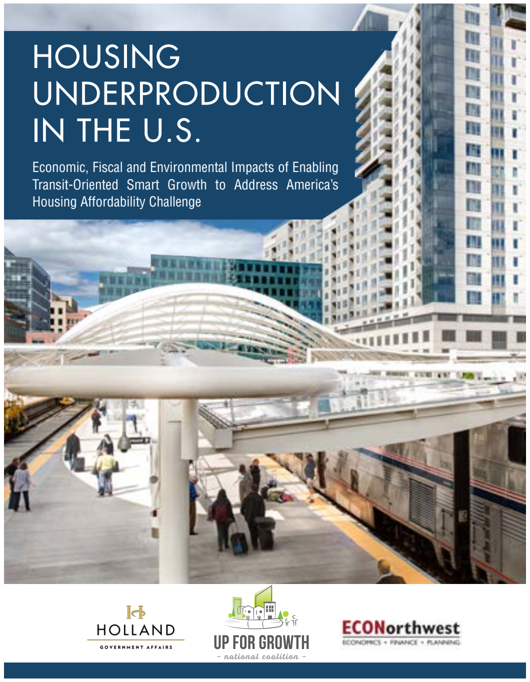
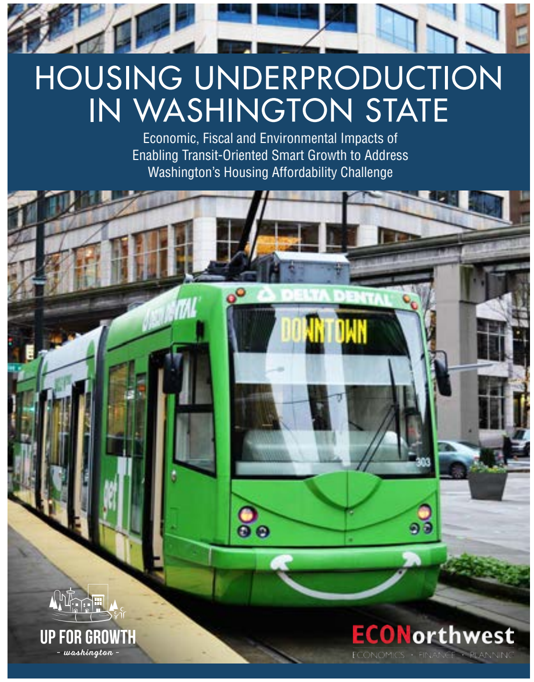
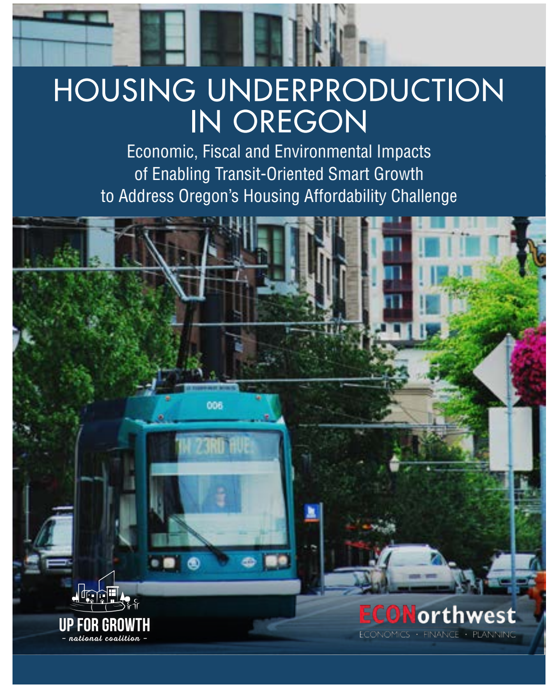






An Integrated Land-Use and Economic Impact Approach to Modeling Housing Policy

2018 REMI Users' Conference – San Diego, CA – October 10, 2018

ECONorthwest
ECONOMICS • FINANCE • PLANNING

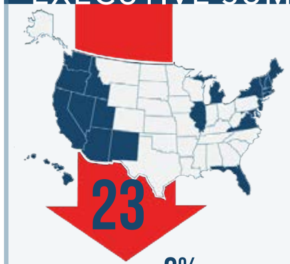
Marley Buchman
Michael Wilkerson, Ph.D.

Overview

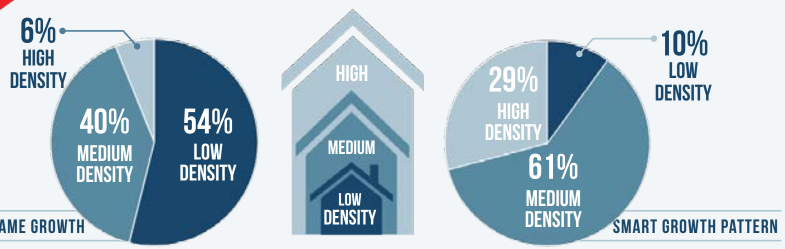
- Motivation and Use Cases
- Housing Underproduction Study
- Pipeline Diagram
- REMI Integration
  - Capacity Modeling
  - Feasibility Modeling
  - MapCraft

National Housing Underproduction Study

EXECUTIVE SUMMARY



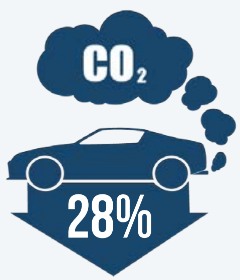
From 2000 to 2015, 23 states under-produced housing to the tune of 7.3 million units, or roughly 5.4% of the total housing stock of the U.S., which has created a supply and demand imbalance that is reflected in today's home prices.

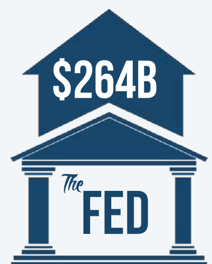


MORE OF THE SAME GROWTH

SMART GROWTH PATTERN

If housing development continues its current pattern with "More of the Same" growth, 54% of the 7.3 million new housing units would be single family homes, while 40% would be missing middle and medium density, and 6% would be towers, nationally. Our scenario-based investigation of growth potential across 23 states with housing shortfalls found that if housing development took on a "Smart Growth" pattern, leveraging existing infrastructure to achieve higher density inside transit corridors, 10% of the new 7.3 million units would be single family, while 61% would be in missing middle and medium density, and 29% would be in towers.





CLEAR SKIES AHEAD

Shifting from current development patterns (More of the Same) to the Smart Growth scenario, only 25% of the land is required to deliver the same number of units. Because these areas would be denser and transit adjacent, this would reduce vehicle miles traveled and cars on the road by as much as 28%.

GDP BOOST

Using a Smart Growth development pattern, cumulative GDP over a 20 year period would increase by $400 billion compared to More of the Same – Smart Growth delivers $2.3 trillion in cumulative GDP over the baseline forecast, which represents 2.4% of GDP growth over that period.

FEDERAL REVENUE HIKE

Smart Growth generates an additional $66 billion in federal revenue over the 20-year growth period compared to More of the Same: federal payroll and income taxes increase $264 billion with Smart Growth development compared to baseline forecast. In the peak year of production, the additional federal revenue generated would equal 6.2% of the current federal deficit.

CALCULATING UNDERPRODUCTION

NUMBER OF HOUSING UNITS UNDERPRODUCED FROM 2000-2015

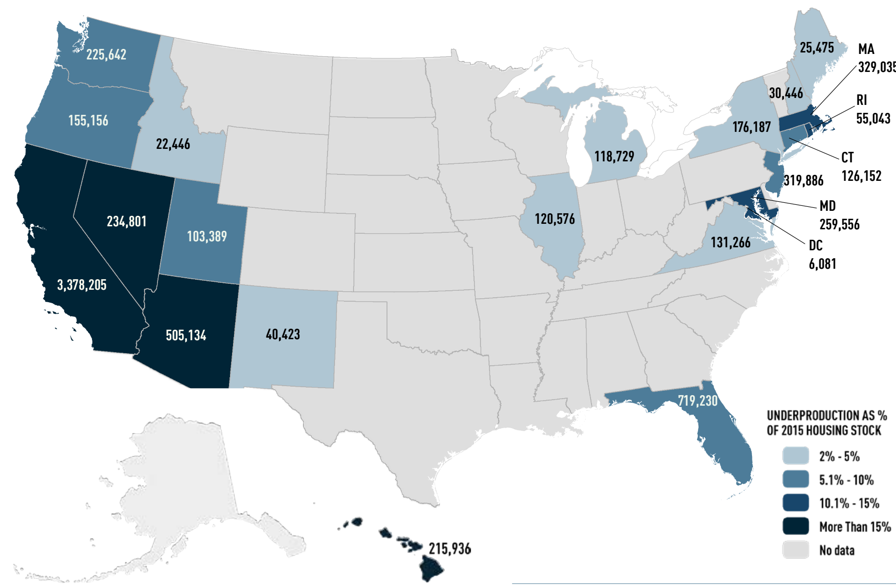
7.3 MILLION UNITS IN 23 STATES

To calculate the total number of units under-produced from 2000 to 2015, we estimated each state's historic relationship between the production of housing units (supply) and a host of demand-side indicators using an econometric statistical model. We then calculated each state's baseline housing production through 2000 and forecasted the number of units that would have been produced in 2015 if each market maintained its historic equilibrium. Then using the actual number of housing units in 2015, we calculated the total units that were under- or over-produced from 2000 to 2015 at the state level. The historic data needed for this calculation were not available for smaller geographies.

The map below shows which states under-produced housing during the 2000-2015 time period. States that produced housing at their long-run equilibrium rate are in grey. Nationally, 23 states under-produced housing to the tune of 7.3 million units, or roughly 5.4% of the total housing stock in the United States. ■

DATA INPUTS TO THE MODEL INCLUDE:

- Home Prices
- Income
- Population
- Housing Stock



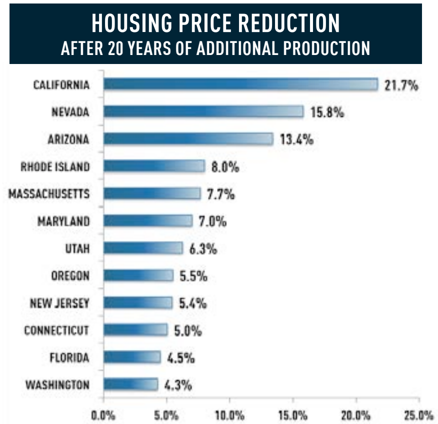
Source: ECONorthwest estimates, Census Bureau ACS 1-year Estimates of housing Stock

Economic Impacts of Increased Housing Production

The greatest economic benefits come from the "Max Density" scenario, which sees the most development in tower prototypes that have the largest amount of construction spending. High-density developments also utilize more of the existing infrastructure, thus placing a smaller burden on governments and developers to both build and maintain new infrastructure.

