LIVE / WORK

Symmetry

in Kendall Square

MAS.552 City Science

Final Presentation

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KENDALL SQUARE NOW

an assessment of the current state of kendall population

whose commute is generating the most CO2?

Challenge

how to attract people who are now commuting to live in kendall square?

how to provide necessary living space for those who are commuting?

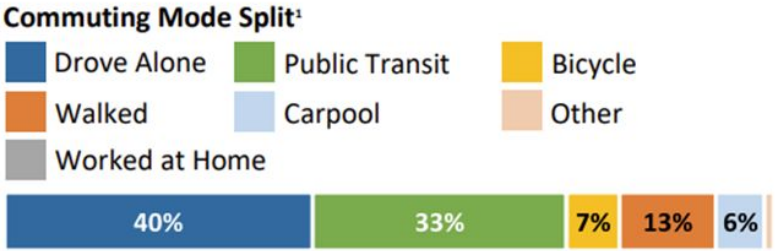
how to provide affordable housing for those who commute to kendall square and cannot afford to live in kendall square?

Research Question

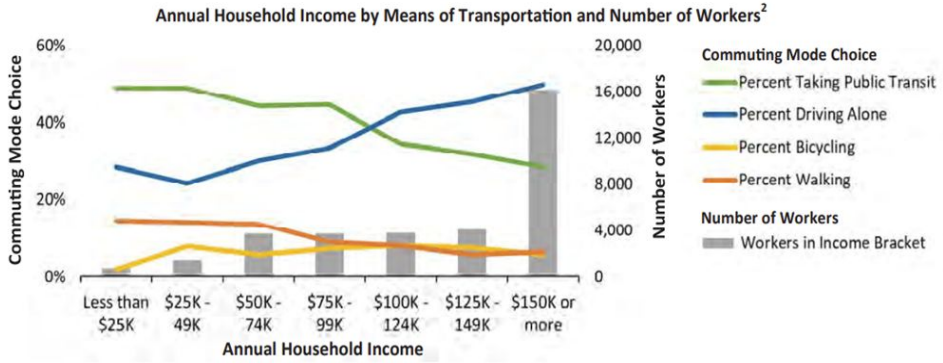
what is the most impactful way to reduce CO2 with live-work symmetry in kendall square?

Findings

43,000 total workers in Kendall Square



40% (drove alone) + 33% (public transit) + 6% (carpool) = 79% target population (CO_2 emission) or **33,970 workers**



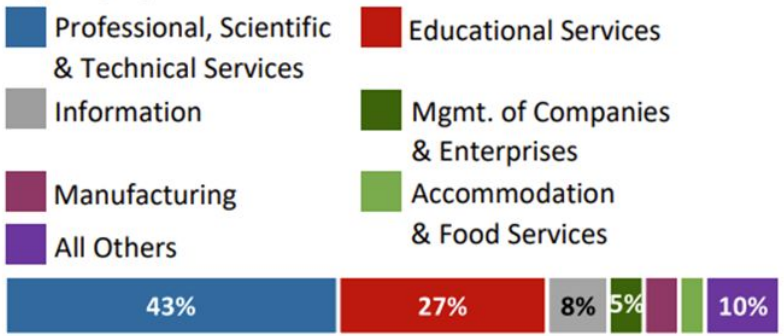
Aprox. 41% (17,630 workers) - $150k or more à aprox. 50% driving alone; 28% public transit
Aprox. 14% (6,020 workers) - $125k – 149k à aprox. 45% driving alone; 30% public transit
Aprox. 13% (5,590 workers) - $100k – 124k à aprox. 42% driving alone; 32% public transit
Aprox. 12% (5,160 workers) - $75k – 99k à aprox. 33% driving alone; 44% public transit
Aprox. 12% (5,160 workers) - $50k – 74k à aprox. 30% driving alone; 44% public transit
Aprox. 5% (2,150 workers) - $25k – 49k à aprox. 23% driving alone; 50% public transit
Aprox. 2% (860 workers) - less tan $25k à aprox. 28% driving alone; 50% public transit

40% (drove alone) = **17,200 workers** (**8,815** - $150k or more; **2,709** - $125k – 149k; **2,348** - $100k – 124k; **1,703** - $75k – 99k; **1,548** - $50k – 74k ; **494** - $25k – 49k; **241** - less tan $25k)

Source: Unless noted otherwise, all data on this page derive from LEHD OnTheMap origin-destination analysis, current as of 2017.
1 Data derived from Census Transportation Planning Products, based on 2012 2016 5-year American Community Survey estimates.

Findings

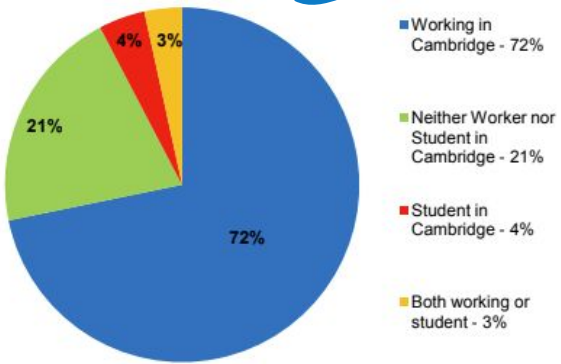
Top Employer Industries in Kendall Square



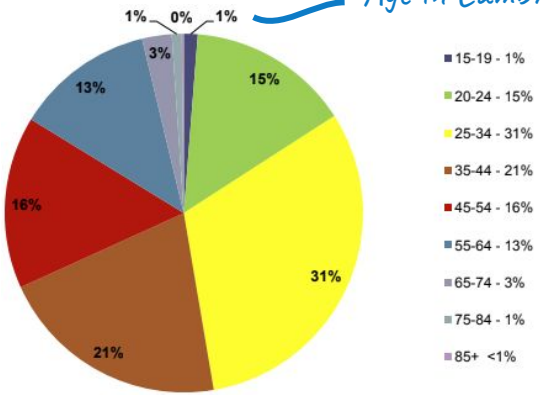
HOUSEHOLDS in Kendall Square

TOTAL	.5 MILE RADIUS	1 MILE RADIUS
Households	3,564	14,687
1 Person	33%	38%
2 Person	35%	35%
3+ Person	32%	27%
Average HH Size	2.21	2.13

Worker/Student in Cambridge



Age in Cambridge



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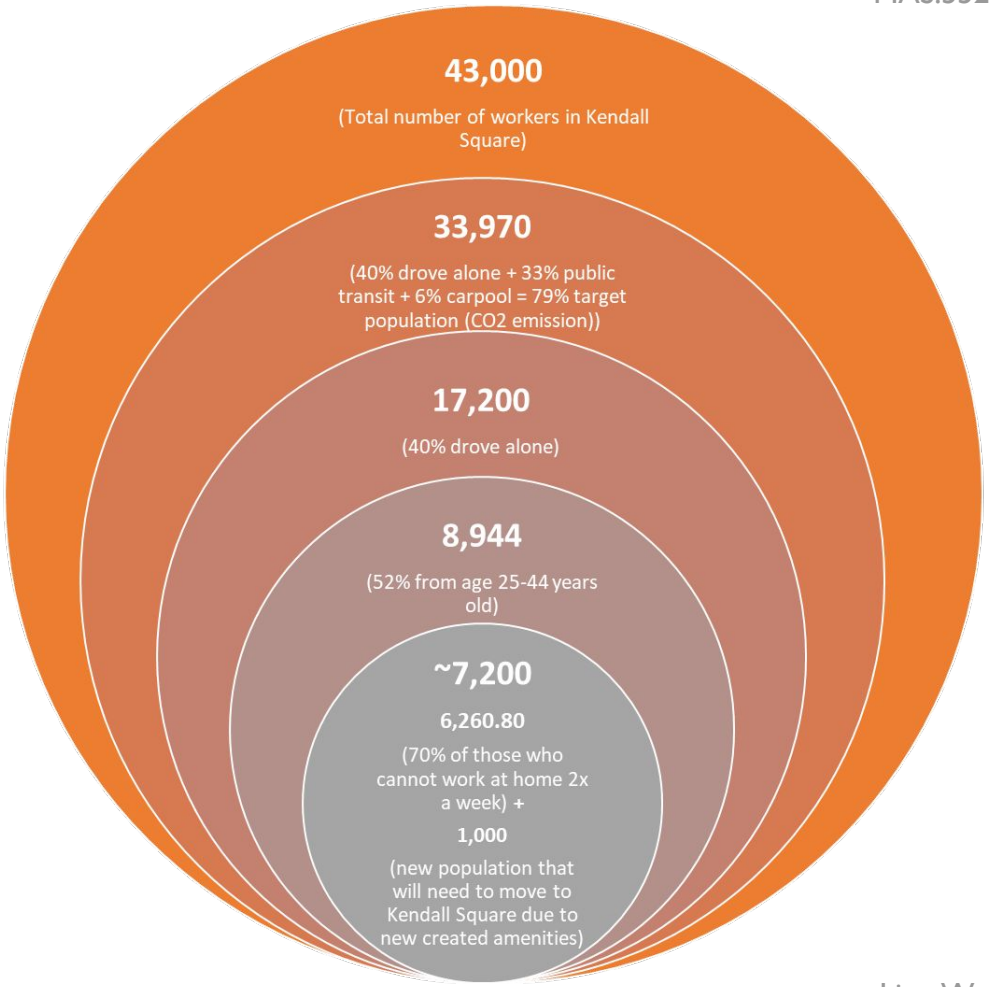
Source: Community Development Department calculations are based on data from ESRI Community Analyst Tool which forecasts data from the U.S. Census Bureau. Additional data comes from the MBTA and data gathered by Community Development Department.s.

Source: Data derived from Cambridge Community Development Department, Economic Development Division, December 2011, Kendall Square Customer Intercept Survey Summary Report

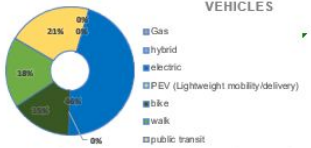
Scenarios

- **1st scenario – 33,970 workers**
  - → higher emission of CO2
- **2nd scenario – 17,200 workers**
  - → incentivize the use of public transportation
- **3rd scenario – 8,944 workers**
  - → age more likely to move
- **4th scenario – 7,200 workers**
  - → assumption given Kendall's industries



Simulations

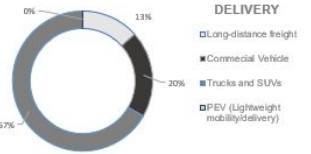
Currently - 43,000 workers

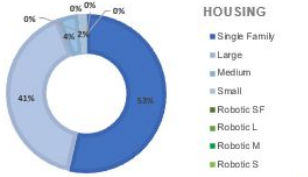


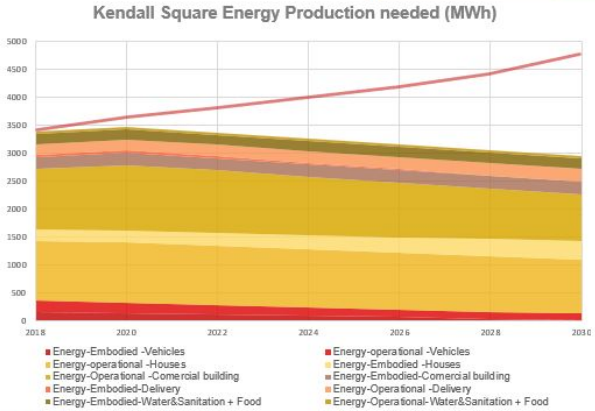
POPULATION IN KENDALL	COMMUTERS
10265	42043

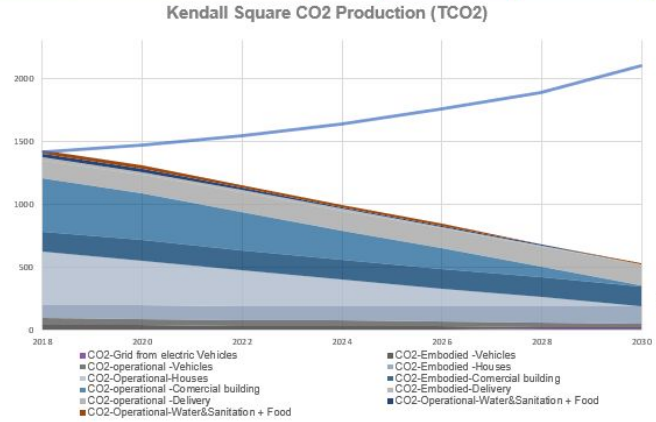
Improvement Index	TOTAL ENERGY MWh	OPERATIONAL ENERGY	TOTAL T-CO2
23	2644	2020	637

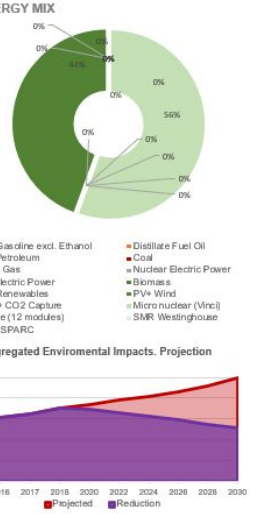
ENERGY IMPROVEMENT %	CO2 IMPROVEMENT %
5	58











REDUCTION OF THE CONSUMPTION

Building Retrofitting
Retrofitting: Building Insulation, Low-e windows, HVAC System, Waste disposal, Light, Construction, Solar thermal, into LEED

Hybrid Work

Day's working at home	0
% of people staying at home	0

% of electric vehicles
Electric transition.
Incentivise policies to persuade all the car drivers to switch from Gas to Electric cars

Live Work Symmetry
People living and working in a walkable distance.
Incentivise living and working on a walkable distance

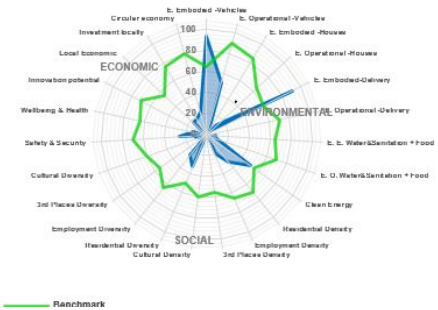
Lightweight mobility/delivery
Autonomous micro mobility.
Incentivise lightweight autonomous electric vehicles as the main mode for

Walkable amenities
Walkable district.
Incentivise policies to have all the amenities needed on a walkable distance

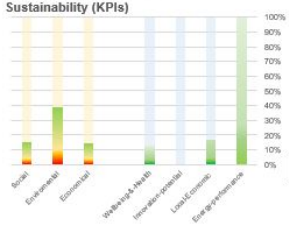
Compact Buildings
Transformable housing and office. 60% reduction of space by transforming the indoor spaces

Local resources
Local production of Food, Water, Sanitation.
Incentivise local production and local consumption of goods, products

COMMUNITY PEFORMANCE

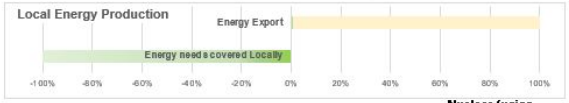


Sustainability (KPIs)



CLEAN PRODUCTION

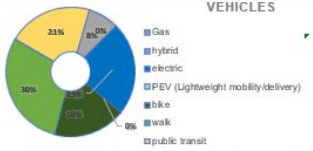
Clean energy can be developed	4	% of the 1km2 land occupied by clean energy



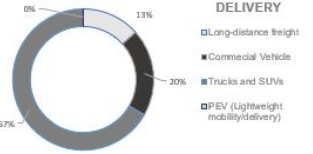
PV Solar + Wind	Natural gas with CO2 Capture	Micro nuclear reactor - Vinci	NuScale	SMR Westinghouse	Nuclear fusion SPARC
Modules: 0	Modules: 0	Modules: 0	Modules: 0	Modules: 0	Modules: 1
% of deplogment of solar panels and	Number of gas power plant	Number of micro nuclear fission	Number of NuScale fission modules	Number of SMR fission modules	Number of fusion nuclear (SPARC)

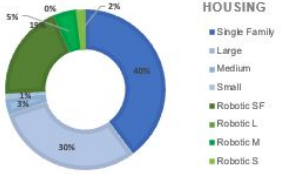
Simulations

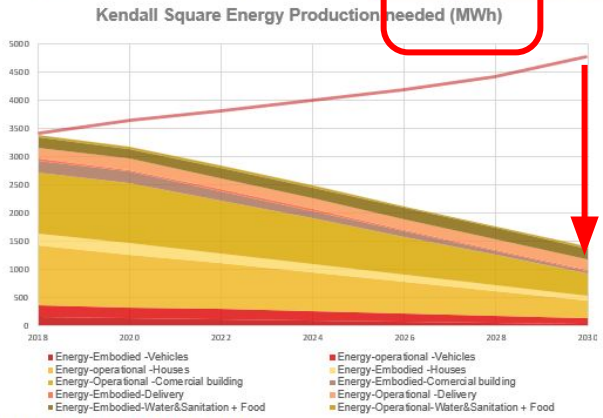
4th scenario – move 7,200 workers

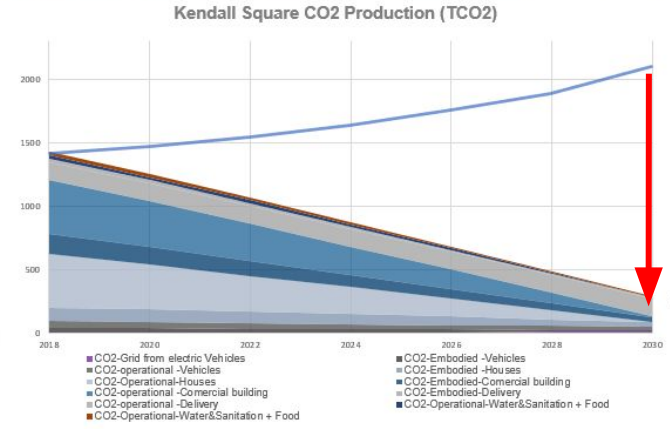


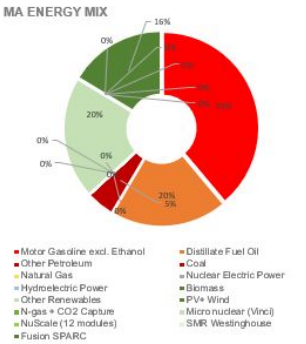
POPULATION IN KENDALL	COMMUTERS	Improvement Index	TOTAL ENERGY MWh	OPERATIONAL ENERGY	TOTAL T-CO2	ENERGY IMPROVEMENT %	CO2 IMPROVEMENT %
16527	35781	37	1320	961	410	61	73

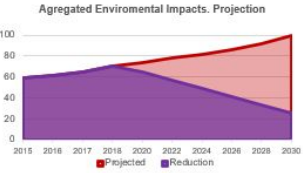












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Hybrid Work

Day's working at home	0
% of people staying at home	0

% of electric vehicles
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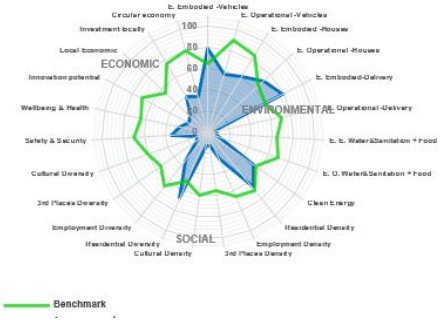
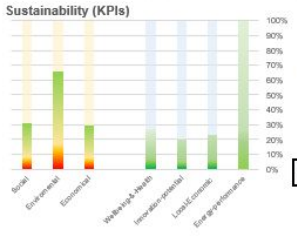




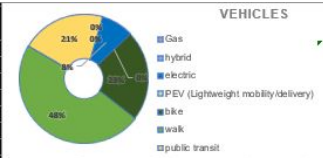
CLEAN PRODUCTION

Clean energy can be developed | 4 | % of the 1km2 land occupied by clean energy

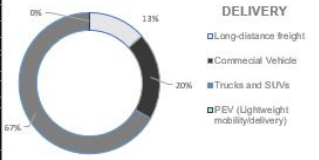
PV Solar + Wind	Natural gas with CO2 Capture	Micro nuclear reactor - Vinci	NuScale	SMR Westinghouse	Nuclear fusion SPARC
Modules: 0	Modules: 0	Modules: 0	Modules: 0	Modules: 0	Modules: 1
% of deployment of solar panels and	Number of gas power plant	Number of micro nuclear fission	Number of NuScale fission modules	Number of SMR fission modules	Number of fusion nuclear (SPARC)

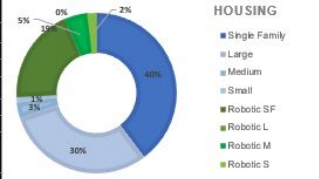
Simulations

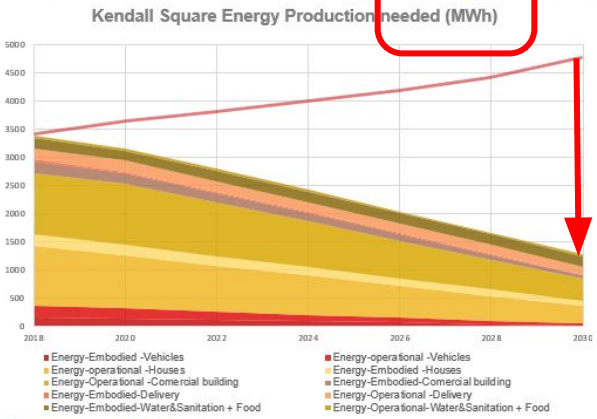
2nd scenario – move 17,200 workers

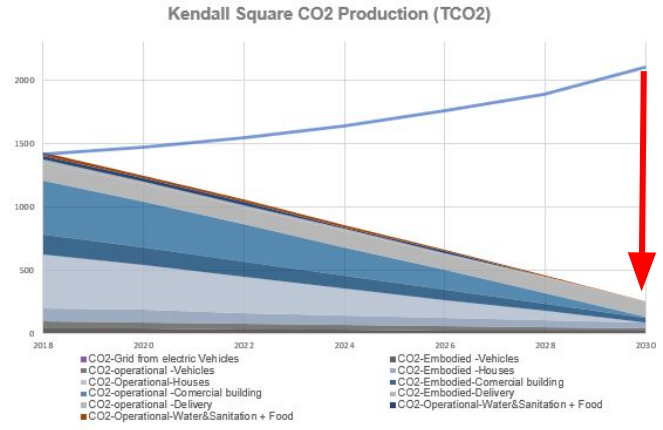


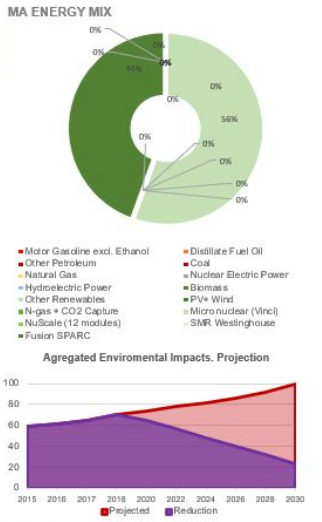
POPULATION IN KENDALL	COMMUTERS	Improvement Index	TOTAL ENERGY MWh	OPERATIONAL ENERGY	TOTAL T-CO2	ENERGY IMPROVEMENT %	CO2 IMPROVEMENT %
26416	25892	45	1204	863	354	63	77





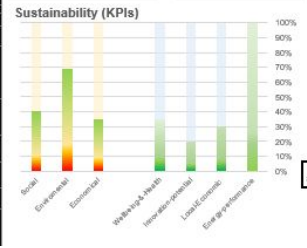






REDUCTION OF THE CONSUMPTION

Building Retrofitting	Hybrid Work	% of electric vehicles	Live Work Symmetry	Lightweight mobility/delivery	Walkable amenitie	Compact Buildings	Local resources
Retrofitting: Building Insulation, Low-e windows, HVAC System, Waste disposal, Light, Construction, Solar thermal, into LEED	Day's working at home: 0; % of people staying at home: 0	Electric transition. Incentivise policies to persuade all the car drivers to switch from Gas to Electric cars	People living and working in a walkable distance. Incentivise living and working on a walkable distance	Autonomous micro mobility. Incentivise lightweight autonomous electric vehicles as the main mode for	Walkable district. Incentivise policies to have all the amenities needed on a walkable distance	Transformable housing and office. 60% reduction of space by transforming the indoor spaces	Local production of Food, Water, Sanitation. Incentivise local production and local consumption of goods, products

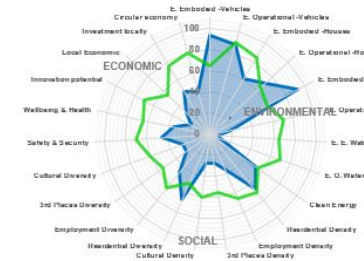


CLEAN PRODUCTION

	Clean energy can be developed	4	% of the 1km2 land occupied by clean energy
	PV Solar + Wind	Natural gas with CO2 Capture	Micro nuclear reactor - Vinci

	NuScale	SMR Westinghouse	Nuclear fusion SPARC
Modules:	0	0	1
	% of deployment of solar panels and	Number of gas power plant	Number of micro nuclear fission	Number of NuScale fission modules	Number of SMR fission modules	Number of fusion nuclear (SPARC)

