Incorporating Discrete Characteristics and Network Relationships of Parking into SF- CHAMP Travel Model

Lisa Zorn, Elizabeth Sall & Billy Charlton

SAN FRANCISCO COUNTY TRANSPORTATION AUTHORITY

3rd Conference on Innovations in Travel Modeling, Tempe, Arizona
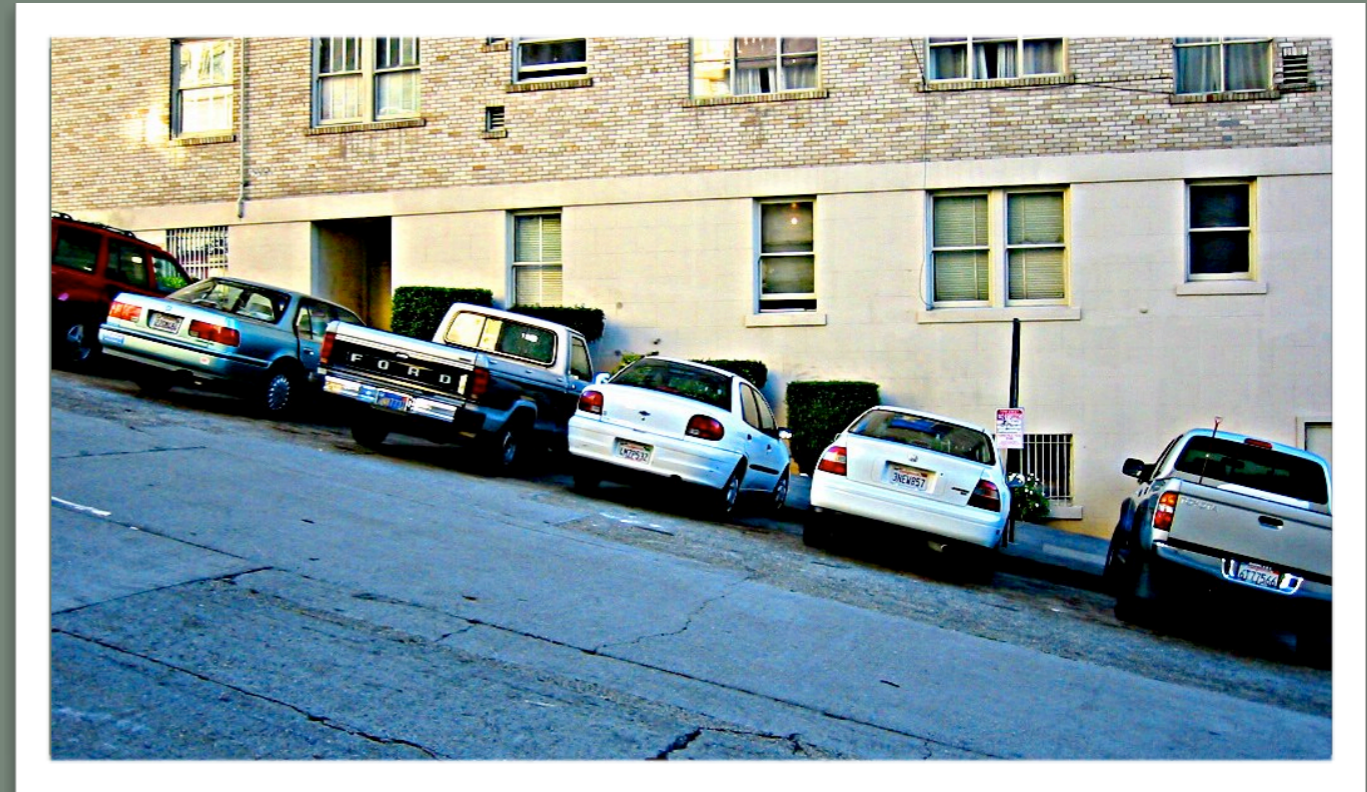May 11, 2010

Why Model Parking?

- **Test effects of varying parking supply and pricing**

- **Test smart parking (reduced search time)**

- **People often don't park in destination zone**

Outline

(1) Background & Goals

(2) Parking in Existing SF-CHAMP

(3) New Data

(4) Parking Enhancements to SF-CHAMP

(5) Results

(6) Next Steps
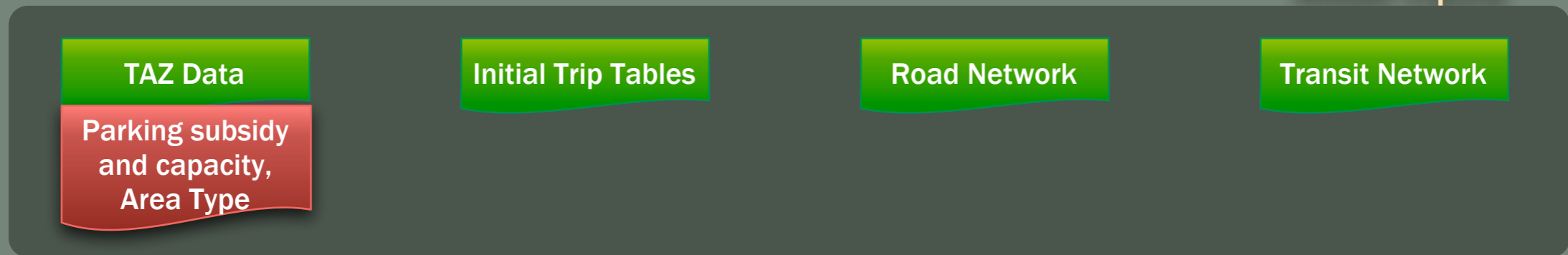

Source: chelseagirlphotos, Flickr
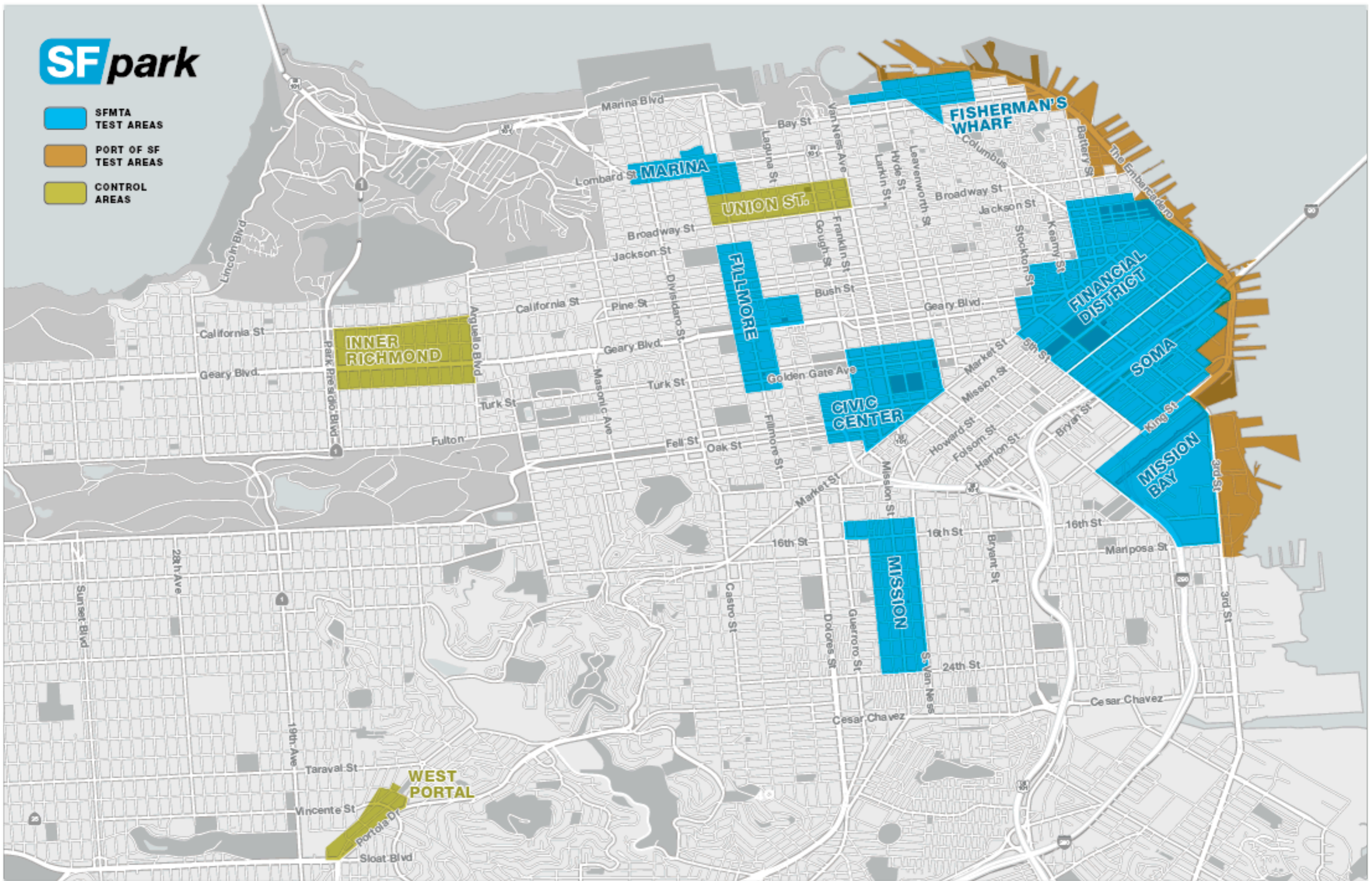
SF-CHAMP Parking Enhancement Goals