Although the "Max Density" growth scenario produces the greatest economic benefits, it is the least politically feasible in terms of a policy solution. This scenario would require a radical restructuring of existing land-use and zoning policies. This growth scenario was designed to showcase the theoretical benefits that could accrue from such a massive, concentrated development effort.

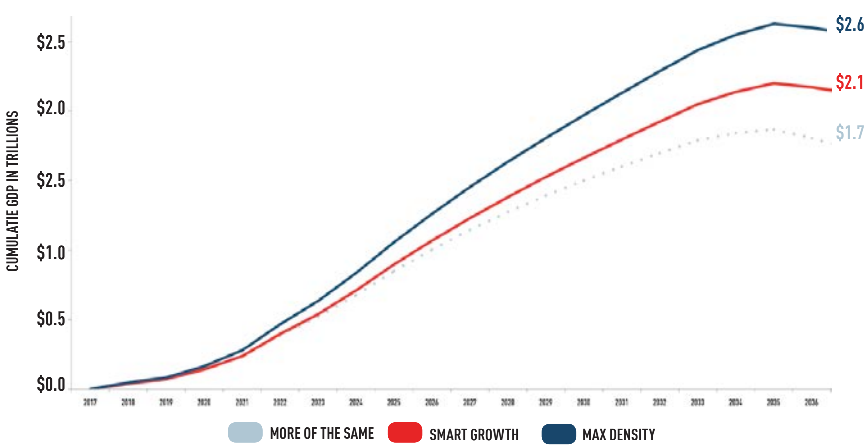
A more realistic outcome would be to design housing policies to support a "Smart Growth" approach, instead of continuing with "More of the Same" development patterns. Over the simulated 20-year period of housing production, the "Smart Growth" scenario generates $400 million of additional GDP compared to "More of the Same." With lower up-front infrastructure costs and reduced operating and maintenance costs associated with development, this scenario deploys capital more efficiently and produces higher economic output.



The chart above displays the states with the largest price reductions associated with the additional production of units. For example, if 3.3 million units are built in California during the next 20 years, prices would be 21.7% lower than they would have been without the additional production of units. This does not mean that prices are reduced from their current level, but are lower in the future than they would have been due to the increase in the number of housing units.

U.S. CUMULATIVE GDP BY SCENARIO

20-YEAR PRODUCTION PERIOD COMPARED TO BASELINE



This chart demonstrates the cumulative GDP achieved in each of the growth scenarios. The growth in GDP is measured against the REMI model's baseline growth projections.

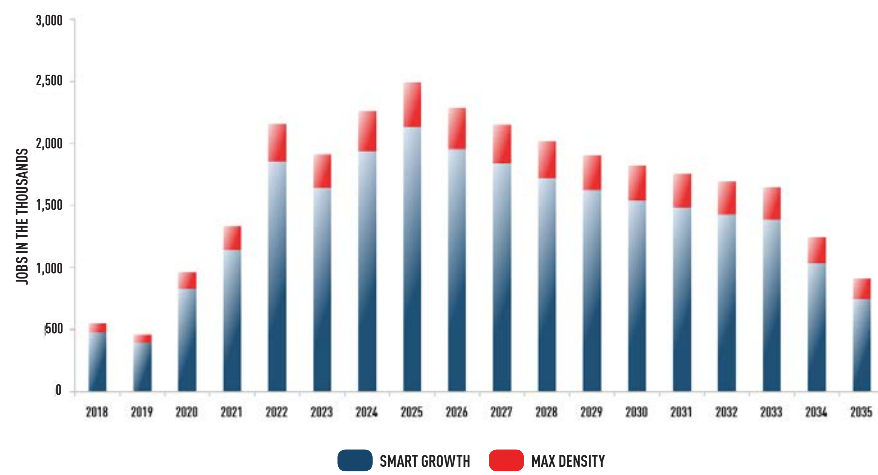
REMI MODEL: ECONOMIC IMPACTS

The "Smart Growth" scenario produces greater economic benefits than the "More of the Same" approach. This scenario targets development in transit corridors: areas with existing transportation infrastructure and a large number of households commuting by public transit. Jobs are added to the economy in each year compared to the baseline over the 20-year production period for all three scenarios. Jobs should not be thought of as cumulative impacts. It's not uncommon for one individual to be employed by the same company for several years, so it's difficult to trace the number of individuals employed year by year. Looking at employment impacts, however, we can see in a given year how many more jobs are supported compared to the baseline scenario. For example, at the peak job year, "Smart Growth" creates 2.1 million more jobs than the REMI baseline projection, and "Max Density" creates 400,000 more than "Smart Growth", reaching 2.5 million jobs in 2025.

To summarize, all three growth scenarios lead to large economic benefits for the U.S. economy. Producing 7.3 million housing units (in addition to expected development over the next 20 years) provides a boost to the national economy, as well as at the state and local levels of government. However, there is opportunity for greater economic growth, fiscal health and environmental impacts by implementing a growth scenario that concentrates growth in areas of existing density and transportation infrastructure. ■

ANNUAL U.S JOBS BY SCENARIO

20-YEAR PRODUCTION PERIOD COMPARED TO BASELINE



This chart demonstrates the increase in "job years" above the REMI model baseline projections resulting from the "Max Density" and "Smart Growth" scenarios. Job years are an economic measure representing one year's worth of full-time work. One job year could be one person working full time for one year, or two people working half time for one year. The increases in jobs correlate with the 20-year development time frame and span every sector.

Upstream Analysis Pipeline

Upstream

MapCraft (Parcel based feasability)

Upstream Analysis Pipeline

Upstream

MapCraft (Parcel based feasability)

Policy Intervention

Upstream Analysis Pipeline

Upstream

MapCraft (Parcel based feasability)

Policy Intervention

Change Baseline

Upstream Analysis Pipeline

Upstream

MapCraft (Parcel based feasability)

Policy Intervention

Change Baseline

REMI/ Fiscal Impacts

Upstream Analysis Pipeline Example

1

SINGLE-FAMILY HOME (UP TO 3 STORIES): MAX 5 UNITS PER ACRE

MISSING MIDDLE & MEDIUM DENSITY (UP TO 5 STORIES): MAX 120 UNITS PER ACRE

TOWER HIGH-RISE (6+ STORIES): MAX 240 UNITS PER ACRE

2

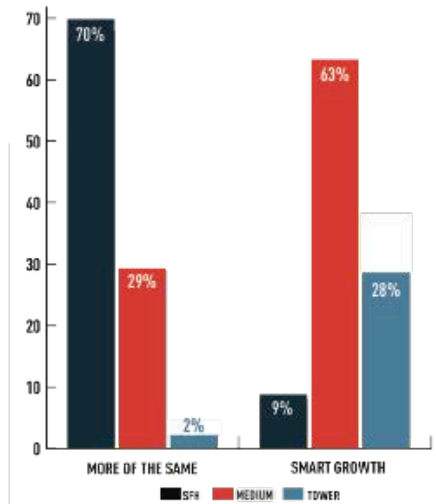
DENSITY DISTRIBUTION & PROTOTYPE MATRIX

SMART GROWTH

CURRENT DENSITY	% TOWER	% MEDIUM	% SFH
30.0+ Units per acre	100%		
12.5-30 Units per acre	50%	50%	
5.0-12.5 Units per acre		100%	
3.0-5.0 Units per acre		25%	75%
1.0-3.0 Units per acre			100%
Less Than 1.0 UPA	Development Threshold — No Density Added		

3

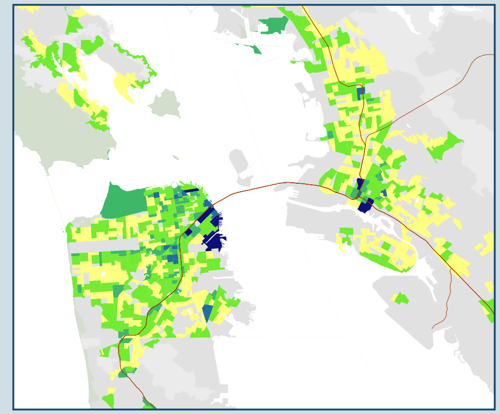
OREGON PROTOTYPE DISTRIBUTION BY GROWTH SCENARIO



