Building Electrification Institute

CITIES DRIVING CHANGE

Berkeley Building and Housing Stock Analysis

Completed January 2020

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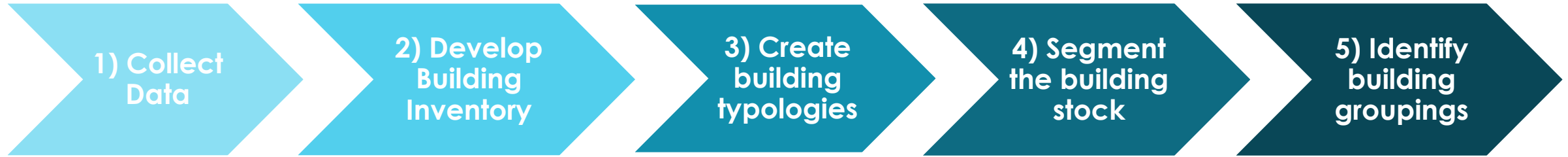# Building and Housing Stock Analysis Background

Background and Summary of Project

Berkeley, CA has long been a leader in local climate action and has committed to achieve net-zero carbon emissions by 2045. Berkeley also became the first city in the U.S. to end the use of gas in new buildings and require all-electric construction, which is a significant and critical step in achieving the City's commitment to become a "fossil fuel free city."

In 2019, Berkeley partnered with the Building Electrification Institute (BEI) to conduct a building and housing stock assessment to understand its local building stock and identify opportunities to convert heating and hot water systems away from fossil fuels while also improving the health, resiliency, and affordability of Berkeley's communities, and particularly its low-income communities and communities of color. The analysis will guide Berkeley in developing new programs and revenue streams that will be needed to equitably accelerate building electrification and decarbonization across the Berkeley community.

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Building and Housing Stock Assessment | Approach

1) Collect Data

2) Develop Building Inventory

3) Create building typologies

4) Segment the building stock

5) Identify building groupings

The BEI team collected publicly available building data on technical, market, and socio-demographic factors.

Using this data, the team developed an inventory of all Berkeley buildings, with datapoints for each parcel.

Using technical building factors, the team then created building typologies that are common in the Berkeley building stock.

The team then segmented the building stock based on technical, ownership/ decision-making, social vulnerability, and environmental risk indicators.

Together with Berkeley City staff, the team identified potential groupings of buildings that lend themselves to particular types of interventions or strategies for electrification.

Following the completion of the building and housing stock analysis, *Berkeley will engage with key community stakeholders on the opportunities and barriers identified to develop new programs, policies, and strategies to scale up electrification in different building segments.*

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Building and Housing Stock Assessment | Approach

To ensure that Berkeley has a comprehensive assessment of its buildings and understands the social vulnerabilities and environmental risks faced by the residents living in these buildings, BEI assessed three types of indicators:

1) Technical indicators: Help identify buildings that have promising opportunities for building electrification due to the building type or construction.

➤ *These may be good initial candidates for building electrification with promising economics for building owners and residents.*

2) Ownership and Decision-making Indicators: Help identify buildings with owners or decision-makers who are more likely to decide to pursue building electrification.

➤ *These may be good candidates for early outreach and assistance programs to build the market for building electrification. However, additional programs will need to be designed to ensure harder-to-reach customers are also assisted.*

3) Social Vulnerability and Environmental Risk Indicators: Help identify buildings that may need greater assistance and public investments to help the City design appropriate programs or strategies.

➤ *These buildings may be harder to reach or more difficult to electrify, but they are important to prioritize. This will require the City or others to design specific strategies tailored to their needs in order to ensure an equitable transition to building electrification.*

Note for Users: *This analysis is based on publicly available data from the City of Berkeley. All analysis, charts, and maps presented in this report are based on datasets that were pulled in 2019 and represent the best publicly available data at the time, however these datasets are without warranty or any representation of accuracy, timeliness, or completeness.*

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Building and Housing Stock Assessment | Goals

Based on conversations with Berkeley, BEI identified several goals and potential ways to use the building and housing stock analysis going forward.

Goals for the analysis:

- Provide basic information about Berkeley's building stock and ideas for ways to start working strategically with key segments of the market.

- Support Berkeley in developing, prioritizing, and launching new programs, policies, and/or strategies to help scale up building electrification in existing buildings.

Potential ways to use the analysis:

- Make decisions about where to invest time and resources based on common characteristics.

- Justify investments needed in new policies, programs, or strategies that the City may seek to pursue.

- Identify specific opportunities and/or intervention points for successful implementation of programs, policies, and strategies.

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- Summary and Potential Next Steps

Technical Indicators

List of Technical Indicators

- Building Typologies

- Building Vintage

- Building Size

- Residential Units

- Potential Accessory Dwelling Units (ADUs)