(1) Separate treatments of on- and off-street parking

(2) Model parking price and availability variations across time of day

(3) Relate parking search time to available spaces

(4) Represent parking explicitly in the roadway network

(5) Capture the trade off between parking search time, cost, and walk time

Parking in Existing SF-CHAMP

Model Inputs

TAZ Data

Parking subsidy and capacity, Area Type

Initial Trip Tables

Road Network

Transit Network

Multiple Iterations

Initial Road Assignment

Transit Skimming

Full-Day Tour Generation

Intermediate Stop Choice

Final Road Assignment

Roadway Skimming

Terminal time per OD-pair

Work Loc & Destination Choice

TAZ-based parking time, costs

Tour Mode Choice

TAZ-based parking time, costs

Trip Mode Choice

TAZ-based parking time, costs

Transit Assignment

Model Outputs

Roadway Skims

Transit Skims

Person Trip Tables

Loaded Road Network

Parking in Existing SF-CHAMP

1) *pctPaying*

2) *totalParking*

3) *parkCostWorkHourly* and *parkCostOtherHourly*

4) *areatype*

Parking in Existing SF-CHAMP

$$
\begin{aligned}
U_{\mathrm{DA}} \quad = \quad & C_{\mathrm{IVT}}W_{\mathrm{walk}}t_{\mathrm{terminal}} + \\
& C_{\mathrm{park,inclow}}D_{\mathrm{inclow}}c_{\mathrm{park,DA}} + \\
& C_{\mathrm{park,incmed}}D_{\mathrm{incmed}}c_{\mathrm{park,DA}} + \\
& C_{\mathrm{park,inchi}}D_{\mathrm{inchi}}c_{\mathrm{park,DA}} + \\
& C_{\mathrm{pkind}}a_{\mathrm{dtaz}} + \\
& ...\text{(other components of utility)}...
\end{aligned}
$$

New Data: 2006 Stated Preference Survey on Parking

	Low Price Level	High Price Level
Search Time	Pay **$0.50 to $1.00** <u>more</u> per hour to **find a parking space in less than 5 minutes** but may require me to **walk 2 to 3 blocks** from my parking space to my destination	Pay **$1.50 to $2.00** <u>more</u> per hour to **find a parking space immediately** but may require me to **walk 2 to 3 blocks** from my parking space to my destination
Walk Distance	Pay **$0.50 to $1.00** <u>more</u> per hour to **park within 1 to 2 blocks** of my destination but may require me to **drive around for more than 5 minutes** searching for a parking space	Pay **$1.50 to $2.00** <u>more</u> per hour to **park right in front of my destination** but may require me to **drive around for more than 5 minutes** searching for a parking space

Discrete Choice Model Estimation Results

Significant Variables:
- trip purpose
- frequency of parking
- frequency of transit use
- number of household vehicles
- weekdays or weekends
- disability limiting physical movement

Discrete Choice Model Estimation Results

Variables	Value	t-test	p-value
Alternative 1	0.00	*fixed*	
Alternative 2	0.06	0.72	0.48
Cost ("Additional Dollars/hour")			
No. times park per week	0.44	2.11	0.03
Trip purpose: errand	-5.44	-5.02	0.00
Trip purpose: shopping	-4.84	-3.98	0.00
Trip purpose: work	-5.80	-4.29	0.00
Trip purpose: work-based errand	-5.45	-2.88	0.01
Search Time ("Minutes")			
Physical disability	0.14	6.18	0.00
No. times park per week	0.18	2.41	0.01
Trip purpose: errand	-1.69	-4.40	0.00
Trip purpose: shopping	-1.56	-3.63	0.00
Trip purpose: work	-1.87	-3.91	0.00
Trip purpose: work-based errand	-1.56	-2.35	0.02
Walking Distance ("Blocks")			
Physical disability	-0.20	-4.37	0.00
No. times park per week	0.32	2.09	0.03
Trip purpose: errand	-3.01	-3.79	0.00
Trip purpose: shopping	-2.69	-3.03	0.00
Trip purpose: work	-3.23	-3.26	0.00
Trip purpose: work-based errand	-2.75	-1.99	0.05

n= 5187, ρ^2= 0.165, adjusted ρ^2= 0.160

Discrete Choice Model Estimation Results

Trip Category	Value of Search Time ($/hour)	Value of Walk Distance ($/block)	Value of Walk Time ($/hour)
Trip purpose: errand	16.49	0.49	13.45
Trip purpose: shopping	17.13	0.48	13.21
Trip purpose: work	17.63	0.50	13.74
Trip purpose: work-based errand	14.46	0.42	11.57

Assuming parking duration of 1 hour
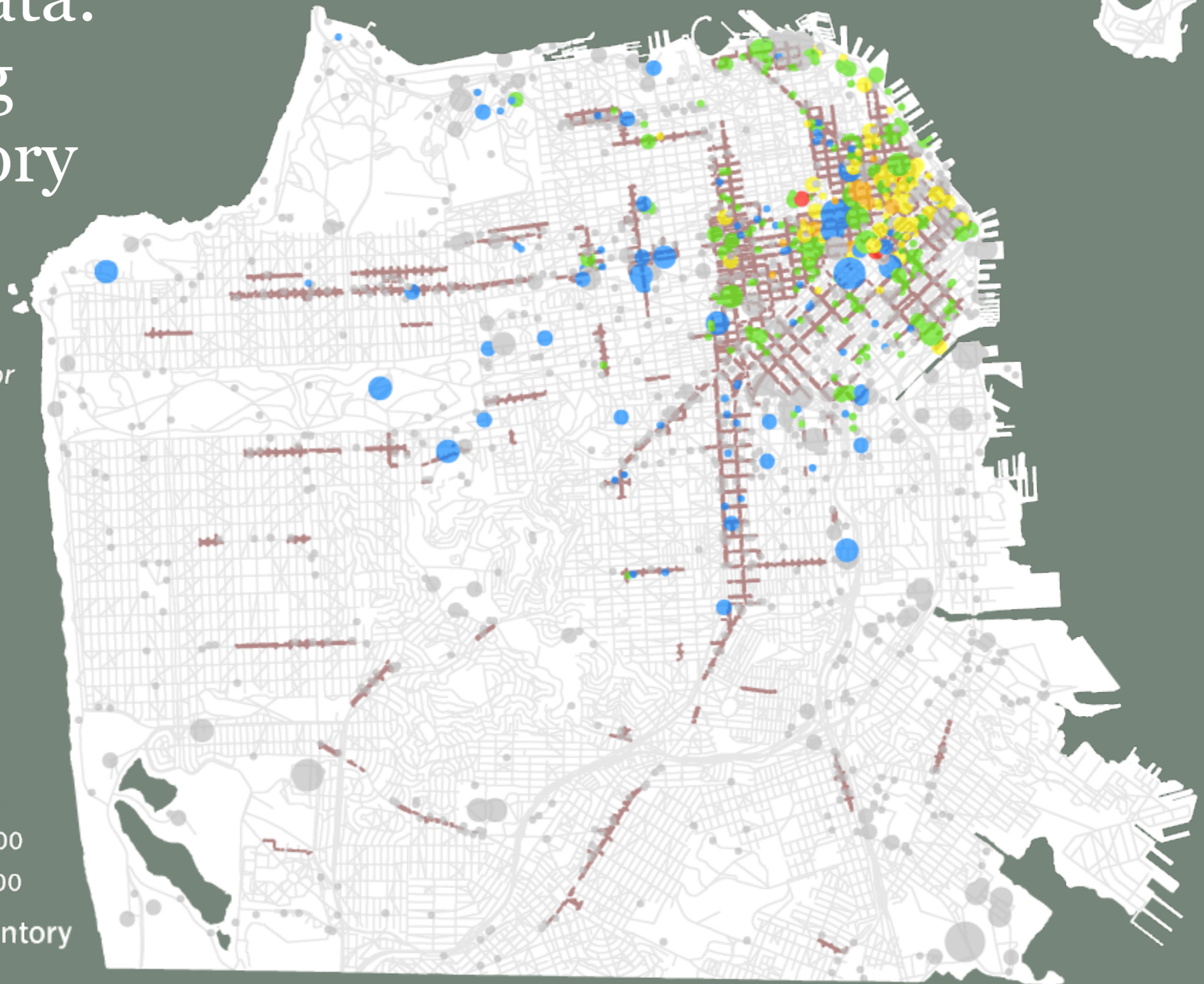
New Data: Parking Inventory

