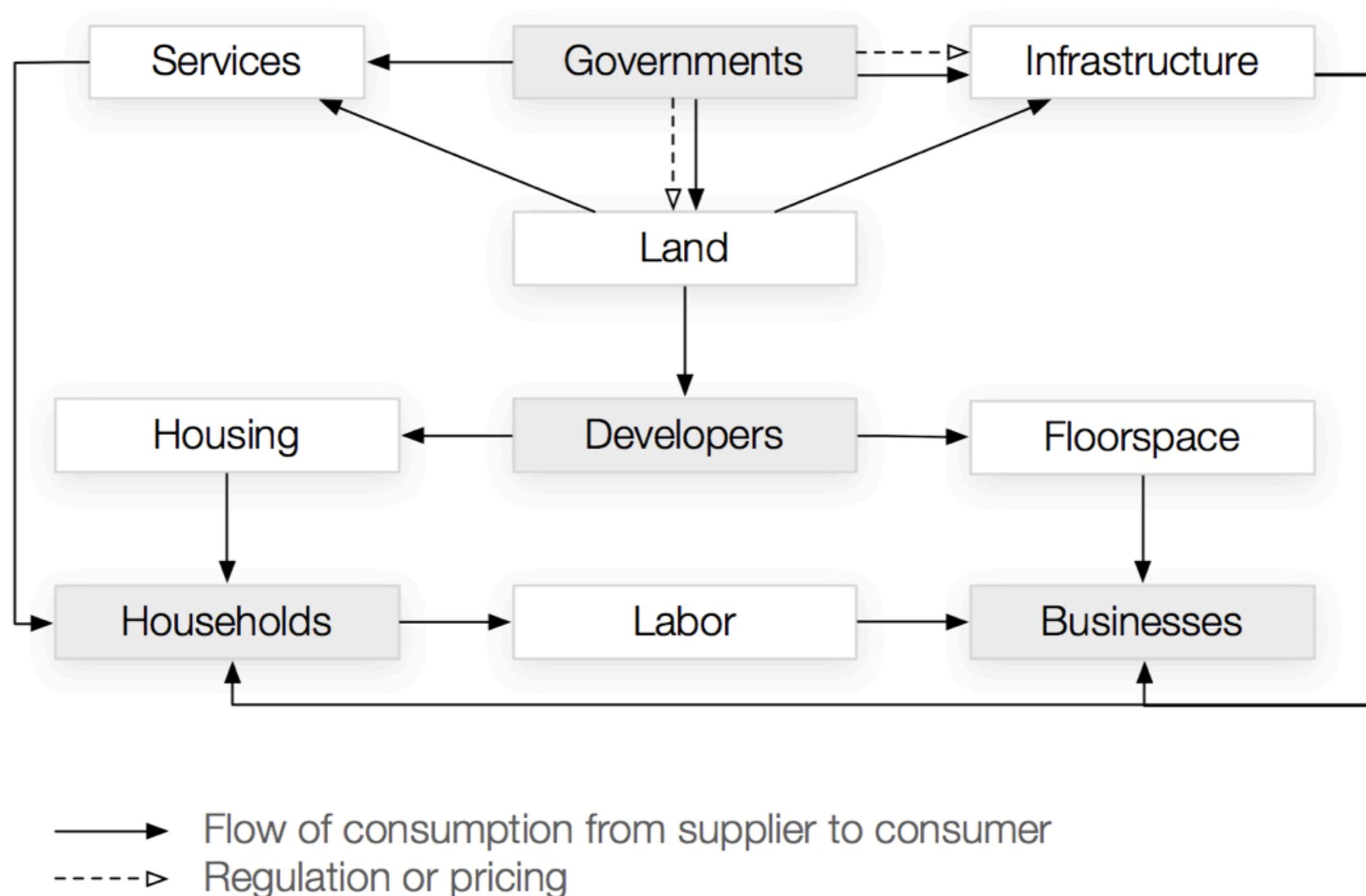


# UrbanSim

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- Designed by Dr. Paul Waddell, Professor and Chair, Department of City and Regional Planning, University of California Berkeley
- UrbanSim is a model system to support land use, transportation and environmental planning
- Licensed as an Open Source software system, and is freely downloadable from the project website ([www.urbansim.org](http://www.urbansim.org))
- Developed with numerous collaborators
- It is a full microsimulation model system: simulates choices of millions of agents: households, businesses, developers
- Funded mainly by NSF, with additional grants from EPA, FHWA, state and local governments, and the European Research Council
- Recent surveys show that UrbanSim has become the most widely used land use model system by planning agencies in US

# UrbanSim Models Agents Interacting in Urban Markets



# Selected UrbanSim Applications (Completed or In Progress)

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- United States:
- Albuquerque, NM
- Detroit, MI
- Denver, CO
- Durham, NC
- Eugene-Springfield, OR
- Honolulu, HI
- Houston, TX
- Phoenix, AZ
- Salt Lake City, UT
- San Antonio, TX
- San Francisco, CA
- Seattle, WA
- Tucson, AZ
- International:
- Accra
- Amsterdam
- Beijing
- Brussels
- Durban
- Paris
- Rome
- Seoul
- Taipei
- Tel Aviv
- Turin
- Zurich