COMMUNITY PEFORMANCE



Carbon footprint weight

		total	drive alone	public transit	bicycle	walk	carpool			
		100.00%	40.00%	33.00%	7.00%	14.00%	6.00%			
all ages	100.00%	43,000	17,200	14,190	3,010	6,020	2,580		33,970	
0-24	16.00%	6880	2752	2270	482	963	413	6880		
25-34	31.00%	13330	5332	4399	933	1866	800	13330		
35-45	21.00%	9030	3612	2980	632	1264	542	9030		
45+	32.00%	13760	5504	4541	963	1926	826	13760		
			17200	14190	3010	6020	2580			
	Average Carbon		237.50	35.00	0.00	0.00	79.17			
	Total Carbon		4085000	496650	0	0	204250		Total Carbon	4785900
		logic for carbon estimate:	average of large car, medium car	light rail	no carbon	no carbon	car average divided by 3		Divided by people:	140.886
		total	drive alone	public transit	bicycle	walk	carpool			
			85.35%	10.38%	0.00%	0.00%	4.27%			
all ages	100.00%	43,000	36,703	4,462	0	0	1,835			
0-24	16.00%	6880	5872	714	0	0	294	6880		
25-34	31.00%	13330	11378	1383	0	0	569	13330		
35-45	21.00%	9030	7708	937	0	0	385	9030		
45+	32.00%	13760	11745	1428	0	0	587	13760		
			36703	4462	0	0	1835			
		commuters 25-45 actual drivers:	8944							
		commuters 25-45 weighted equivalent drivers:	19085							

MOBILITY DECISION

how do we most efficiently intervene to influence mobility decisions to drive migration towards live work balance

MIGRATION MOTIVATION

Analyze the mobility decision making process

Apply the effects of Lifetime Mobility Profiles on urban housing tenure (simulated with anagent based model)

Research age and family size profiles in existing high density live-work balanced communities

Propose Design/Policy/Development interventions that target high leverage segments of the Lifetime Mobility Profile

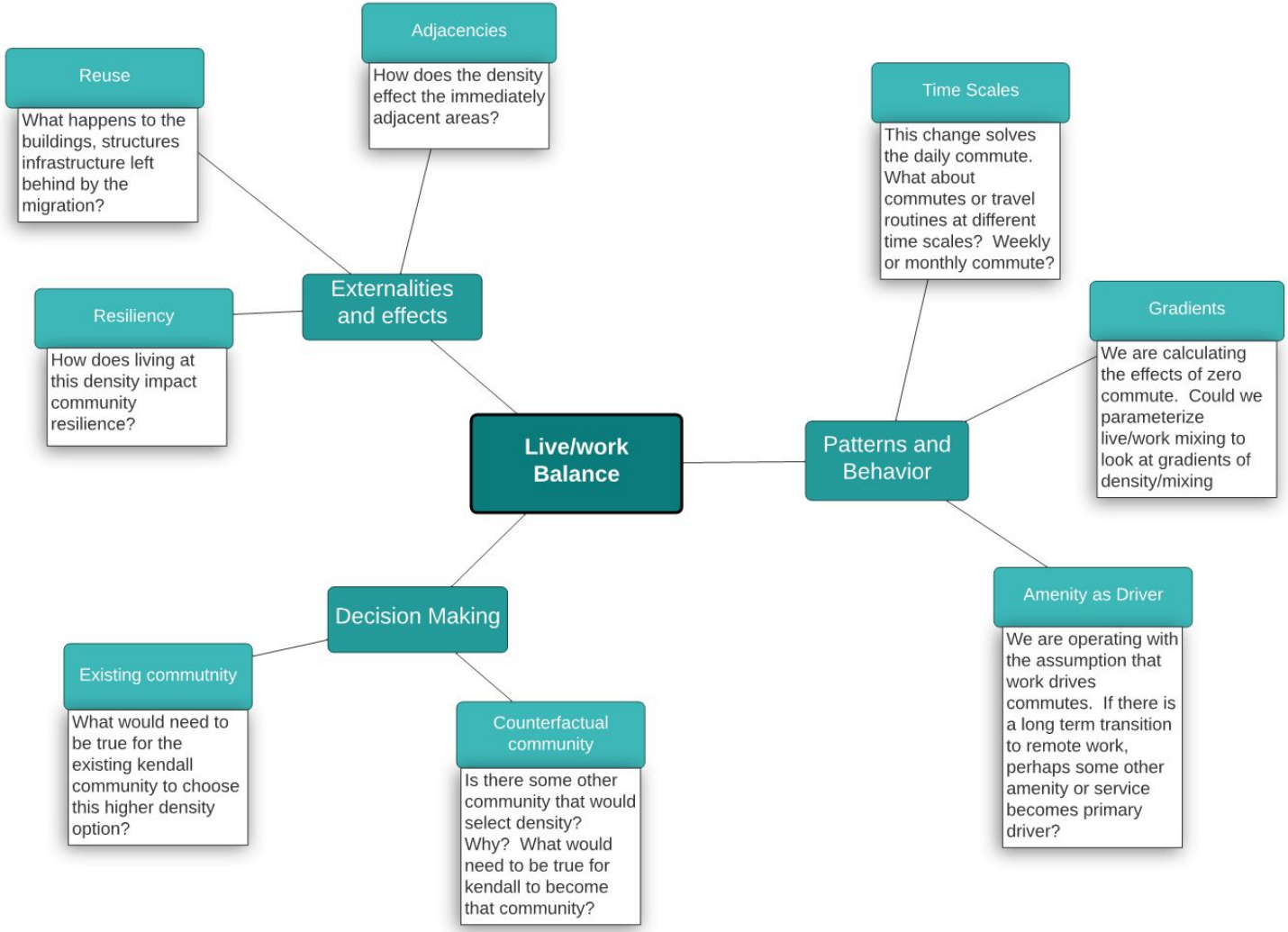
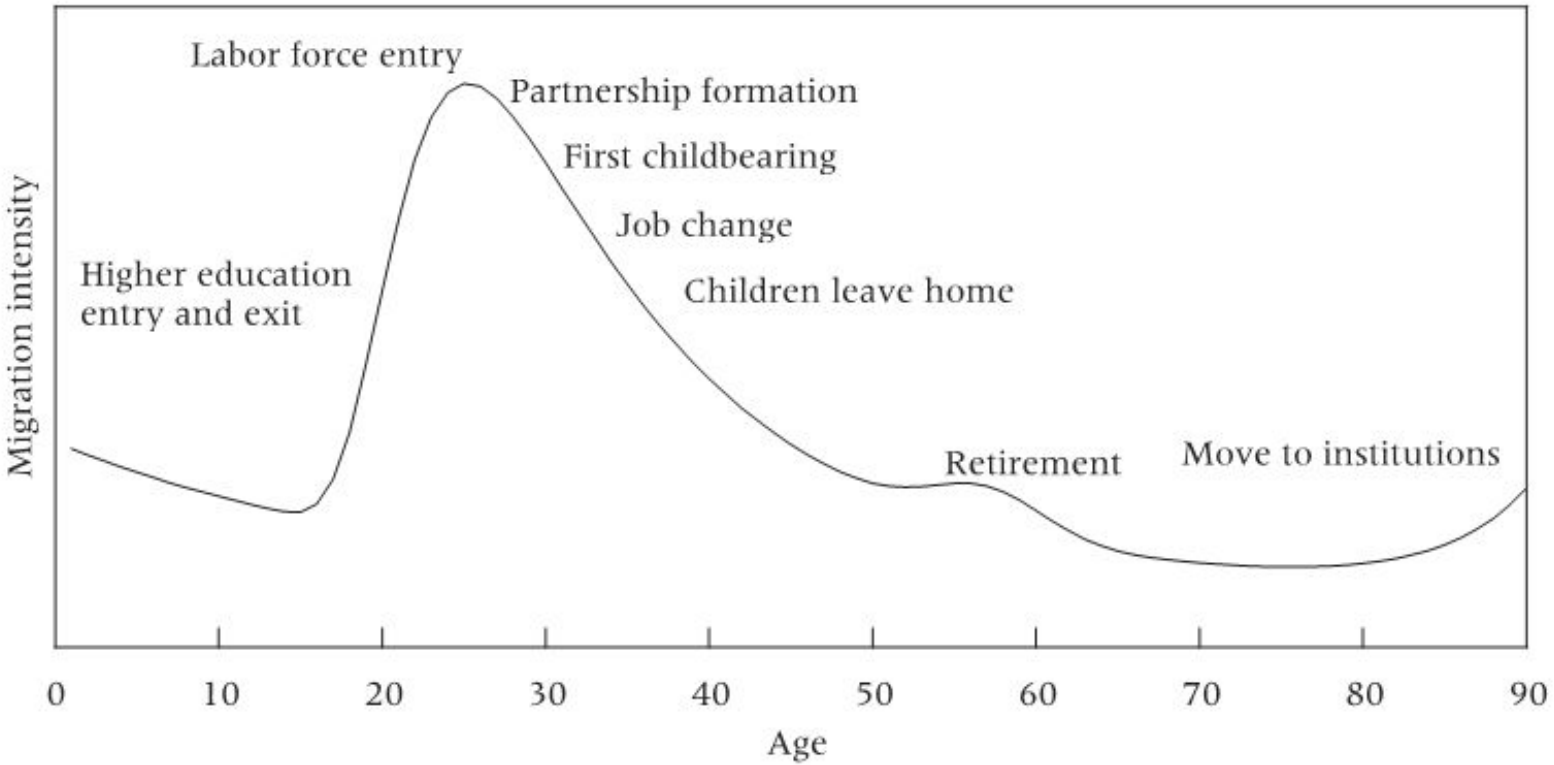

Reuse
What happens to the buildings, structures infrastructure left behind by the migration?
Adjacencies
How does the density effect the immediately adjacent areas?
Externalities and effects
Resiliency
How does living at this density impact community resilience?
Time Scales
This change solves the daily commute. What about commutes or travel routines at different time scales? Weekly or monthly commute?
Gradients
We are calculating the effects of zero commute. Could we parameterize live/work mixing to look at gradients of density/mixing
Live/work Balance
Patterns and Behavior
Decision Making
Existing commutnity
What would need to be true for the existing kendall community to choose this higher density option?
Counterfactual community
Is there some other community that would select density? Why? What would need to be true for kendall to become that community?
Amenity as Driver
We are operating with the assumption that work drives commutes. If there is a long term transition to remote work, perhaps some other amenity or service becomes primary driver?

FIGURE 1 Typical age profile of migration and key life-course transitions



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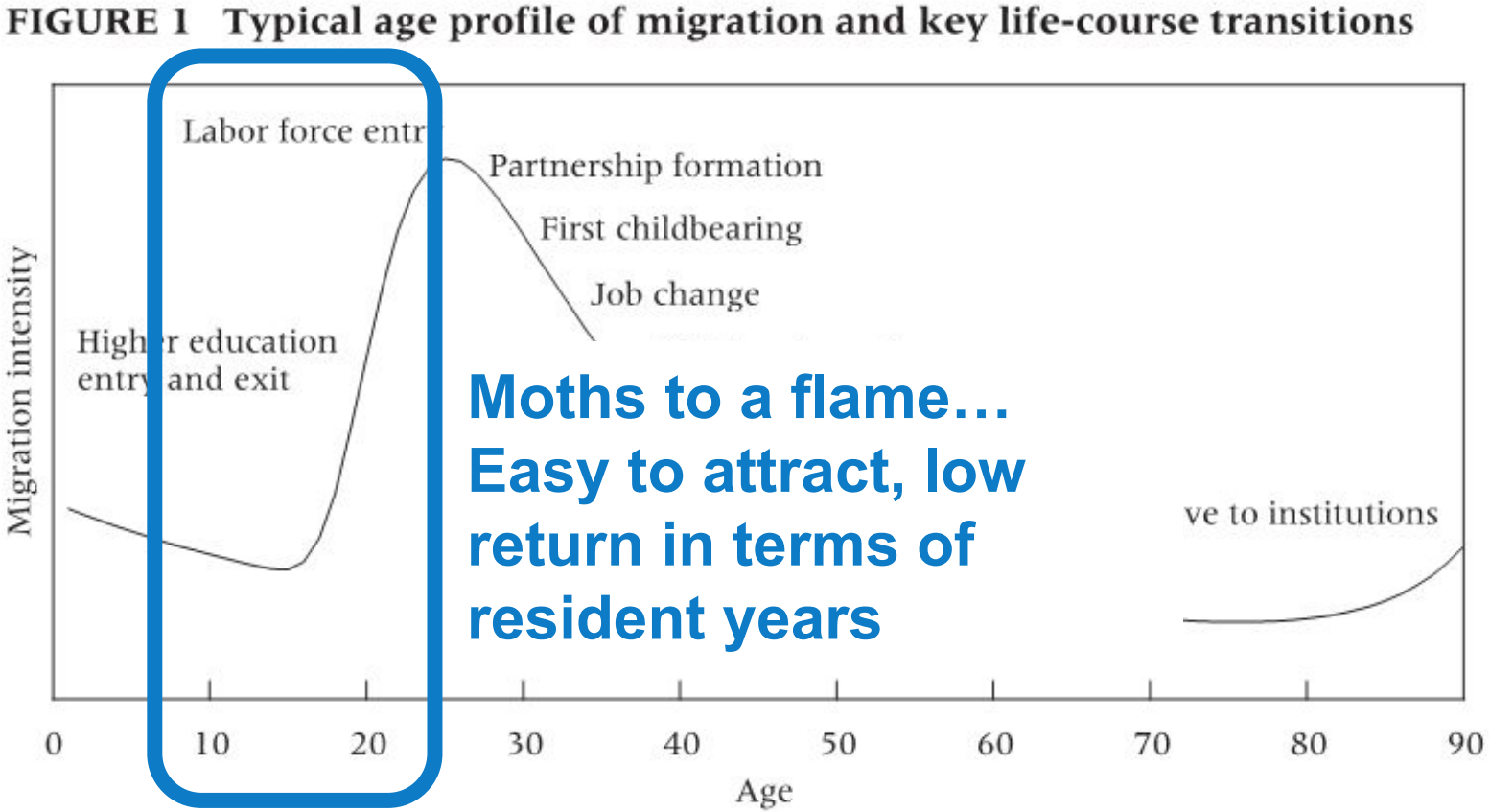

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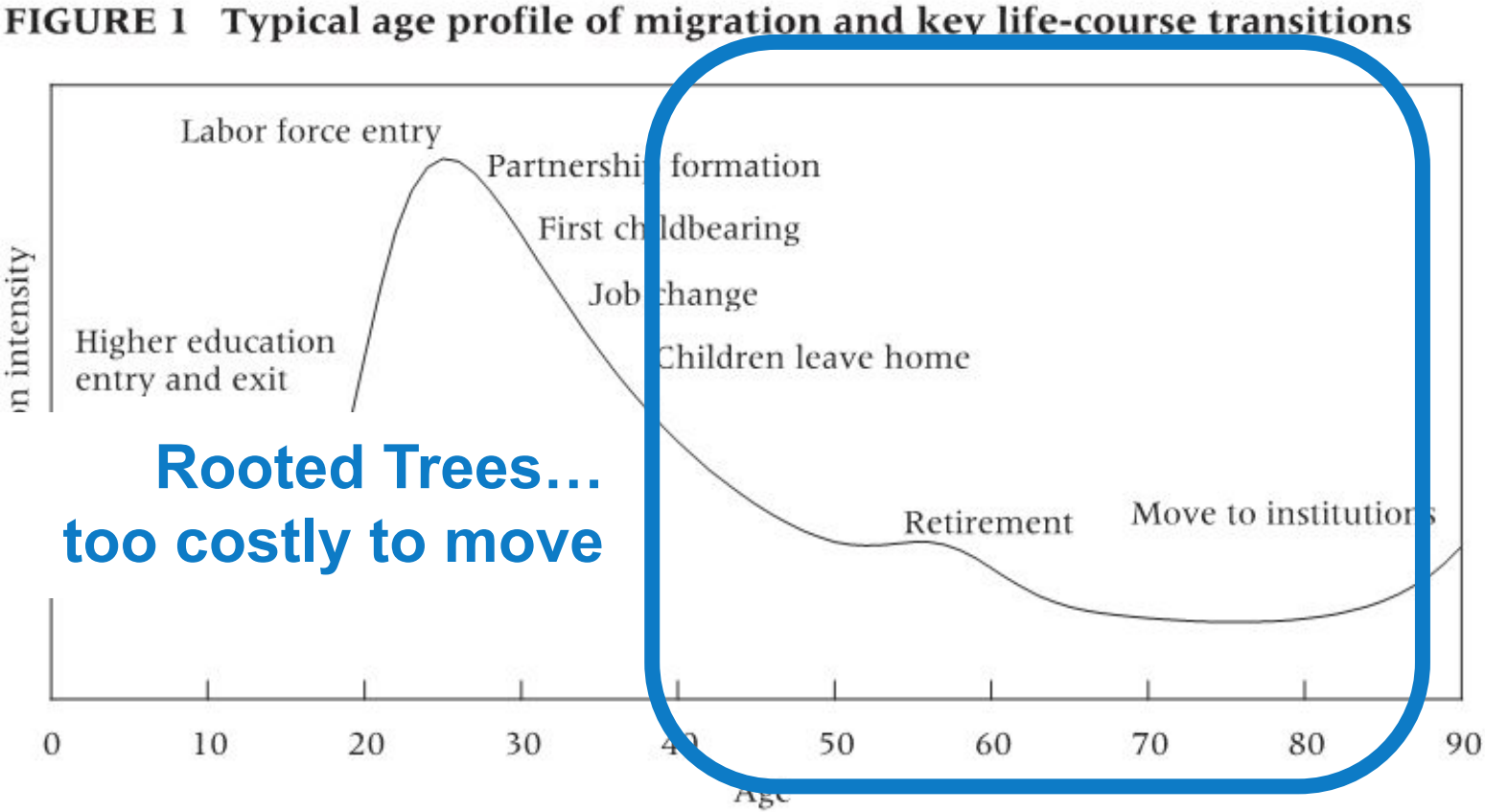
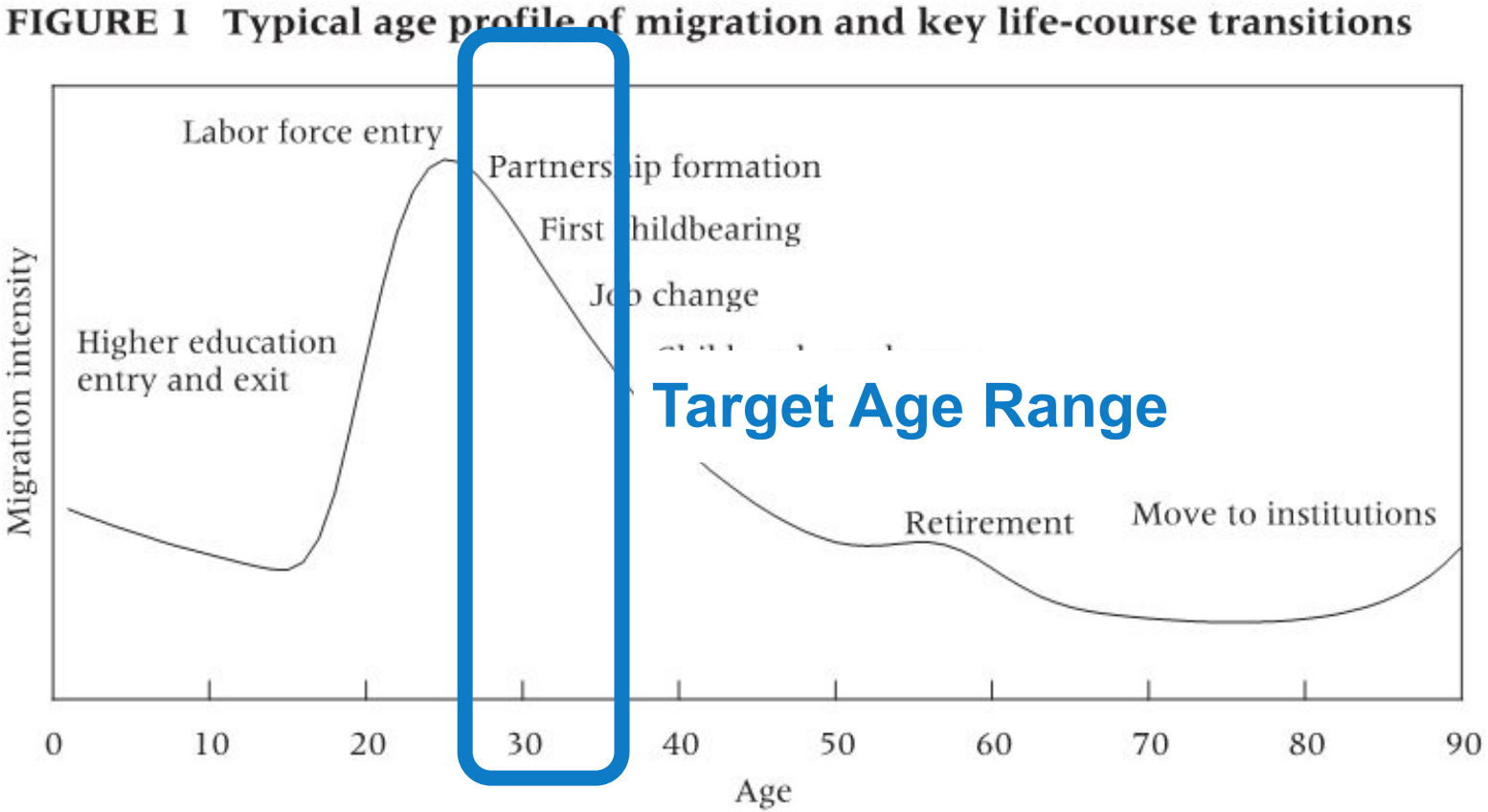
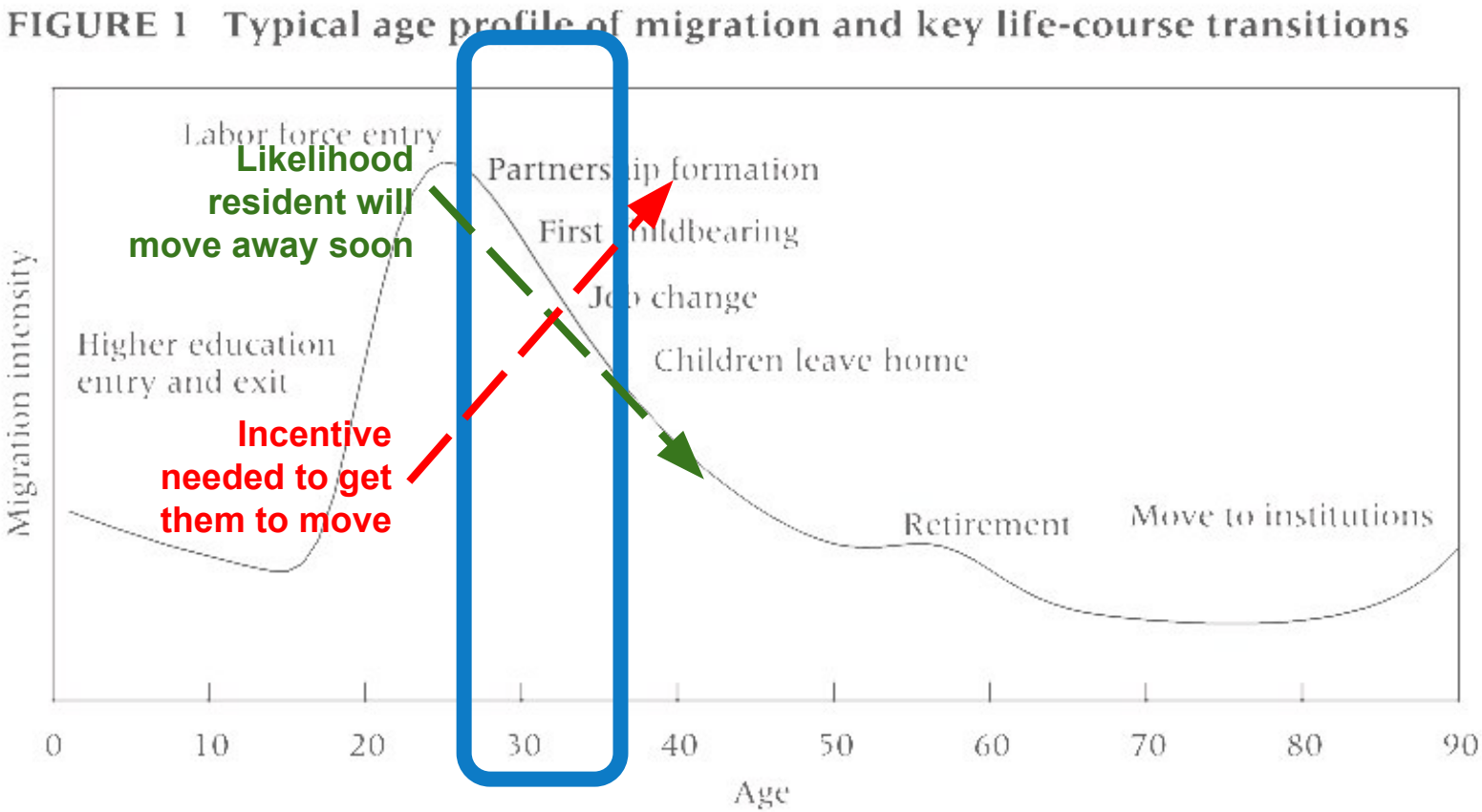


Bernard, Aude & Bell, Martin & Charles-Edwards, Elin. (2014). Life-Course Transitions and the Age Profile of Internal Migration. Population and Development Review. 40. 10.1111/j.1728-4457.2014.00671.x.