Onstreet Inventory

Cost to Park for 2 Hours
- Free
- $1 - $8
- $9 - $16
- $17 - $24
- $25 - $32
- $33 - $40

No. of Spaces
- 2 - 170
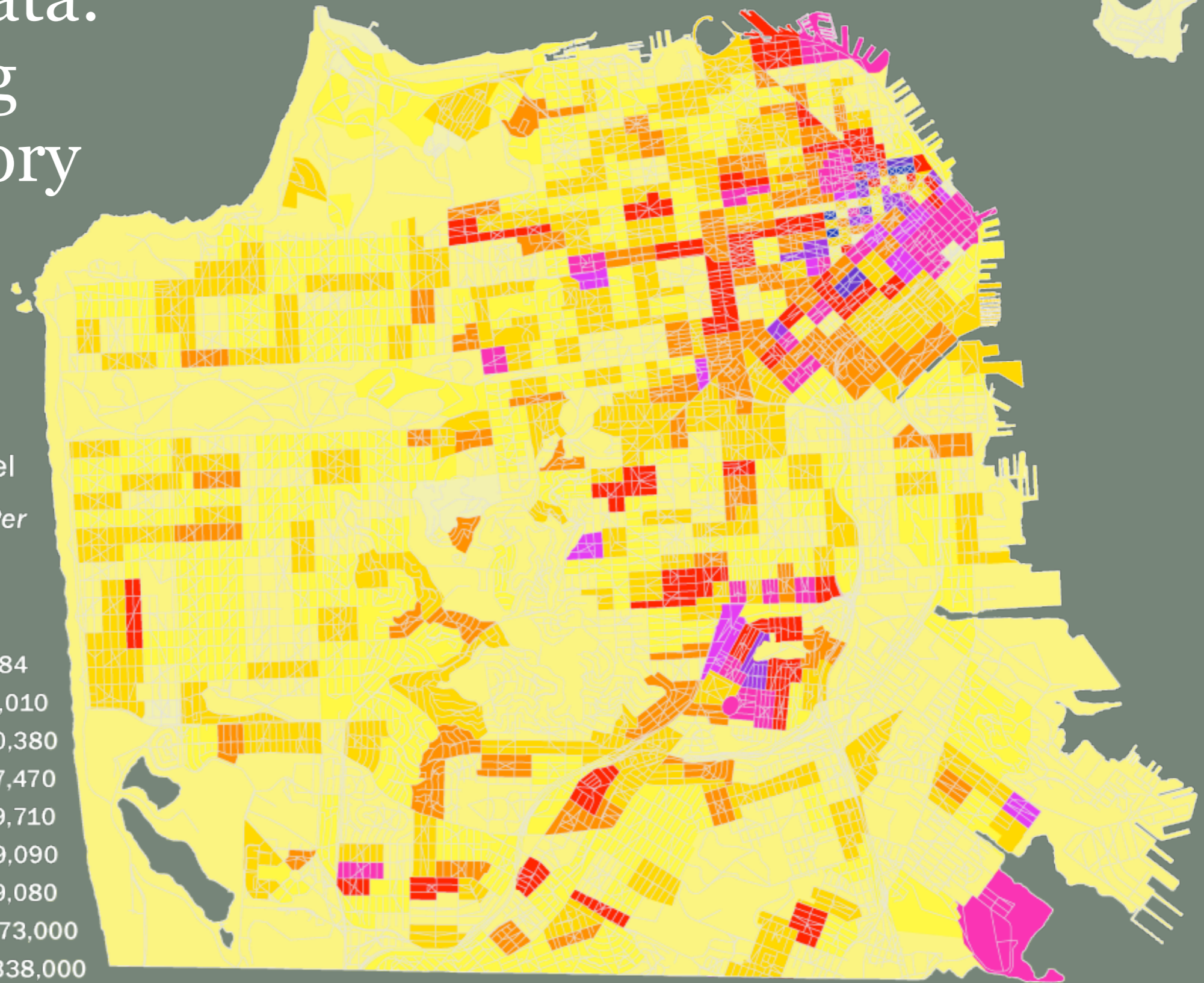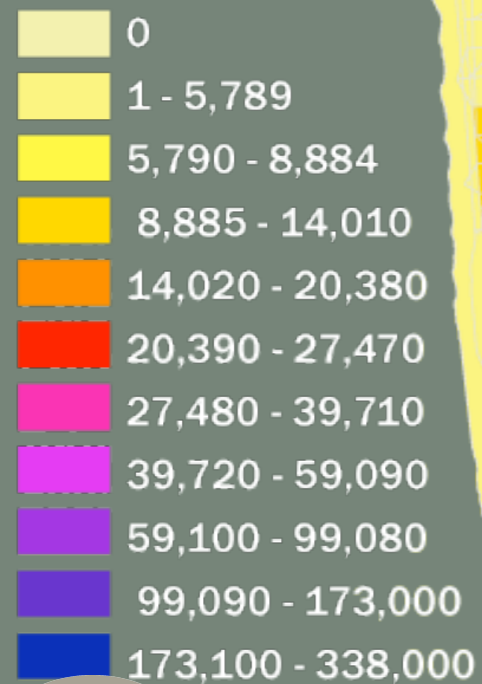- 171 - 550
- 551 - 1,681
- 1,682 - 3,700
- 3,701 - 9,000

Onstreet Inventory
- Meter
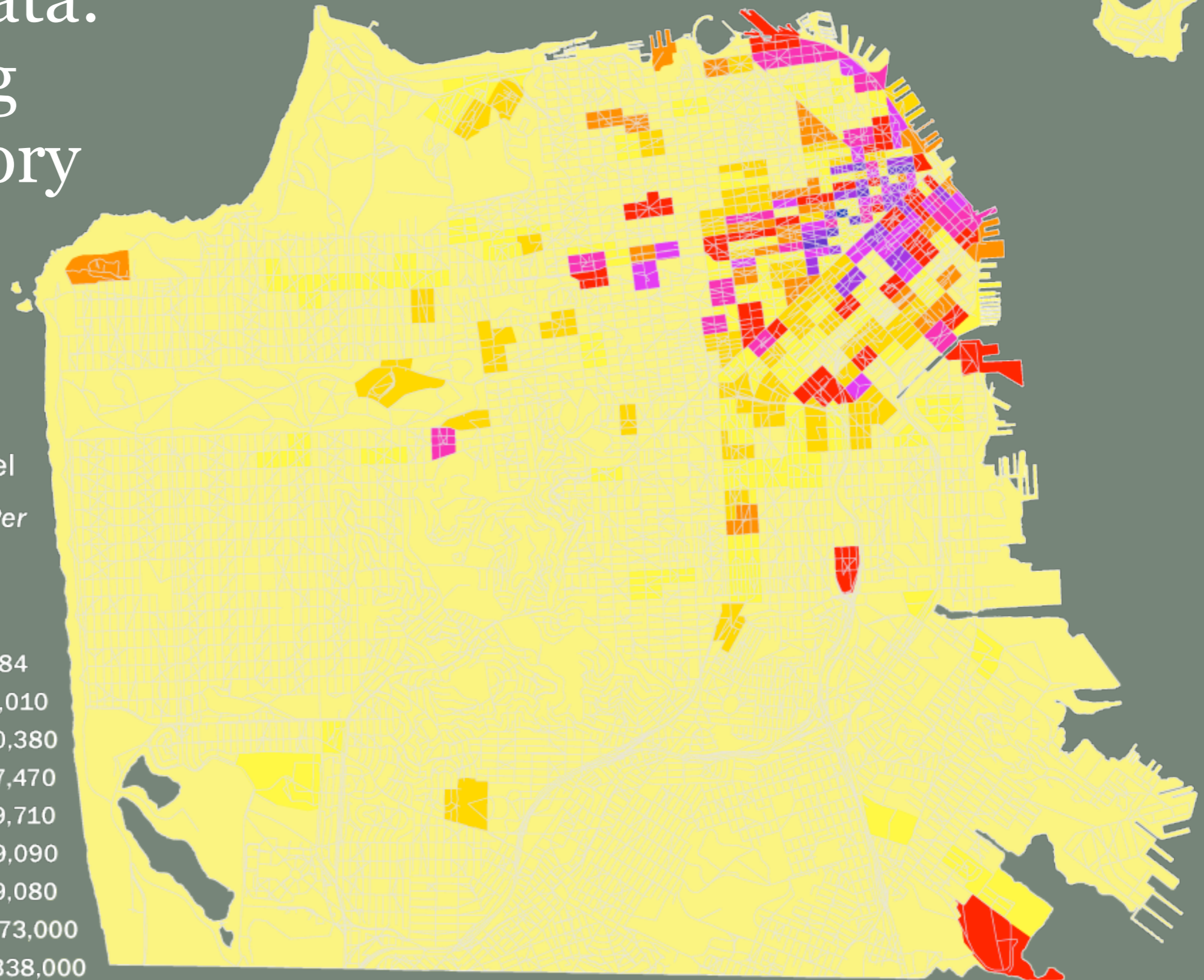
New Data: Parking Inventory