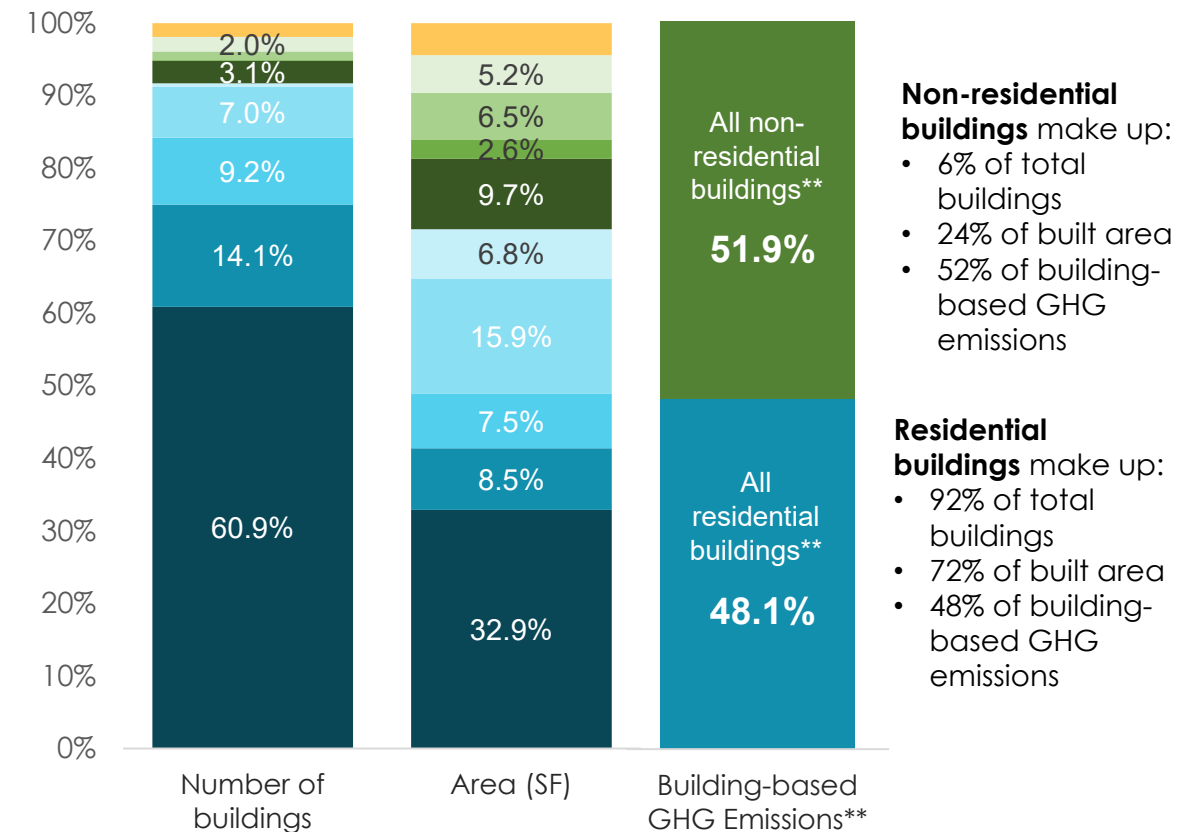- Solar Photovoltaics (PV)

- Wall Furnaces

Technical Indicators | Building Typologies

Summary of Building Typologies

	Typologies	Number of Units	Number of Stories	Total buildings*	Total square feet (SF)
1	Commercial, low rise	Any	Up to 3	1,083	8,279,496
2	Commercial, mid-high rise	Any	4+	38	2,268,880
3	Industrial	Any	Any	426	5,567,934
4	Institutional (non-residential)*	Any	Any	720	4,476,671
5	Single family homes	1	Up to 3	21,582	28,200,352
6	Duplexes	2	Up to 3	5,013	7,253,688
7	3-4 family homes	3-4	Up to 3	3,246	6,428,229
8	5+ unit multifamily, low rise	5+	Up to 3	2,476	13,620,735
9	5+ unit multifamily, mid-high rise	5+	4+	182	5,797,275
	Missing Data	n/a	n/a	666	3,794,381
TOTAL				**35,432**	**85,687,641**

*Institutional (non-residential) category removes all buildings on the UC Berkeley campus. The total number of buildings includes multiple buildings that exist on a single lot.

Buildings by Count, Area, and GHG Emissions

Number of buildings: 2.0%, 3.1%, 7.0%, 9.2%, 14.1%, 60.9%

Area (SF): 5.2%, 6.5%, 2.6%, 9.7%, 6.8%, 15.9%, 7.5%, 8.5%, 32.9%

Building-based GHG Emissions: All non-residential buildings** 51.9%; All residential buildings** 48.1%

Non-residential buildings make up:
- 6% of total buildings
- 24% of built area
- 52% of building-based GHG emissions

Residential buildings make up:
- 92% of total buildings
- 72% of built area
- 48% of building-based GHG emissions

**GHG emissions based on best available data but may over-estimate non-residential emissions (which includes emissions from BART) and may under-estimate residential building emissions.

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Technical Indicators | Building Typologies

#	Typologies	Number of Units	Number of Stories	Total Parcels	Total buildings*	% of buildings	Total square feet (SF)	% of citywide SF	Total residential units*	% of residential units
1	**Commercial, low rise**	Any	Up to 3	829	1,083	3%	8,279,496	10%	---	---
2	**Commercial, mid-high rise**	Any	4+	32	38	0.1%	2,268,880	3%	---	---
3	**Industrial**	Any	Any	255	426	1%	5,567,934	6%	---	---
4	**Institutional (non-residential)**	Any	Any	633	720	2%	4,476,671	5%	---	---
5	**Single family homes**	1	Up to 3	16,156	21,582	61%	28,200,352	33%	16,156	30%
6	**Duplexes**	2	Up to 3	3,279	5,013	14%	7,253,688	8%	6,558	12%
7	**3-4 family homes**	3-4	Up to 3	2,047	3,246	9%	6,428,229	8%	7,101	13%
8	**5+ unit multifamily, low rise**	5+	Up to 3	1,630	2,476	7%	13,620,735	16%	16,974	32%
9	**5+ unit multifamily, mid-high rise**	5+	4+	160	182	1%	5,797,275	7%	6,154	11%
	Missing Data	N/A	N/A	1,148	666	2%	3,794,381	4%	---	---
TOTALS				**26,169**	**35,432**	**100%**	**85,687,641**	**100%**	**52,943**	**100%**

*Notes: The total number of buildings includes multiple buildings that exist on a single lot. For single family homes, these buildings may include accessory dwelling units (ADUs), detached garages, and sheds. However, all single family homes are assumed to have only one unit, which is why the number of units is less than the number of buildings. Total residential units only count units in residential building typologies.