*Currently being used to support the Plan Bay Area analysis of scenarios for EIR*

# Policies to Evaluate With UrbanSim

(over 1-30 years)

---

- **Transportation**

- Transit investments (Rail, Bus)
- Roadway investments (GP, HOV, HOT, Bike, Pedestrian)
- Pricing (Tolls, Congestion)

- **Land Use Regulations**

- City comprehensive Plans
- Transit Oriented Development, Urban Villages & Centers
- Subsidies, Impact Fees
- Urban Growth Boundaries
- Protection of Environmentally-sensitive Areas

# UrbanSim Outcomes and Indicators

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- **Land and Development**

- Housing units by type, density, price (affordability)
- Non-residential buildings by type, density, price
- Acreage in agricultural land, forest, open space

- **Demographics:** households by income, size, life cycle

- **Economics:** employment by sector and building type

- **Transportation**

- Accessibility, Mode Shares, Vehicle Miles Traveled, Congestion Delay
- Long-term Induced demand of transportation projects via land use impacts

- **Environment**

- Greenhouse Gas Emissions
- Pollution
- Energy Use
- Water Use

# Travel Modeling at MTC

David Ory (dory@mtc.ca.gov)

Metropolitan Transportation Commission

December 6, 2012

*Presentation for Air Quality Conformity Task Force*



**Step 1:** Create a list of families

**Step 2:** Simulate the behavior of each family

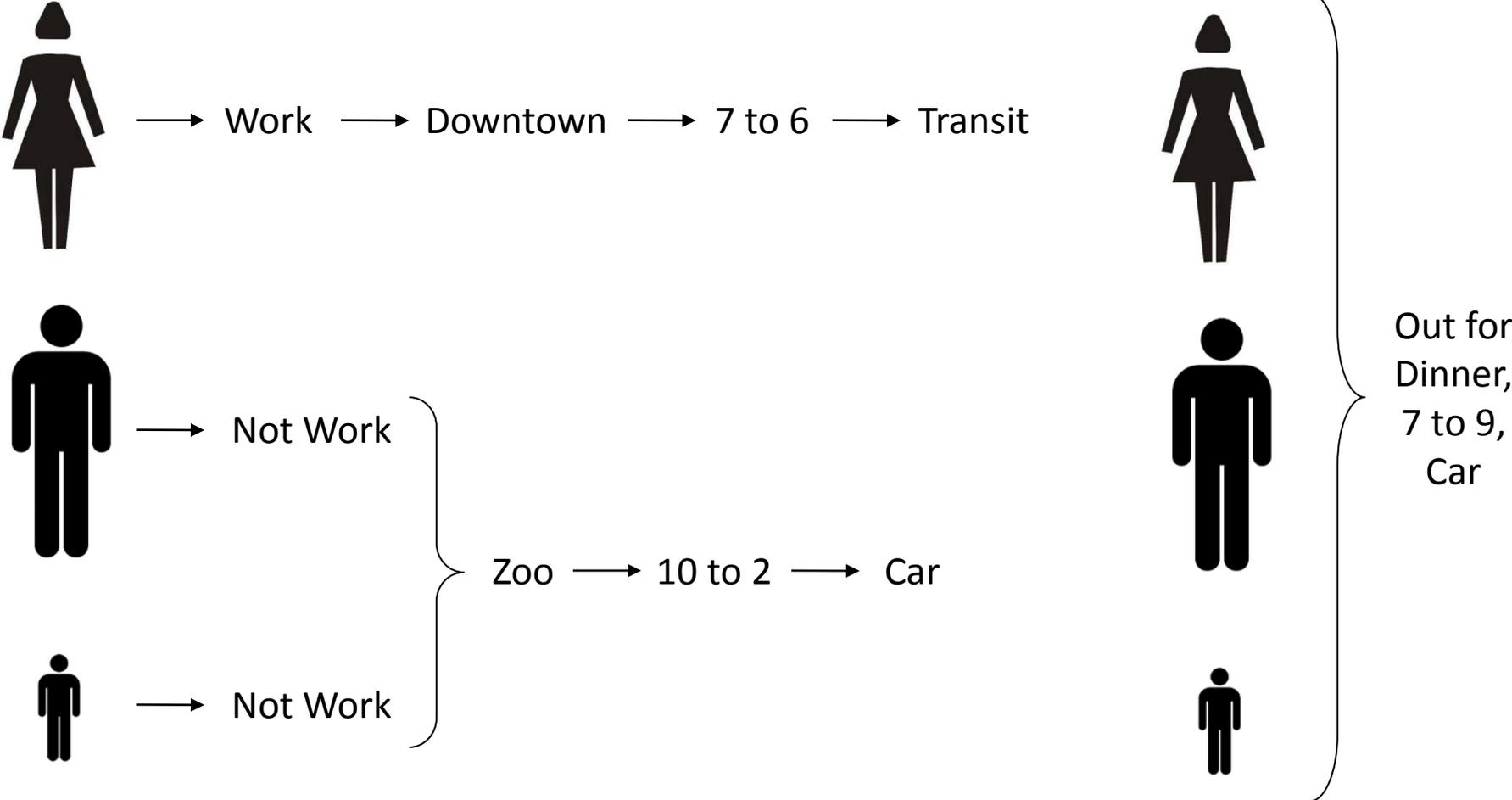
**Step 3:** Aggregate the behavior of all families