TazData in Existing Parking Model

Total Parking Per Square Mile

- 0
- 1 - 5,789
- 5,790 - 8,884
- 8,885 - 14,010
- 14,020 - 20,380
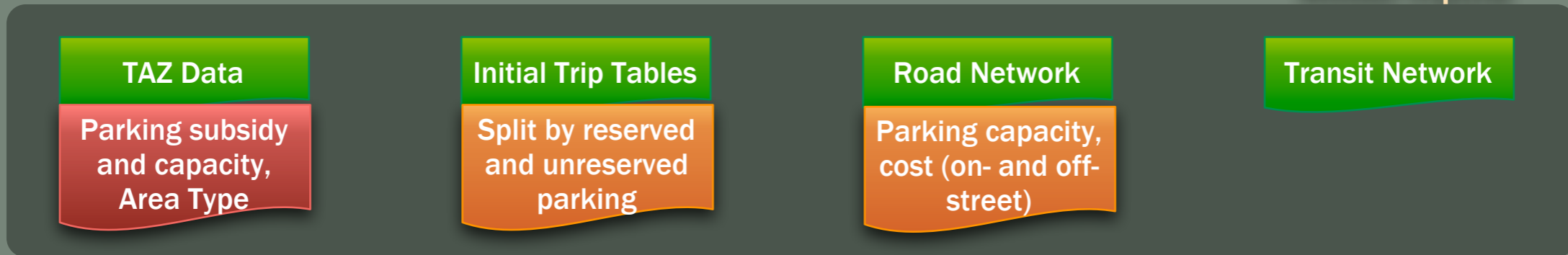- 20,390 - 27,470
- 27,480 - 39,710
- 39,720 - 59,090
- 59,100 - 99,080
- 99,090 - 173,000
- 173,100 - 338,000

New Data: Parking Inventory

TazData in Enhanced Parking Model

Total Parking Per Square Mile

- 0
- 1 - 5,789
- 5,790 - 8,884
- 8,885 - 14,010
- 14,020 - 20,380
- 20,390 - 27,470
- 27,480 - 39,710
- 39,720 - 59,090
- 59,100 - 99,080
- 99,090 - 173,000
- 173,100 - 338,000
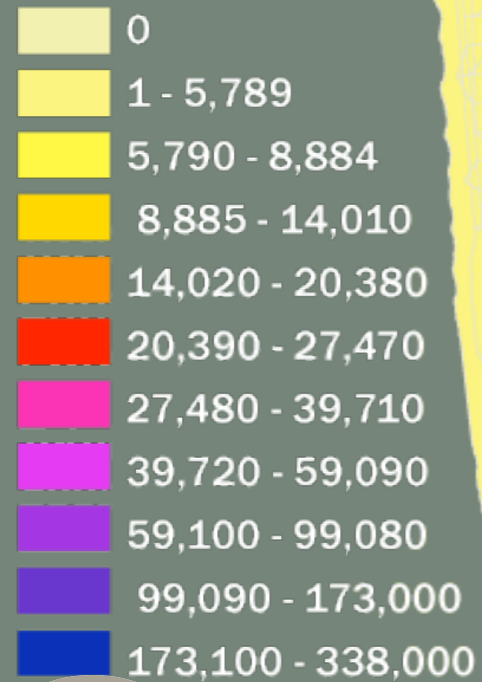
SF-CHAMP Enhanced Parking Model

Model Inputs

TAZ Data	Initial Trip Tables	Road Network	Transit Network
Parking subsidy and capacity, Area Type	Split by reserved and unreserved parking	Parking capacity, cost (on- and off-street)	

Multiple Iterations

Parking General Cost

Initial Road Assignment → Roadway Skimming (Terminal time per OD-pair) → Transit Skimming → Work Loc & Destination Choice (Skim-based parking time, costs) → Full-Day Tour Generation → Tour Mode Choice (Skim-based parking time, costs) → Intermediate Stop Choice → Trip Mode Choice (Skim-based parking time, costs) → Final Road Assignment (Parking General Cost) → Transit Assignment

Model Outputs

Roadway Skims	Transit Skims	Person Trip Tables	Loaded Road Network
Parking costs, travel times for unreserved		Split by reserved and unreserved parking	

Deciding Who Pays

Reserved Parking	Unreserved Parking
• To home • Some work and school trips • Disabled placard holders	All others

Deciding Who Pays

Reserved Parking	Unreserved Parking
• To home • Some work and school trips • Disabled placard holders	All others

44% **56%**
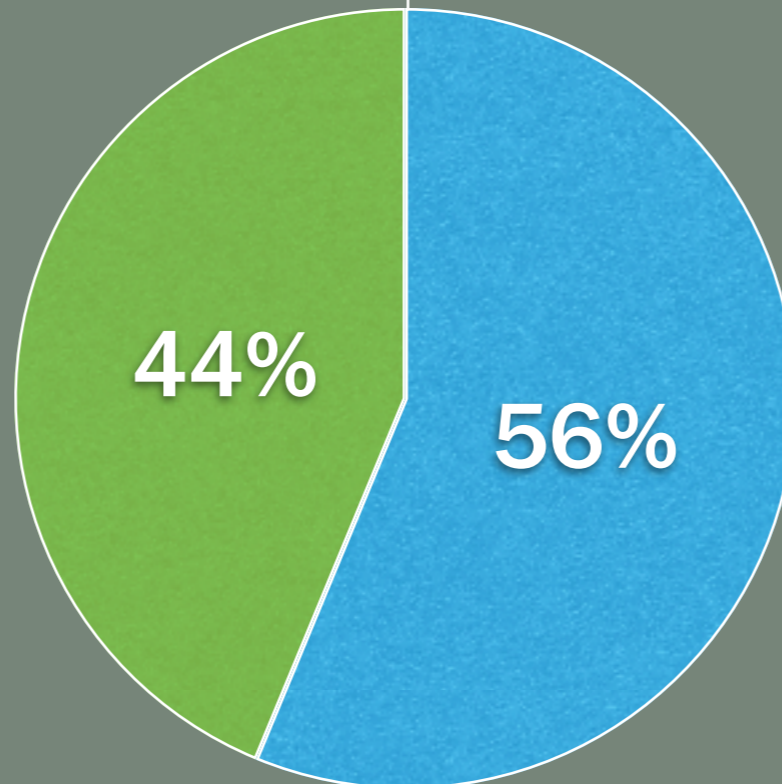
Network Representation: Offstreet

Reserved

Legend:
- Roadway
- TAZ Boundary
- TAZ Centroid
- Centroid Connector

Unreserved

Legend:
- Roadway
- TAZ Boundary
- TAZ Centroid
- Parking Link
- Roadway to Parking
- Parking to Walkable TAZs