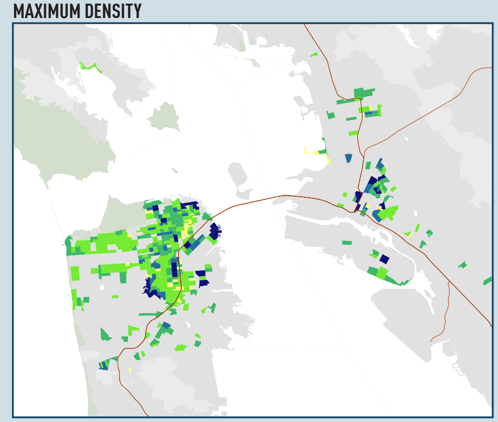
4

SMART GROWTH VERSUS MAXIMUM HOUSING DENSITY IN THE BAY AREA

SMART GROWTH



MAXIMUM DENSITY

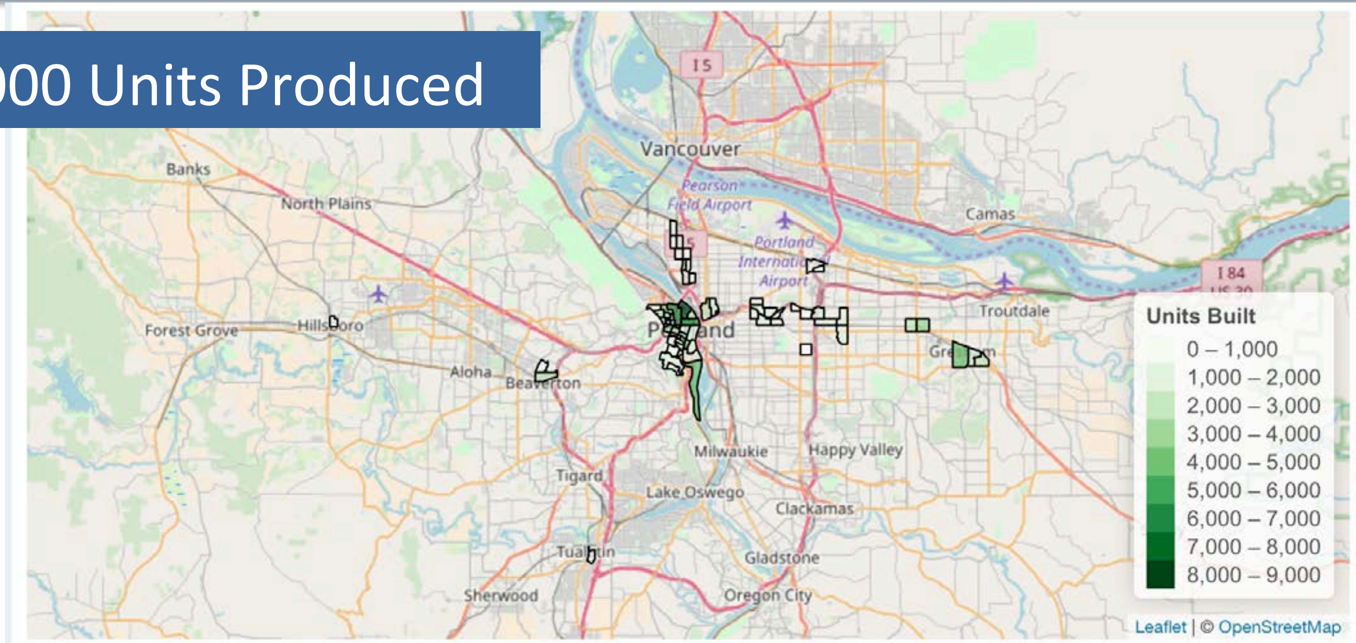


MAXIMUM DENSITY:
167 units per acre for tower
75 units per acre for tower/medium
50 units per acre for medium

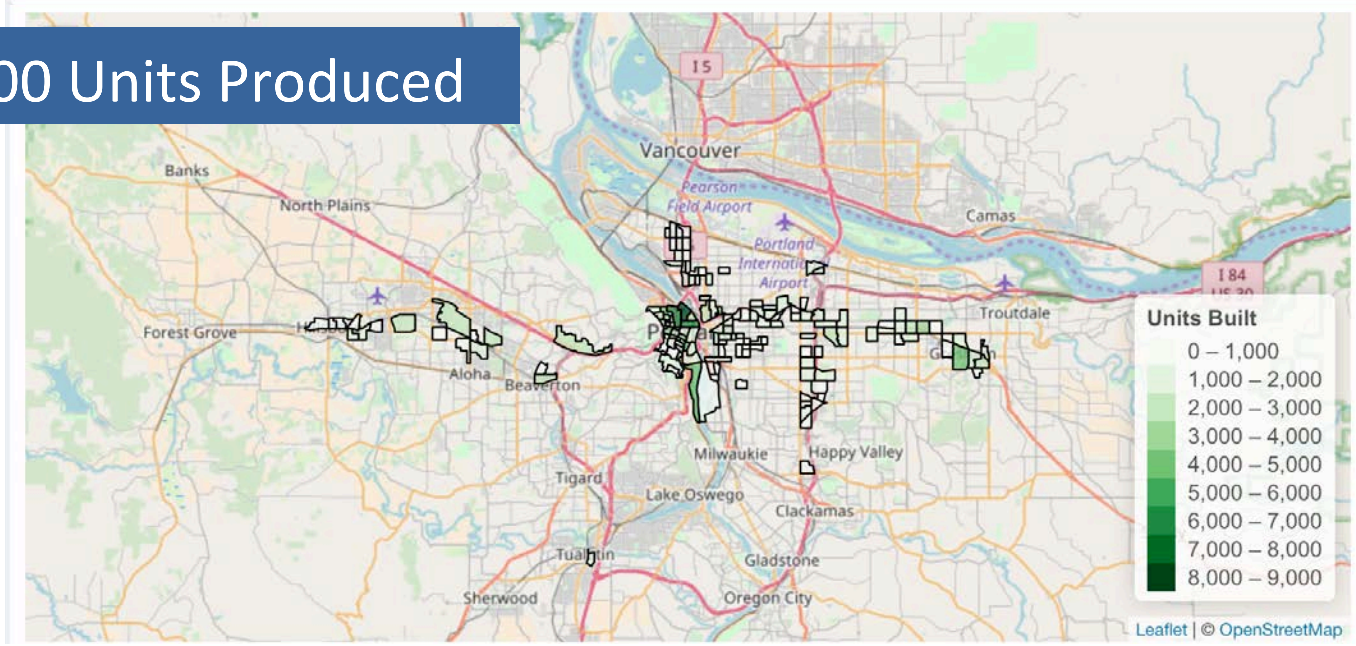
TOTAL UNITS ADDED:
- Less Than 1,000
- 1,001-2,000
- 2,001-3,000
- 3,001-4,000
- 4,001 or More