**Step 4:** Assess the burden on the transport network

**Step 5:** Repeat 2 through 4 → Equilibrium

**Step 6:** Input vehicle speeds to EMFAC

# Activity-based Micro-simulation Models in a Nutshell



# Regional Emission Inventory Calculation Overview

- *EMFAC2011-SG is used to calculate current and future inventories of motor vehicle emissions at the state, county, air district, air basin, or air basin within county level*
- *Total daily regional emissions are generated by applying emission factors (from EMFAC2011-SG) to VMT estimates generated from MTC's travel model*

# VMT Adjustment Methodology for the Bay Area

Per ARB guidance, the VMT forecasting procedure involved the use of MTC's validated network-based travel demand forecast model in order to apply adjustment factors to the future year travel demand model VMT estimate, based on the equation below:

*Forecasted VMT(future(i)) = Actual VMT(2000) \* Travel Demand Model VMT(future(i)) / Travel Demand Model VMT(2000),*

*where I = 2020 or 2035.*

# Regional Emission Inventory Calculation Process

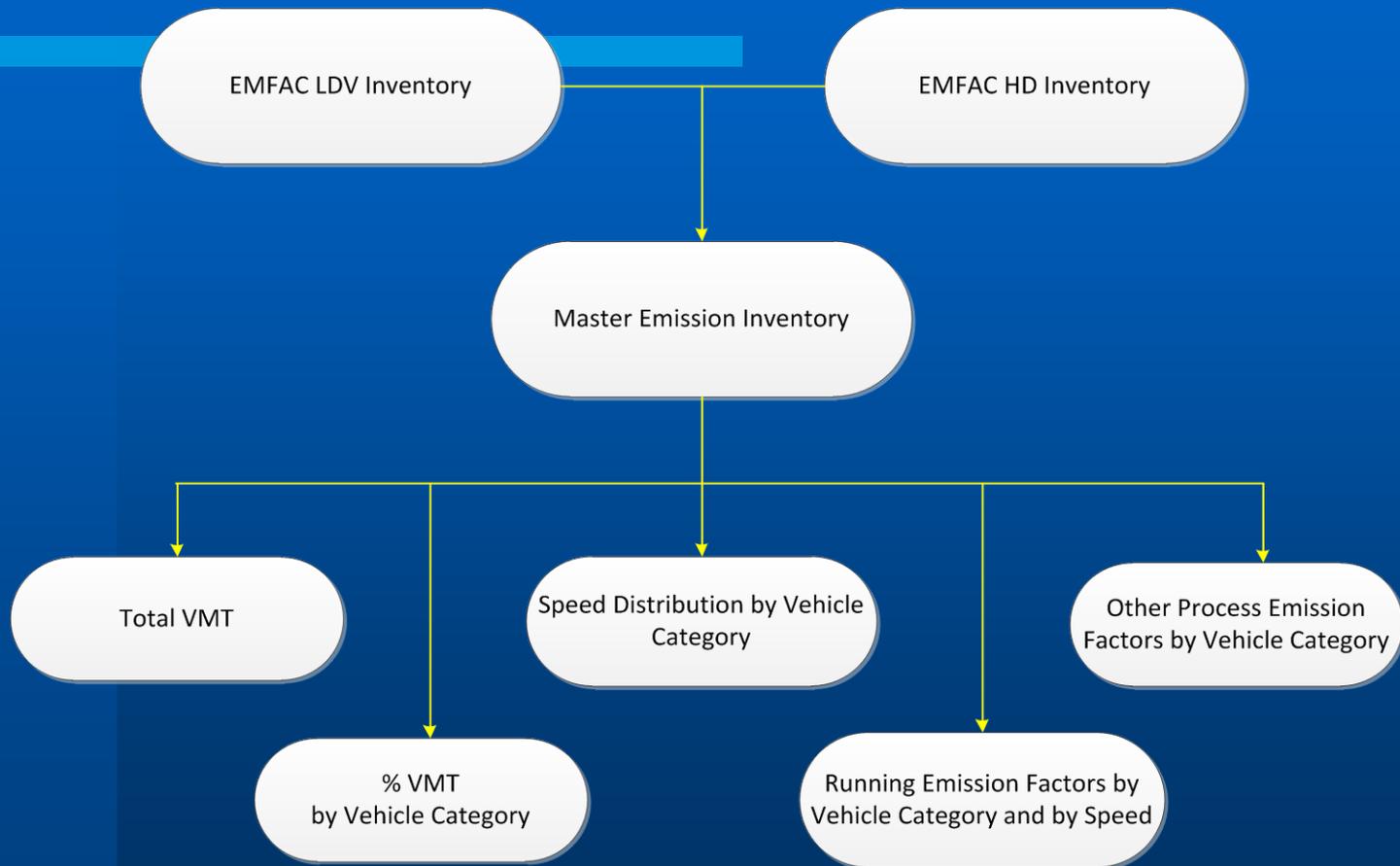
- From MTC's travel demand model, each link's travel by individual time period daily travel (ADT) estimate is divided into volumes by hour of day and direction. Emissions can be calculated hourly and diurnal factors are used to allocate travel to five time periods covering the entire day, specifically five time period-specific assignments are performed:
  - early AM, 3 am to 6 am
  - AM peak period, 6 am to 10 am
  - midday, 10 am to 3 pm
  - PM peak period, 3 pm to 7 pm
  - evening, 7 pm to 3 am