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Technical Indicators
Building Typologies

Number of Buildings by Typology

Typologies	Total buildings*	% of buildings
Single family homes	21,582	61%
Duplexes	5,013	14%
3-4 family homes	3,246	9%
5+ unit multifamily, low rise	2,476	7%
5+ unit multifamily, mid-high rise	182	1%
Commercial, low rise	1,083	3%
Commercial, mid-high rise	38	0.1%
Industrial	426	1%
Institutional (non-residential)	980	2%

UC Berkeley Campus
(excluded from Census data)

General Use Categories

Types of uses from parcel data

- Single-Family
- Duplex
- 3-4 family homes
- 5+ multi-family buildings, low rise
- 5+ multi-family buildings, mid-high rise
- Commercial, low rise
- Commercial, mid-high rise
- Industrial
- Institutional (non-residential)

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Source: BEI buildings inventory
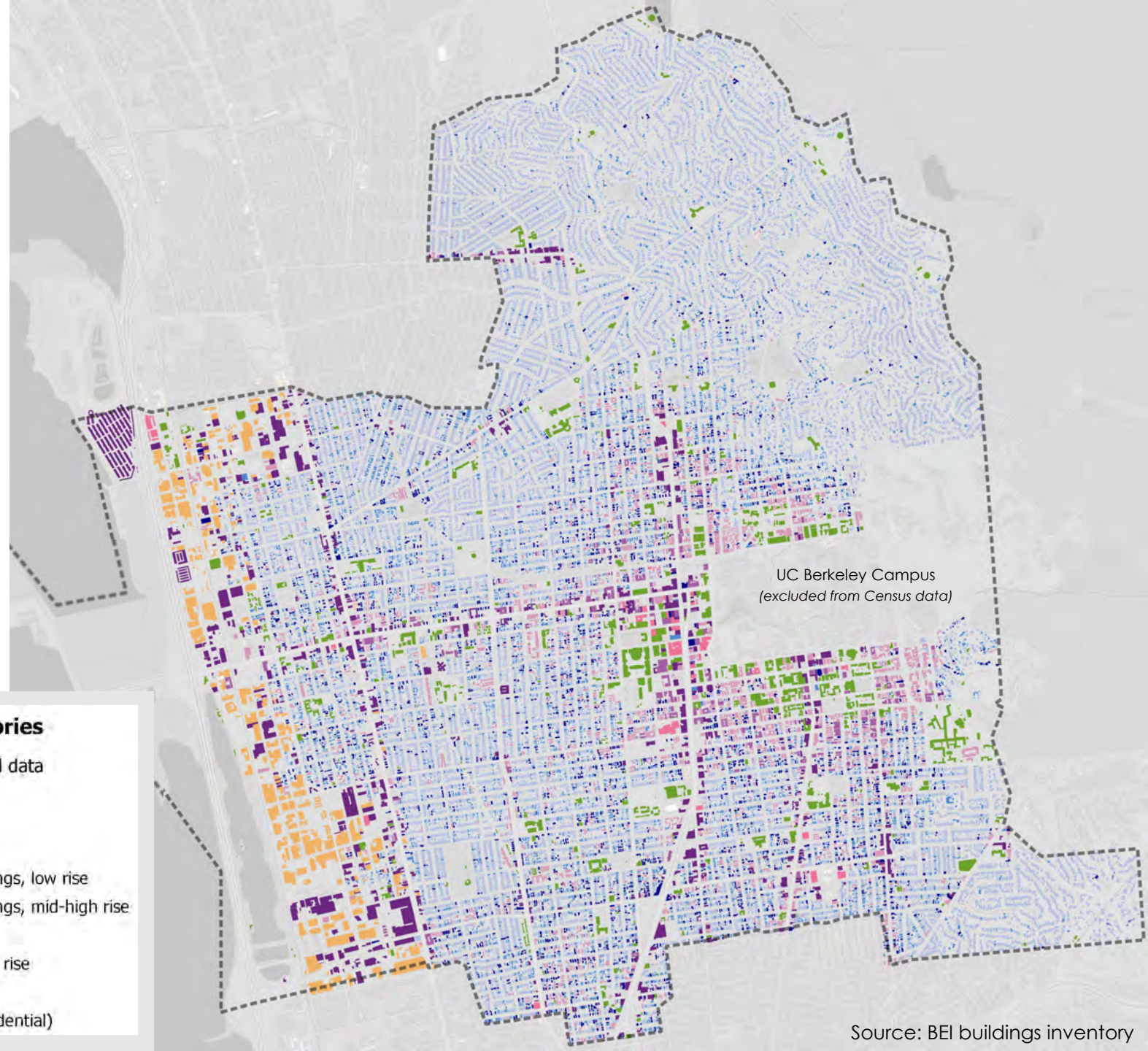
Technical Indicators | Building Vintage