Density Distribution Model

155,000 Units Produced



255,000 Units Produced



Downstream Analysis Pipeline

Downstream

“What if”/
Planning

Downstream Analysis Pipeline

Downstream

"What if"/ Planning → Change Baseline

Downstream Analysis Pipeline

Downstream

Downstream Analysis Pipeline

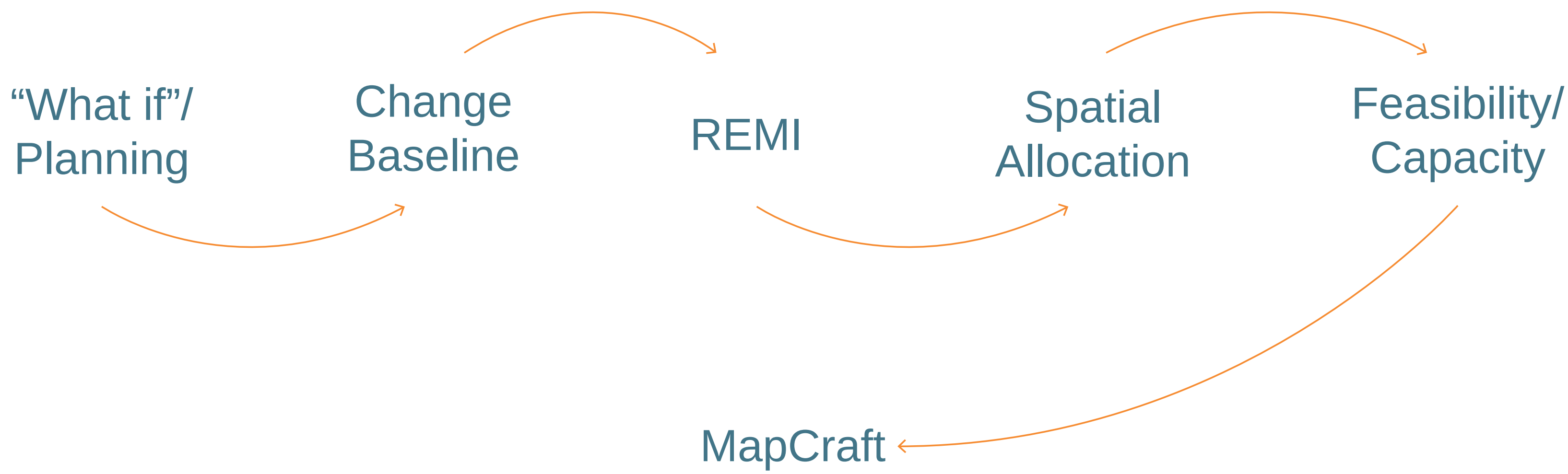
Downstream

Downstream Analysis Pipeline

Downstream

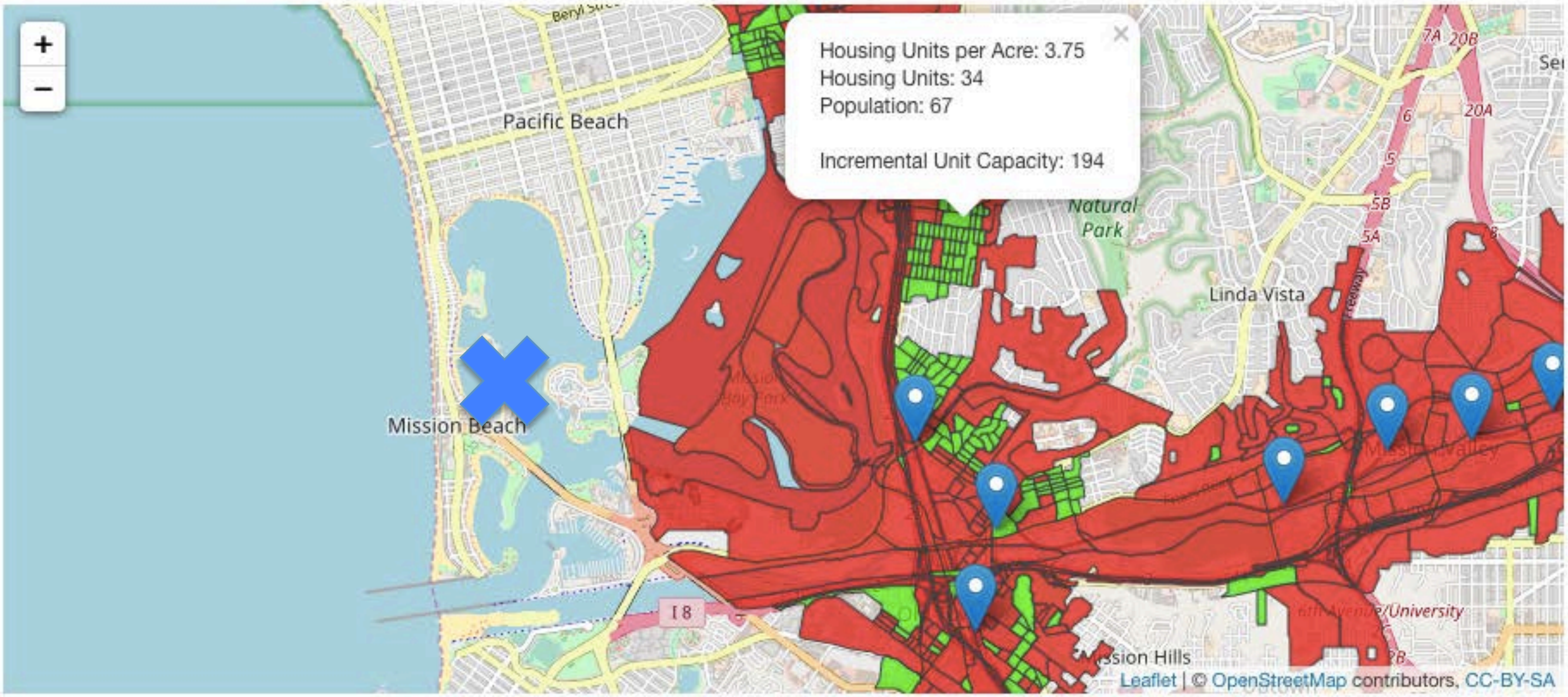
Downstream Analysis Pipeline

Downstream



TOD Feasibility App

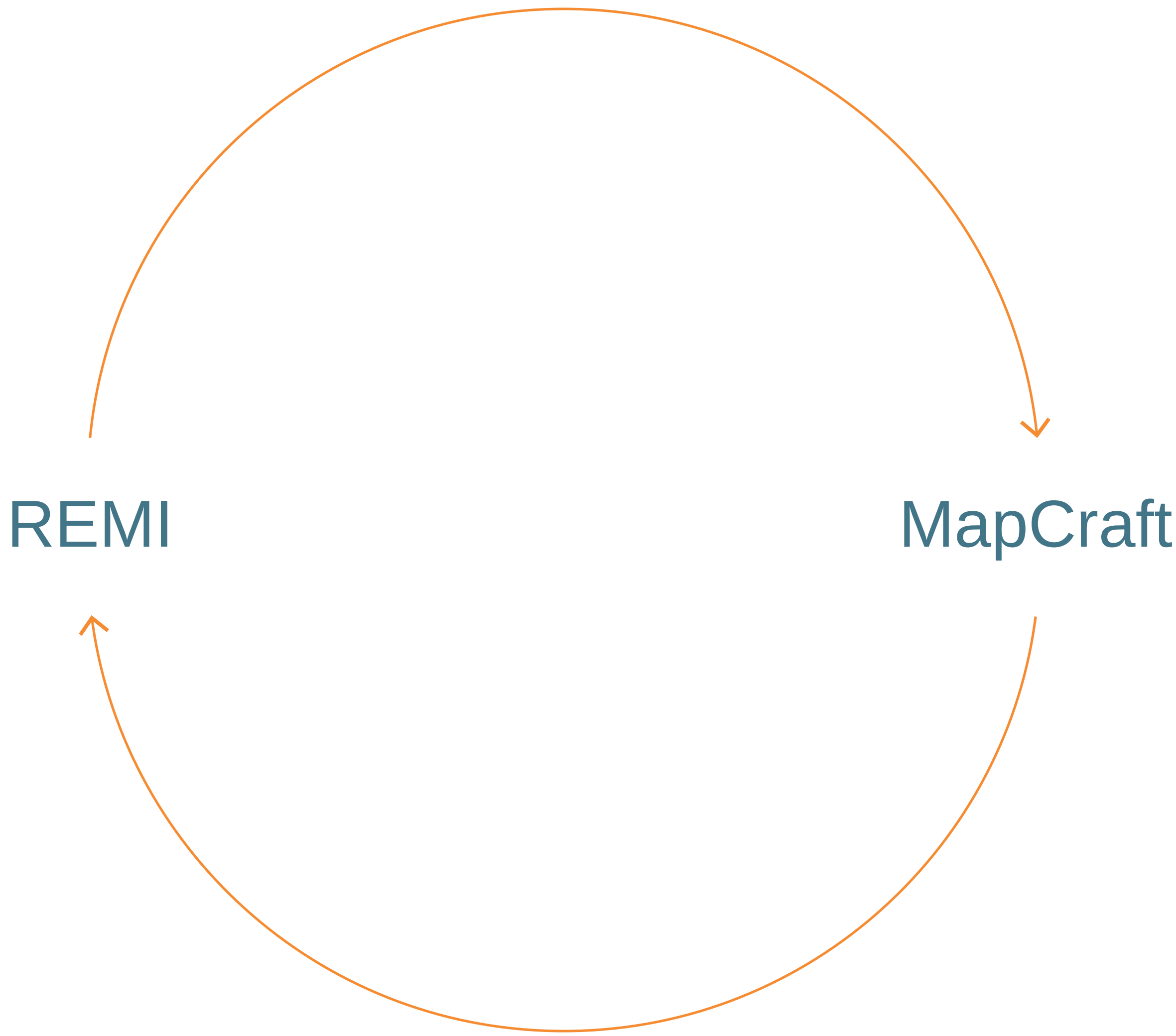
Estimating the Capacity for T.O.D.