# Regional Emission Inventory Calculation

## Process (continued)

- An average speed specific to the facility class, area type and time-of-day was selected and used to select the appropriate exhaust ROG, CO, NO<sub>x</sub>, PM<sub>10</sub>, PM<sub>2.5</sub> and CO<sub>2</sub> factors
- The three factors listed below are multiplied to yield emissions for the link for one hour and direction for a given pollutant:
  - The VMT for one hour and direction from Step 1 (48 combinations)
  - The percent of the link VMT attributable to vehicle type *v* for which emissions are calculated. The percent of link VMT by vehicle type is generated for four categories (urban freeways, urban arterials)
  - The pollutant emission rate (be it ROG, CO, NO<sub>x</sub>, PM<sub>10</sub>, PM<sub>2.5</sub> and CO<sub>2</sub>) for vehicle type *v*, the speed calculated from previous bullet

# Schematic of EMFAC2011-SG Logic Flow



# EMFAC2011-SG uses the following equations to calculate the emissions by Vehicle Category (VC):

$$\text{Running Emissions}_{VC} = \text{Total VMT} \times \text{VMT Fraction}_{VC} \times \left[ \sum_{\text{Speed}=5}^{70} \text{Speed Fraction}_{\text{Speed},VC} \times \text{Running Emission Factor}_{\text{Speed},VC} \right]$$

$$\text{Other Process Emissions}_{VC} = \text{Total VMT} \times \text{VMT Fraction}_{VC} \times \text{Process Emission Factors}_{VC}$$

Where:

$$\text{VMT Fraction}_{VC} = \frac{\text{VMT}_{VC}}{\text{Total VMT}}$$

$$\text{Speed Fraction (\% VMT}_{\text{Speed}}) = \frac{\text{VMT}_{\text{Speed}, VC}}{\text{Total VMT}_{VC}}$$

$$\text{Running Emission Factor (g/mile)} = \frac{\text{Default Running Emissions}_{\text{Speed}, VC}}{\text{Default VMT}_{\text{Speed}, VC}}$$

$$\text{Process Emission Factor (g/mile)} = \frac{\text{Default Process Emissions}_{VC}}{\text{Default Total VMT}_{VC}}$$