All Buildings, Year Built
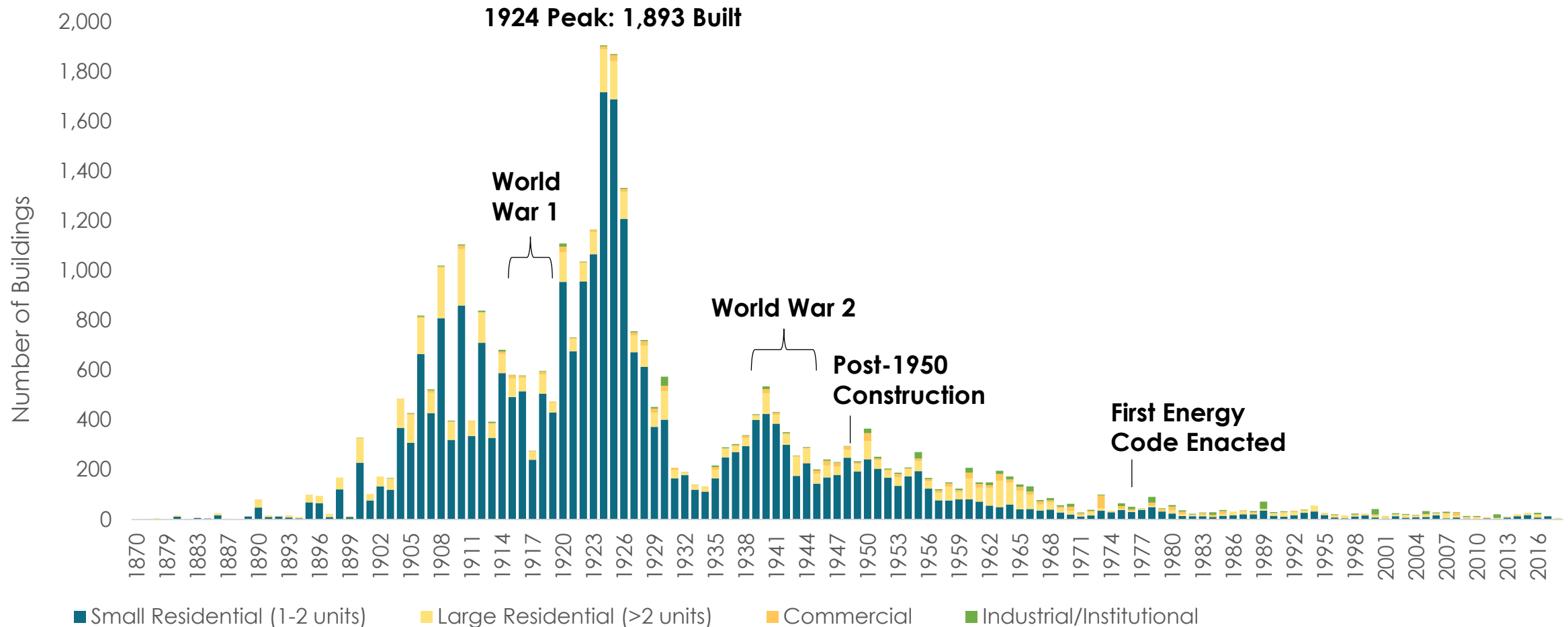
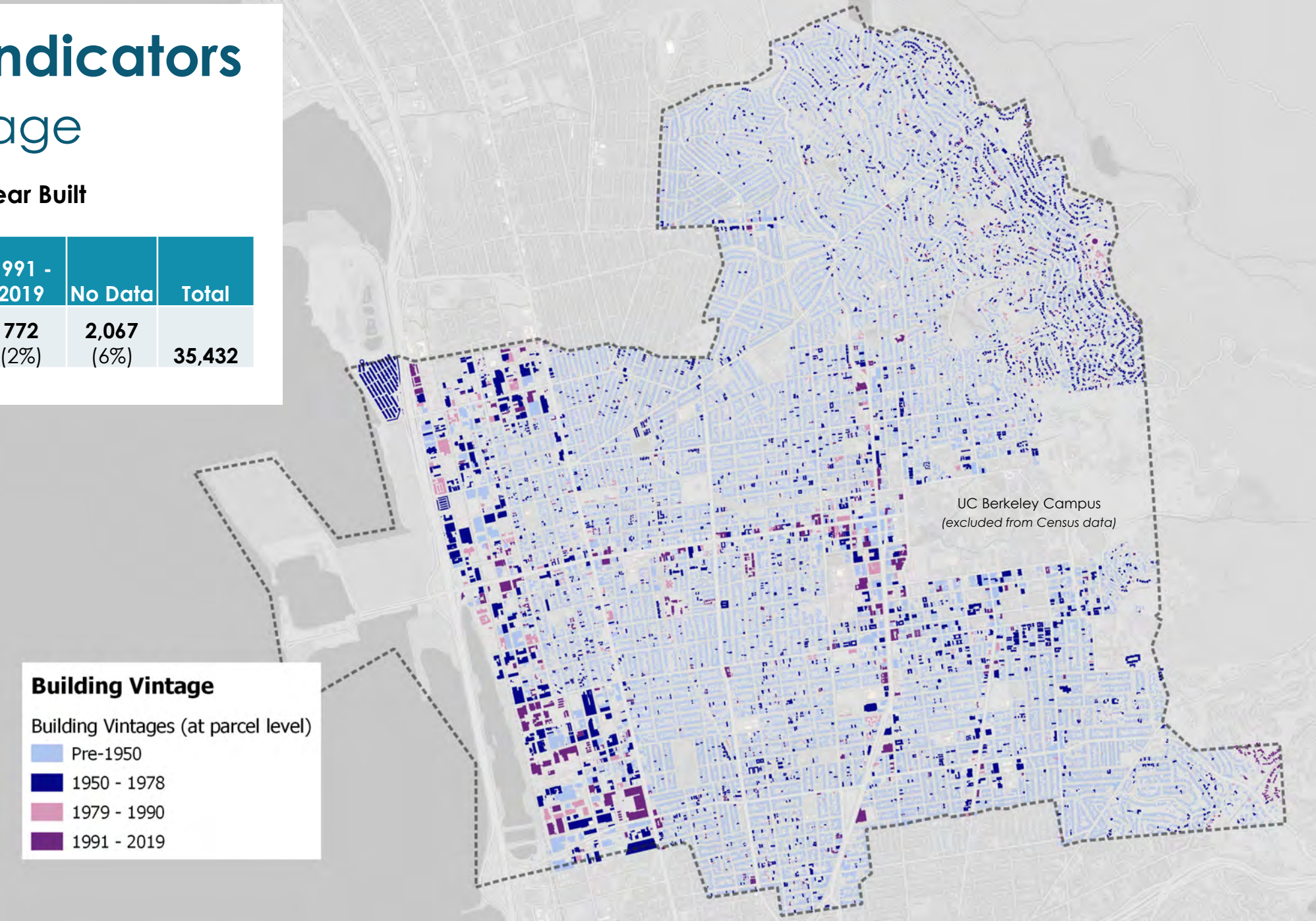Sources: BEI inventory, summarized from BESO, tax assessor, and CoStar data.
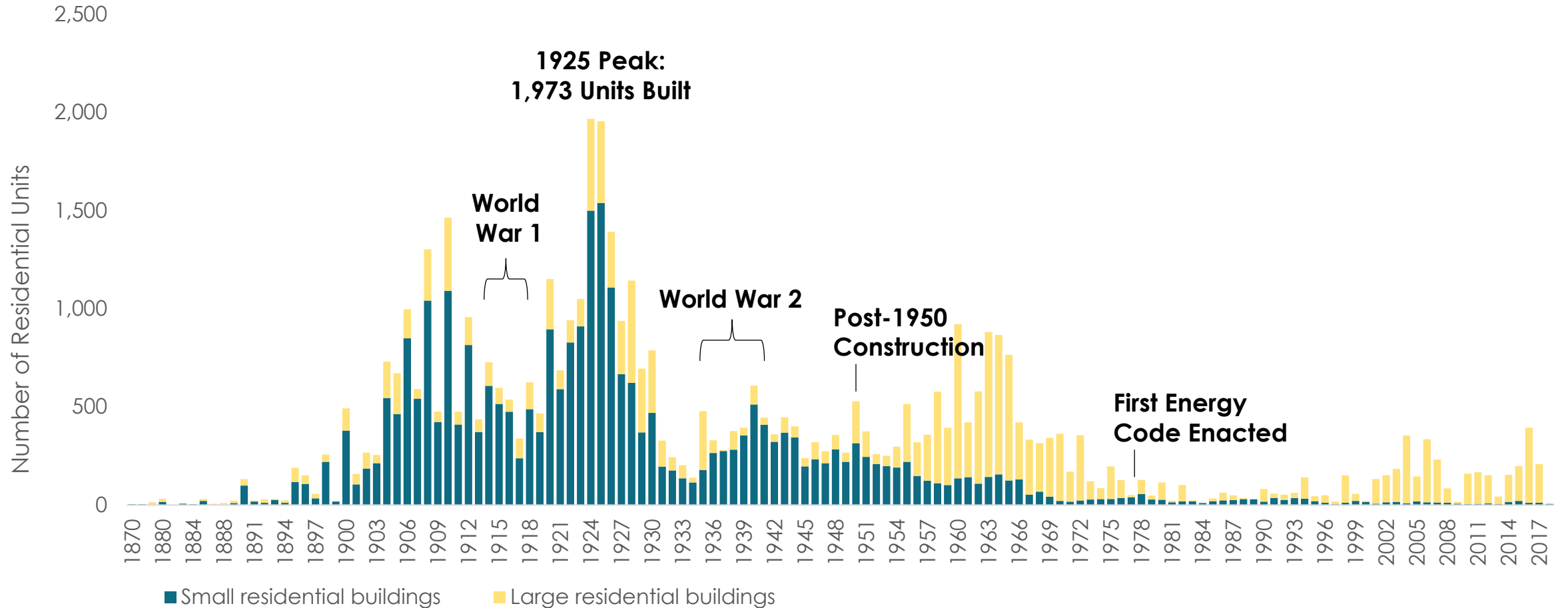
Technical Indicators
Building Vintage