Bernard, Aude & Bell, Martin & Charles-Edwards, Elin. (2014). Life-Course Transitions and the Age Profile of Internal Migration. Population and Development Review. 40. 10.1111/j.1728-4457.2014.00671.x.



Bernard, Aude & Bell, Martin & Charles-Edwards, Elin. (2014). Life-Course Transitions and the Age Profile of Internal Migration. Population and Development Review. 40. 10.1111/j.1728-4457.2014.00671.x.

Mobility decisions

choice set formation

interventions

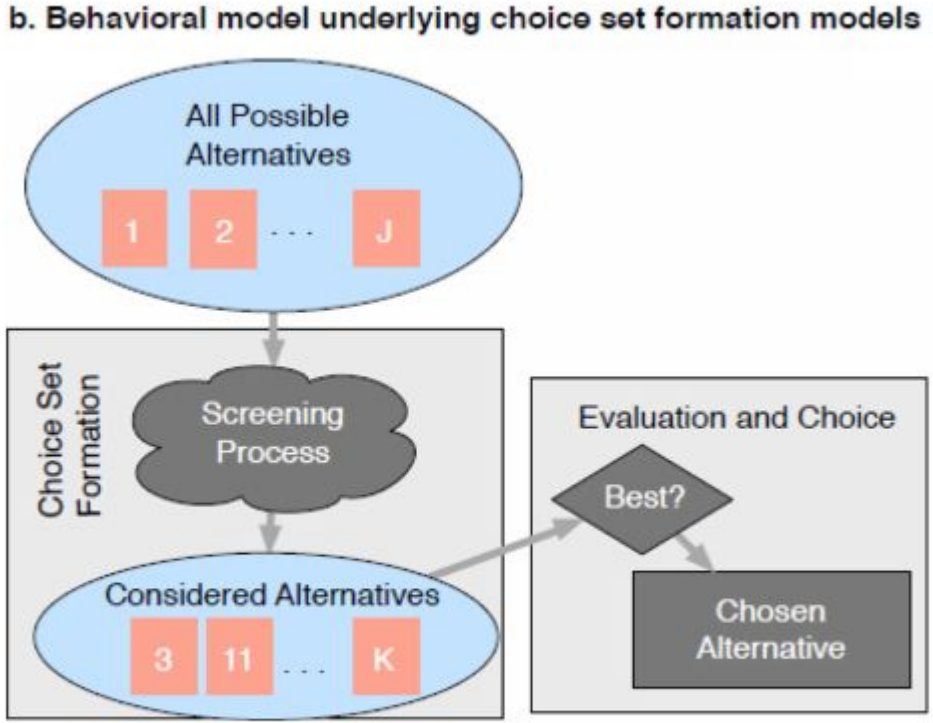


Fig. 1.
Contrasting conventional choice models with choice set formation models

Bruch E, Swait J. Choice Set Formation in Residential Mobility and Its Implications for Segregation Dynamics. Demography. 2019 Oct;56(5):1665-1692. doi: 10.1007/s13524-019-00810-5. PMID: 31435838; PMCID: PMC6800645.

Causality/sequencing is complex…

decisions can be caused by the anticipation of future events

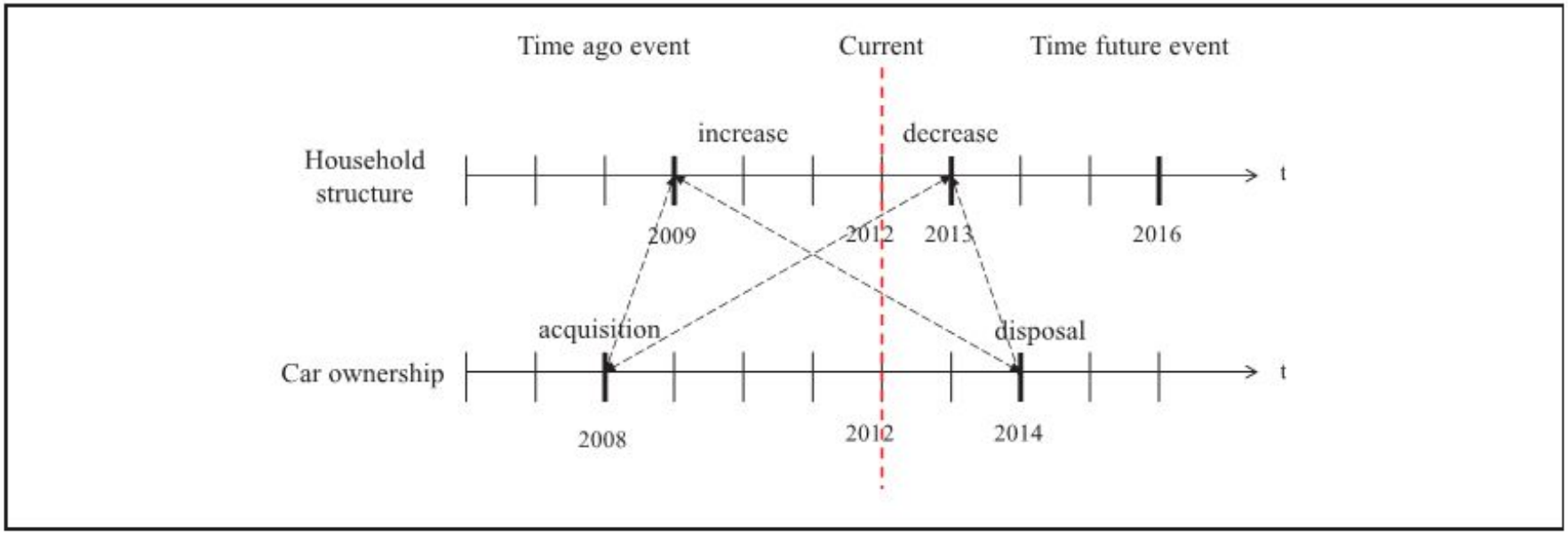
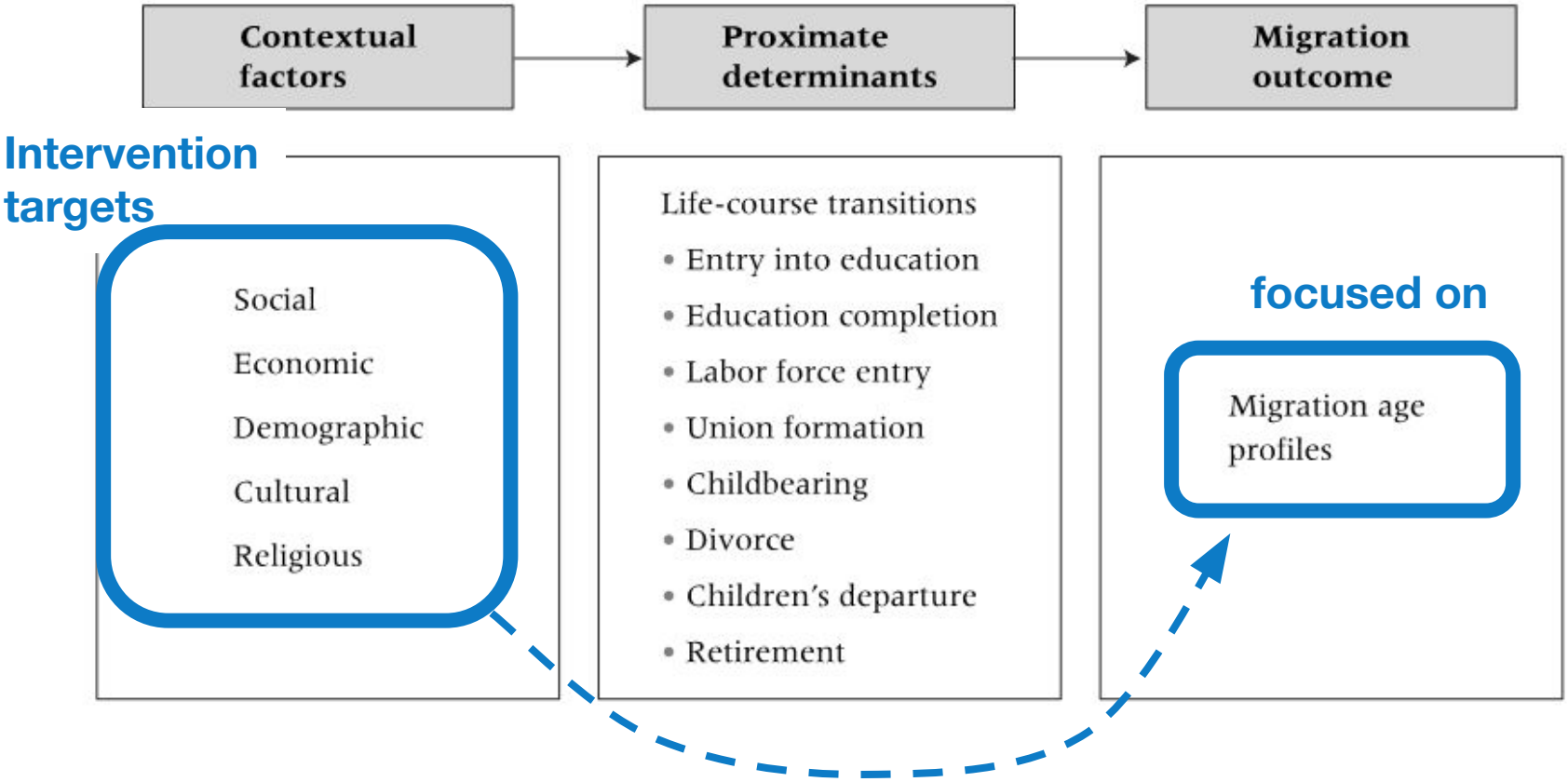


Figure 1. Relationships between household structure events and car ownership events.

Transportation Research Record 2018, Vol. 2672(47) 159–170 National Academy of Sciences: Transportation Research Board 2018 Article reuse guidelines: sagepub.com/journals-permissions DOI: 10.1177/0361198118777604journals.sagepub.com/home/trr

FIGURE 3 Proximate determinants of migration age profiles



Bernard, Aude & Bell, Martin & Charles-Edwards, Elin. (2014). Life-Course Transitions and the Age Profile of Internal Migration. Population and Development Review. 40. 10.1111/j.1728-4457.2014.00671.x.

EXPERIMENT

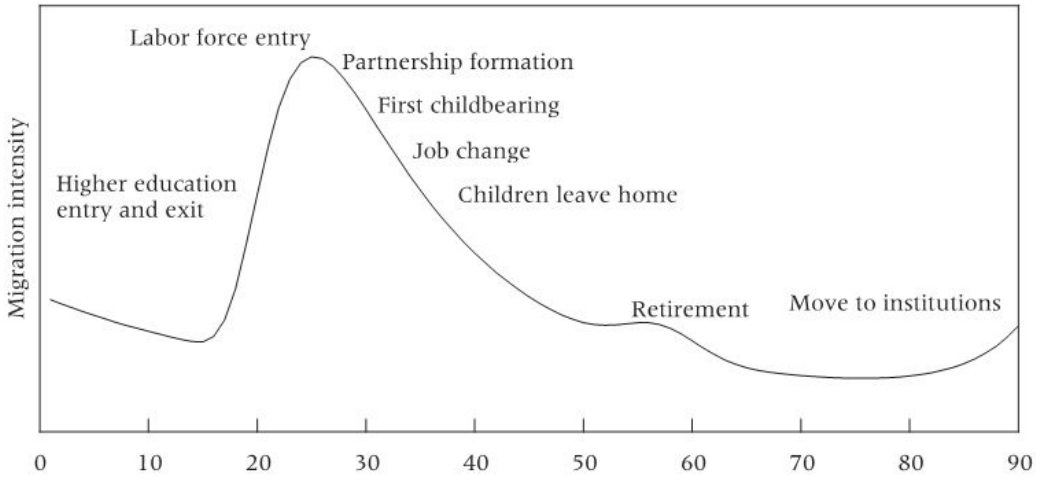
Simple economic disparity model as a base -- agents are moving around within a changing value landscape

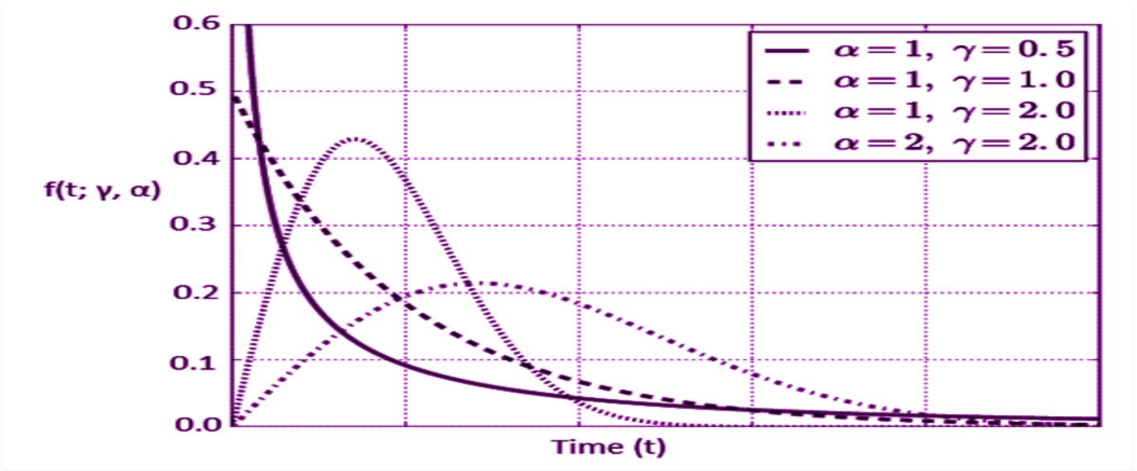
Adding age and mobility-threshold preference to agent characteristics, using weibull function to model mobility-threshold-profile

Adding age target as input to services providing value to agents unevenly

Reporting average tenure generated by services

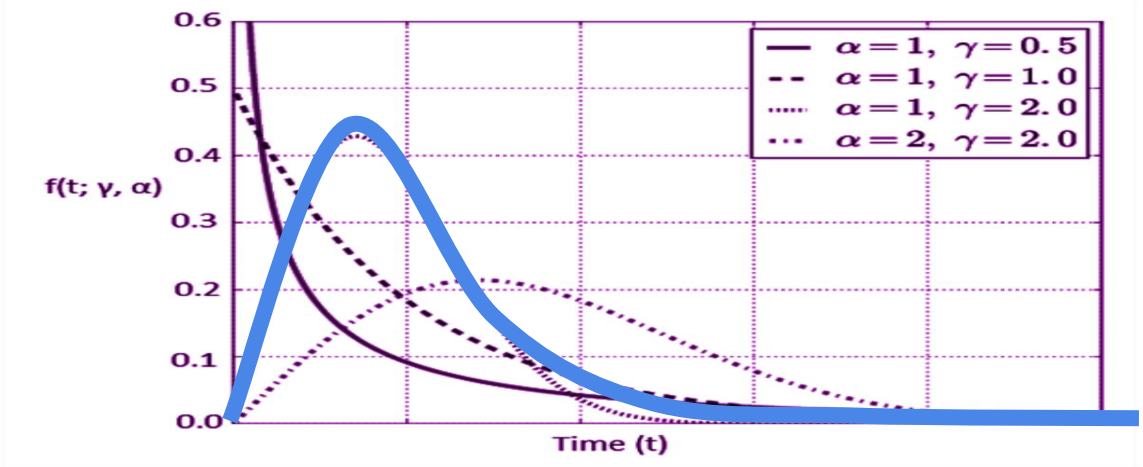
FIGURE 1 Typical age profile of migration and key life-course transitions





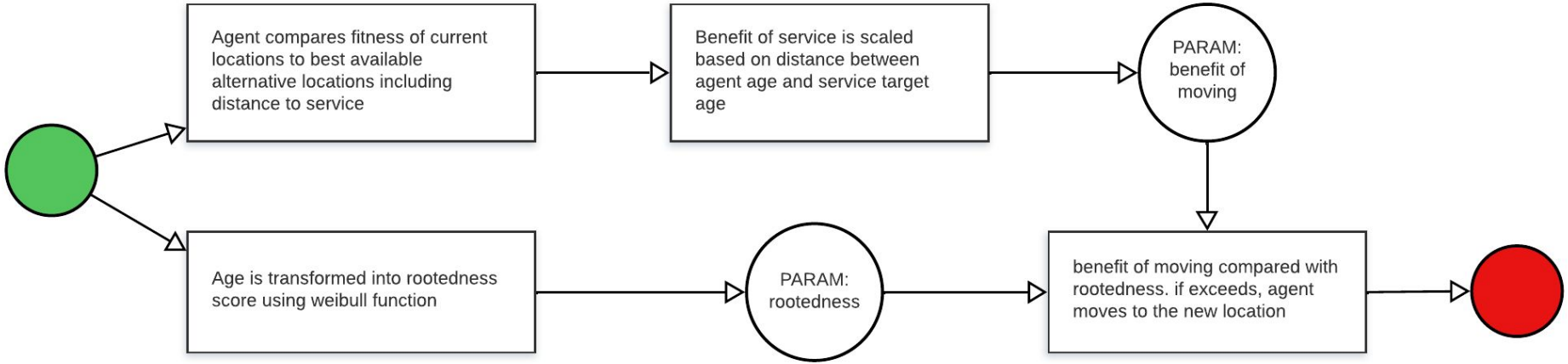
https://byjus.com/maths/weibull-distribution/

```
; simulated residential migration profile
to-report weibull [ wx ]
  let gamma 2
  let wy ( 2.2 *  ( gamma / 2 ) * ( ( wx * 3 ) ^ ( gamma - 1 ) ) ) * (exp ( - ( ( wx * 3 ) ^ gamma ) ) )
  report wy
end
```

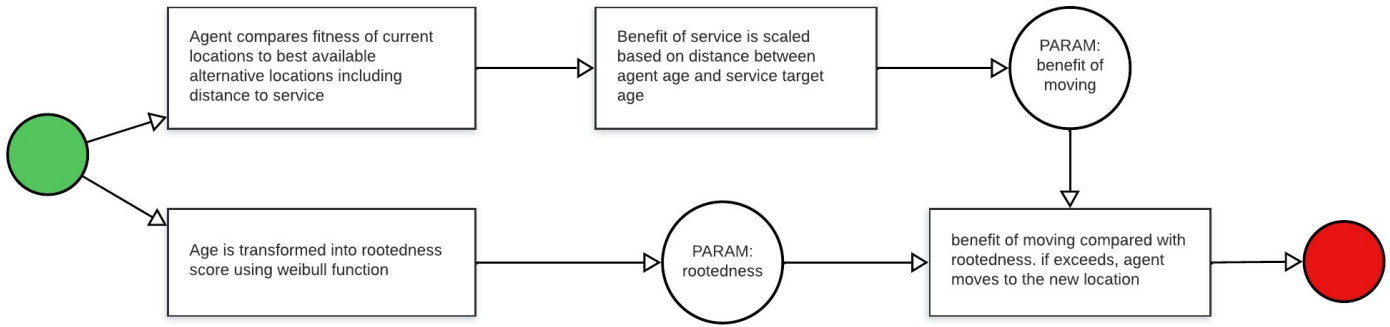


https://byjus.com/maths/weibull-distribution/

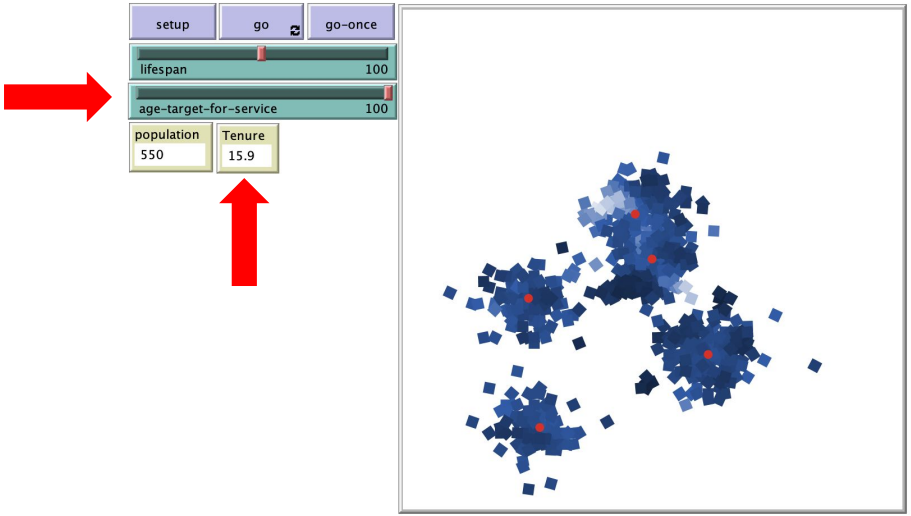
MOBILITY DECISION PROCESS

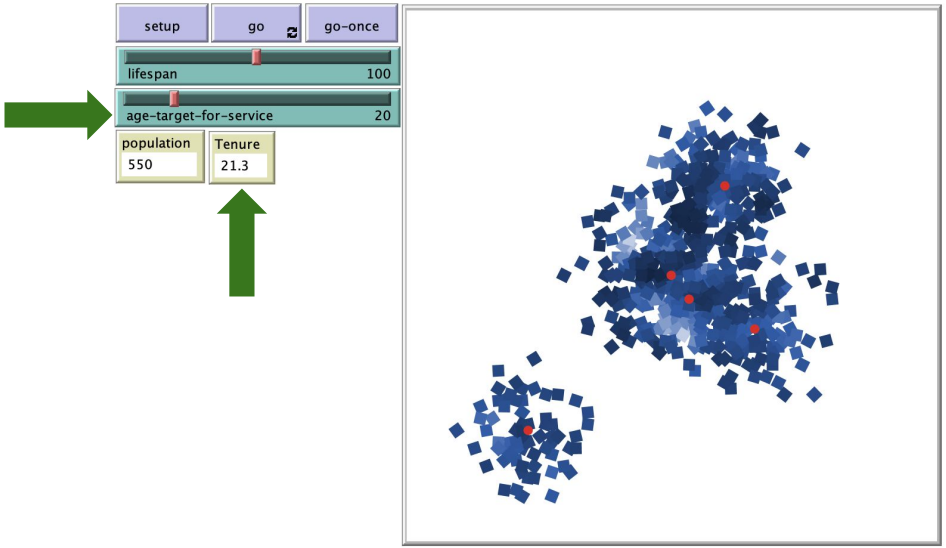


```
;;compare the current location to the best move
let cl [ patch-utility-for-rich ] of patch-here
let nl [ patch-utility-for-rich ] of best-candidate
let improvement ( nl - cl ) / cl

;weight the perceived improment based on its appeal to a certain age group by getting difference betwee agent age and target
let age-alignment (abs (AGE-TARGET-FOR-SERVICE - (ticks - birth )) ) / LIFESPAN
let age-improvement improvement * age-alignment

set age-improvement (age-improvement * churn) ;;increase overall movement

;compare the perceived benefit of moving to the rootedness of the agent
ifelse age-improvement > move-threshold
[
  set see-better true;
][
  set see-better false;
]
```