# Plan BayArea

## **Draft Preferred Scenario**

\* *Jobs-Housing Connection*

\* *Transportation Investment Strategy*

Air Quality Conformity Task Force

January 24, 2013

# Trends & Projections

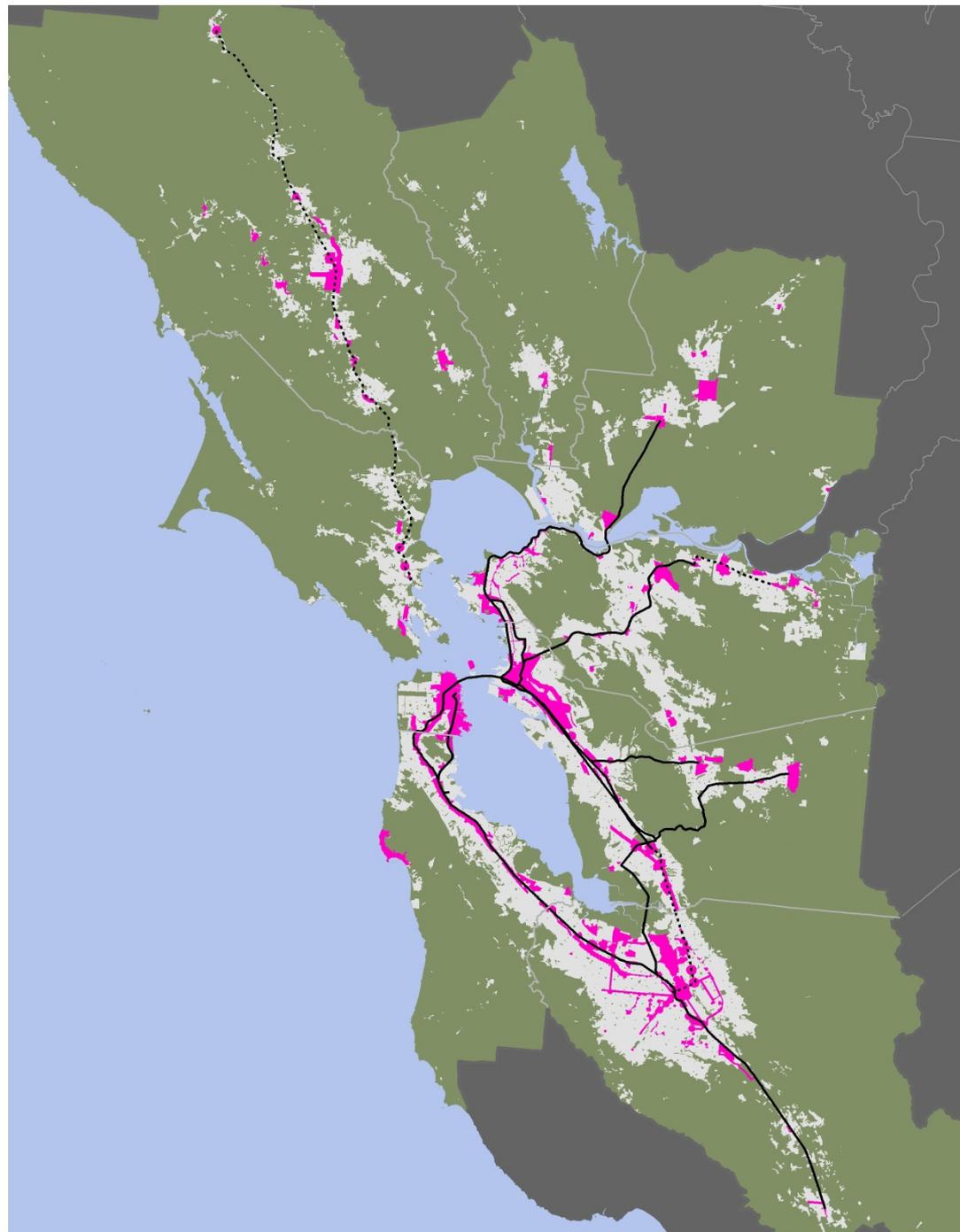
# Regional Growth

	2010	2040	Growth 2010 - 2040
Jobs	3,385,000	4,505,000	<b>1,120,000</b>
Population	7,152,000	9,299, 000	<b>2,147,000</b>
Housing Units	2,786,000	3,446,000	<b>660,000</b>

**Source:** California Department of Finance, US Census, Center for Continuing Study of the California Economy, United States Department of Labor, Bureau of Labor Statistics, ABAG

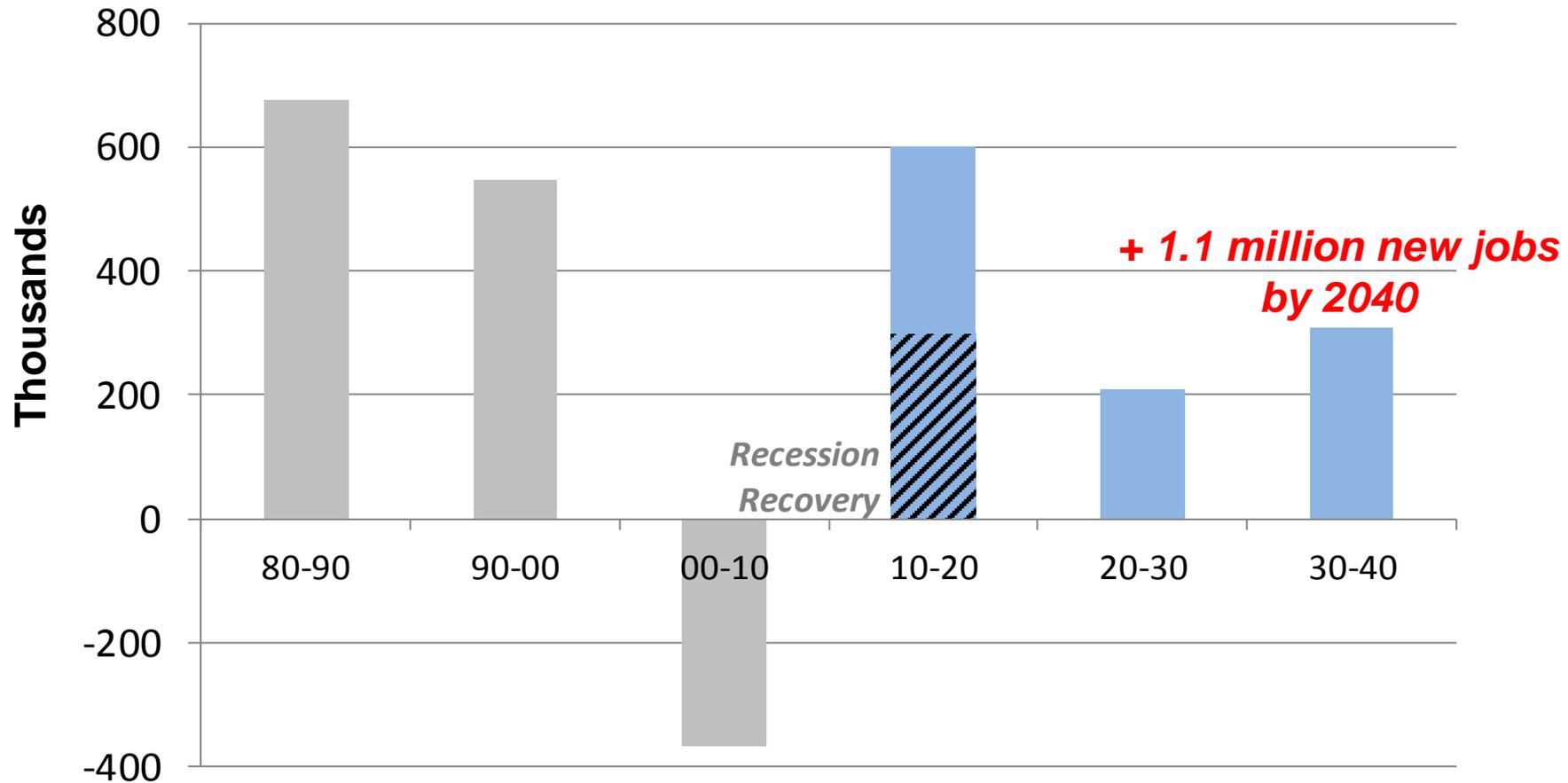
# Jobs-Housing Connection Growth Strategy