Number of Buildings by Year Built

Pre-1950	1950 - 1978	1979 - 1990	1991 - 2019	No Data	Total
28,091 (79%)	4,015 (11%)	487 (1%)	772 (2%)	2,067 (6%)	35,432

UC Berkeley Campus (excluded from Census data)

Building Vintage

Building Vintages (at parcel level)
- Pre-1950
- 1950 - 1978
- 1979 - 1990
- 1991 - 2019

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Technical Indicators | Building Vintage

Common Construction Methods by Building Vintage

- **Knob and tube wiring** was commonly installed from 1880-1940s. Buildings with knob and tube wiring may require rewiring to accommodate building electrification.

- **Wall furnaces** (which last up to 20-30 years) were commonly installed from 1930s-1960s and are typically less efficient than other types of fossil fuel heating systems.

- **Lath and plaster** was typical of wall construction until the 1950s, when builders generally began transitioning to drywall and plywood.

- **Stucco** has often been the siding of choice in the West and Southwest, where brick and stone were too scarce and costly to use for building materials. Stucco is also safer in earthquake-prone areas.

- **Asbestos** was a common building product until the 1970s.

- **Vinyl Siding** was introduced to the exterior market in the late 1950s as a replacement for aluminum siding.

- **Aluminum Windows** were most common in the1970s.

- **Sliding Glass Doors** were most common in the late 1950s and 1960s (example: Eichler homes).
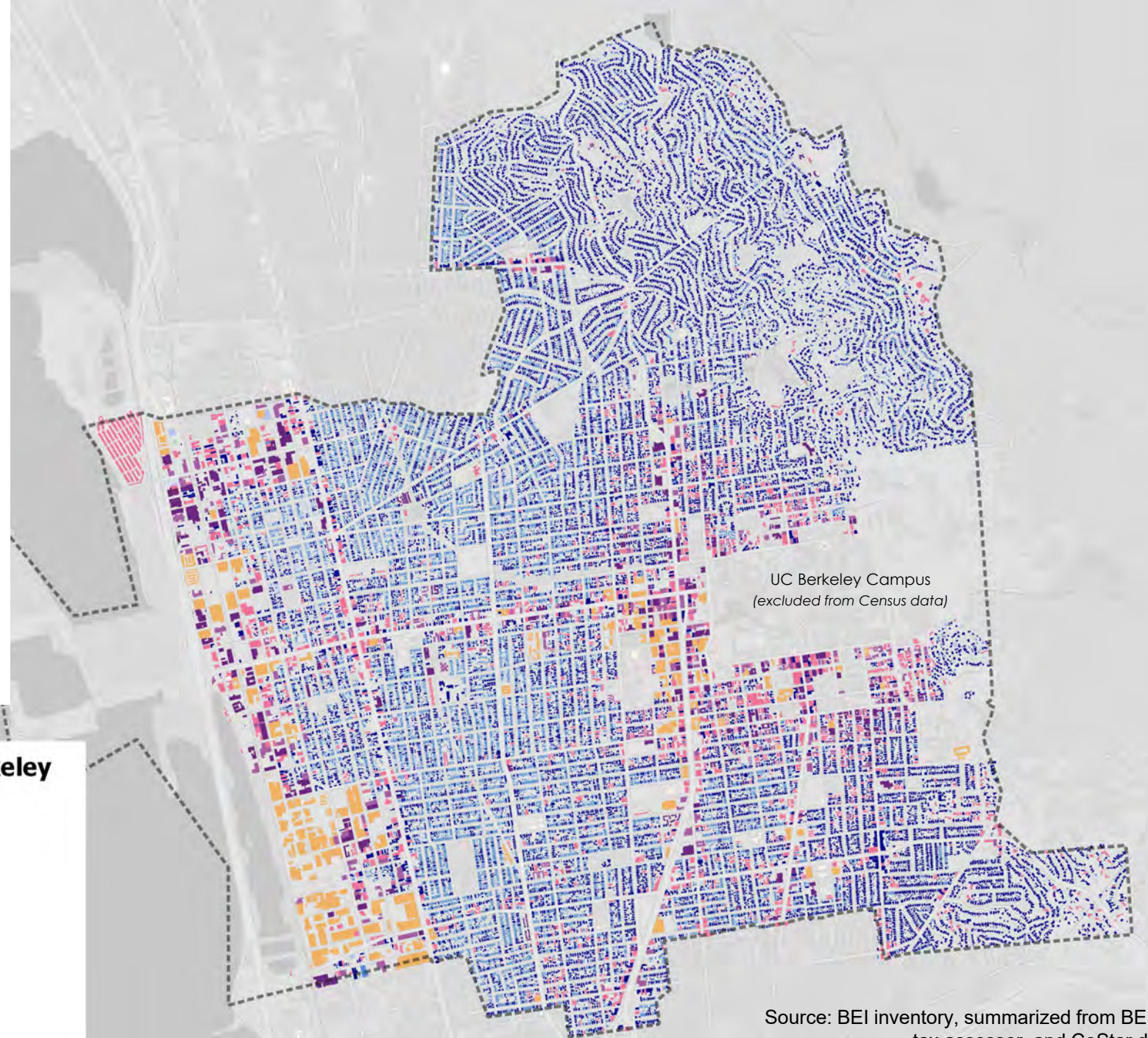
Technical Indicators
Building Size