Network Representation: Offstreet
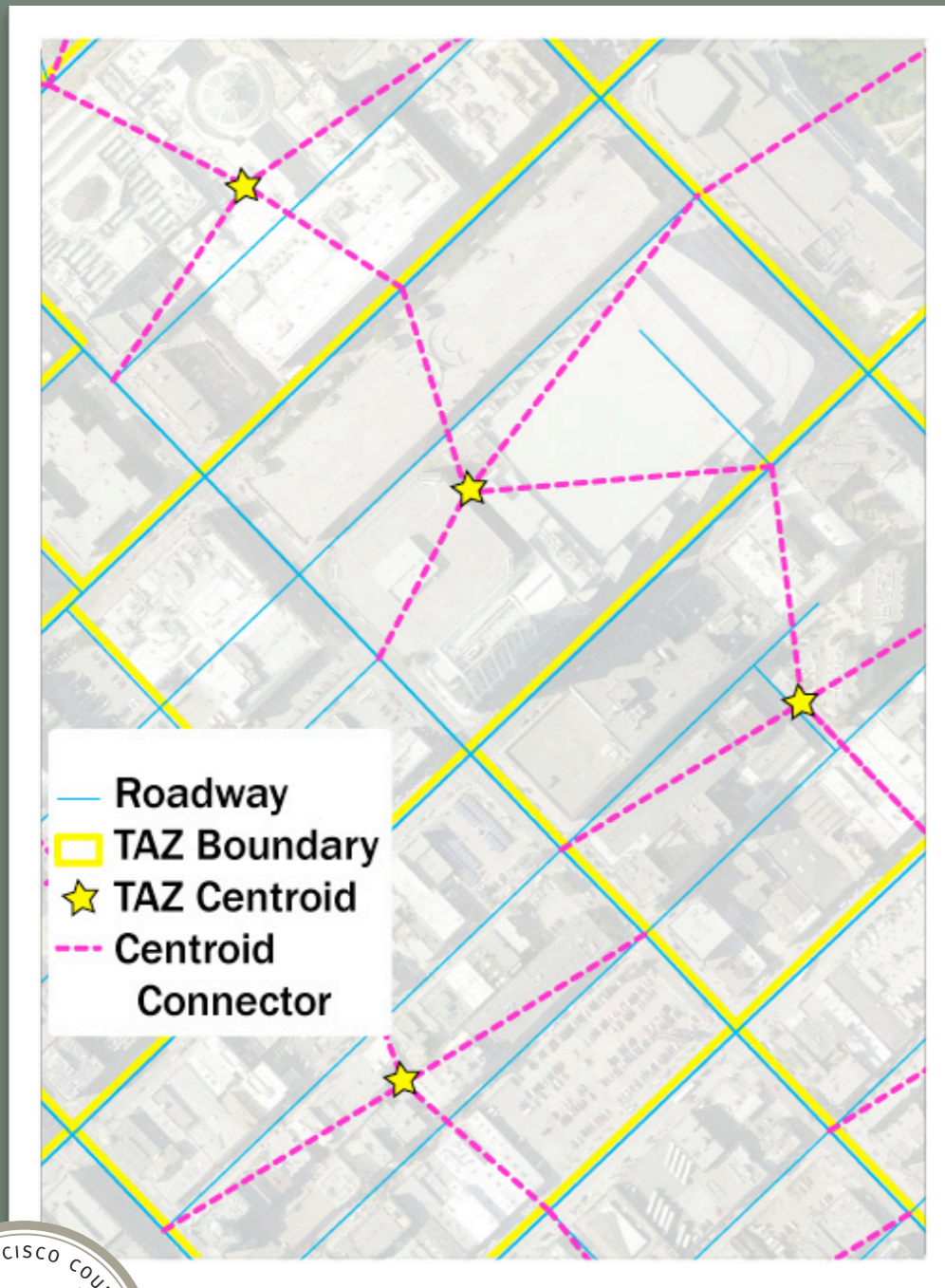
Network Representation: Onstreet