-  Non-urbanized land
-  Urbanized land
-  PDAs
  - 4% of region's land
  - 80% of new homes
  - 66% of new jobs



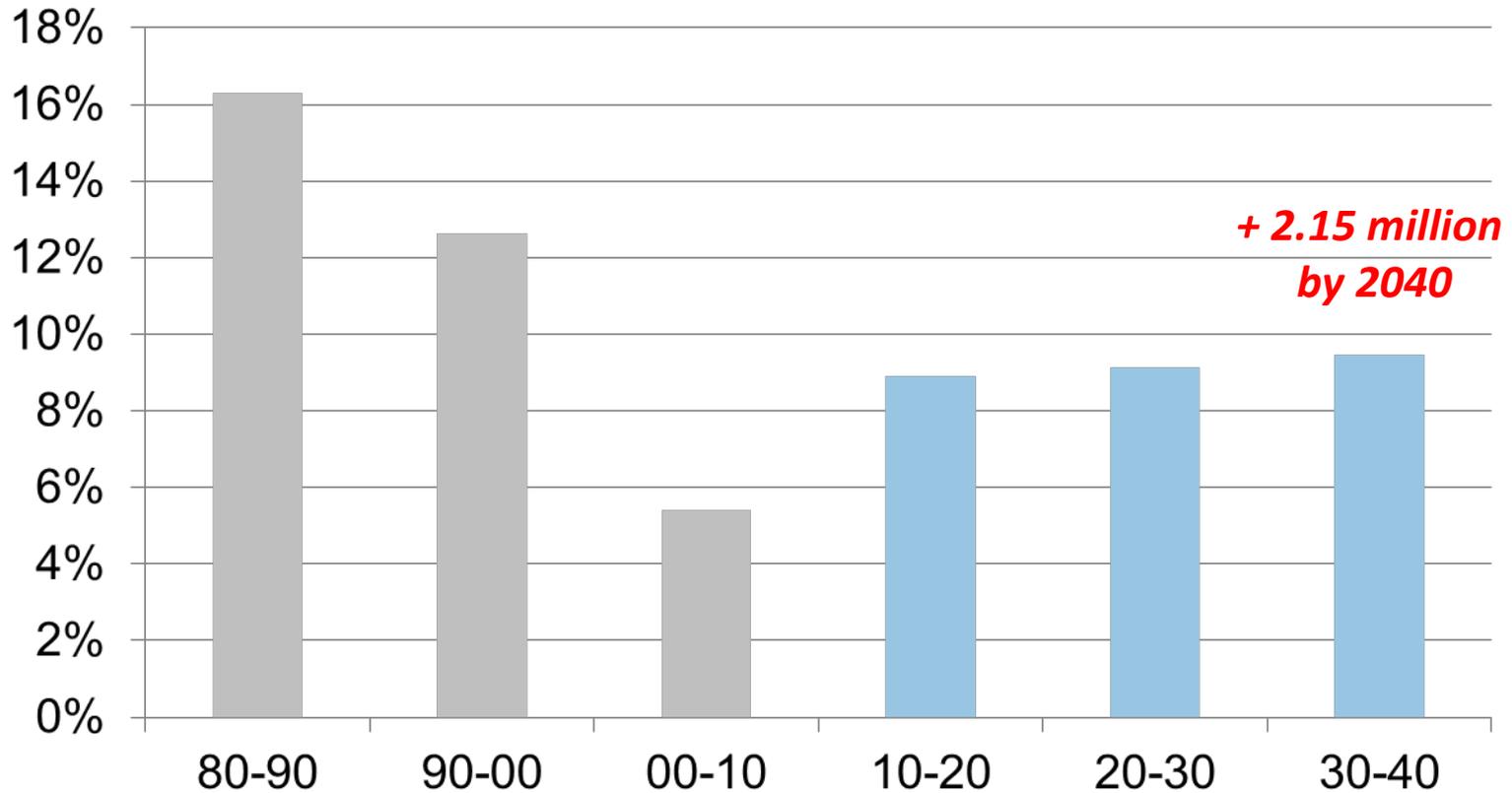
# Employment Growth

## Total Growth by Decade



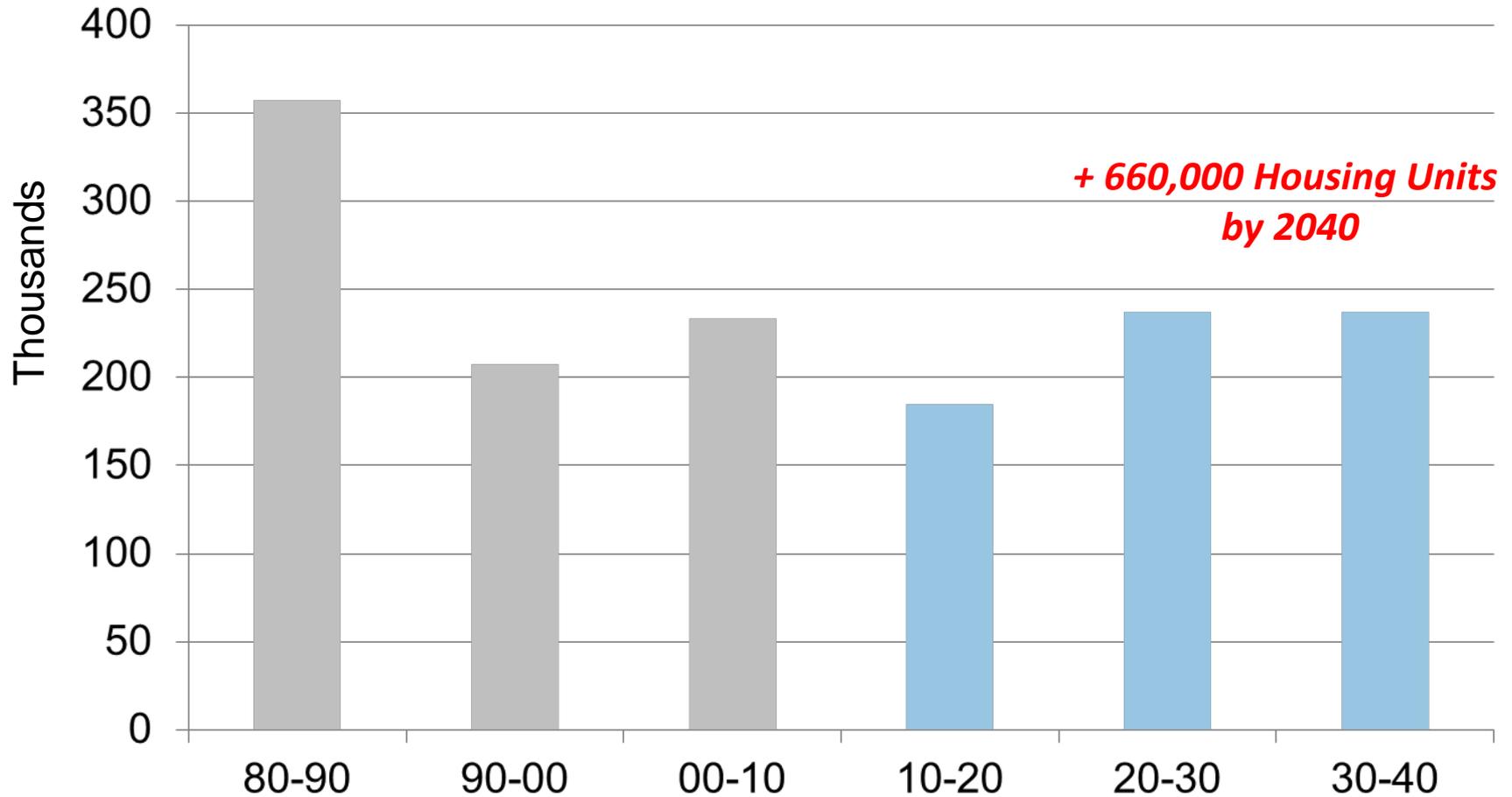
# Population Growth

## Growth Rate by Decade



# Housing Production

## Total Production by Decade

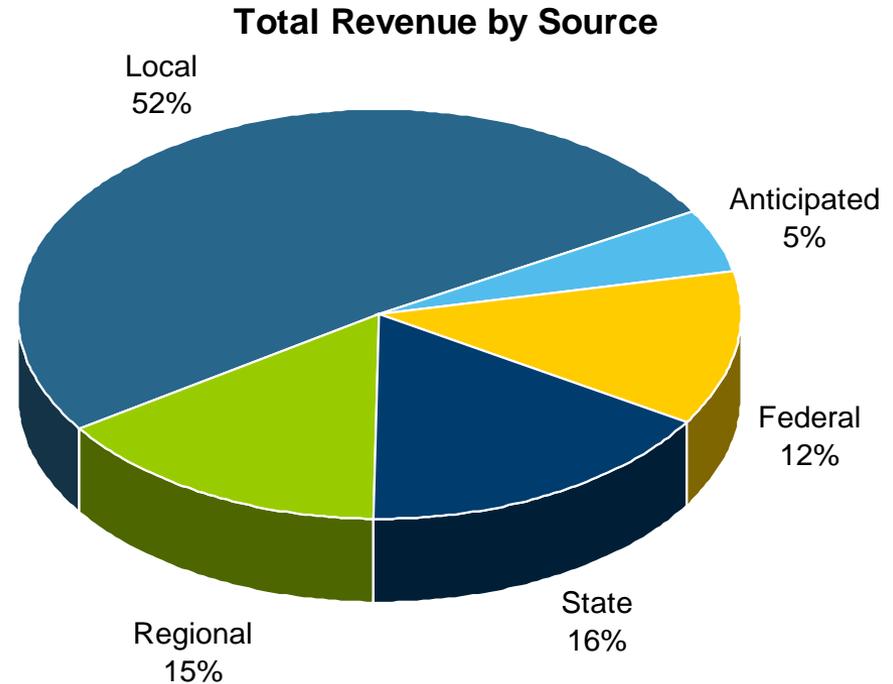