AGE-TARGETED SERVICE | **AVERAGE TENURE**

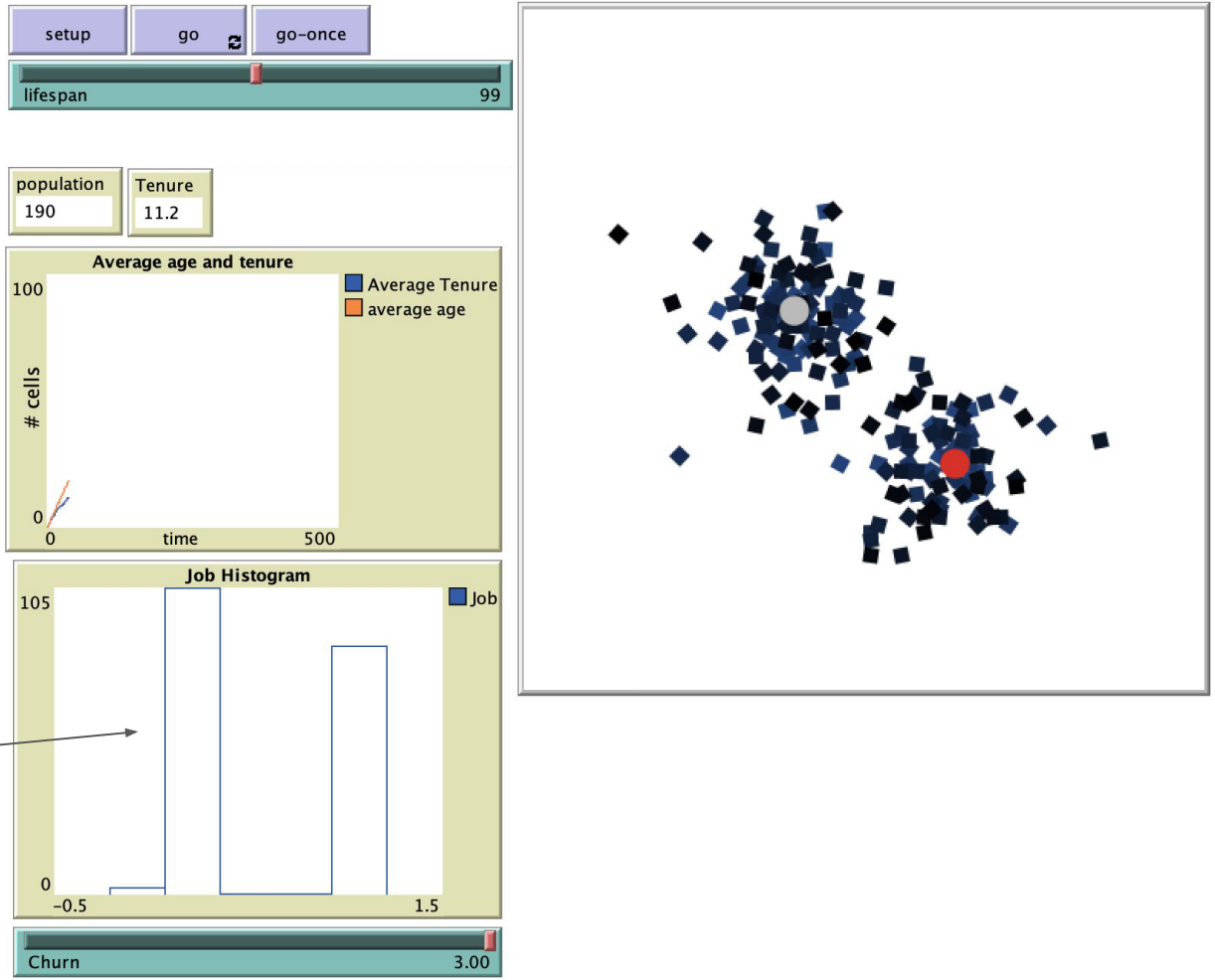




SERVICES BATTLE

Starting point lots of available space

Age-profile targeting clearly working

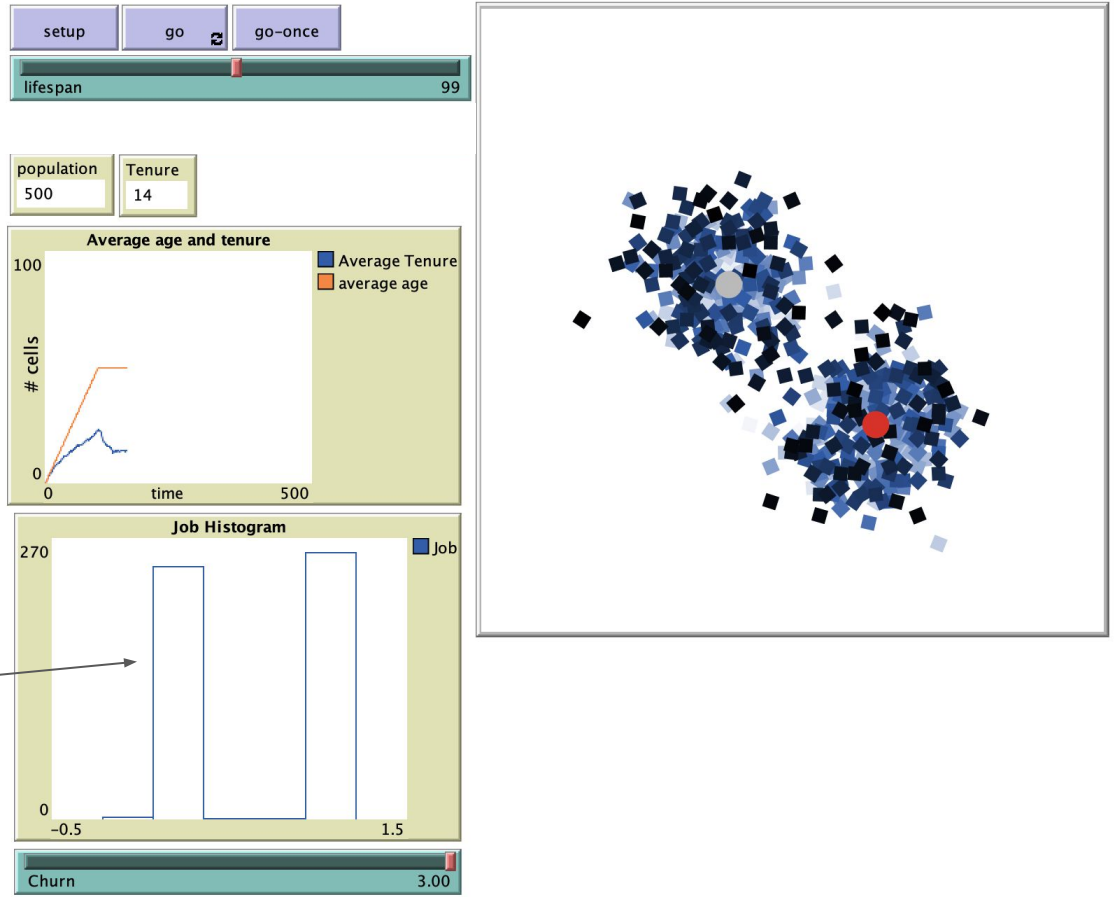


SERVICES BATTLE

Mature city, few “better” locations available

supply in-elasticity problem

Age-profile targeting failing



DEVELOPMENT GUIDANCE

decentralized autonomous organization managing real estate ibuying system

INTERVENTION

Target high impact age bracket

Amenity Inventives can target anticipated/future benefits

Price is still the greatest barrier to entry

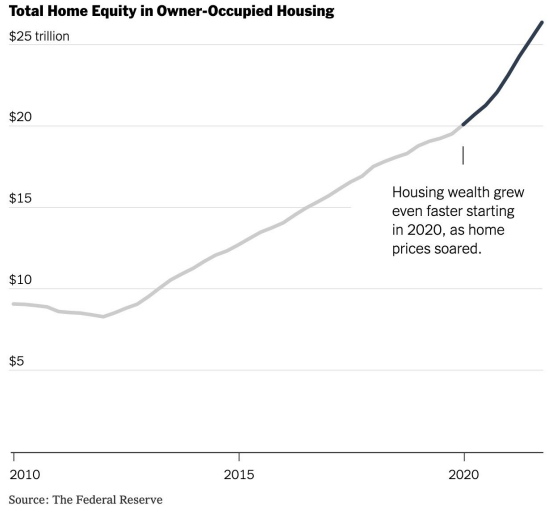
PRICE = BROKEN MARKET DYNAMICS

Demand Inelastic to price due to long term mortgages and belief in appreciation

Location scarcity do to unresponsive development creates **supply inelasticity**

SCOPE OF PRICING DYSFUNCTION

CONCERNED ABOUT INFLATION?



$1.8 Trillion

COVID stimulus to individuals

Consumers

Home Owners

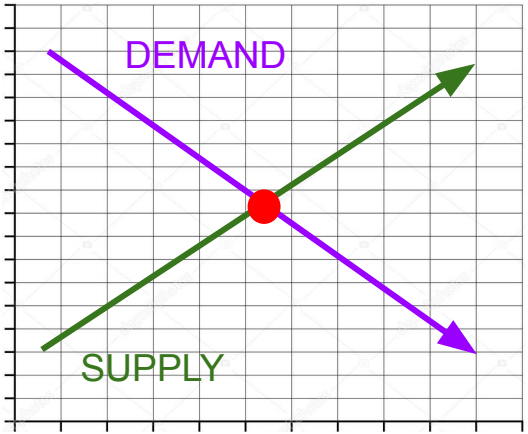
$ 6 Trillion

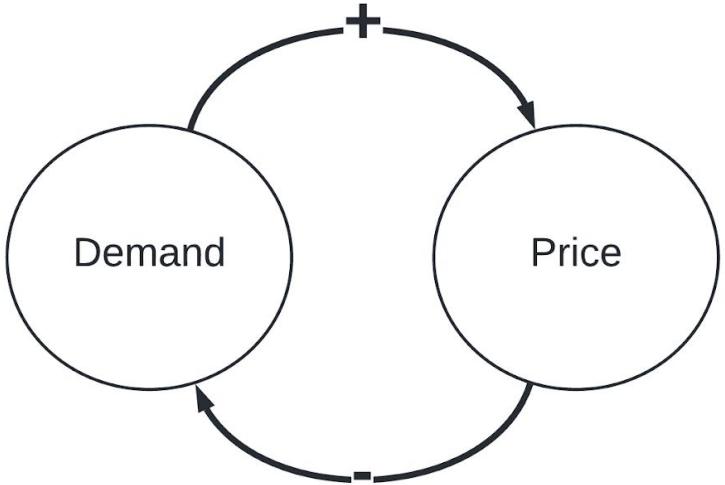
Equity gains for homeowners 2020-2022

Parlapiano, Solomon, Ngo and CowleyMarch **Where $5 Trillion in Pandemic Stimulus Money Went,** 11, 2022
https://www.nytimes.com/interactive/2022/03/11/us/how-covid-stimulus-money-was-spent.html

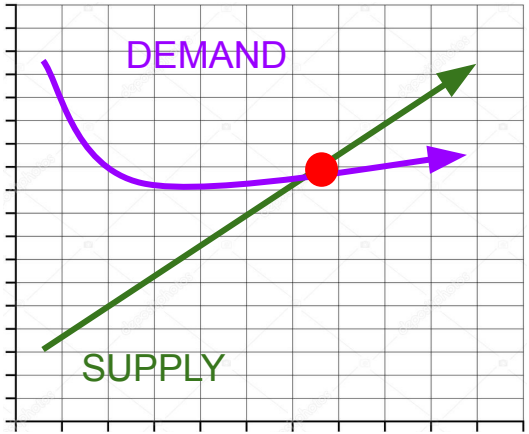
Badger, Bui. **The Extraordinary Wealth Created by the Pandemic Housing Market,** May 1, 2022
https://www.nytimes.com/2022/05/01/upshot/pandemic-housing-market-wealth.html?smid=url-share

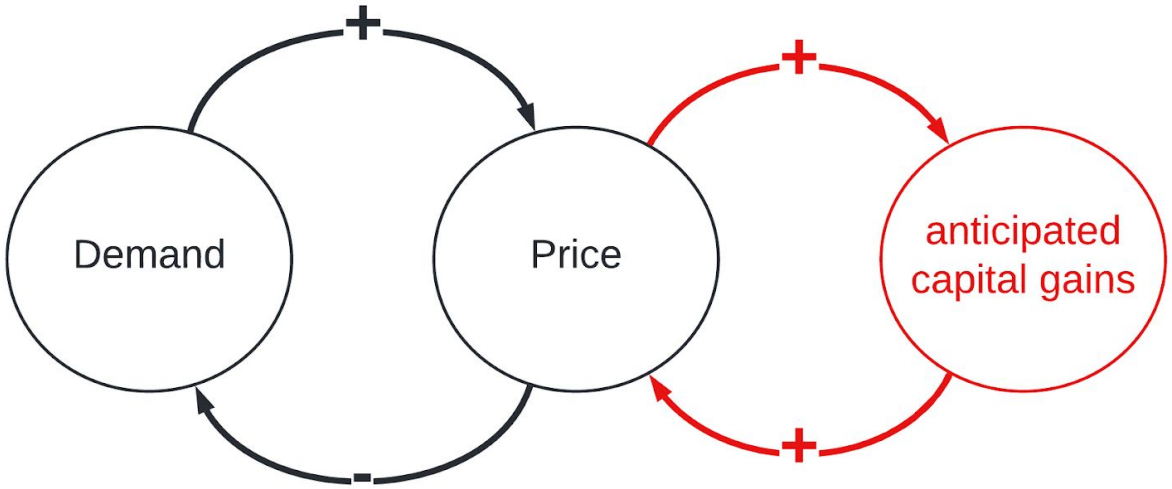
DEMAND IN-ELASTICITY TO PRICE



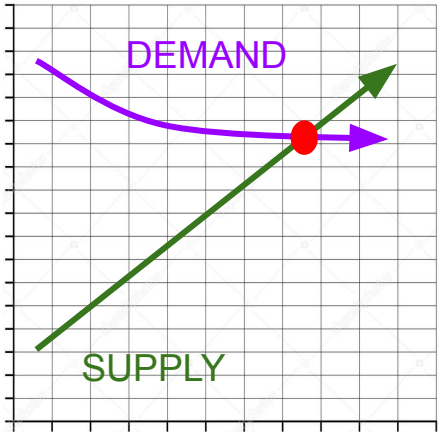


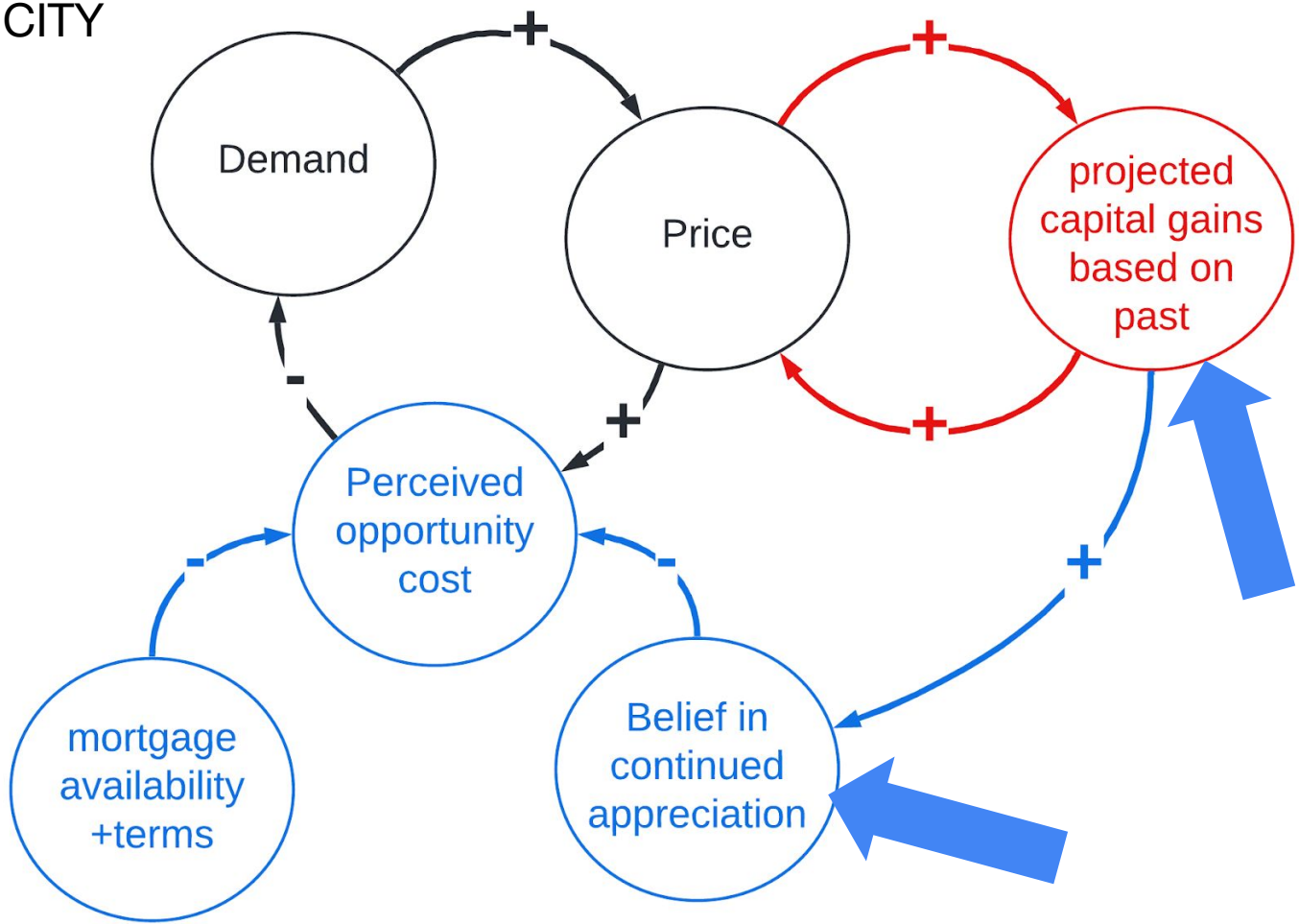
DEMAND IN-ELASTICITY
TO PRICE





DEMAND IN-ELASTICITY TO PRICE





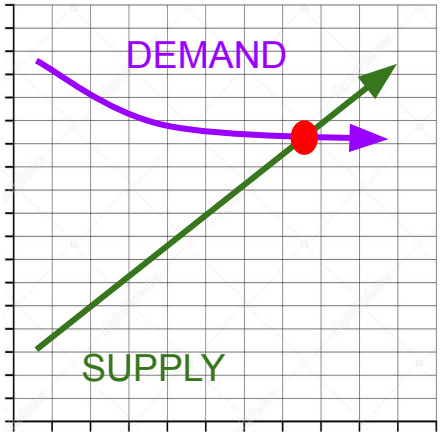
INTERVENTIONS:
Price Elasticity of Demand

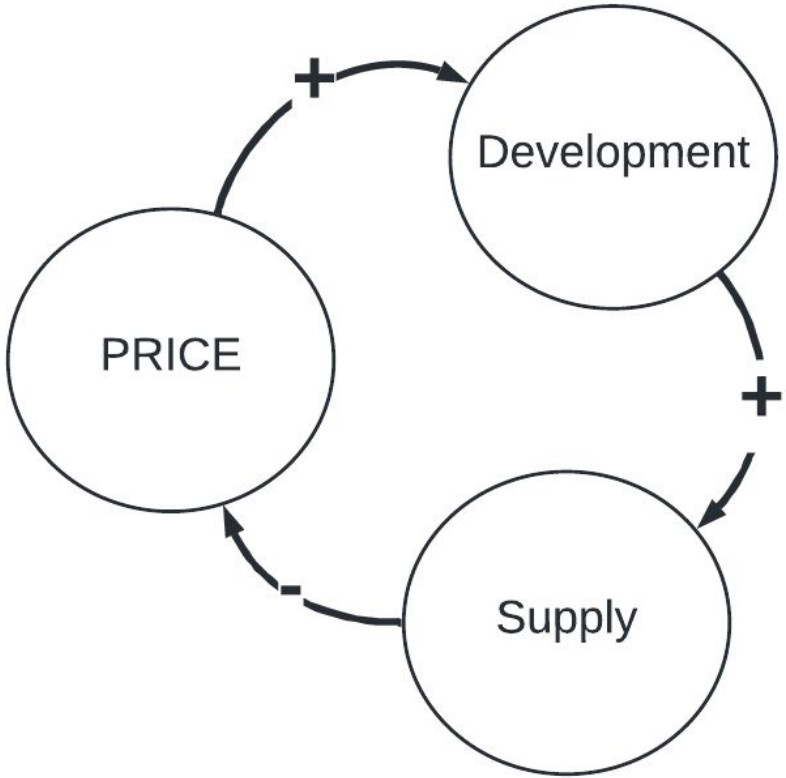
Reduce reliance on future capital gains through high percentage municipal gains tax

Redistribute community equity (appreciation should benefit all residents, not just those that can get mortgages)

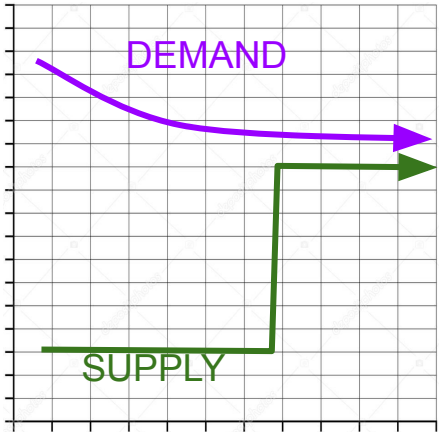
Create Price floor with iBuying program, reducing risk