Reserved

Unreserved

Legend (Reserved):
- Roadway
- TAZ Boundary
- TAZ Centroid
- Centroid Connector

Legend (Unreserved):
- Roadway
- TAZ Boundary
- TAZ Centroid
- Parking Link
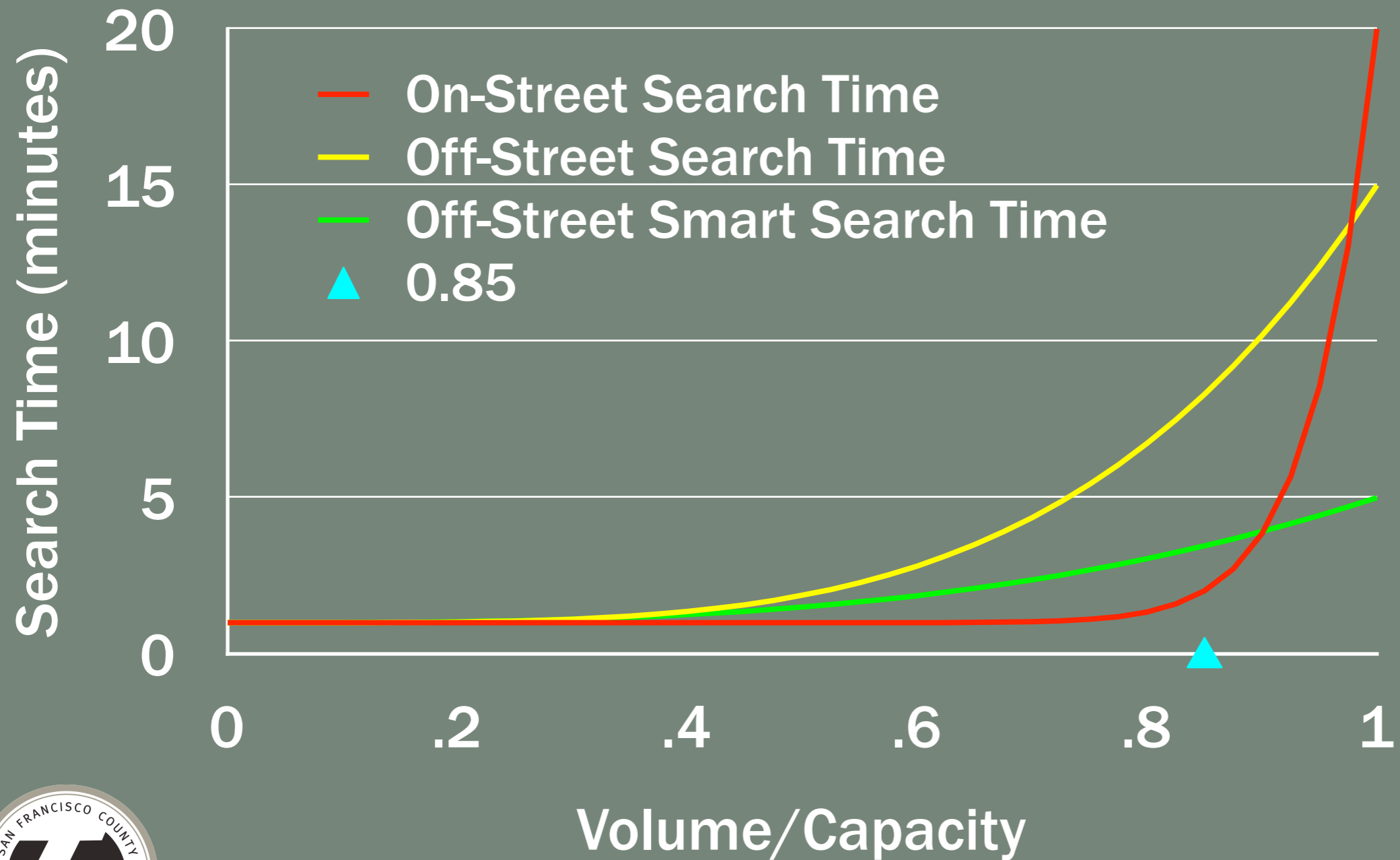- Roadway to Parking
- Parking to Walkable TAZs
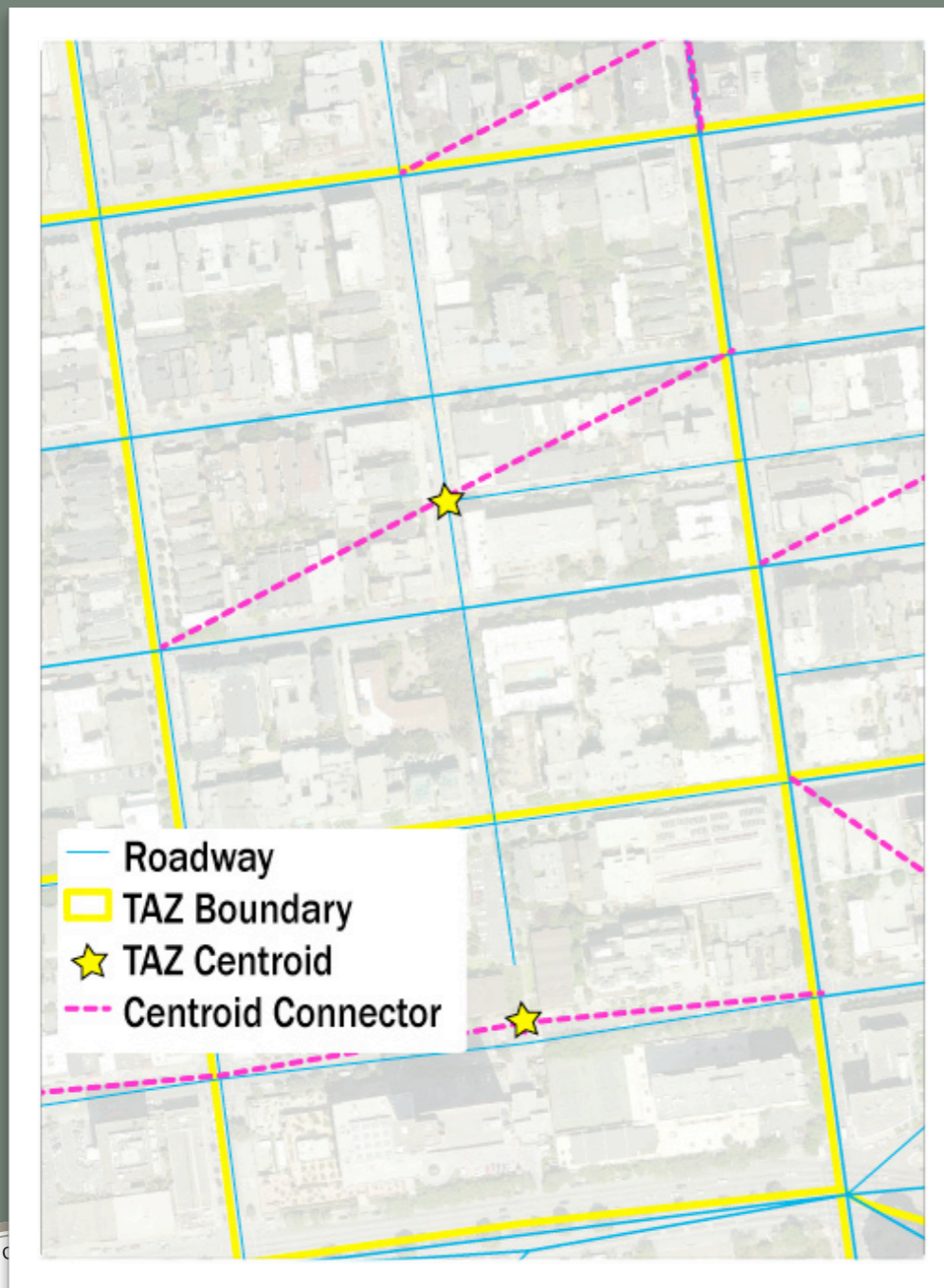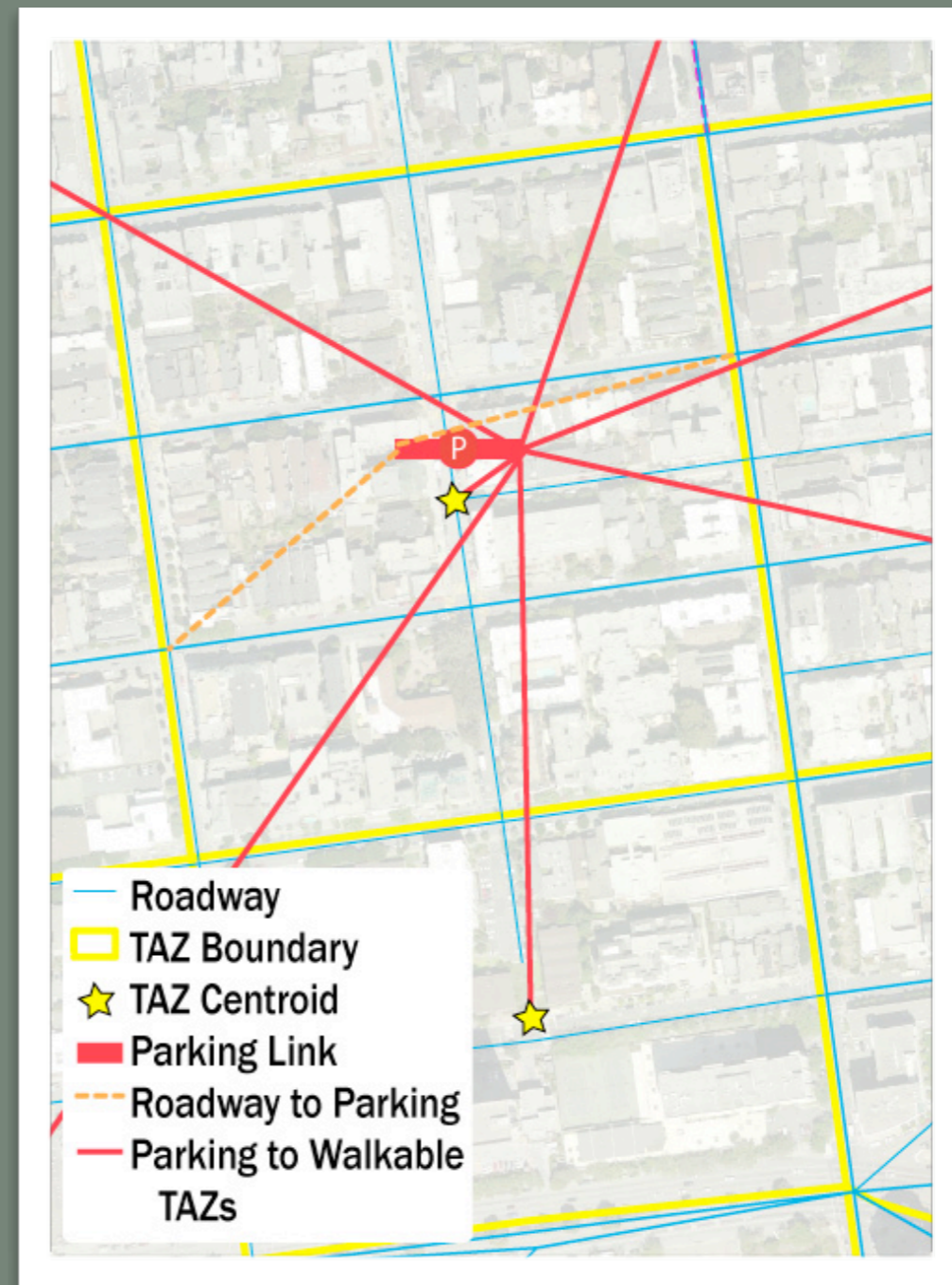
Generalized Cost

$$GC = \beta_{\text{Cost}} C + \beta_{\text{Search}} S + \beta_{\text{Dist}} D$$

	β Cost (Utility/$)	β Search (Utility/ Minute)	β Dist (Utility/Mile)
Drive Alone	-3.908	-1.100	-25.904
Shared Ride 2	-3.722	-1.031	-24.450
Shared Ride 3+	-3.643	-1.002	-23.844

Search Time for Parking Links

Results

AM Walk Volumes

Offstreet to TAZ
- 5 - 36
- 37 - 82
- 83 - 145
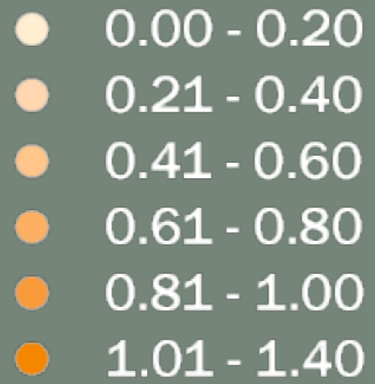- 146 - 269
- 270 - 686