**+ 660,000 Housing Units  
by 2040**

# Draft Transportation Investment Strategy

# Plan Bay Area 28-Year Revenues -- \$277 Billion\*

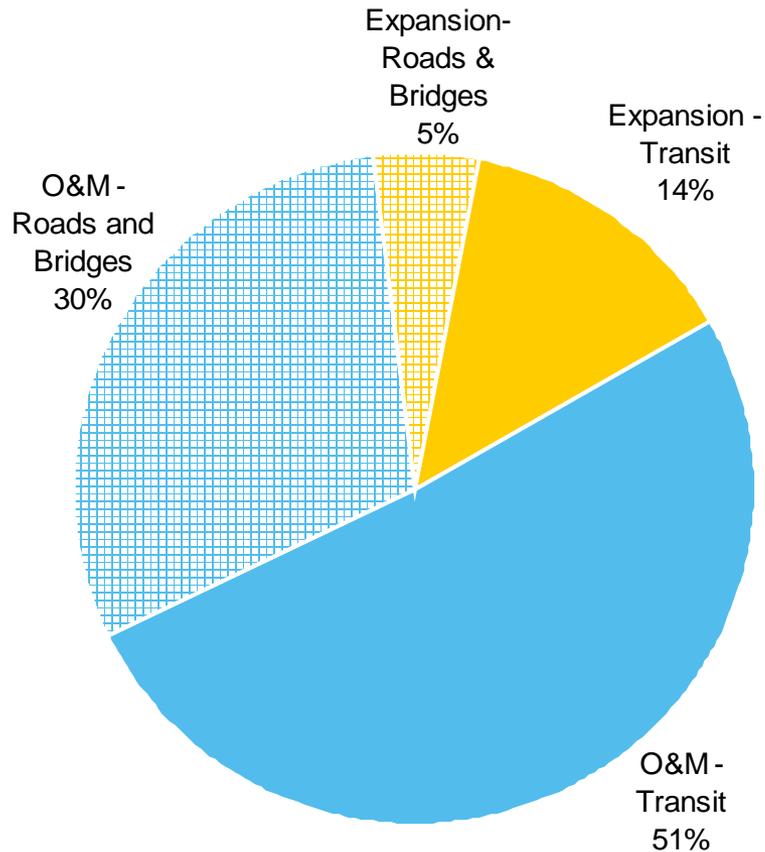
- **Committed Revenue - \$186 B**
- **Conditioned Discretionary - \$35 B**
  - \$34 B (97%) to Transit Operating and Maintenance
  - \$1 B (3%) to Other
- **Revenues Available for Trade-Offs - \$56 B**
- **Total - \$277 B**