Select State

California

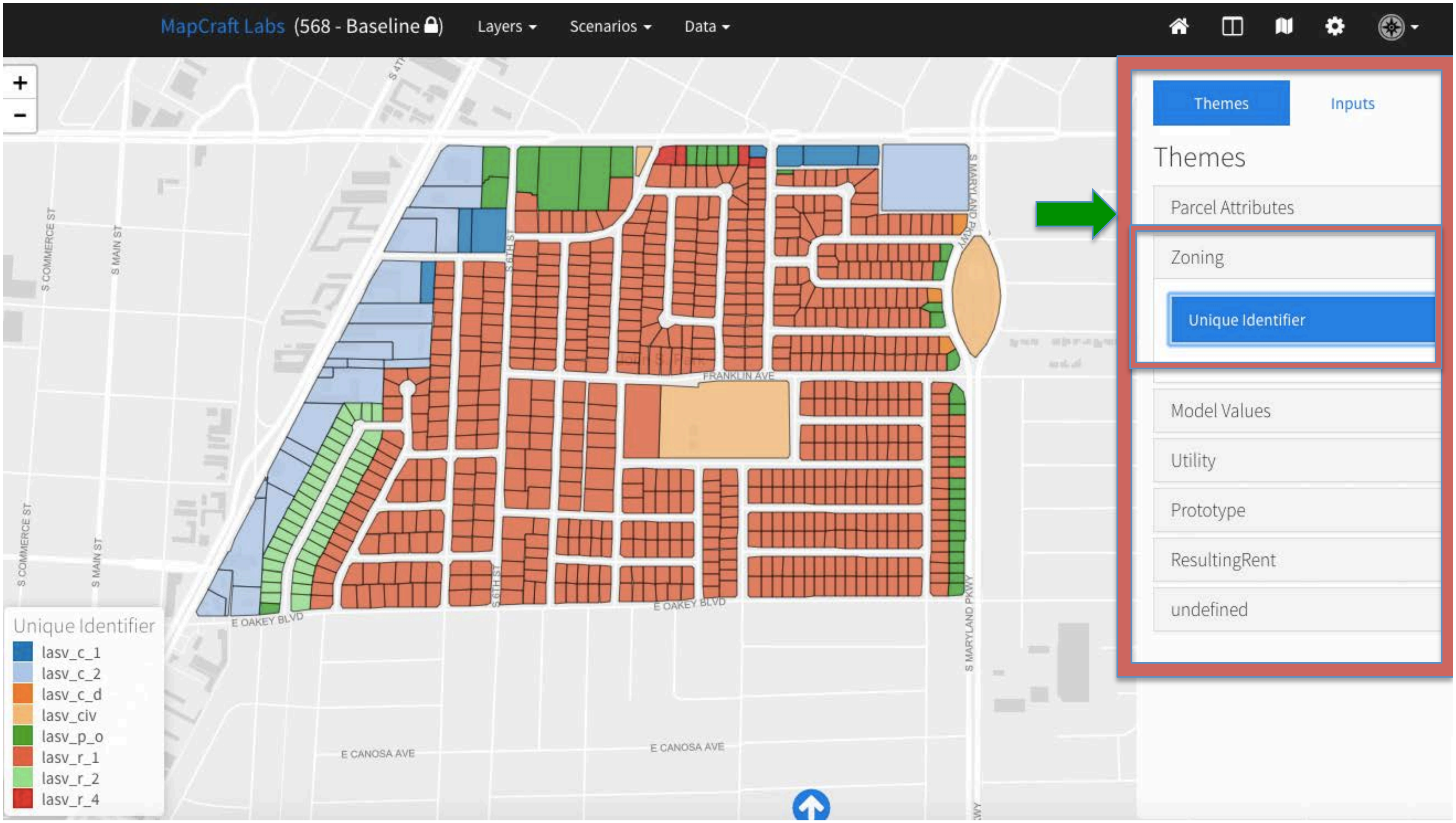
Iterative Modeling Process



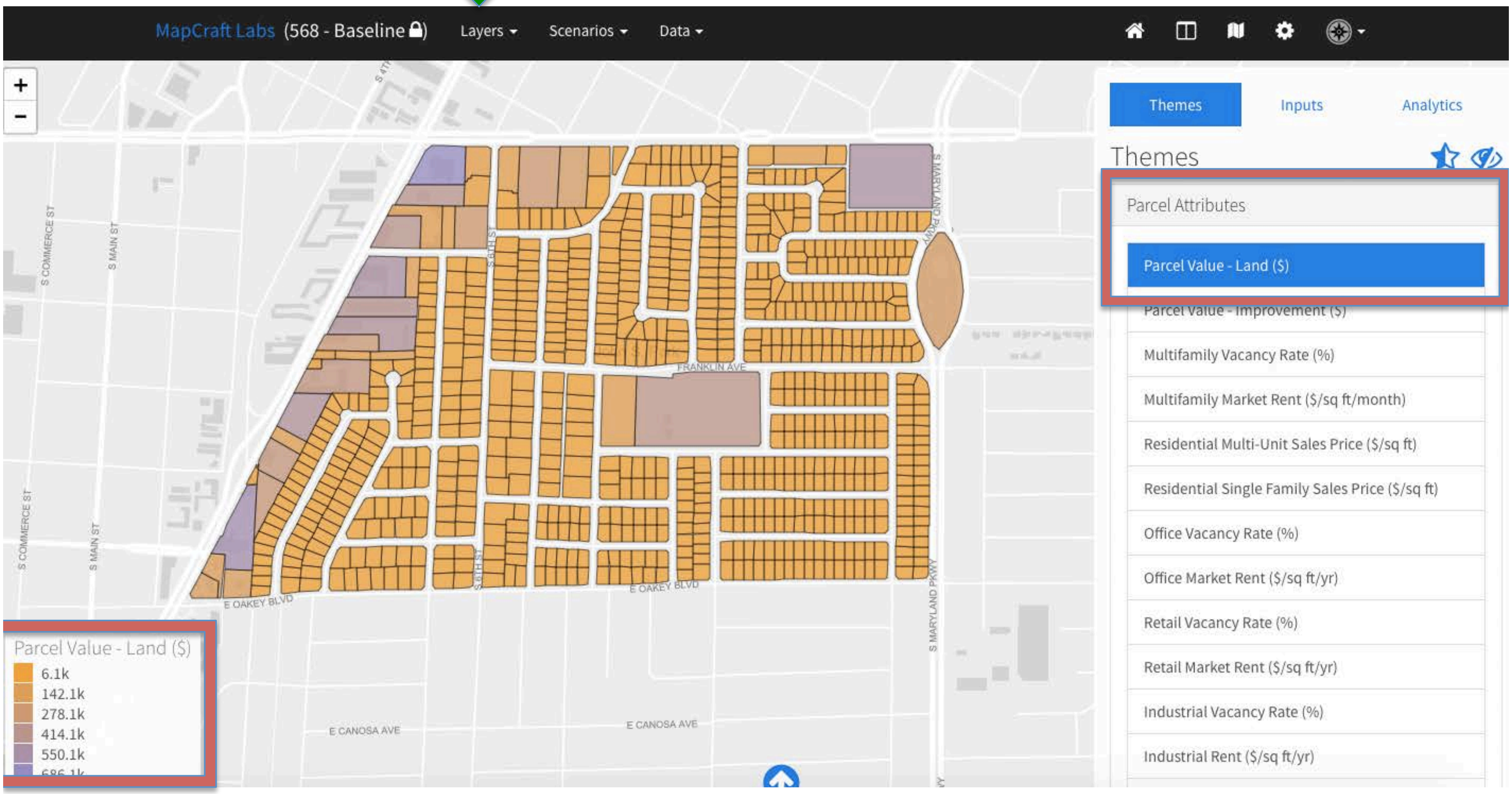
What is MapCraft?

- Interactive web application
- Parcel based analysis
- Integrated land-use and transportation
- Agent based model
  - Developer is the agent
- Utility function to distribute regional forecast
  - TAZ - Census – Custom Neighborhood
- Upstream or downstream REMI integration