Number of Buildings by Size (Square Feet)

Size Threshold (SF)	Total Buildings	% of Buildings
<850 SF	1,121	3%
850 - 1,499 SF	10,606	30%
1,500 – 4,999 SF	19,842	57%
5,000 - 14,999 SF	2,212	6%
15,000 - 24,999 SF	468	1%
25,000 - 50,000 SF	354	1%
Over 50,000 SF	295	1%
Total	35,432	100%

Building Sizes in Berkeley

Building Size Classes
- Less than 850
- 850 to 1,499
- 1,500 to 4,999
- 5,000 to 14,999
- 15,000 to 24,999
- 25,000 to 49,999
- Over 50,000

UC Berkeley Campus
(excluded from Census data)

Source: BEI inventory, summarized from BESO, tax assessor, and CoStar data.

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Technical Indicators
Residential Housing Units

Number of Residential Parcels by Units

1 unit*	2 units	3-4 units	5+ units	Total units
16,156 (30%)	6,558 (12%)	7,101 (13%)	23,128 (43%)	52,943

*Note that this assumes all single-family homes are 1 unit. However, a significant number of single-family parcels have multiple buildings on the parcel, indicating there may be a potential additional unit on some of these parcels. See slide 20 for more information.

UC Berkeley Campus
(excluded from Census data)

Units per Building in Berkeley

Unit Classes for Residential Buildings
- 1 unit
- 2 units
- 3-4 units
- 5+ units

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Housing Units in Residential Buildings
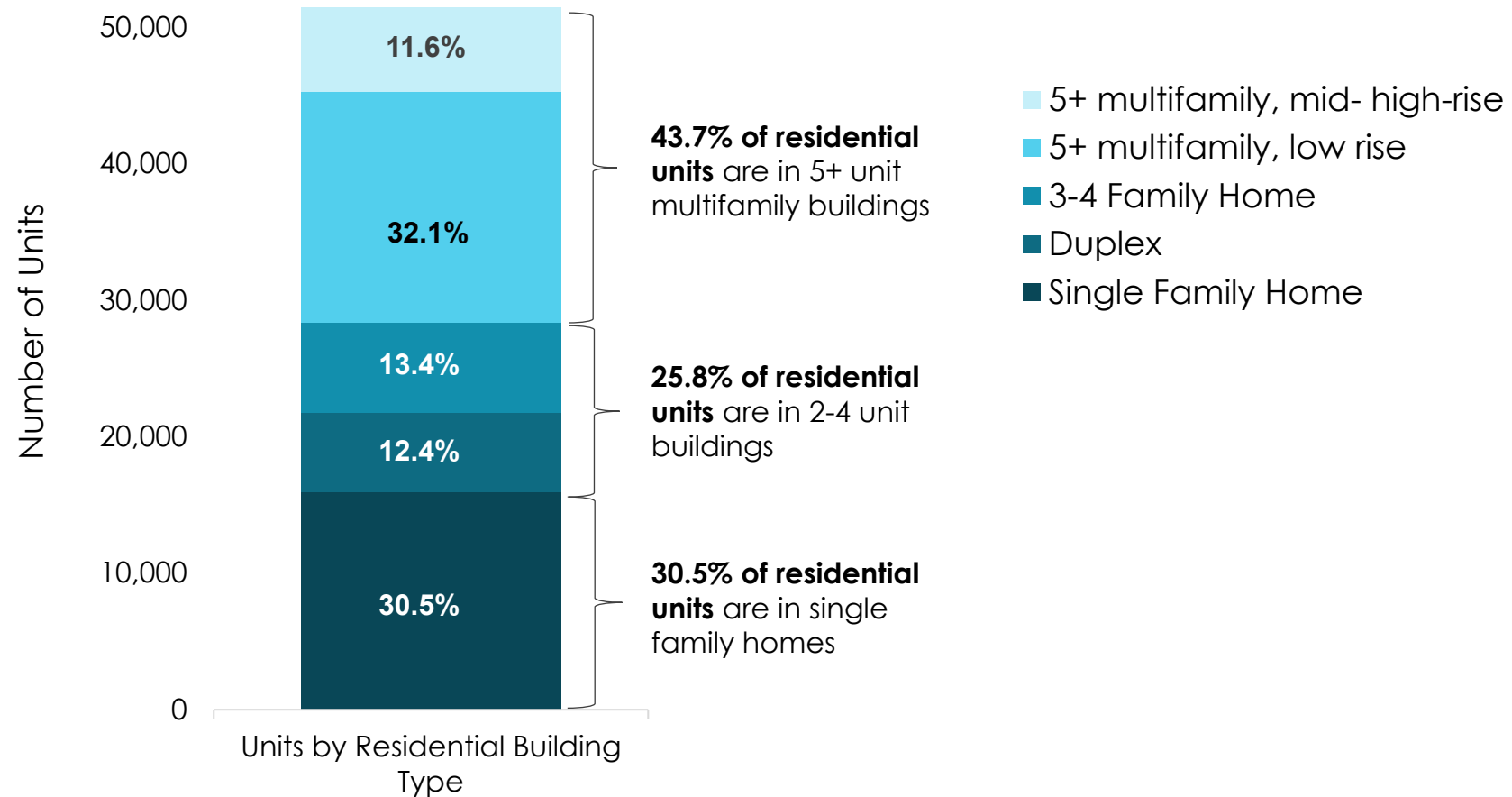
Technical Indicators | Building Size