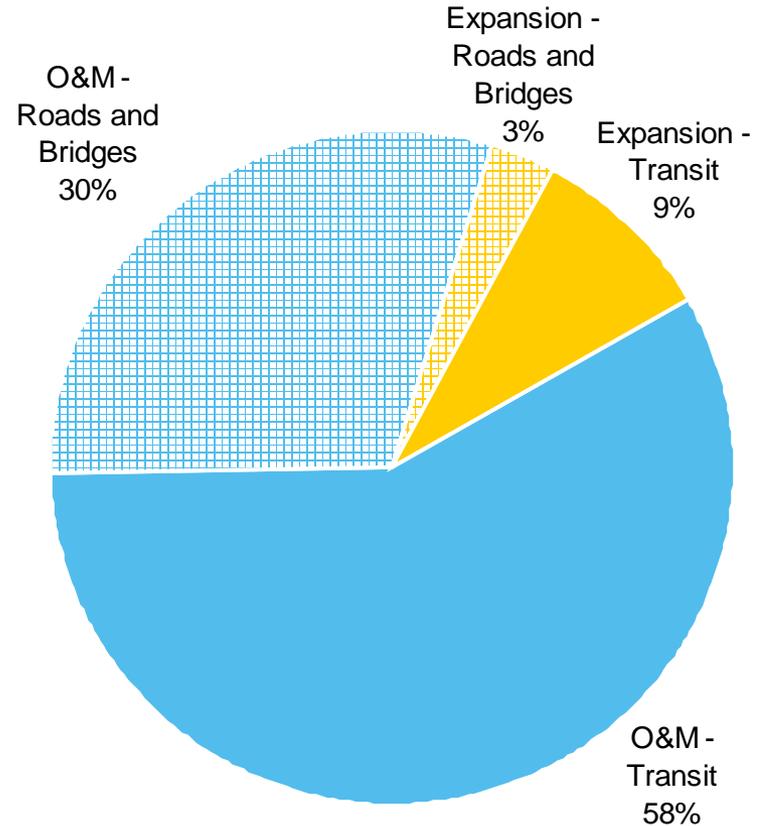
*\*represents an \$11 billion increase from February (\$9 billion for regional and Santa Clara express lanes and \$2 billion for San Francisco cordon pricing). Figures are in the process of being updated for Draft Plan release.*

# Plan Bay Area Summary

**T2035 by Function - \$218 B**



**Plan Bay Area by Function - \$277 B**



- See detail in Appendices 1-3