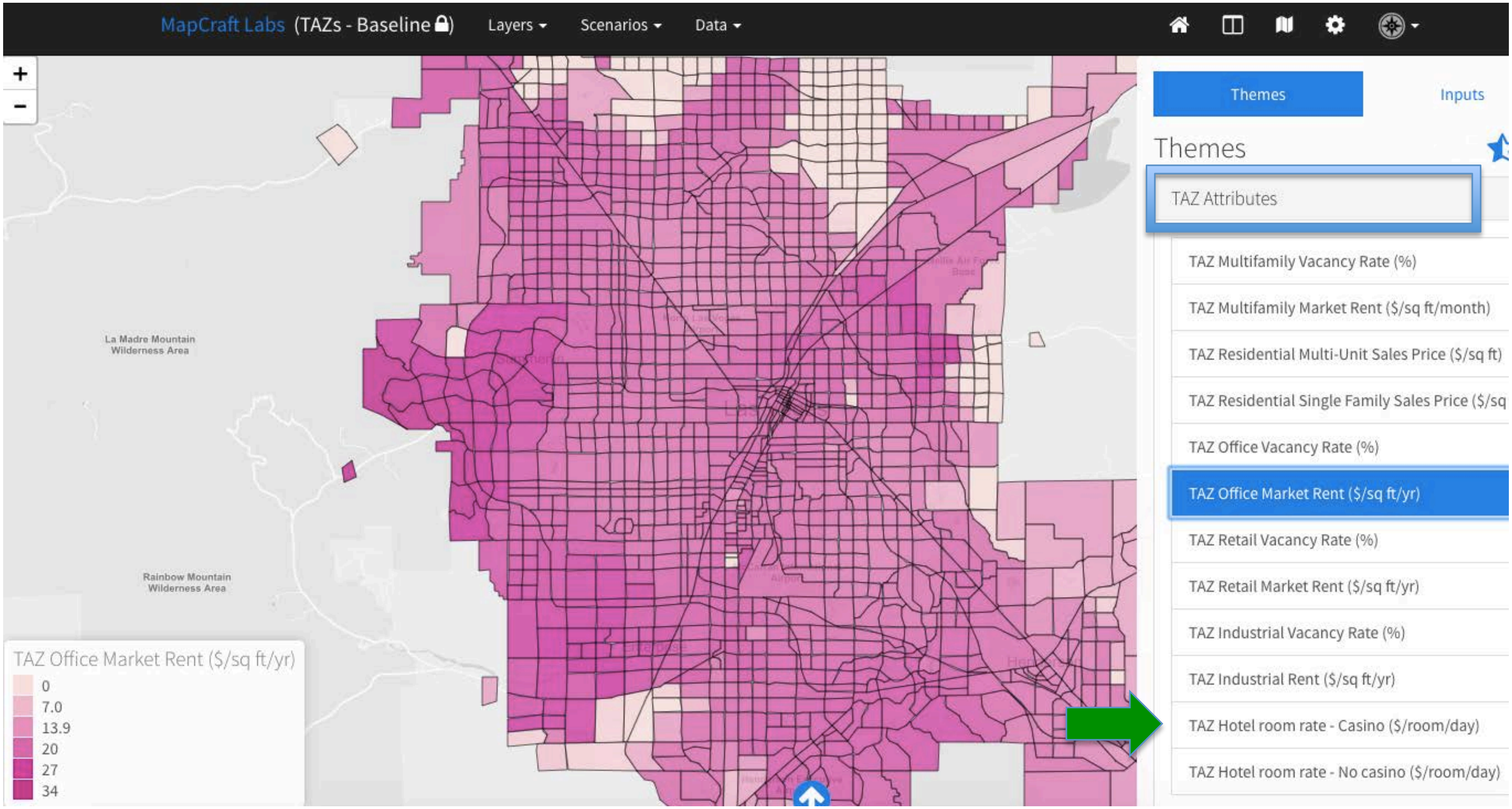
Parcel Based Data for Entire Region



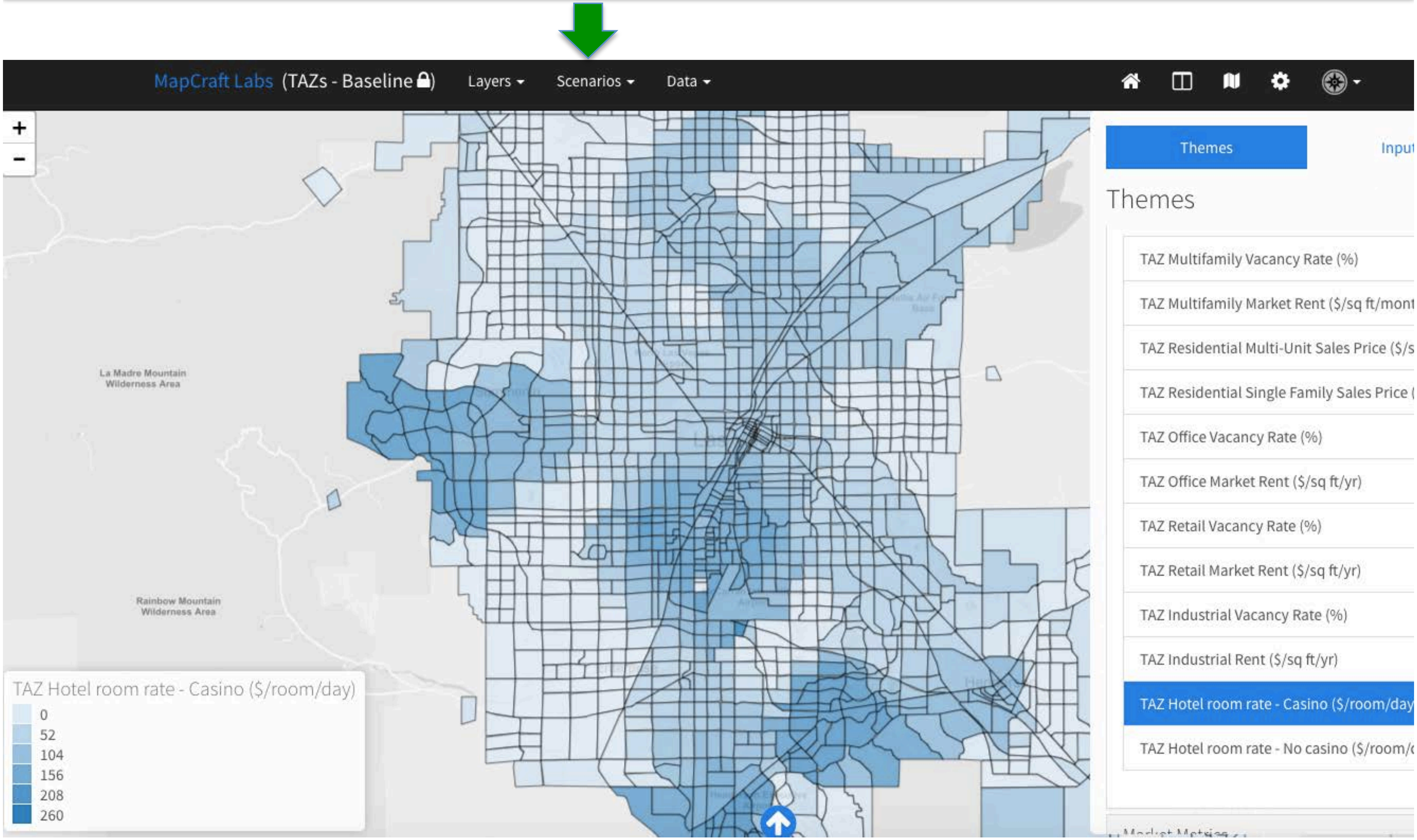
Parcel Based Data for Entire Region



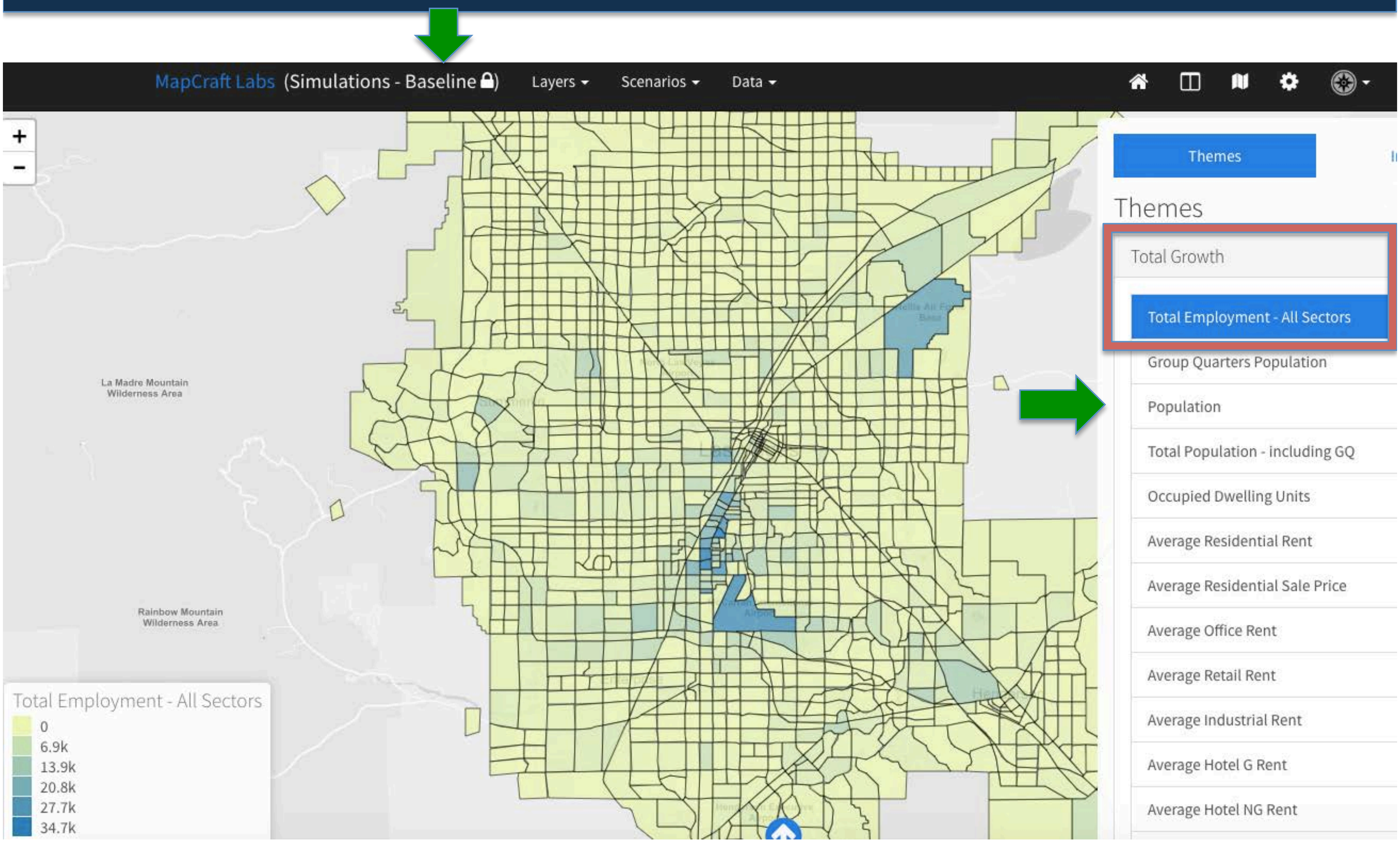
Regional Market Data – TAZ Level



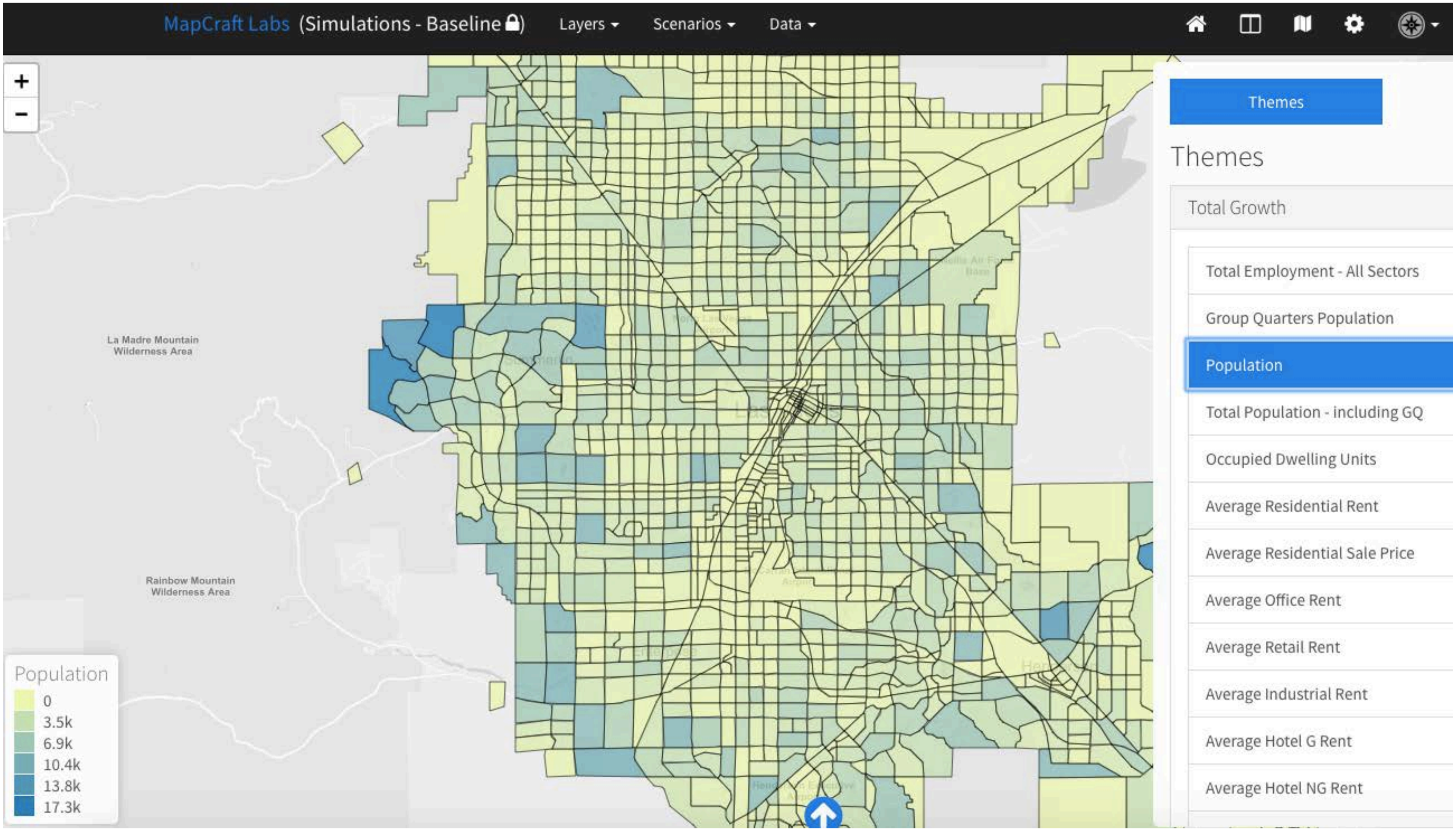
Regional Market Data – TAZ Level



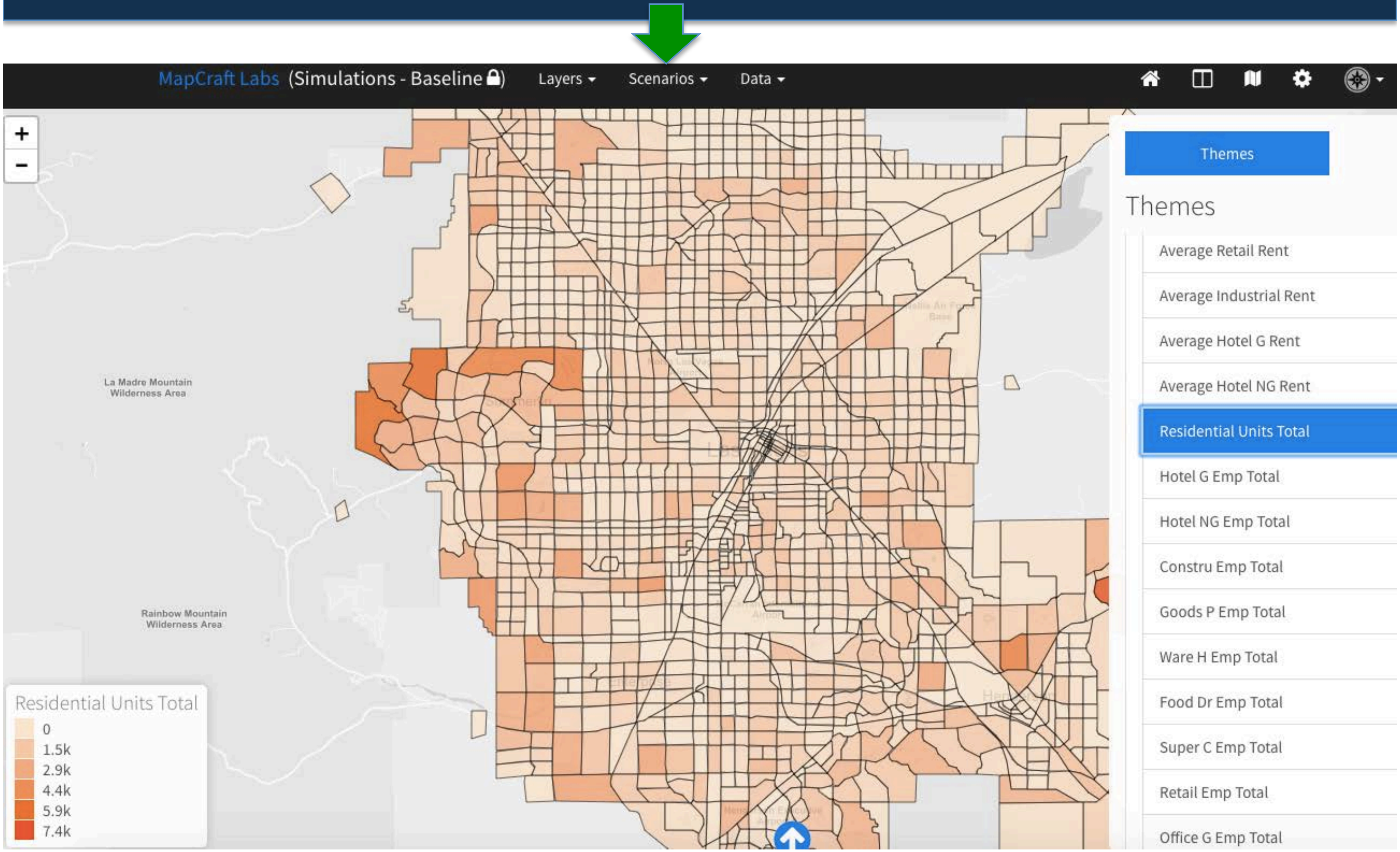
Baseline Allocation



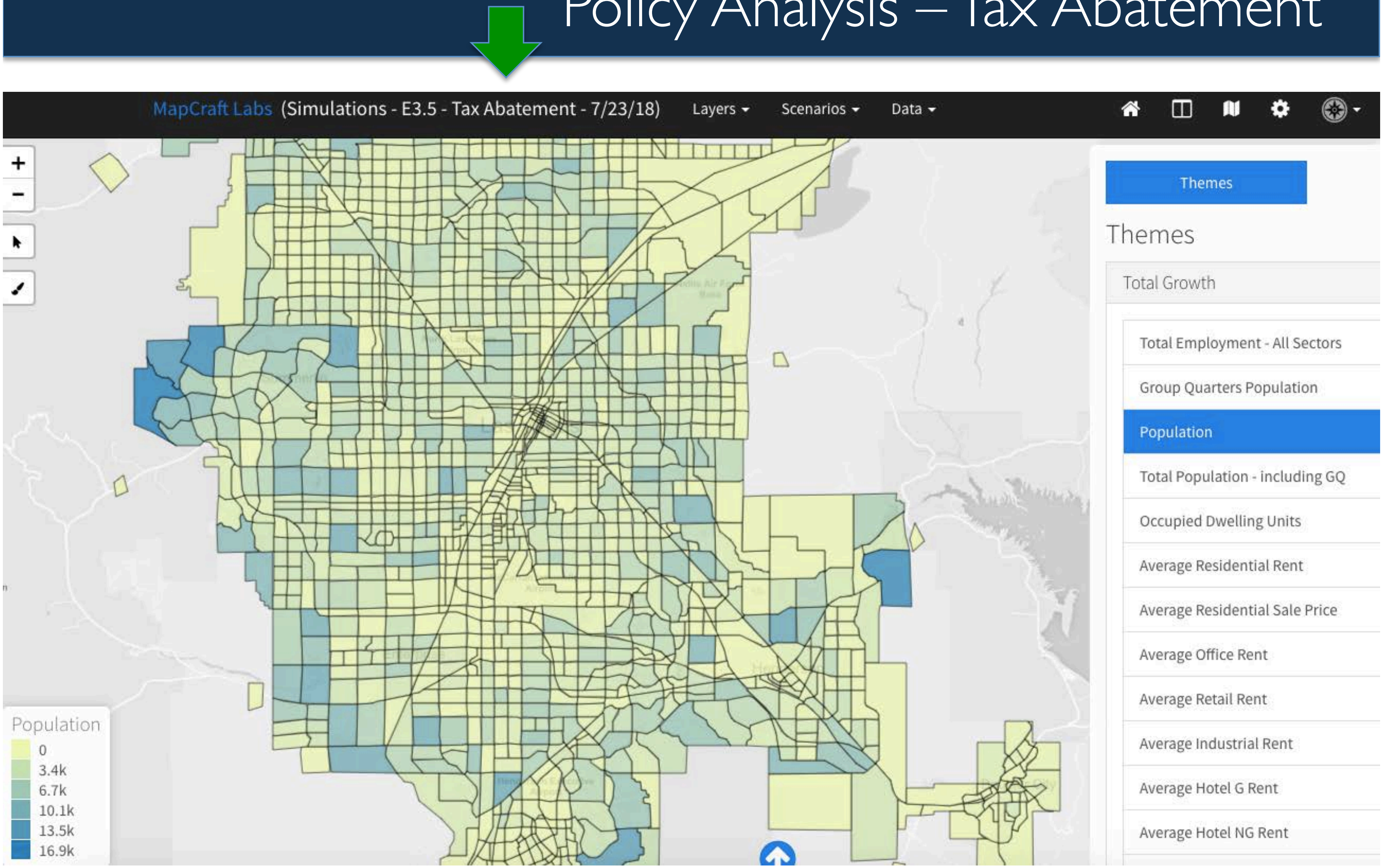
Baseline Allocation



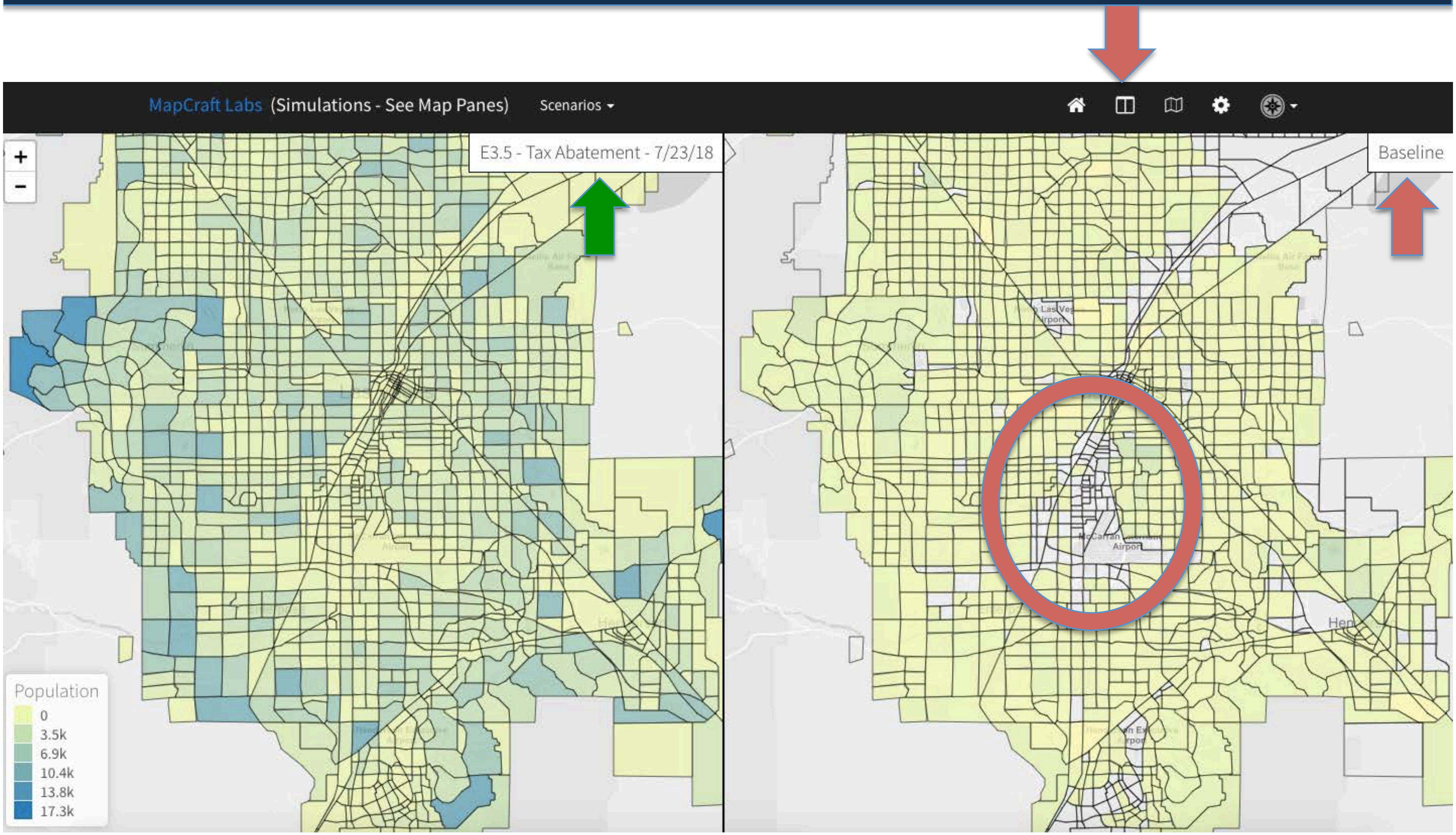
Baseline Allocation



Policy Analysis – Tax Abatement

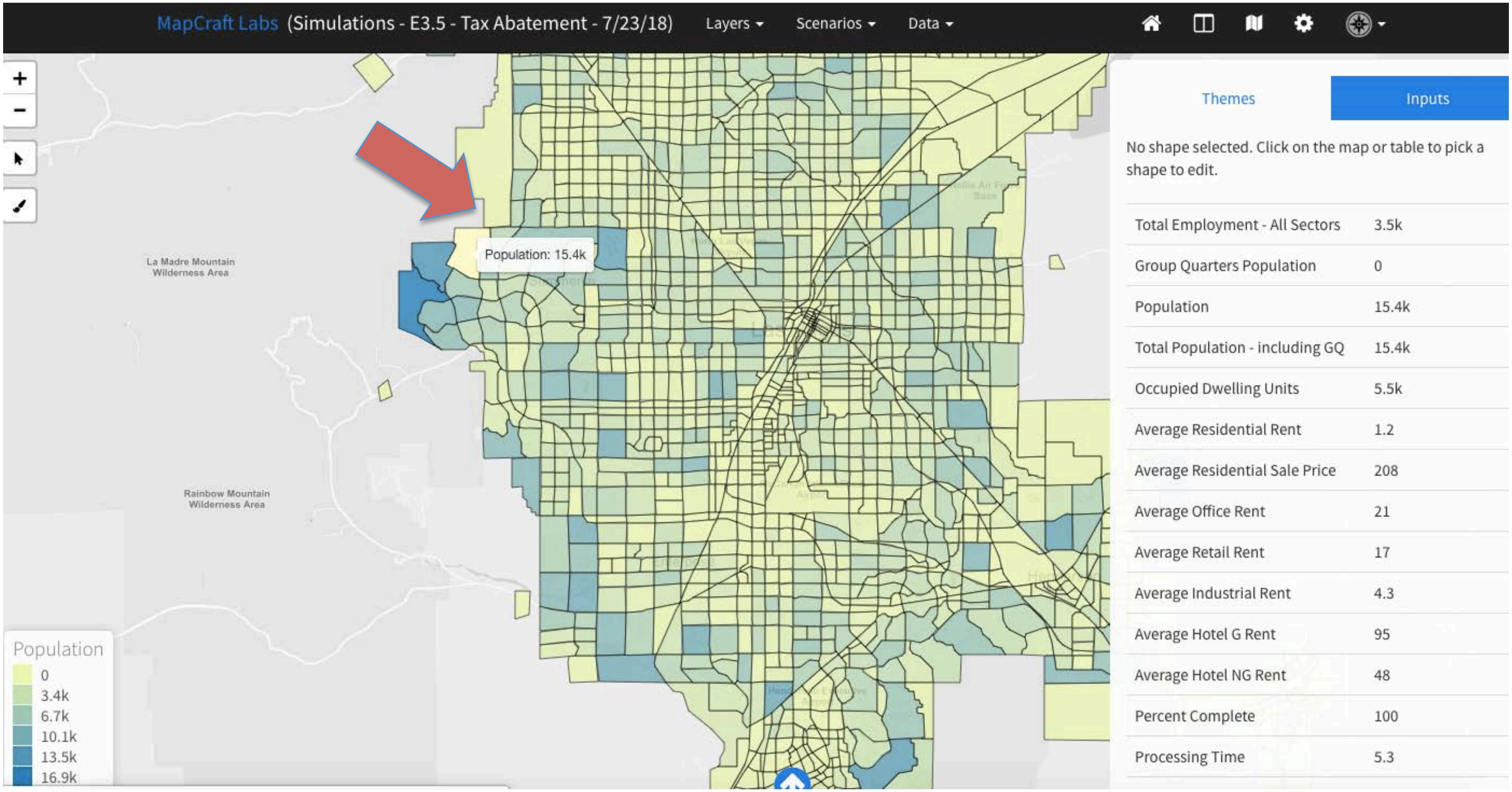


Reallocates Population – Compare to Baseline



Net Difference from Policy Scenario

Spatial reporting of variables of interest



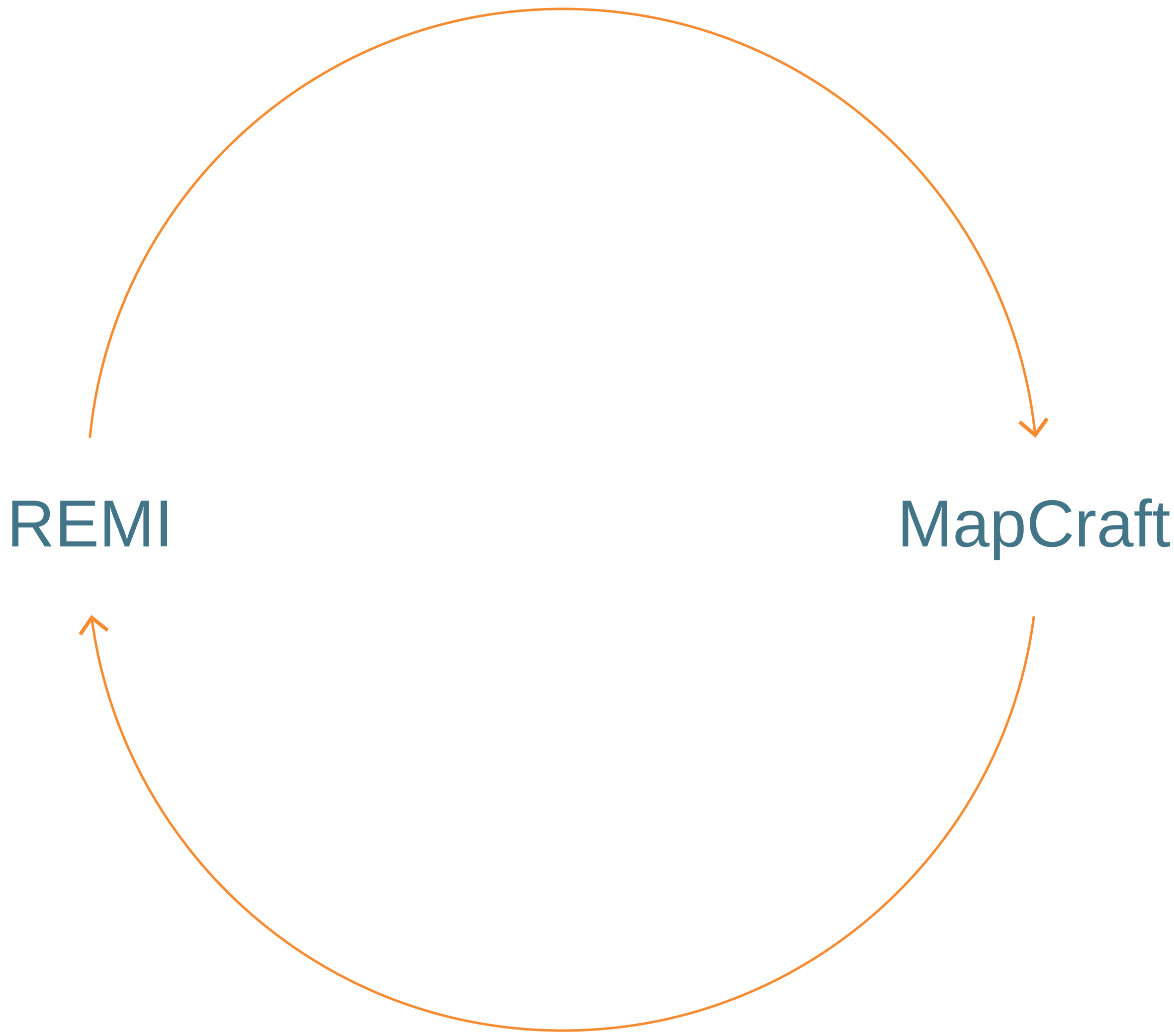