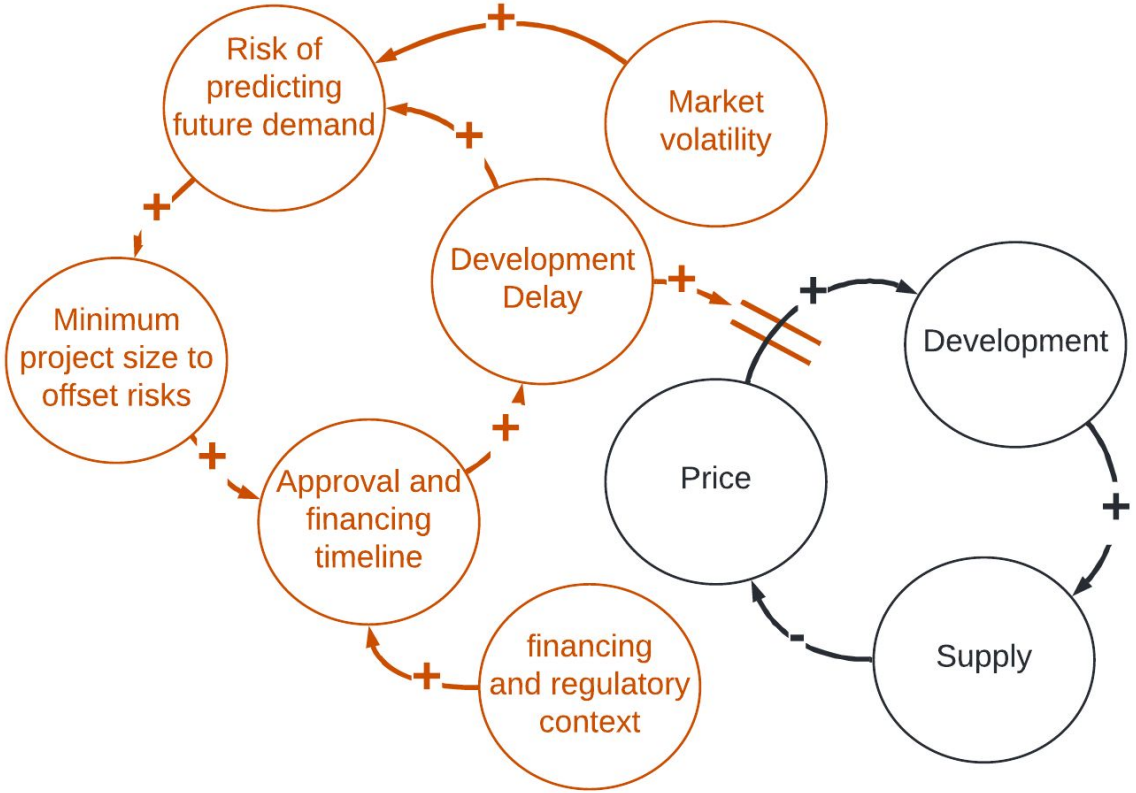
SUPPLY IN-ELASTICITY
TO PRICE



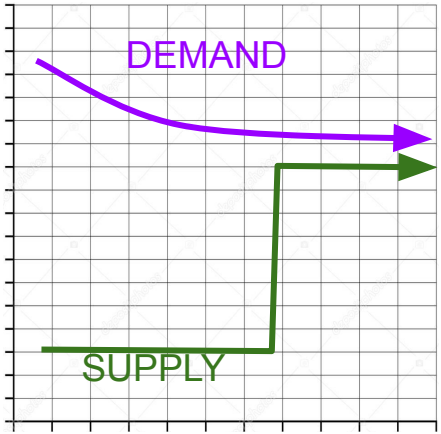


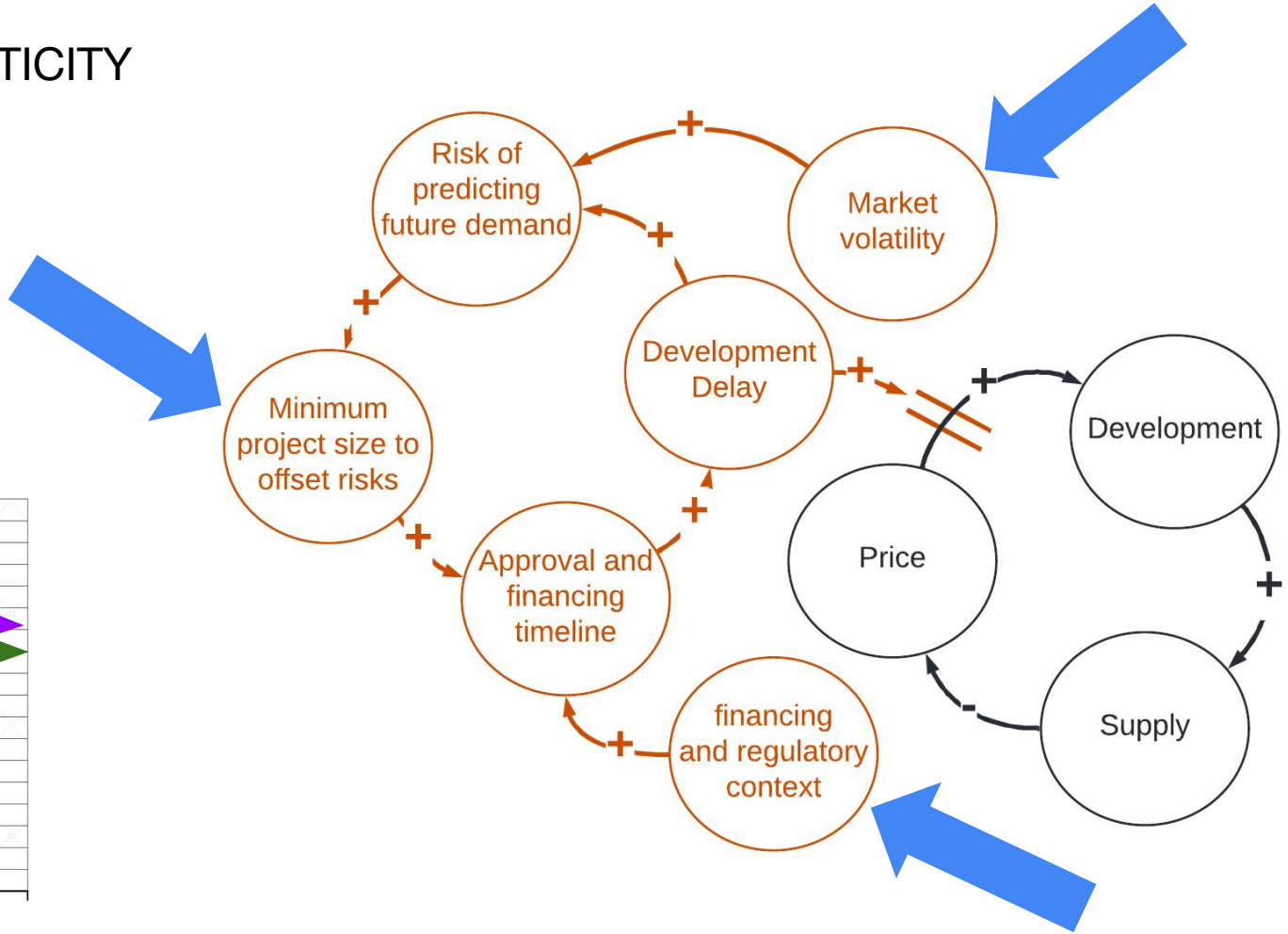
SUPPLY IN-ELASTICITY TO PRICE





SUPPLY IN-ELASTICITY
TO PRICE





TESTING EFFECTS

SIMPLE SYSTEM DYNAMICS MODEL

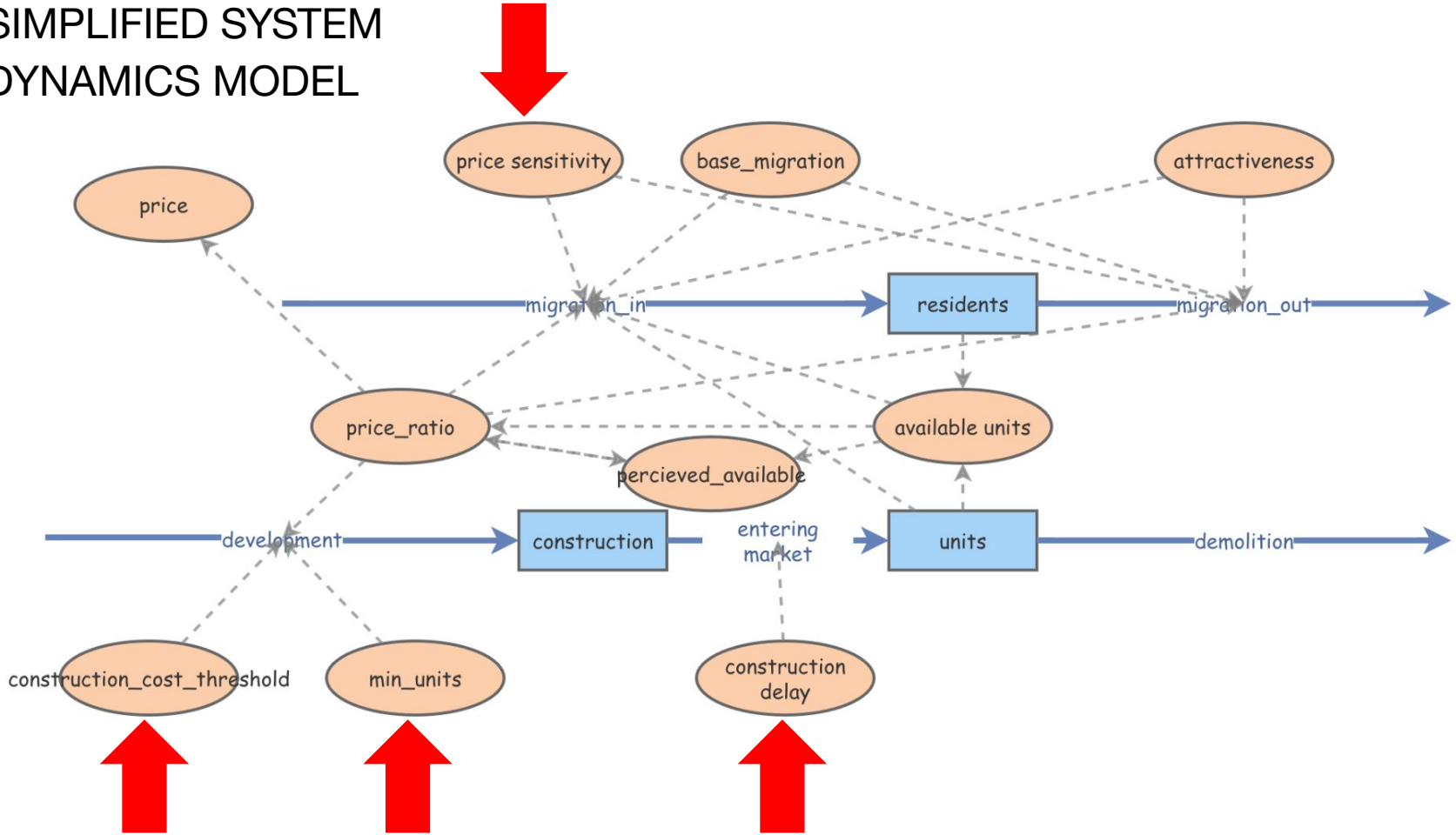
Impact of **Minimum Project Size**

Impact of price **elasticity of Demand**

Impact of price **elasticity of Supply**

Impact of **Delayed Supply** Response

SIMPLIFIED SYSTEM DYNAMICS MODEL



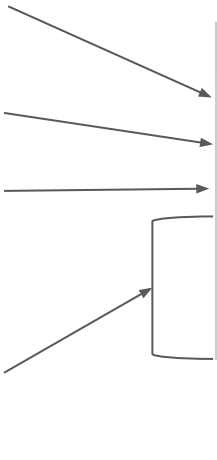
SIMPLIFIED SYSTEM DYNAMICS MODEL

Speed of migration through the city (churn)

Desirability of city (growth)

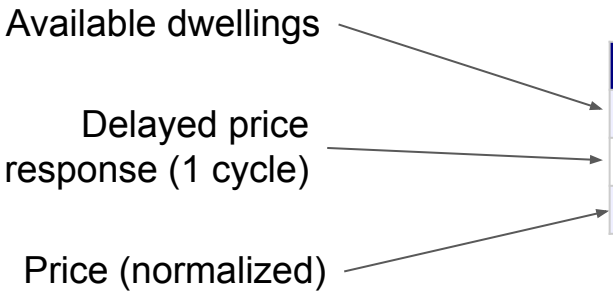
Price sensitivity

Supply elasticity:
Minimum project size
Profitability threshold
Construction time to market



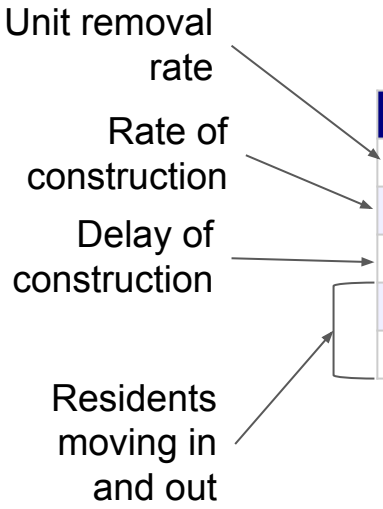
Critical Inputs Parameters	
base_migration	**Value: 20**
attractiveness	**Value: 1.58**
price sensitivity	**Value: 0.6**
min_units	**Value: 1**
construction_cost_threshold	**Value: 0.1**
construction delay	**Value: 1**

SIMPLIFIED SYSTEM DYNAMICS MODEL



Dependent Variables	
available units	**Value: ([units]-[residents])/[units]**
percieved_available	**Value: Delay([price_ratio],1, 1)-[available units]**
price_ratio	**Value: [percieved_available]**

SIMPLIFIED SYSTEM DYNAMICS MODEL



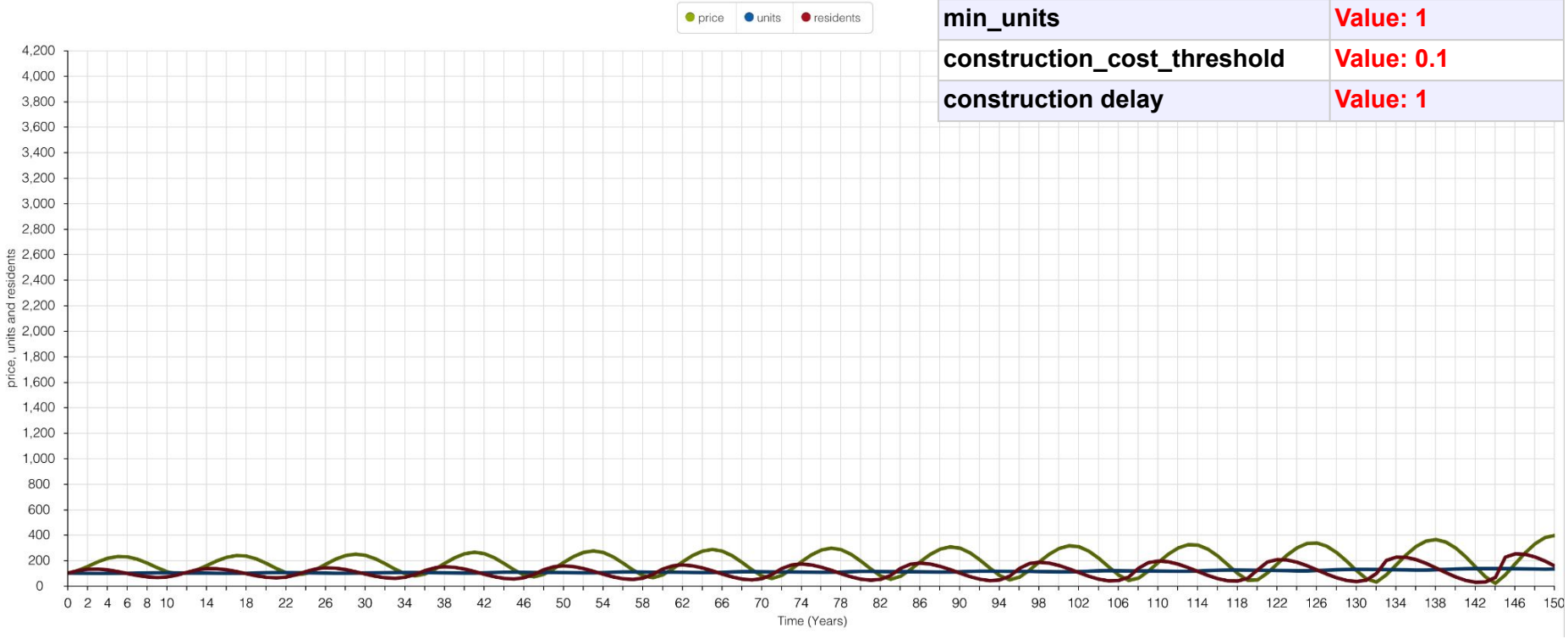
Model Flows	
demolition	**Rate: Round([units]*.01)**
development	**Rate: (Floor(([price_ratio]-[construction_cost_threshold])/[min_units])*[min_units])**
entering market	**Rate: Delay([construction], [construction delay], 0)**
migration_in	**Rate: [base_migration]*(1/([price_ratio]*[price sensitivity]))*[attractiveness]**
migration_out	**Rate: [base_migration]*([price_ratio]*[price sensitivity])*(1/[attractiveness])**

SIMPLIFIED SYSTEM DYNAMICS MODEL | INITIAL

Critical Inputs Parameters	
base_migration	Value: 20
attractiveness	Value: 1.58
price sensitivity	Value: 0.1
min_units	Value: 10
construction_cost_threshold	Value: 2.7
construction delay	Value: 3

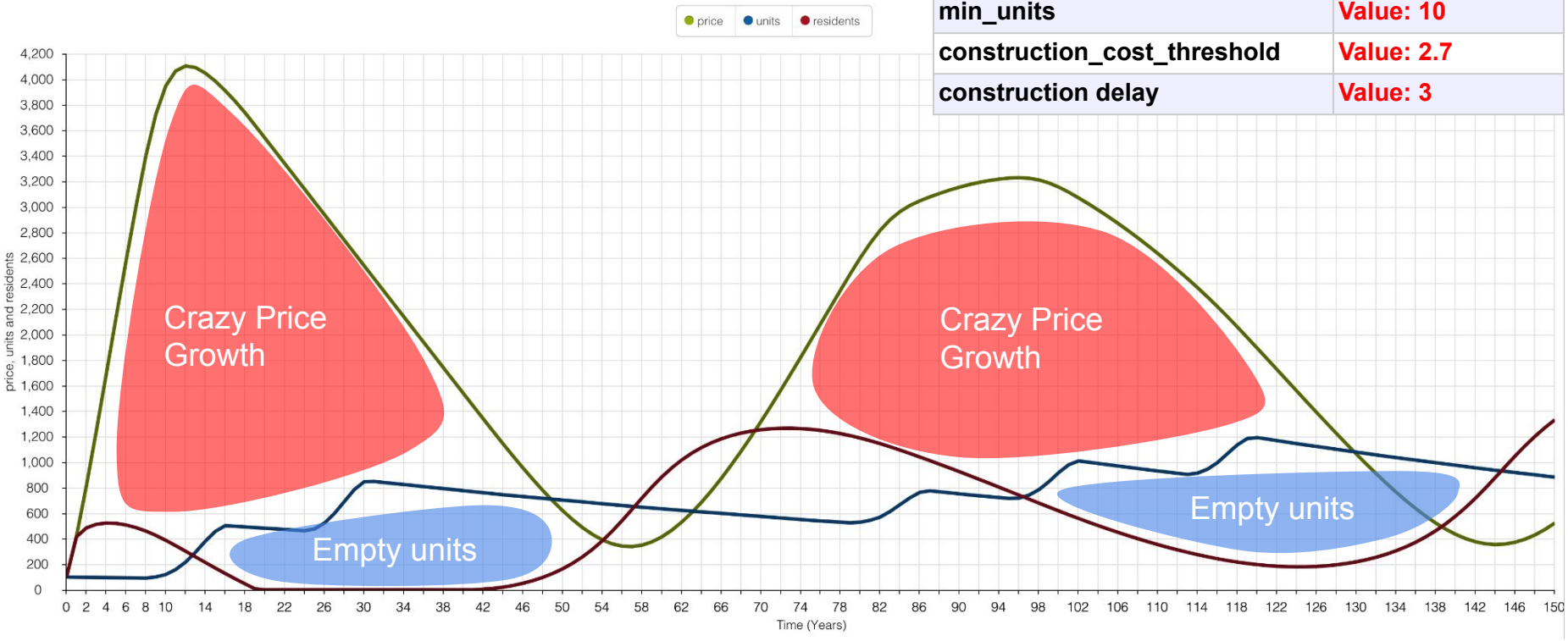
SIMPLIFIED SYSTEM DYNAMICS MODEL | INTERVENTION

Critical Inputs Parameters	
base_migration	Value: 20
attractiveness	Value: 1.58
price sensitivity	Value: 0.6
min_units	Value: 1
construction_cost_threshold	Value: 0.1
construction delay	Value: 1



SIMPLIFIED SYSTEM DYNAMICS MODEL | INITIAL

Critical Inputs Parameters	
base_migration	Value: 20
attractiveness	Value: 1.58
price sensitivity	Value: 0.1
min_units	Value: 10
construction_cost_threshold	Value: 2.7
construction delay	Value: 3



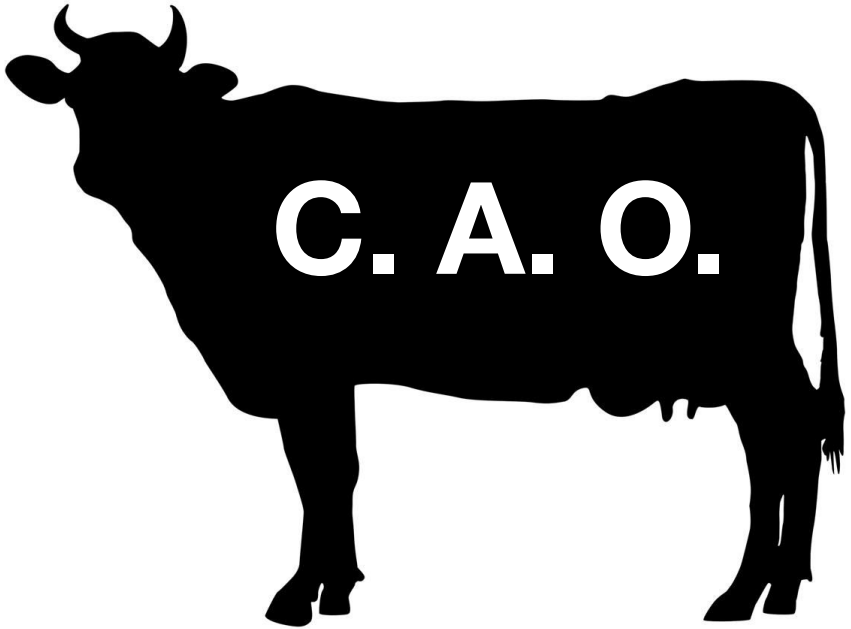
INTERVENTIONS: RESPONSIVE DEVELOPMENT

Reduce development risk with Municipal iBuying

Align development with community needs with C.A.O. tokenized incentive system

Reduce minimum development scale with standardized vertical structure and vertical circulation

Reduce development delay for approvals/financing



Community autonomous organization managing a community based Real Estate Investment Fund

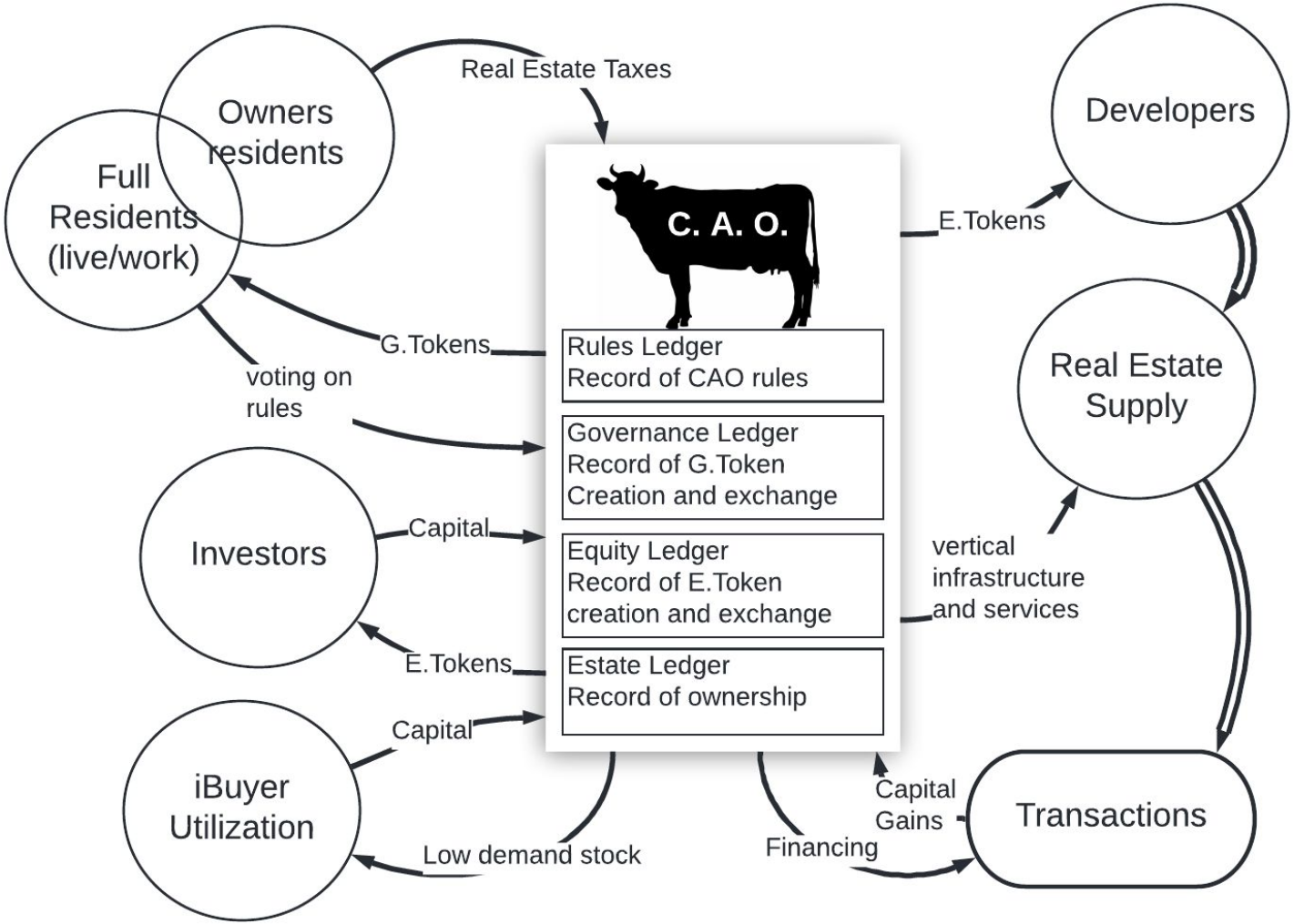
Local investment promotes informed investing and aligned values

Blockchain based system allows fluid exchange between different types and quantities of value

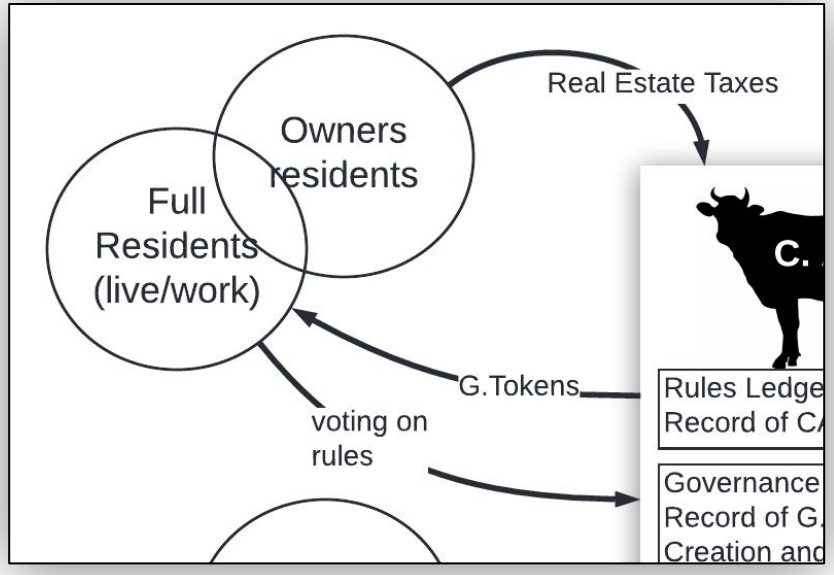
Blockchain based decision-making allows fluid information exchange informing systems of value exchange

Precedents:

crowd based real estate fund
https://www.crowdstreet.com/
DAO value exchange system
https://app.klimadao.finance/


Owners residents
Full Residents (live/work)
Real Estate Taxes
C. A. O.
Developers
E.Tokens
G.Tokens
voting on rules
Rules Ledger
Record of CAO rules
Governance Ledger
Record of G.Token
Creation and exchange
Real Estate Supply
Investors
Capital
Equity Ledger
Record of E.Token
creation and exchange
vertical infrastructure and services
E.Tokens
Estate Ledger
Record of ownership
Capital
iBuyer Utilization
Capital Gains
Transactions
Low demand stock
Financing

Residents

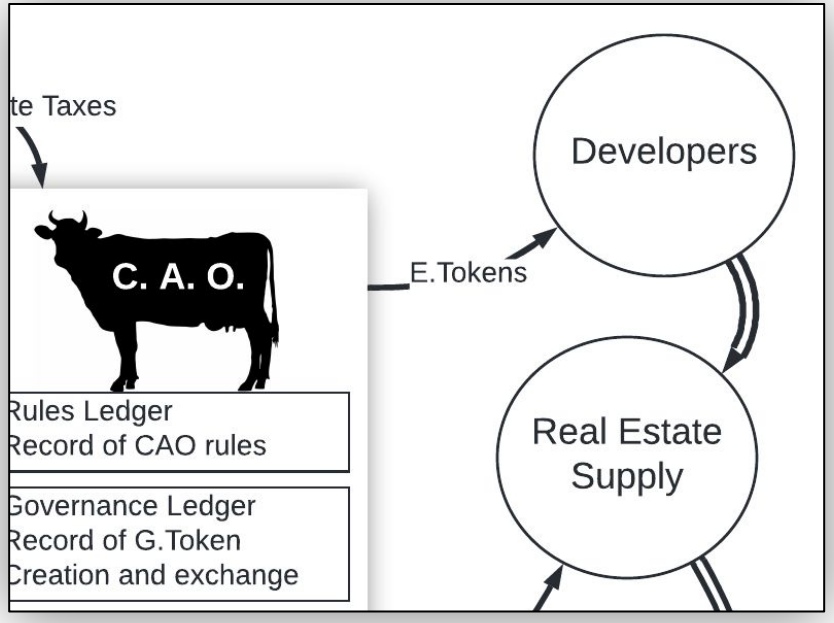


All Real Estate is taxes at an elevated rate to directly fund the CAO, with rates adjusted for assessed per/sqft and for prosocial program as determined by the Rules ledger

Full Residents (that live and work) **accrue Governance tokens each year.** Governance tokens represent voting shares and can be exchanged earned or forfeited as determined by the rules ledger