Onstreet to TAZ
- 5 - 36
- 37 - 82
- 83 - 145
- 146 - 269
- 270 - 686

TAZ Boundary
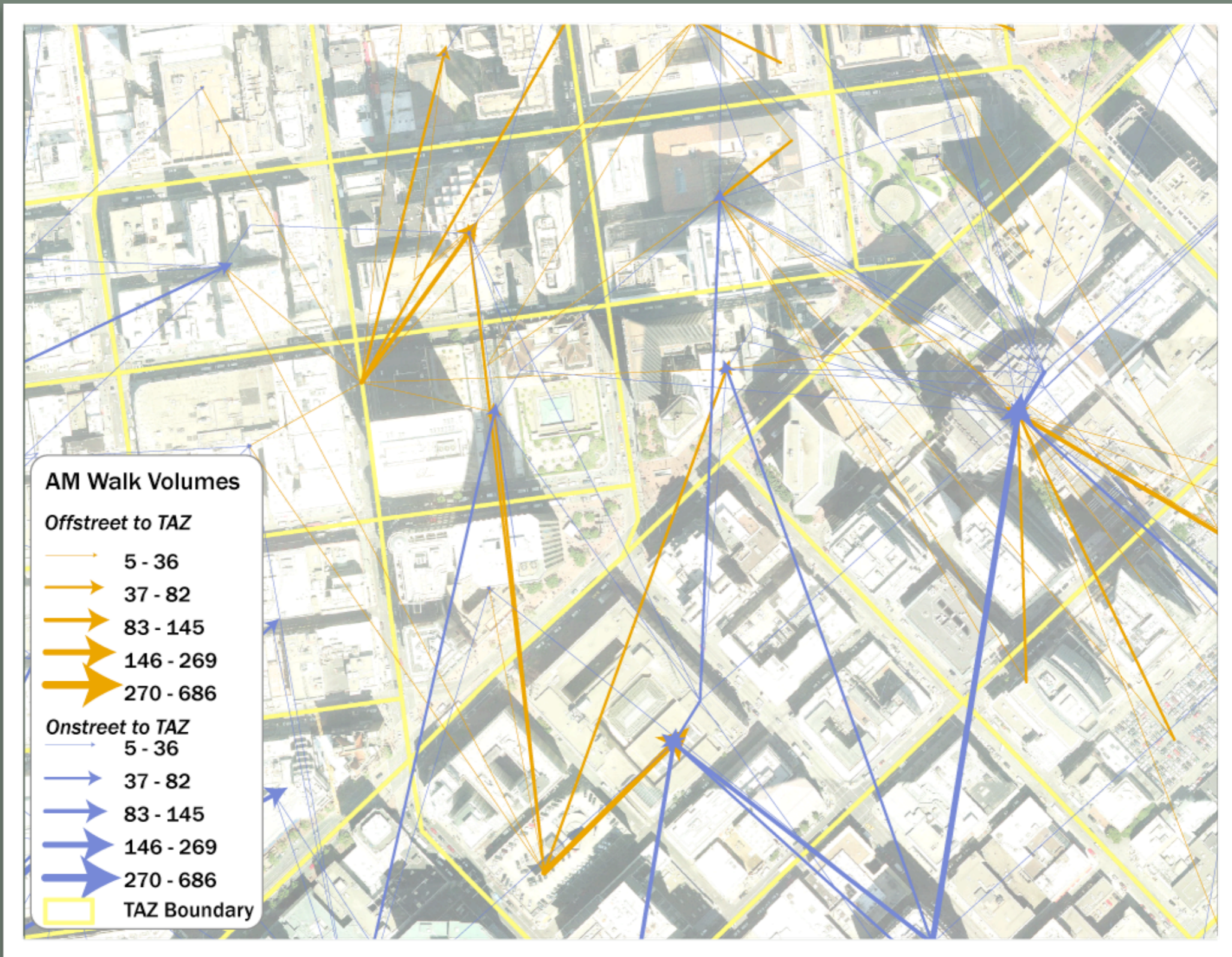
Results

V/C for Offstreet

- 0.00 - 0.20
- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
- 0.81 - 1.00
- 1.01 - 1.40