Large Buildings (Over 25,000 Square Feet)

Number of Buildings

Only 217 multifamily buildings are over 25,000 SF (~8% of MF buildings)

An additional 387 non-residential buildings are over 25,000 sq ft (~17% of non-res buildings)

Square Footage

6.8 million SF of multifamily buildings are over 25,000 SF (~35% of multifamily SF)

12.9 million SF of non-residential buildings are over 25,000 SF (~72% of non-residential SF)

Legend:
- Over 50,000 SF
- 25,000 - 49,999 SF
- 15,000 - 24,999 SF
- 5,000 - 14,999 SF
- 1,500 - 4,999 SF
- 850 - 1,499 SF
- <850 SF
- No Data

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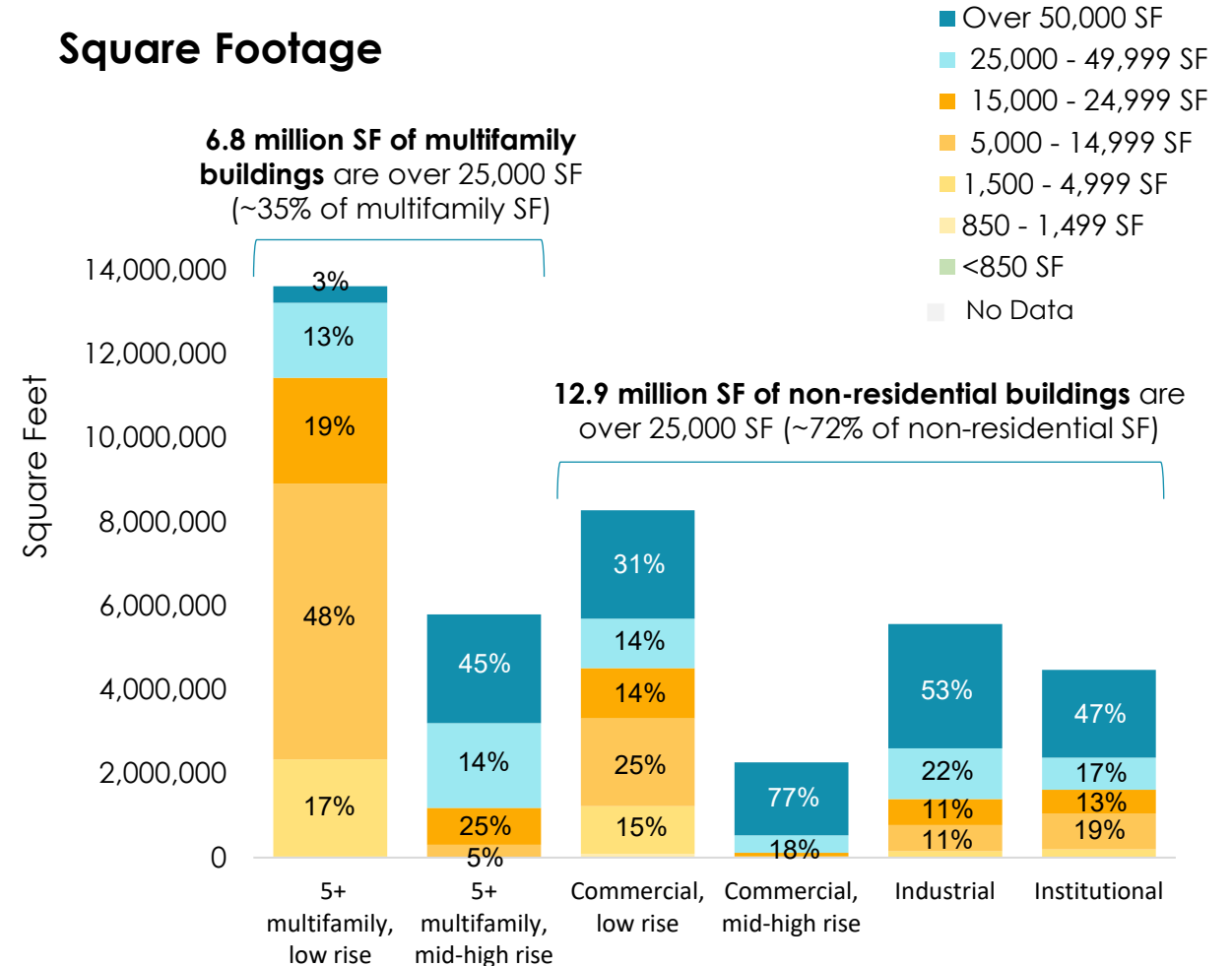
Technical Indicators
Potential ADUs

Potential ADUs in Single Family Homes

Assuming single family home parcels with multiple buildings on a lot have detached garages or already have an ADU (Accessory Dwelling Unit)

Single Family Parcels by Number of Buildings

Number of Buildings on Parcel	Total Buildings	% of buildings
1 building	11,006	68%
2 buildings	4,885	30%
3 buildings	244	2%
4+ buildings	18	0.1%
Total parcels	16,153	100%

32% of single-family home parcels (5,150 total parcels) have multiple buildings on the parcel, meaning they could be potential ADUs.