Full residents determine the rules of the CAO, in particular determining systems of token exchange and distribution. Full residents transfer or forfeit their tokens upon migration or death per the rules ledger

Development

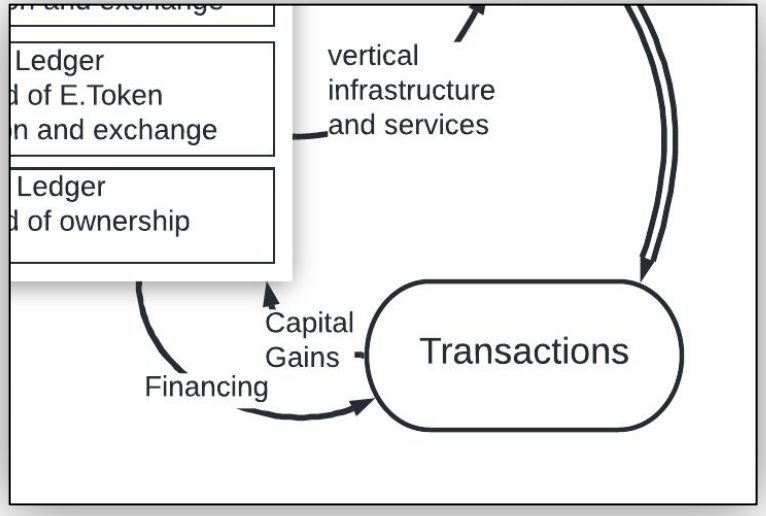


CAO **incentivizes prosocial development by distributing E.Tokens**, backed by ownership shares in the CAO

CAO reduces minimum project size by supplying **vertical structure and vertical circulation** infrastructure to all new development, scaled for a minimum of 40 storeys

Roofs can be resold at % of ground floor value diminishing to 0% at floor 40

Transaction Process

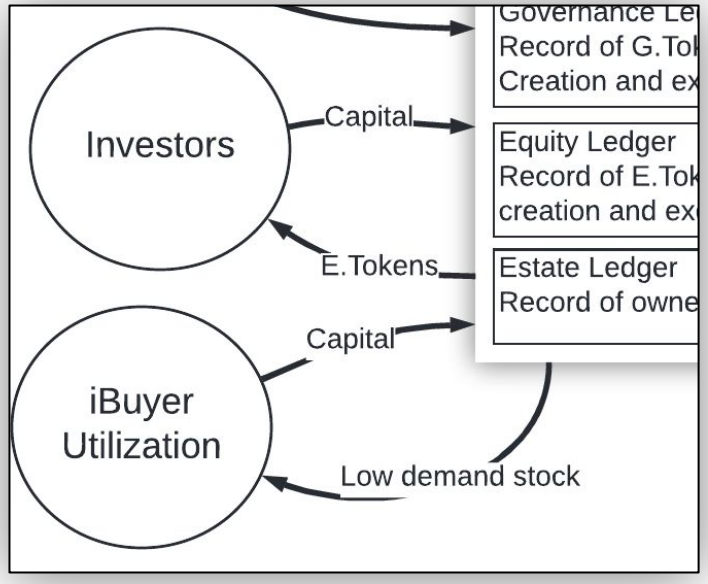


CAO provides equitable financing with terms set the Rules Ledger

Excessive Capital Gains is taxes at 100%, Capitalizing the CAO fund, distributing appreciation to the entire community and disincentivizing supply restriction

Price floor created by CAO serving as an iBuyer of last resort (buying all properties after some duration on the market)

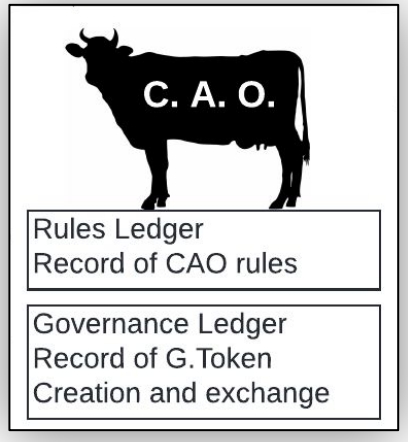
Transaction Process



Real Estate investors buy E.Tokens backed by shares in the CAO. **These are investments in the community** not specific geographic areas so more appropriately match how value grows

iBuyer partners are businesses that can rapidly/flexibly monetize free space. The CAO buys any unsold property and **transfers management to the iBuyer partner** (food production?) until demand increases.

Potential C.A.O. Rules



Token incentives to develop **age-profile targeted amenities**

Penalize excessive car ownership via parking access distributing/exchanging **specialized parking stickers**

Match housing to varied income population through varied **building form** and **financing opportunities**

URBAN FORMS | SCENARIOS

what forms with these scenarios take in the city?

what will cambrige looks like with these interventions?

Kendall Square

PHASE I

Building Properties

FAR (floor area ratio)
GFA (gross floor area)
BC (building coverage)

Functions

%

Amenities Office Commercial Residential

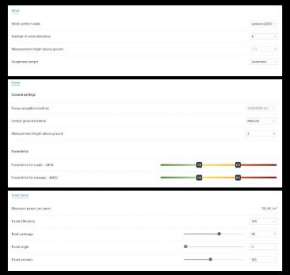
Residential Unit Distribution

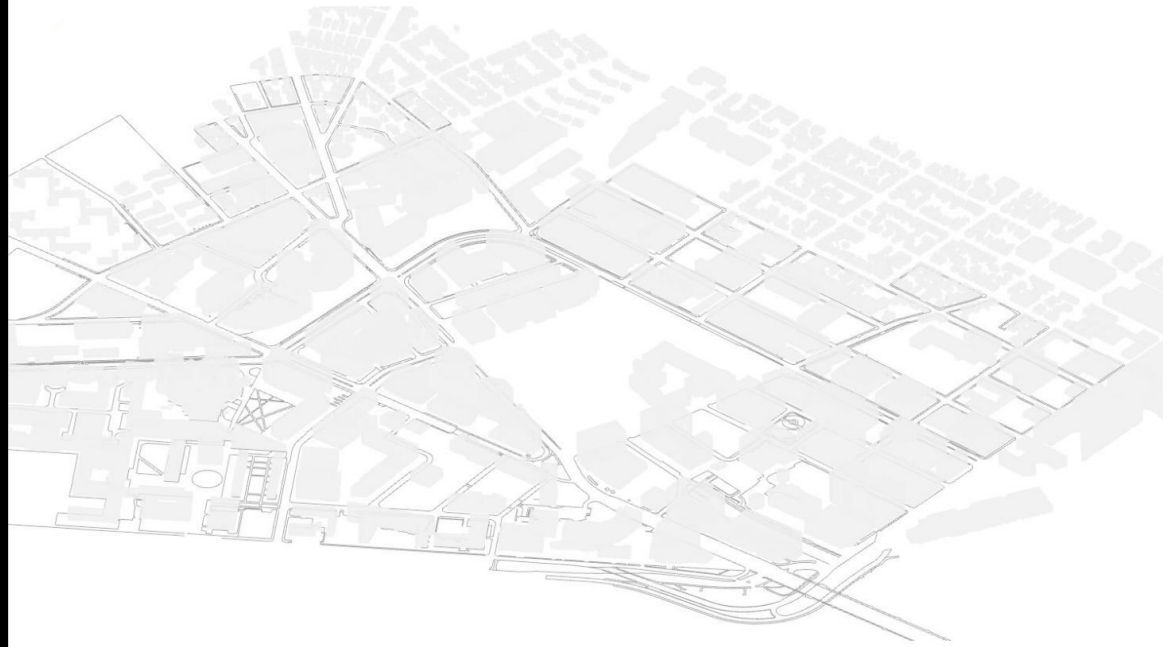
%

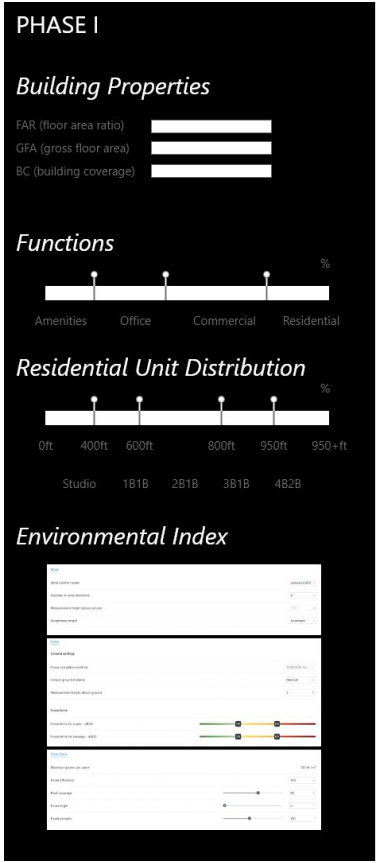
0ft 400ft 600ft 800ft 950ft 950+ft

Studio 1B1B 2B1B 3B1B 4B2B

Environmental Index






PHASE I
Building Properties
FAR (floor area ratio)
GFA (gross floor area)
BC (building coverage)
Functions
%
Amenities
Office
Commercial
Residential
Residential Unit Distribution
%
0ft
400ft
600ft
800ft
950ft
950+ft
Studio
1B1B
2B1B
3B1B
4B2B
Environmental Index


Results (76)
Favorites (0)
Sort by: GFA
Input
Results
Details
Filters
BC 121,040 ft² – 288,871 ft²
RA 3,108,294 ft² – 7,411,867 ft²
GFA 3,453,665 ft² – 8,235,403 ft²
BC - 288,864 ft² RA - 7,411,857 ft² GFA - 8,235,397 ft²
BC - 275,498 ft² RA - 7,070,324 ft² GFA - 7,855,916 ft²
BC - 249,501 ft² RA - 6,402,802 ft² GFA - 7,114,224 ft²
BC - 248,435 ft² RA - 6,376,204 ft² GFA - 7,084,671 ft²
BC - 244,268 ft² RA - 6,268,888 ft² GFA - 6,965,431 ft²
BC - 243,524 ft² RA - 6,246,779 ft² GFA - 6,940,866 ft²
BC - 240,419 ft² RA - 6,170,650 ft² GFA - 6,856,278 ft²
BC - 235,988 ft² RA - 6,054,444 ft² GFA - 6,727,160 ft²
BC - 234,142 ft² RA - 6,007,099 ft² GFA - 6,674,554 ft²
BC - 232,796 ft² RA - 5,973,215 ft² GFA - 6,636,906 ft²
BC - 230,450 ft² RA - 5,913,944 ft² GFA - 6,571,049 ft²
BC - 228,932 ft² RA - 5,872,127 ft² GFA - 6,524,585 ft²
BC - 227,877 ft² RA - 5,845,307 ft² GFA - 6,494,785 ft²
BC - 227,603 ft² RA - 5,839,184 ft² GFA - 6,487,982 ft²
BC - 224,351 ft² RA - 5,758,887 ft² GFA - 6,398,764 ft²

Kendall Square

Scenario planning

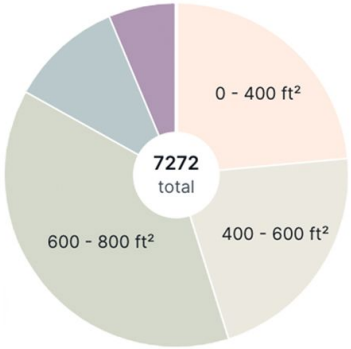
1st scenario - 33,970 workers
→ higher emission of CO2

2nd scenario - 17,200 workers
→ incentivize the use of public transportation

3rd scenario - 8,944 workers
→ age more likely to move

4th scenario - 7,200 workers
→ assumption given Kendall's industries

Unit distribution (RA)



Number of living units	7272

Site area

FAR (Floor Area Ratio)
14.66%

GFA (Gross Floor Area)
8,065,941 ft2

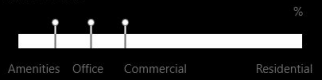
BC (Building Coverage)
282,893 ft2

PHASE I

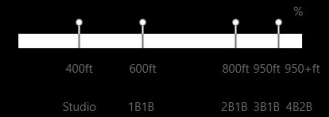
Building Properties

FAR (floor area ratio)	14.66%
GFA (gross floor area)	8,065,941 ft2
BC (building coverage)	282,893 ft2

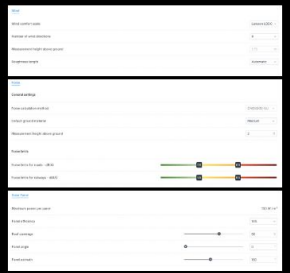
Functions

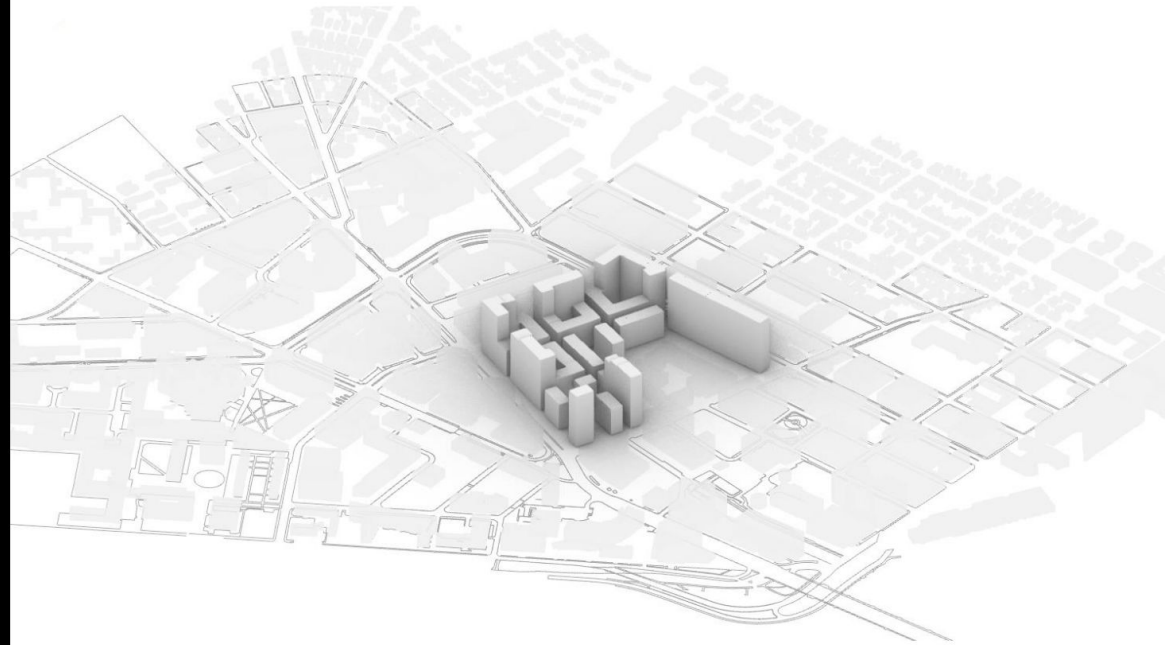


Residential Unit Distribution



Environmental Index





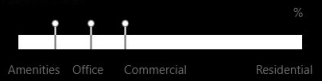
Kendall Square

PHASE I

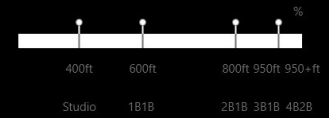
Building Properties

FAR (floor area ratio)	14.66%
GFA (gross floor area)	8,065,941 ft2
BC (building coverage)	282,893 ft2

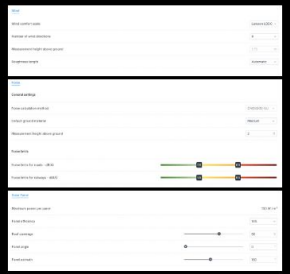
Functions

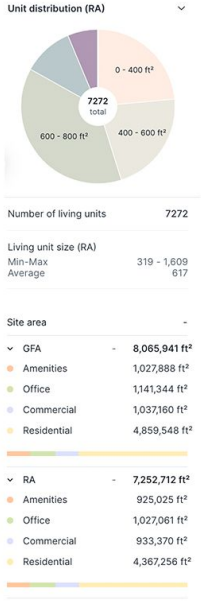


Residential Unit Distribution



Environmental Index





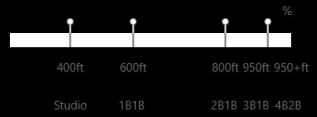
PHASE I

Building Properties

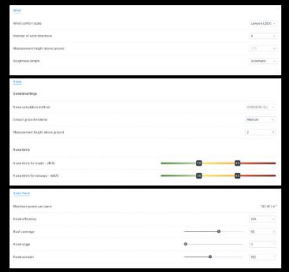
FAR (floor area ratio)	14.66%
GFA (gross floor area)	8,065,941 ft2
BC (building coverage)	282,893 ft2

Functions

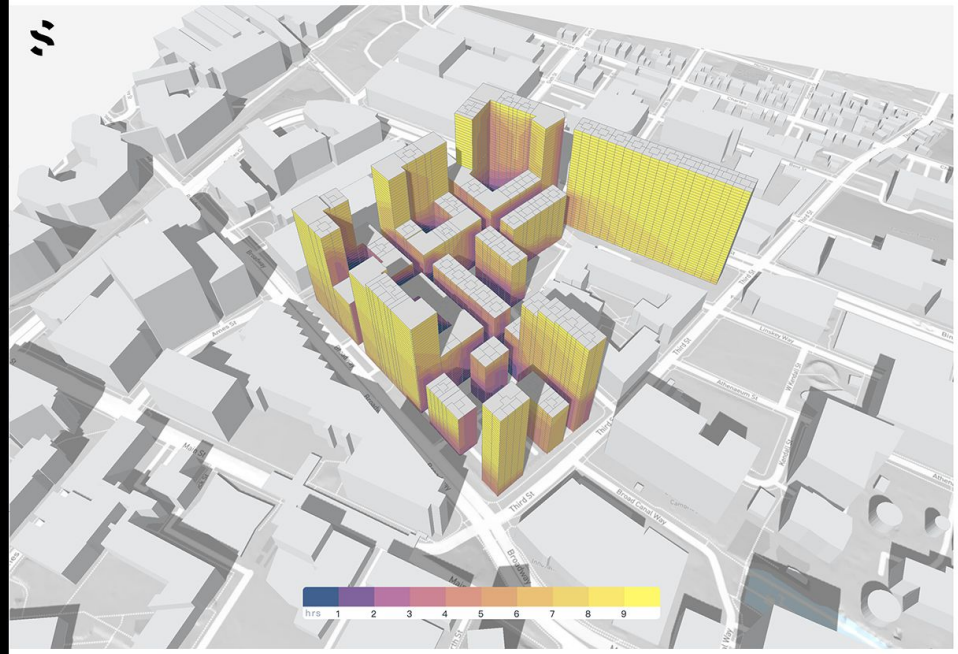
Residential Unit Distribution



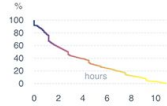
Environmental Index



Solar Radiation



Facade



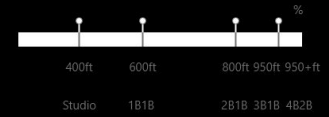
PHASE I

Building Properties

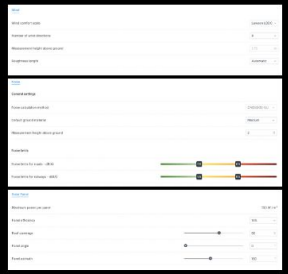
FAR (floor area ratio)	14.66%
GFA (gross floor area)	8,065,941 ft2
BC (building coverage)	282,893 ft2

Functions

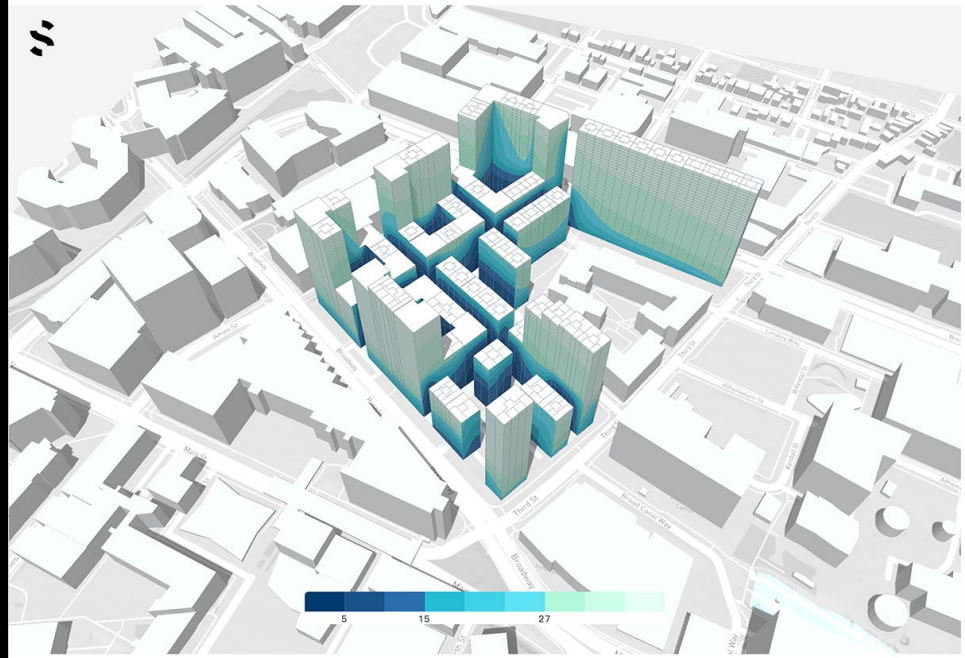
Residential Unit Distribution



Environmental Index



Daylight Autonomy



Facade

Below 5%	16 %
Between 5 and 15%	19 %
Between 15 and 27%	18 %
Above 27%	48 %

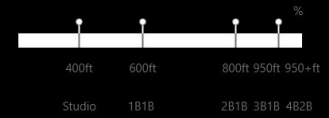
PHASE I

Building Properties

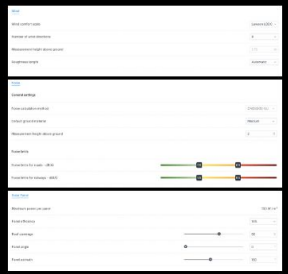
FAR (floor area ratio)	14.66%
GFA (gross floor area)	8,065,941 ft2
BC (building coverage)	282,893 ft2

Functions

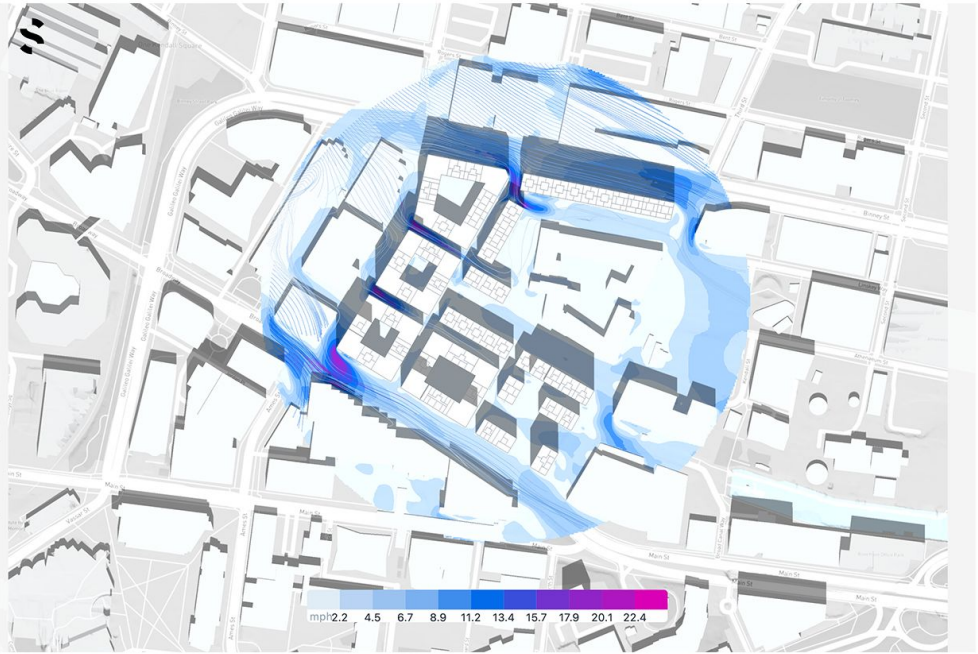
Residential Unit Distribution

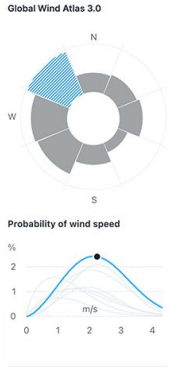


Environmental Index



Wind Flow





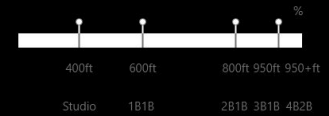
PHASE I

Building Properties

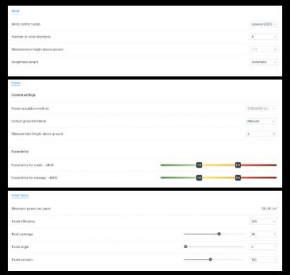
FAR (floor area ratio)	14.66%
GFA (gross floor area)	8,065,941 ft2
BC (building coverage)	282,893 ft2