V/C for Free
Unreserved

- 0.00 - 0.20
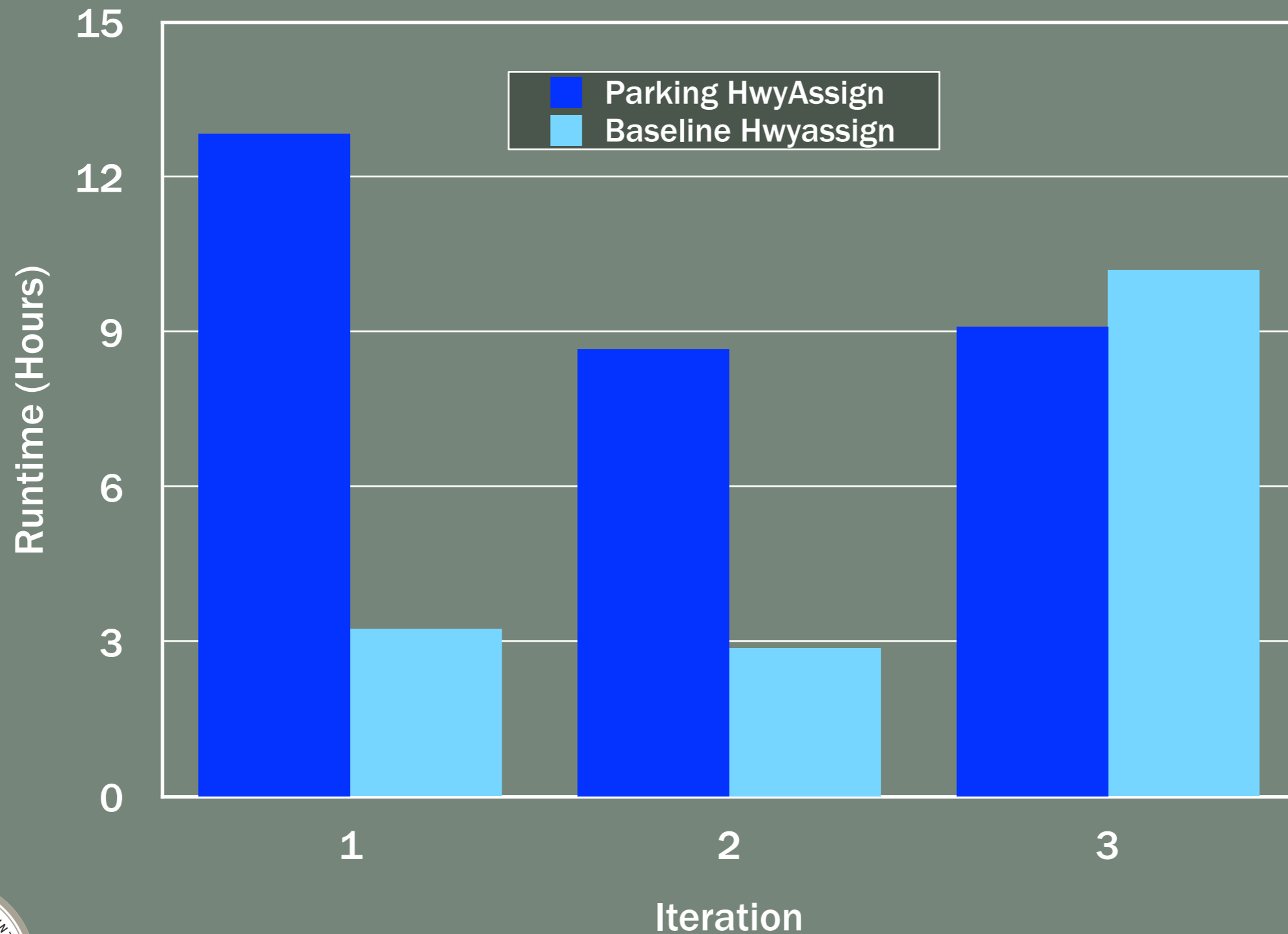- 0.21 - 0.40
- 0.41 - 0.60
- 0.61 - 0.80
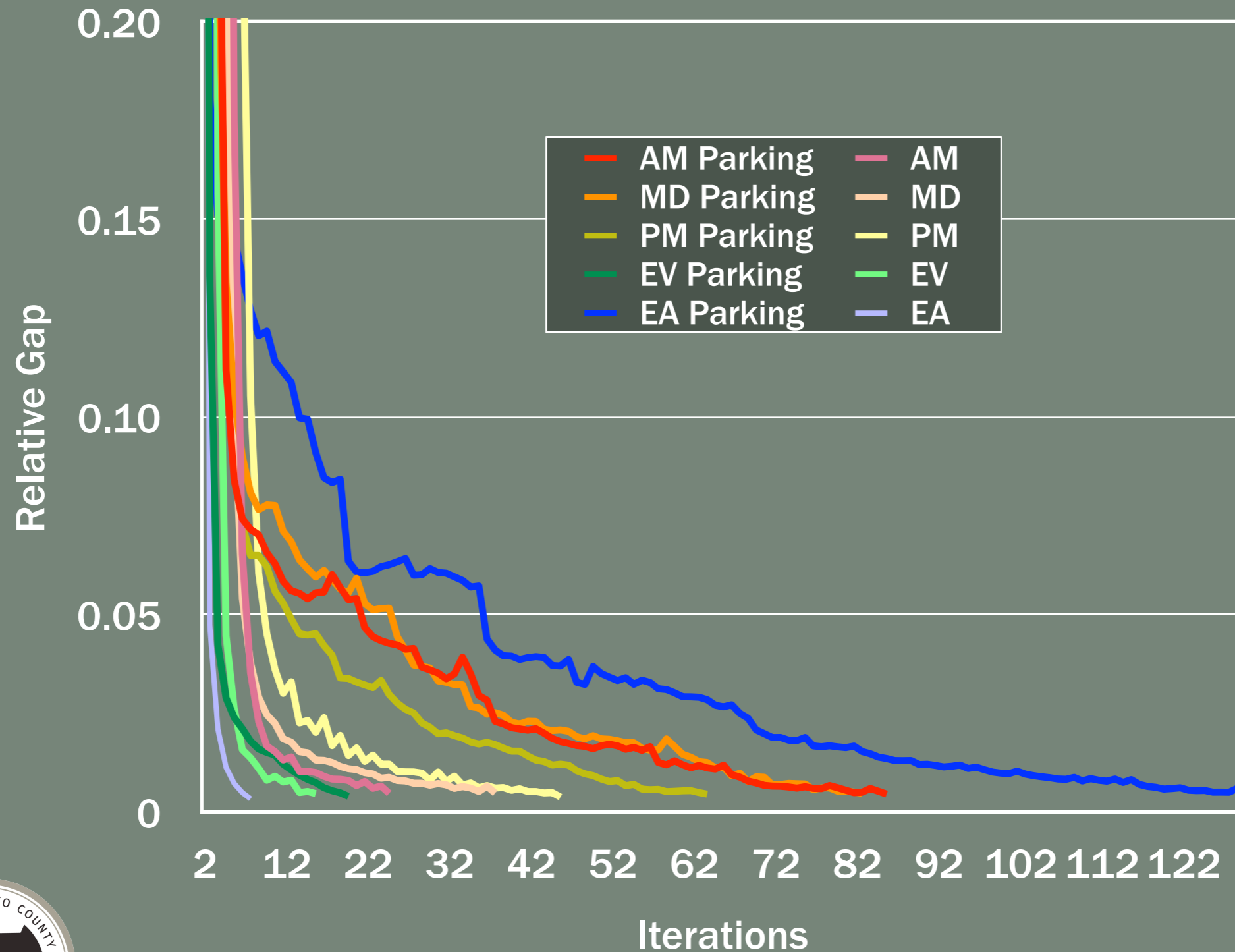- 0.81 - 1.00
- 1.01 - 2.00
- 2.01 - 3.00
- 3.01 - 4.00
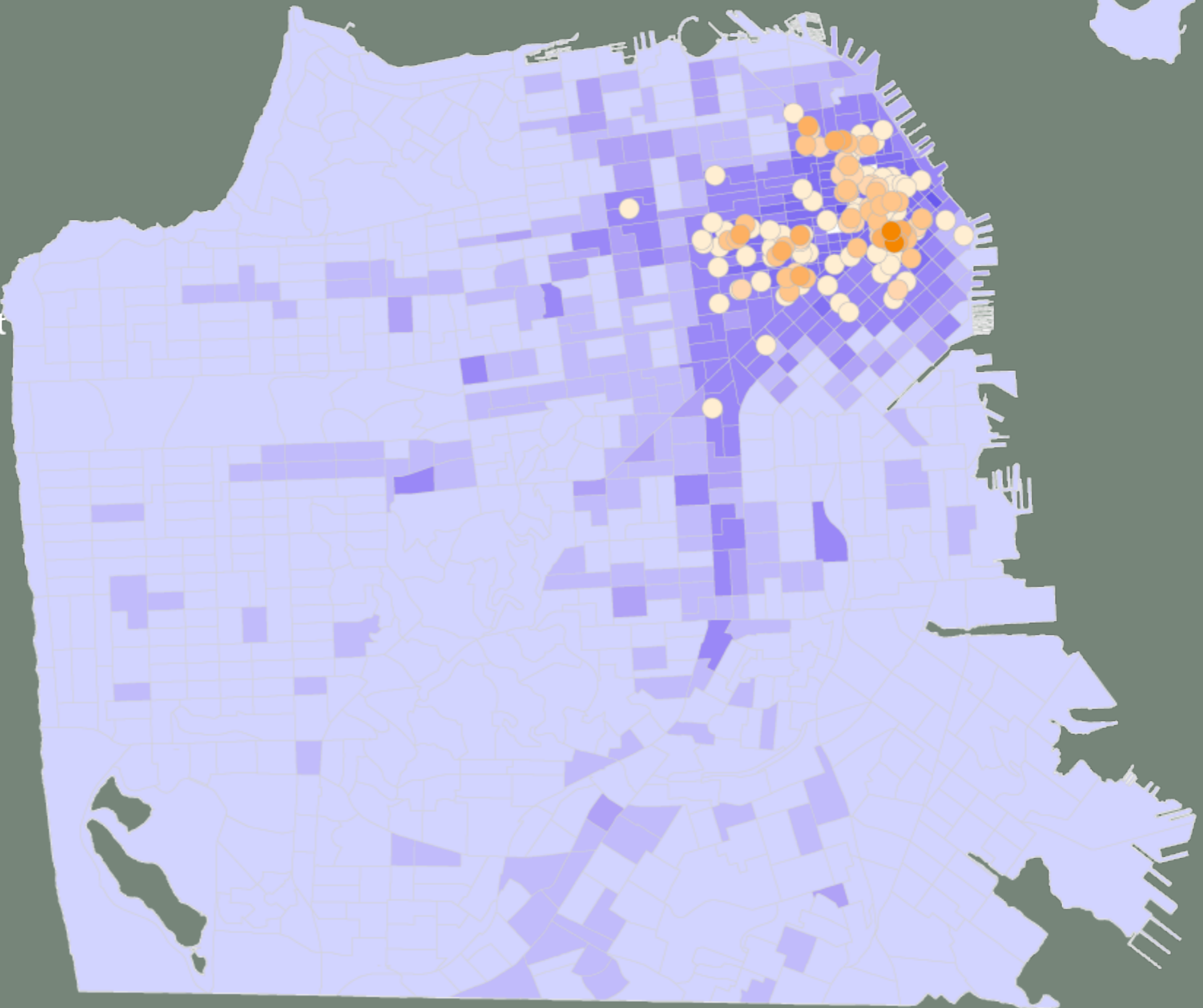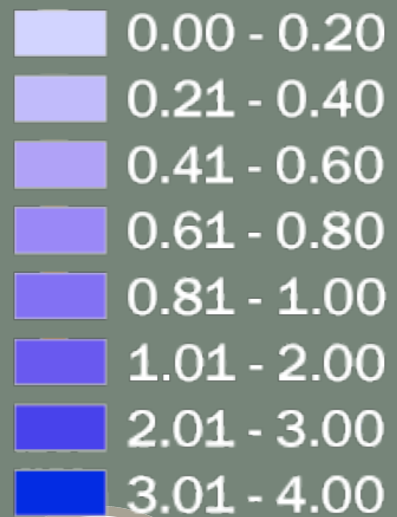
Performance: Run time

Performance:
Final Roadway Assignment Convergence

Discussion

- **Next Steps**
  - **Duration issue**
  - **Better estimates of free unreserved inventory**
  - **Better estimates of parking walkshed**
- **Validation**
  - **Reserved vs unreserved parking**
  - **Parking search time**
  - **Parking occupancy**

Questions?

Or advice & input:
lisa.zorn@sfcta.org 415.593.1660