Export Spatial Data – REMI Input -- Iterations

MapCraft Labs (Simulations - E3.5 - Tax Abatement - 7/23/18)

Data Summary (1658 features)

Attribute	Count	Std	Mean	Min	25%	50%	75%	Max
Total Employment - All Sectors	1658	9664.51	4579.7	0	194.69	1473.94	4602.14	103952.7
Group Quarters Population	1658	151.95	9	0	0	0	0	5949
Population	1658	2092.26	1680.06	0	0	1034.7	2467.26	16851.15
Total Population - including GQ	1658	2099.46	1689.06	0	0	1037.9	2467.84	16851.15
Occupied Dwelling Units	1658	769.36	601.13	0	0.56	364.82	863.46	6902.51
Average Residential Rent	1658	0.33	1.15	0	1.16	1.23	1.3	1.53
Average Residential Sale Price	1658	80.29	200.15	0	163.56	182.72	209.35	767.82
Average Office Rent	1658	8.33	19.26	0	19.12	21.9	24.34	34.82
Average Retail Rent	1658	9	17.19	0	13.3	16.83	22.69	52.32
Average Industrial Rent	1658	4.91	6.45	0	0	8.82	10.11	14.94
Average Hotel G Rent	1658	71.37	76.76	0	0	66.08	114.61	263.9
Average Hotel NG Rent	1658	57.34	71.46	0	0	74.57	117.25	428.87
Percent Complete	1658	0	100	100	100	100	100	100
Processing Time	1658	17.1	18.35	3.1	7.73	11	24.5	194.3
Residential Unit Prob	1658	858.69	594.62	0	75.96	343.54	777.6	7697.59
Hotel G Emp Prob	1658	130.22	31.93	0	0	2.31	19.22	3098.37
Hotel NG Emp Prob	1658	40.63	3.74	0	0	0	0.05	1103.6
Constru Emp Prob	1658	228.64	56.45	0	0	6.19	31.4	4560.21
Goods P Emp Prob	1658	69.43	16.7	0	0	1.8	9.42	1415.93

Iterative Modeling Process



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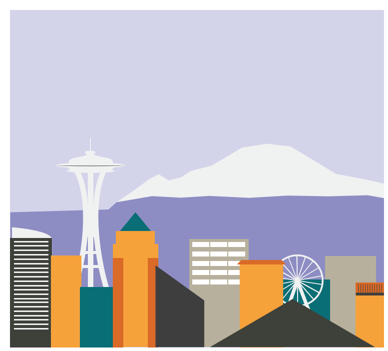
ECONOMICS • FINANCE • PLANNING

Eugene

Portland



Seattle

Boise