Functions

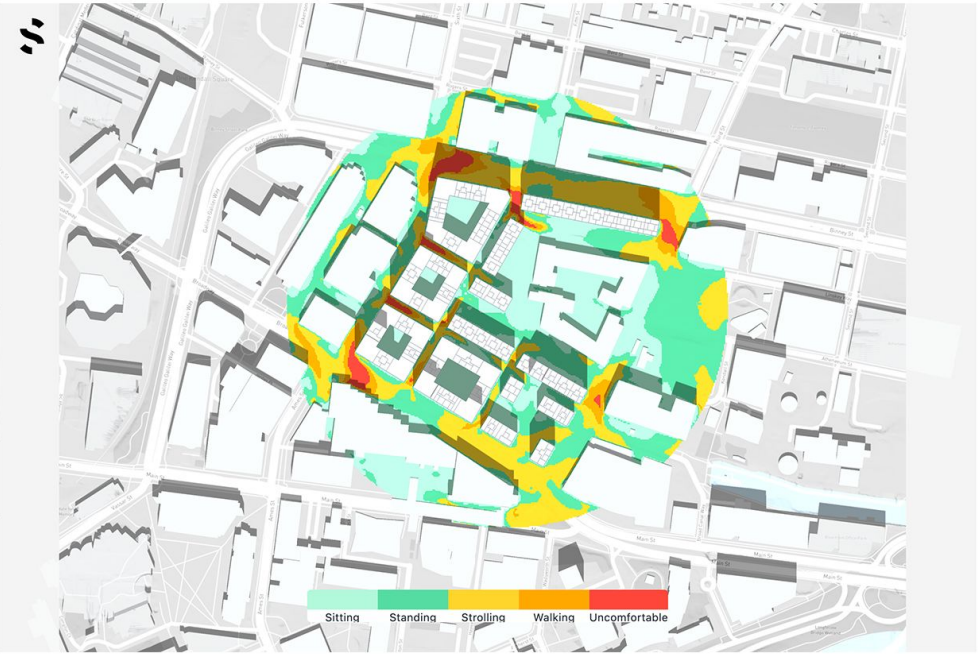
Residential Unit Distribution



Environmental Index



Wind Comfort



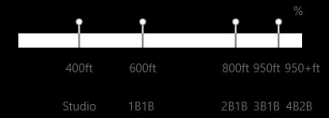
PHASE I

Building Properties

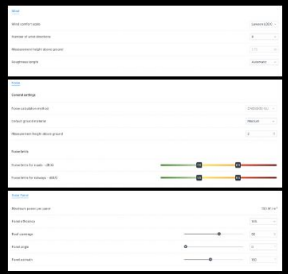
FAR (floor area ratio)	14.66%
GFA (gross floor area)	8,065,941 ft2
BC (building coverage)	282,893 ft2

Functions

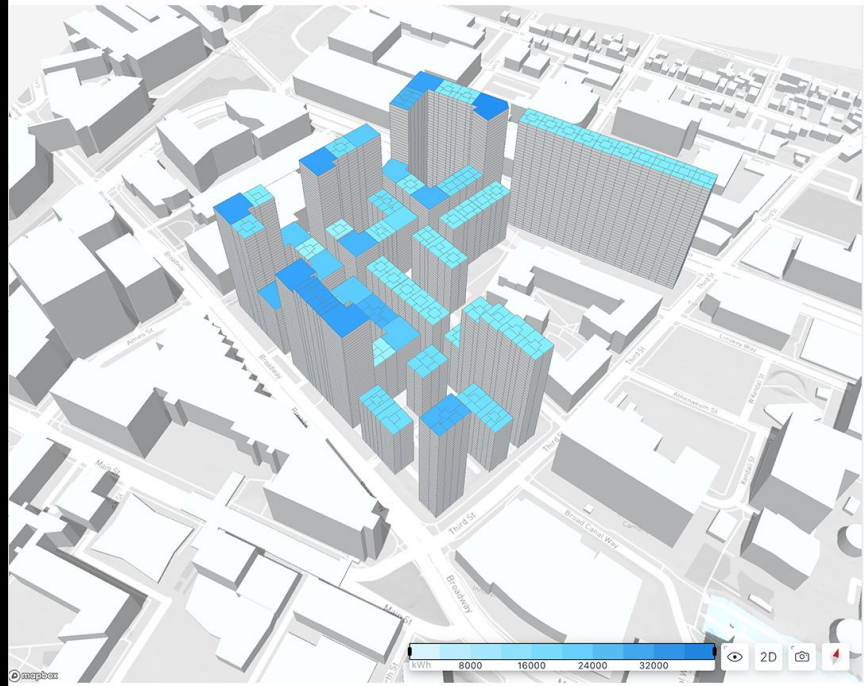
Residential Unit Distribution



Environmental Index



Solar Panel



Kendall Square

Scenario planning

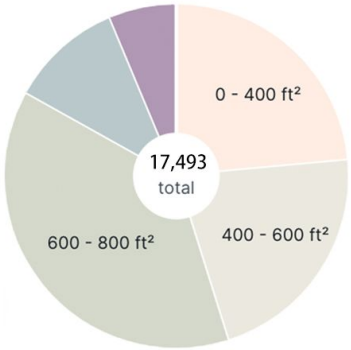
1st scenario - 33,970 workers
→ higher emission of CO2

2nd scenario - 17,200 workers
→ incentivize the use of public transportation

3rd scenario - 8,944 workers
→ age more likely to move

4th scenario - 7,200 workers
→ assumption given Kendall's industries

Unit distribution (RA)



Number of living units	17,493

Site area

FAR (Floor Area Ratio)
14.66%

GFA (Gross Floor Area)
32,339,348 ft2

BC (Building Coverage)
1,134,508 ft2

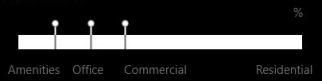
Kendall Square

PHASE II

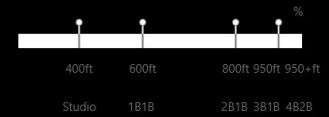
Building Properties

FAR (floor area ratio)	14.66%
GFA (gross floor area)	32,339,348 ft2
BC (building coverage)	1,134,508 ft2

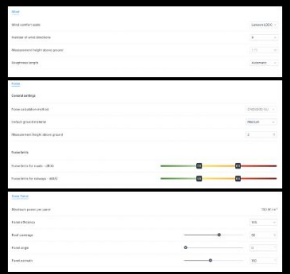
Functions

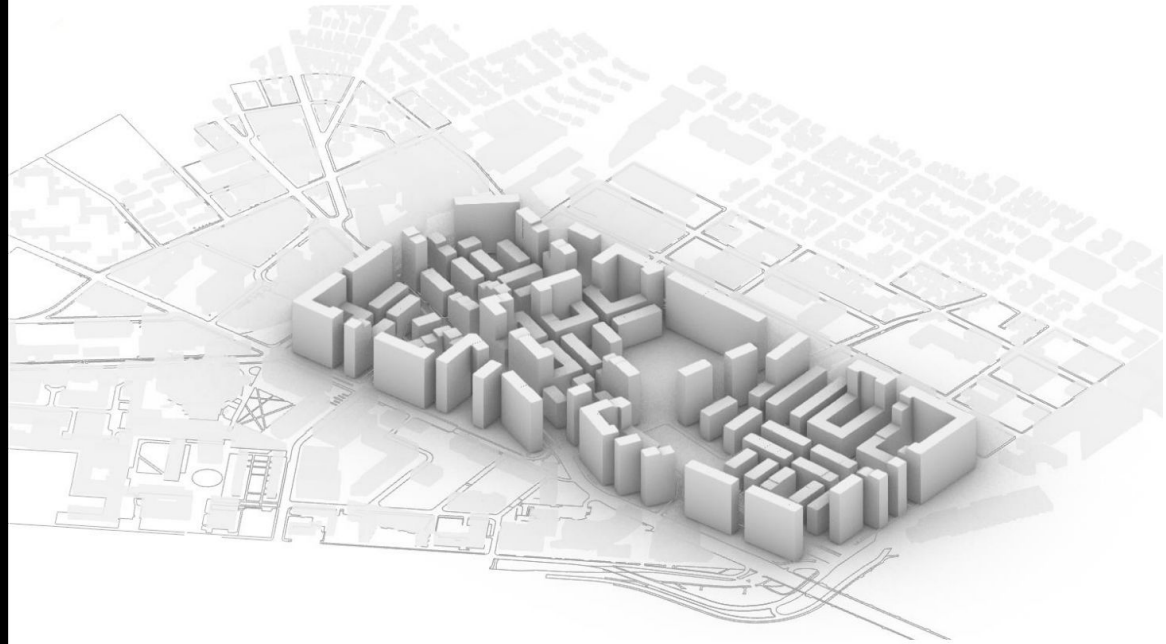


Residential Unit Distribution



Environmental Index



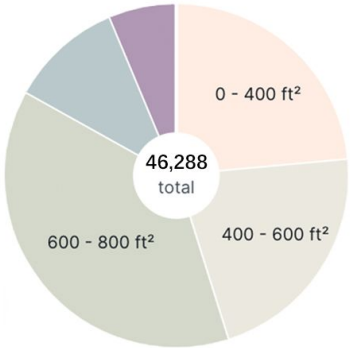


Kendall Square

Scenario planning

- 1st scenario - 33,970 workers
  → higher emission of CO2
- 2nd scenario - 17,200 workers
  → incentivize the use of public transportation
- 3rd scenario - 8,944 workers
  → age more likely to move
- 4th scenario - 7,200 workers
  → assumption given Kendall's industries

Unit distribution (RA)



Number of living units	46,288

Site area

FAR (Floor Area Ratio)
14.66%

GFA (Gross Floor Area)
85,570,482 ft2

BC (Building Coverage)
3,003,529 ft2

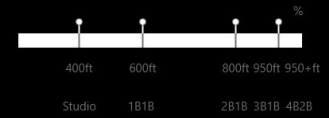
PHASE III

Building Properties

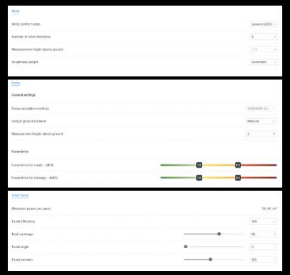
FAR (floor area ratio)	14.66%
GFA (gross floor area)	85,570,482 ft2
BC (building coverage)	3,003,529 ft2

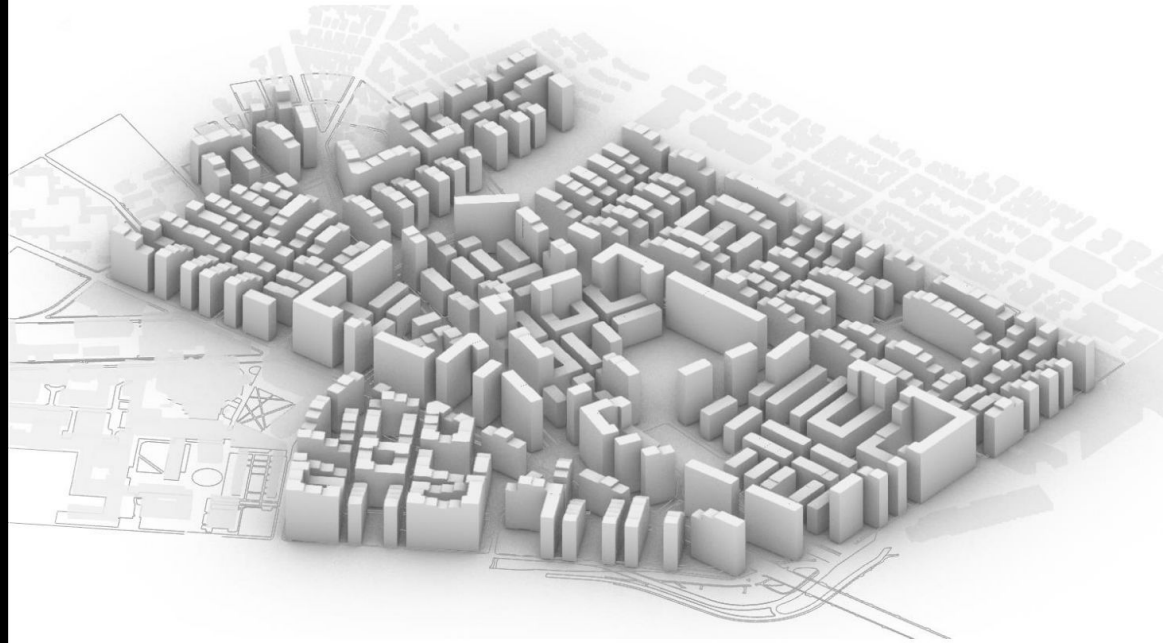
Functions

Residential Unit Distribution

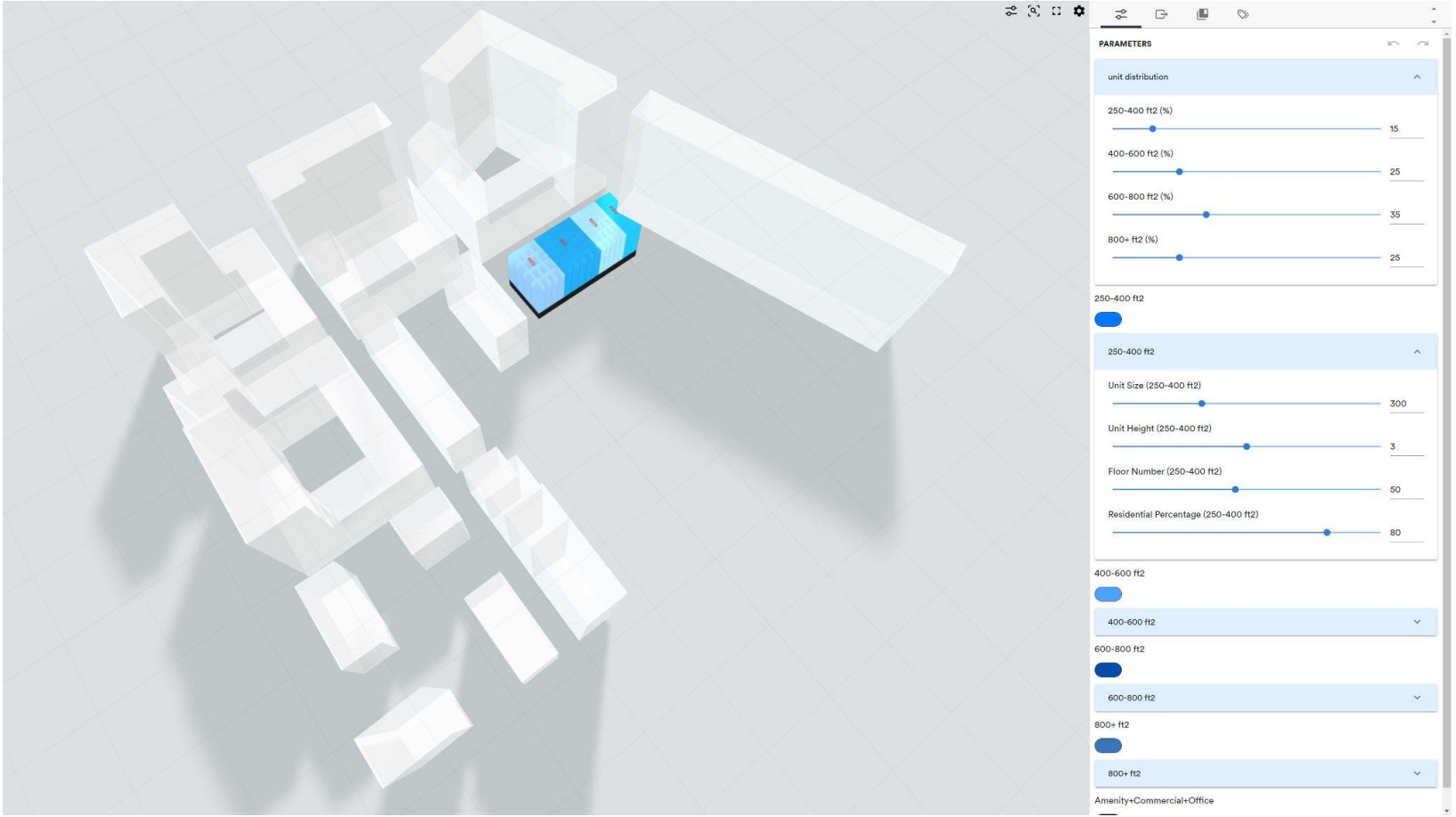


Environmental Index

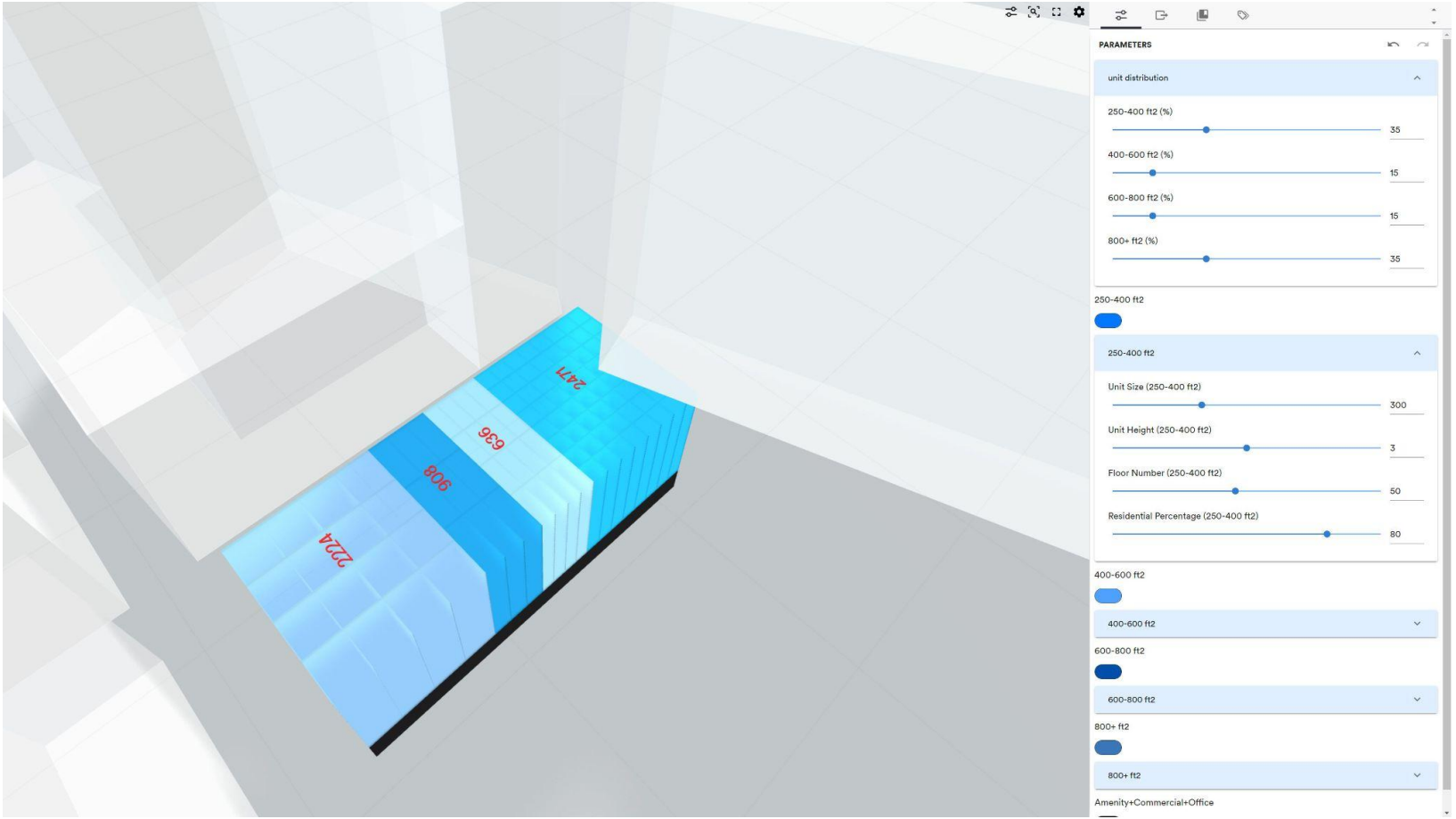


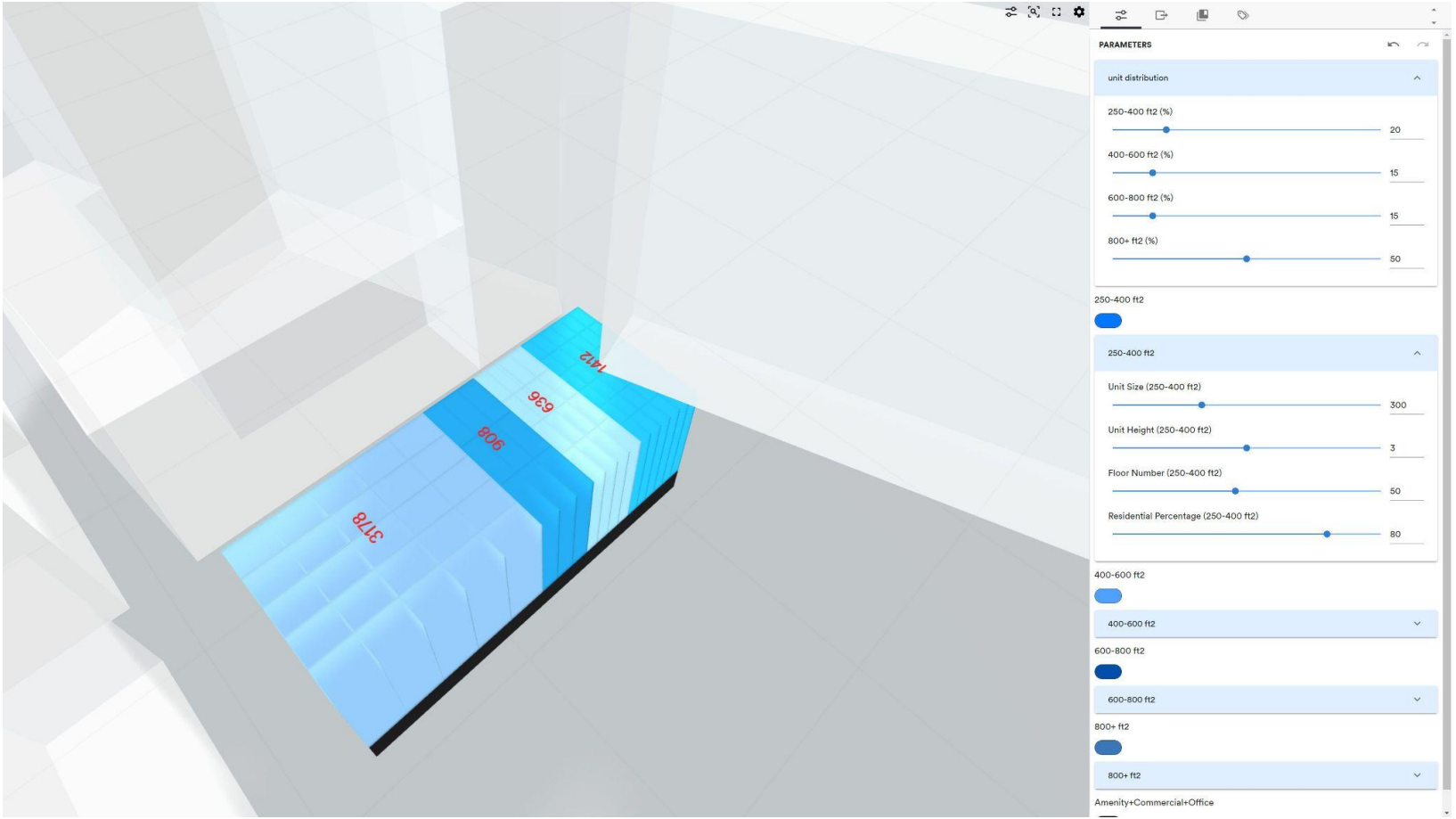


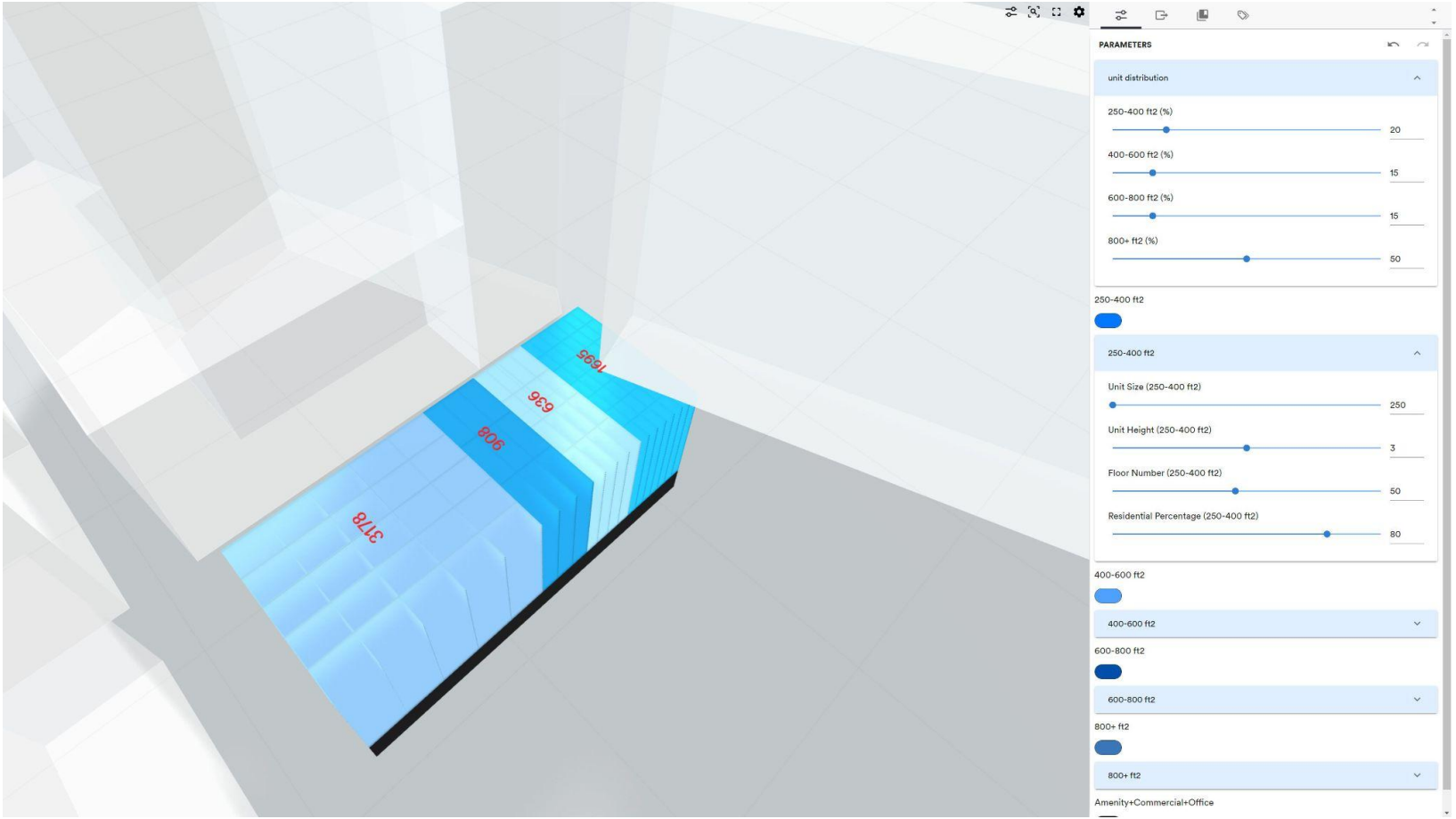
Kendall Square

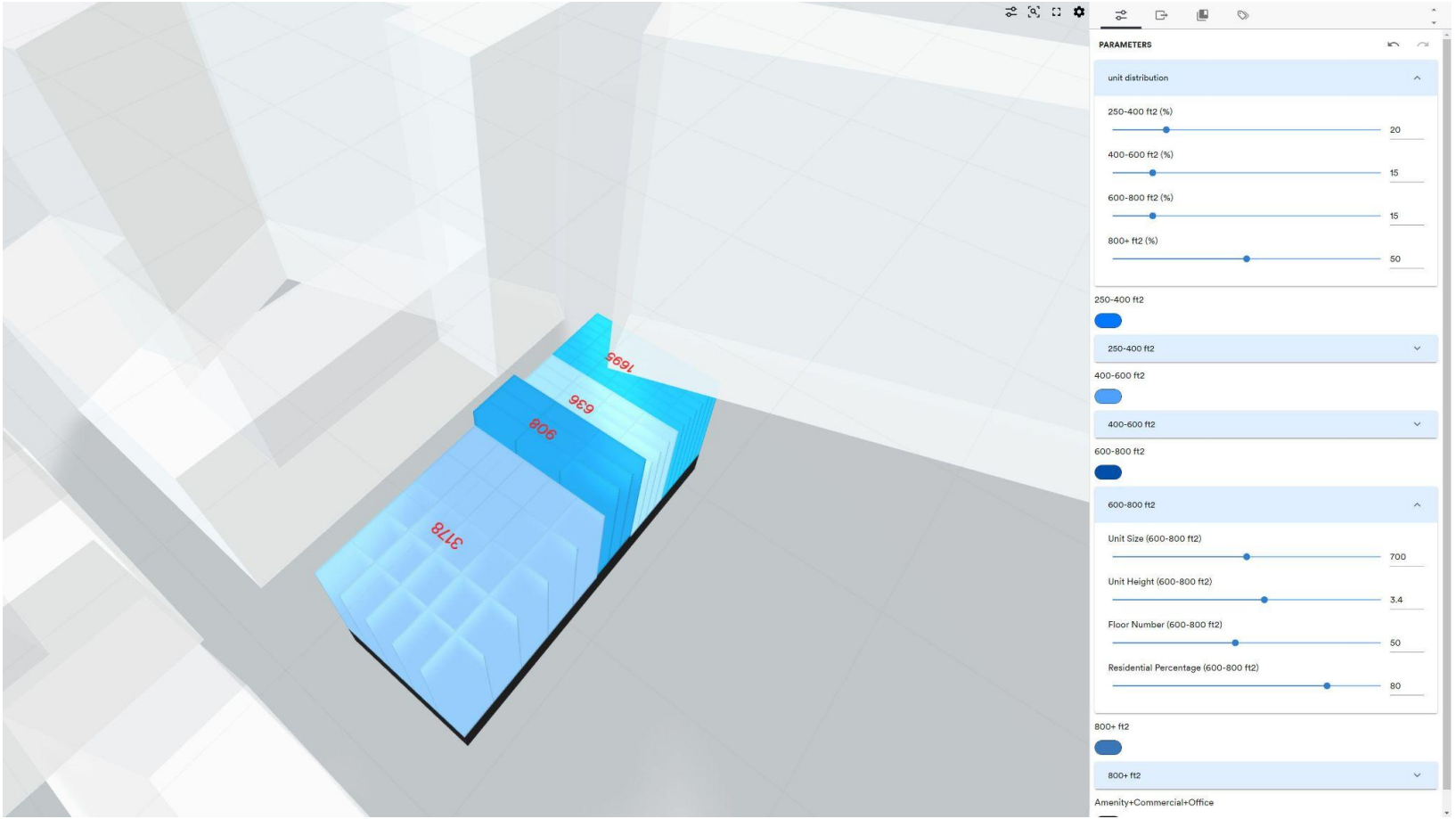


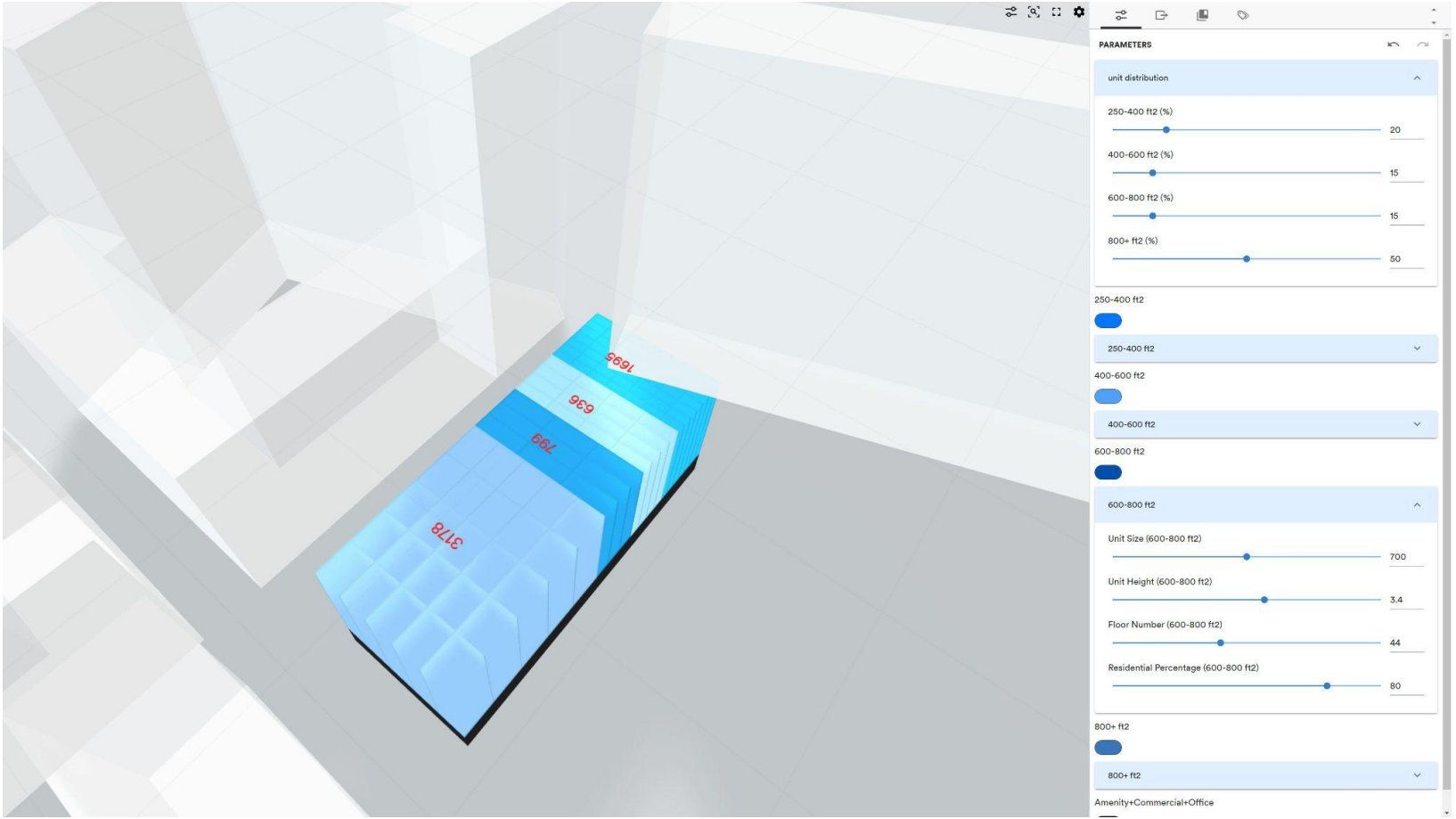
Shapediver Script: https://www.shapediver.com/app/models/city-block-12

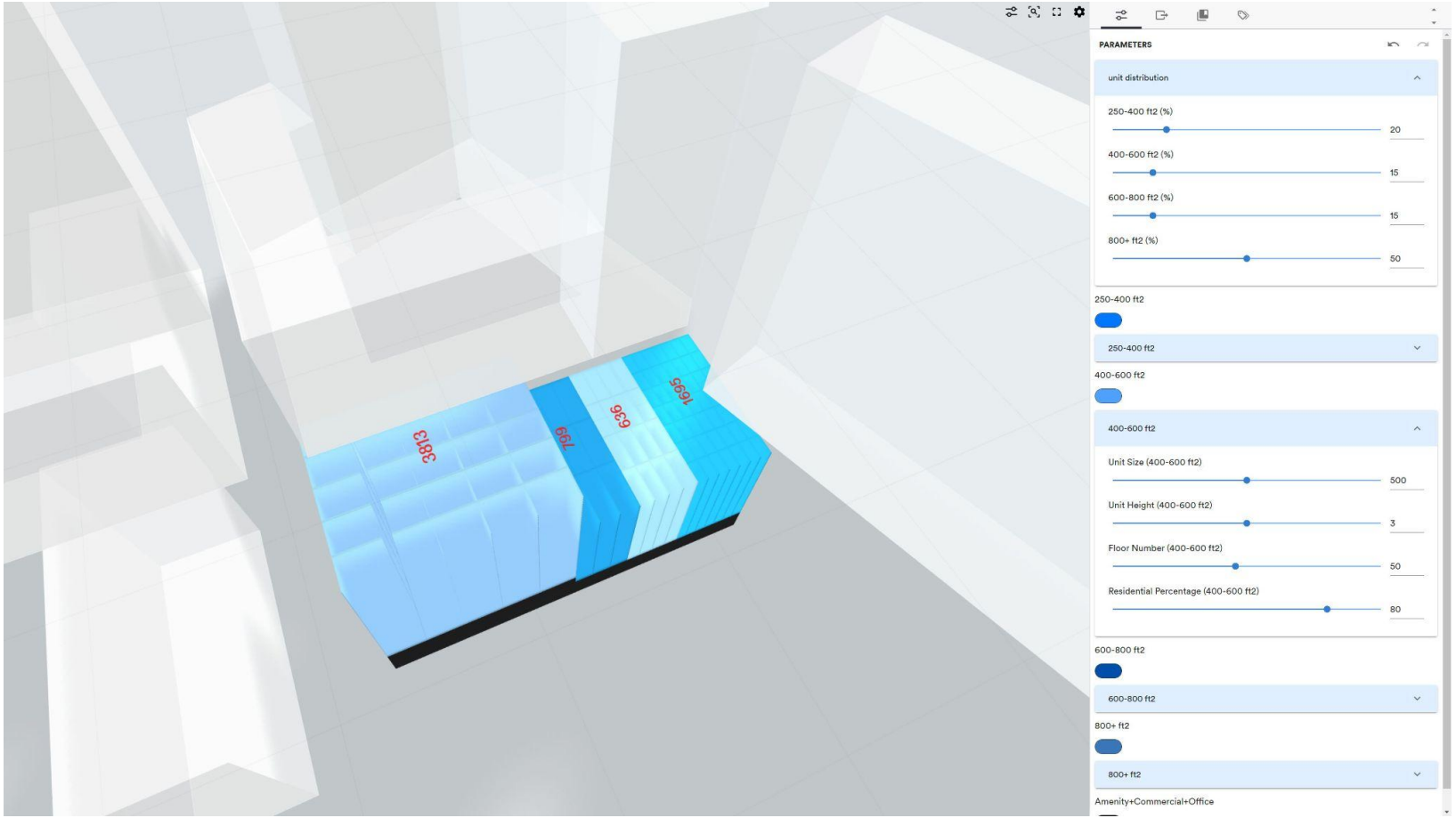

2471
636
908
2224
PARAMETERS
unit distribution
250-400 ft2 (%)
35
400-600 ft2 (%)
15
600-800 ft2 (%)
15
800+ ft2 (%)
35
250-400 ft2
250-400 ft2
Unit Size (250-400 ft2)
300
Unit Height (250-400 ft2)
3
Floor Number (250-400 ft2)
50
Residential Percentage (250-400 ft2)
80
400-600 ft2
400-600 ft2
600-800 ft2
600-800 ft2
800+ ft2
800+ ft2
Amenity+Commercial+Office

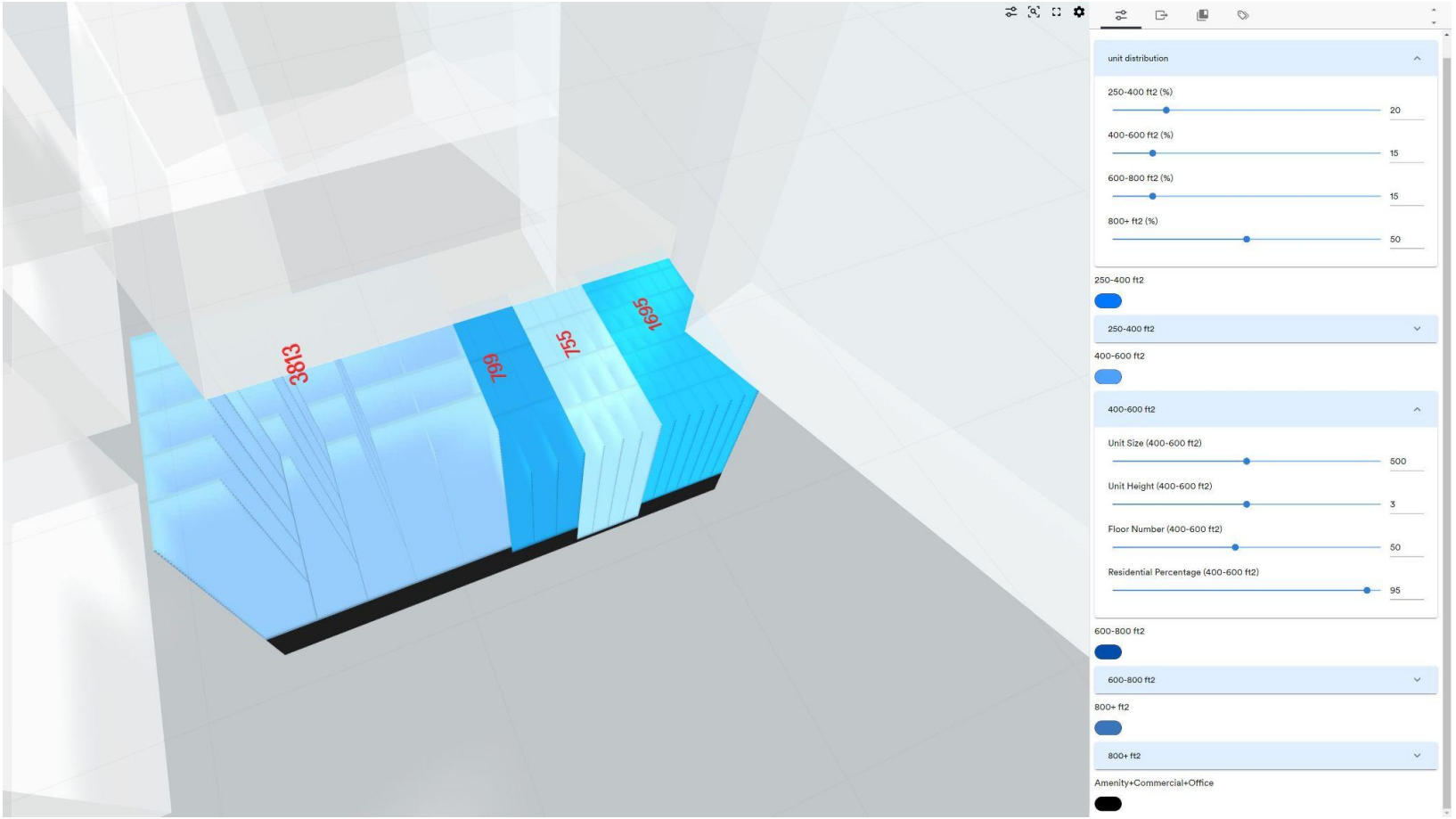

PARAMETERS
unit distribution
250-400 ft2 (%)
20
400-600 ft2 (%)
15
600-800 ft2 (%)
15
800+ ft2 (%)
50
250-400 ft2
250-400 ft2
Unit Size (250-400 ft2)
300
Unit Height (250-400 ft2)
3
Floor Number (250-400 ft2)
50
Residential Percentage (250-400 ft2)
80
400-600 ft2
400-600 ft2
600-800 ft2
600-800 ft2
800+ ft2
800+ ft2
Amenity+Commercial+Office
1412
636
908
3178

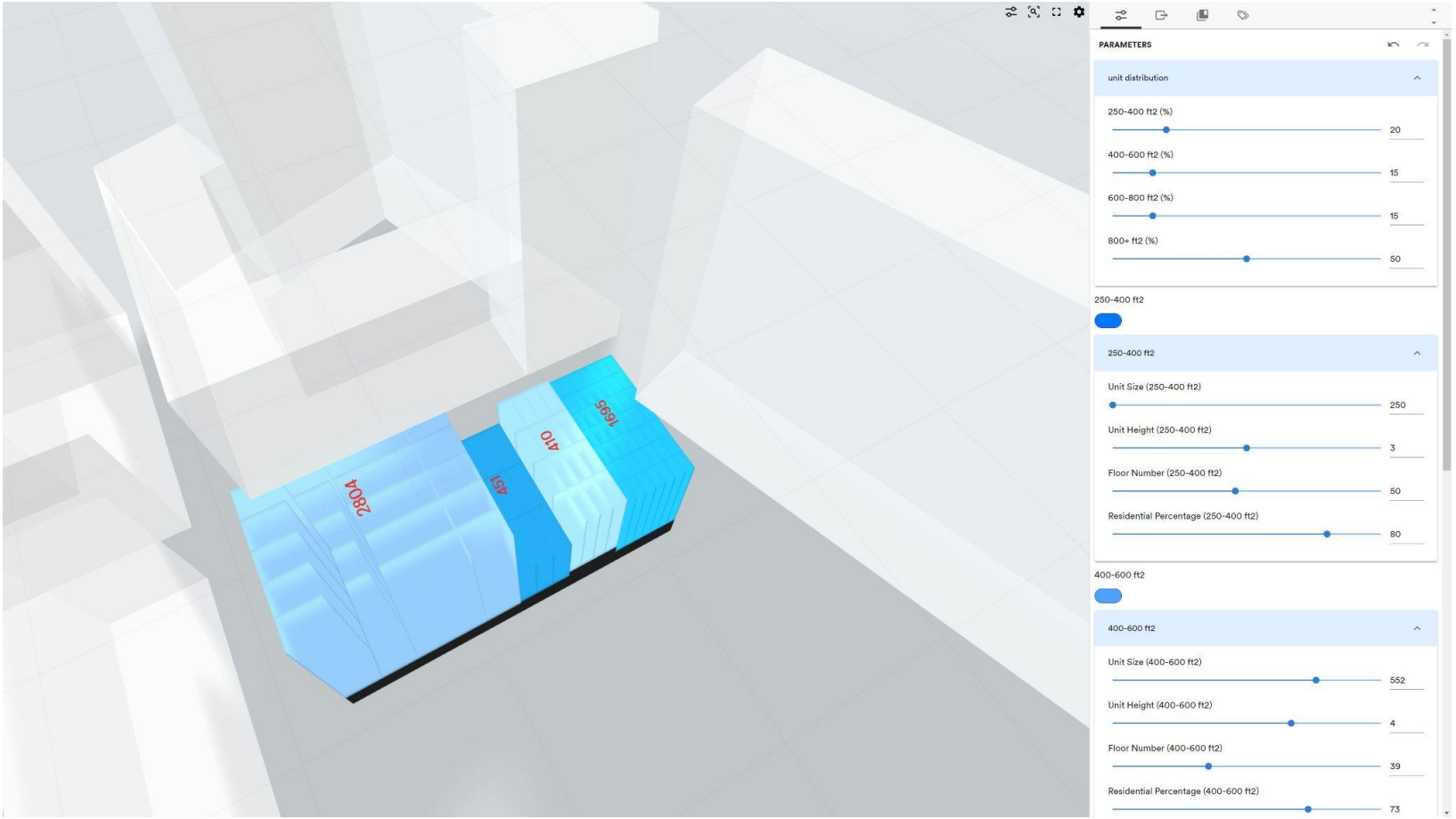

PARAMETERS
unit distribution
250-400 ft2 (%)
20
400-600 ft2 (%)
15
600-800 ft2 (%)
15
800+ ft2 (%)
50
250-400 ft2
250-400 ft2
Unit Size (250-400 ft2)
250
Unit Height (250-400 ft2)
3
Floor Number (250-400 ft2)
50
Residential Percentage (250-400 ft2)
80
400-600 ft2
400-600 ft2
600-800 ft2
600-800 ft2
800+ ft2
800+ ft2
Amenity+Commercial+Office
3178
908
636
1696


1695
636
908
3178
PARAMETERS
unit distribution
250-400 ft2 (%)
20
400-600 ft2 (%)
15
600-800 ft2 (%)
15
800+ ft2 (%)
50
250-400 ft2
250-400 ft2
400-600 ft2
400-600 ft2
600-800 ft2
600-800 ft2
Unit Size (600-800 ft2)
700
Unit Height (600-800 ft2)
3.4
Floor Number (600-800 ft2)
50
Residential Percentage (600-800 ft2)
80
800+ ft2
800+ ft2
Amenity+Commercial+Office


1695
636
799
3178
PARAMETERS
unit distribution
250-400 ft2 (%)
20
400-600 ft2 (%)
15
600-800 ft2 (%)
15
800+ ft2 (%)
50
250-400 ft2
250-400 ft2
400-600 ft2
400-600 ft2
600-800 ft2
600-800 ft2
Unit Size (600-800 ft2)
700
Unit Height (600-800 ft2)
3.4
Floor Number (600-800 ft2)
44
Residential Percentage (600-800 ft2)
80
800+ ft2
800+ ft2
Amenity+Commercial+Office


3813
799
636
1695
PARAMETERS
unit distribution
250-400 ft2 (%)
20
400-600 ft2 (%)
15
600-800 ft2 (%)
15
800+ ft2 (%)
50
250-400 ft2
250-400 ft2
400-600 ft2
400-600 ft2
Unit Size (400-600 ft2)
500
Unit Height (400-600 ft2)
3
Floor Number (400-600 ft2)
50
Residential Percentage (400-600 ft2)
80
600-800 ft2
600-800 ft2
800+ ft2
800+ ft2
Amenity+Commercial+Office


3813
799
755
1695
unit distribution
250-400 ft2 (%)
20
400-600 ft2 (%)
15
600-800 ft2 (%)
15
800+ ft2 (%)
50
250-400 ft2
250-400 ft2
400-600 ft2
400-600 ft2
Unit Size (400-600 ft2)
500
Unit Height (400-600 ft2)
3
Floor Number (400-600 ft2)
50
Residential Percentage (400-600 ft2)
95
600-800 ft2
600-800 ft2
800+ ft2
800+ ft2
Amenity+Commercial+Office


2804
451
410
1695
PARAMETERS
unit distribution
250-400 ft2 (%)
20
400-600 ft2 (%)
15
600-800 ft2 (%)
15
800+ ft2 (%)
50
250-400 ft2
250-400 ft2
Unit Size (250-400 ft2)
250
Unit Height (250-400 ft2)
3
Floor Number (250-400 ft2)
50
Residential Percentage (250-400 ft2)
80
400-600 ft2
400-600 ft2
Unit Size (400-600 ft2)
552
Unit Height (400-600 ft2)
4
Floor Number (400-600 ft2)
39
Residential Percentage (400-600 ft2)
73

Kendall Square