UC Berkeley Campus
(excluded from Census data)

Presence of ADUs in Berkeley

ADU Categories
- ADU
- Other single family homes

Source: GIS analysis conducted to identify single family parcels (based on BEI inventory use type) with multiple building footprints (Microsoft public data).

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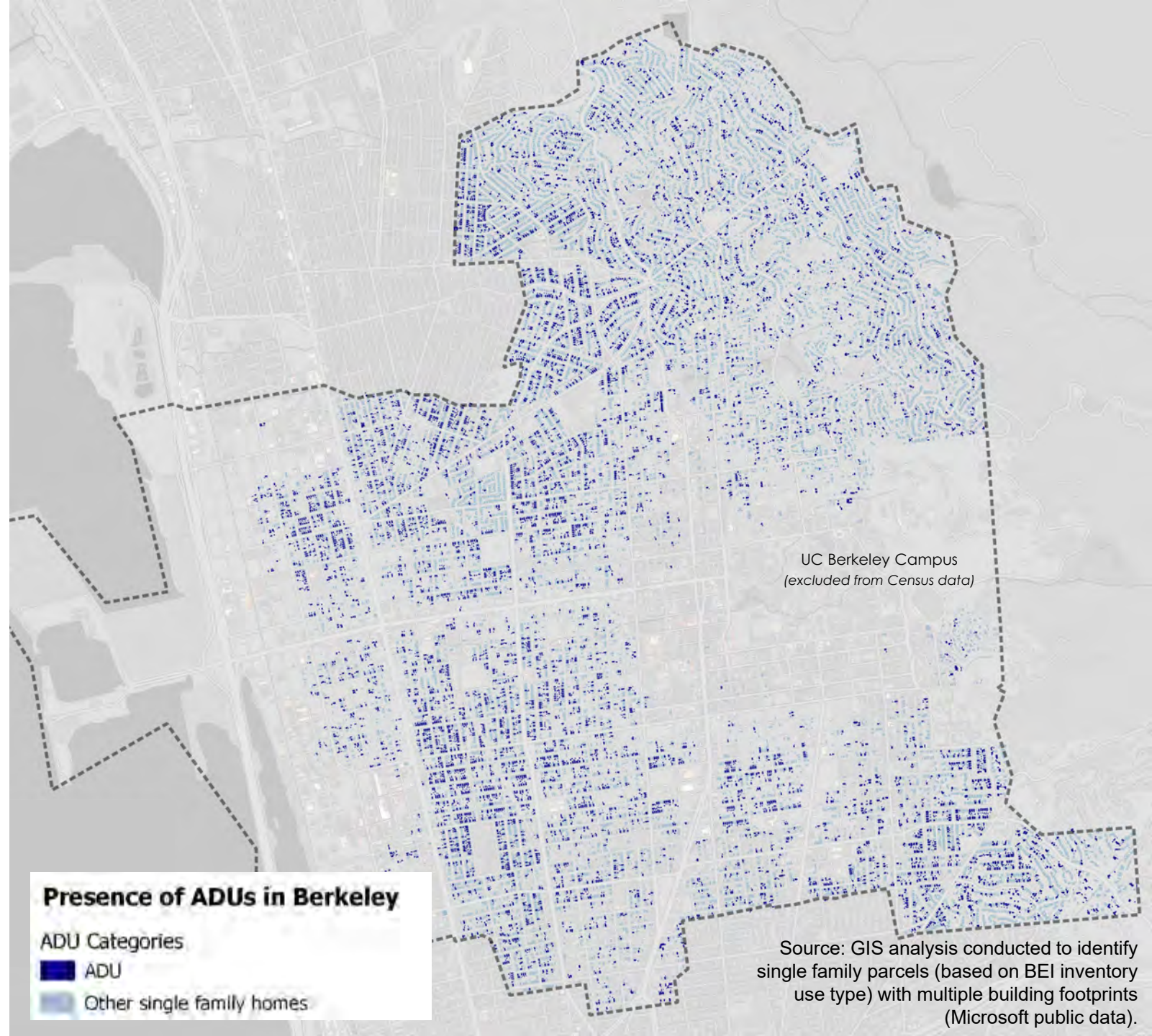
Technical Indicators | Solar PV

Solar PV

Building Square Footage
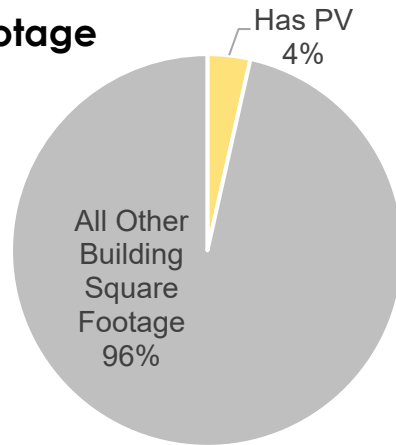
- Has PV 4%
- All Other Building Square Footage 96%

Number of Buildings

- Has PV 8%
- All Other Buildings 92%

Buildings with Solar PV

Legend:
- Institutional
- Industrial
- Commercial, mid-high rise
- Commercial, low rise
- 5+ multifamily, mid-high rise
- 5+ multifamily, low rise
- 3-4 family homes
- Duplex
- Single-Family

# of Buildings:
- 5%
- 14%
- 75%

Area (SF):
- 2%
- 6%
- 7%
- 5%
- 4%
- 5%
- 11%
- 59%
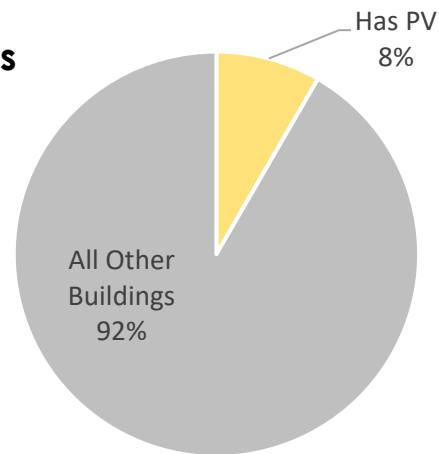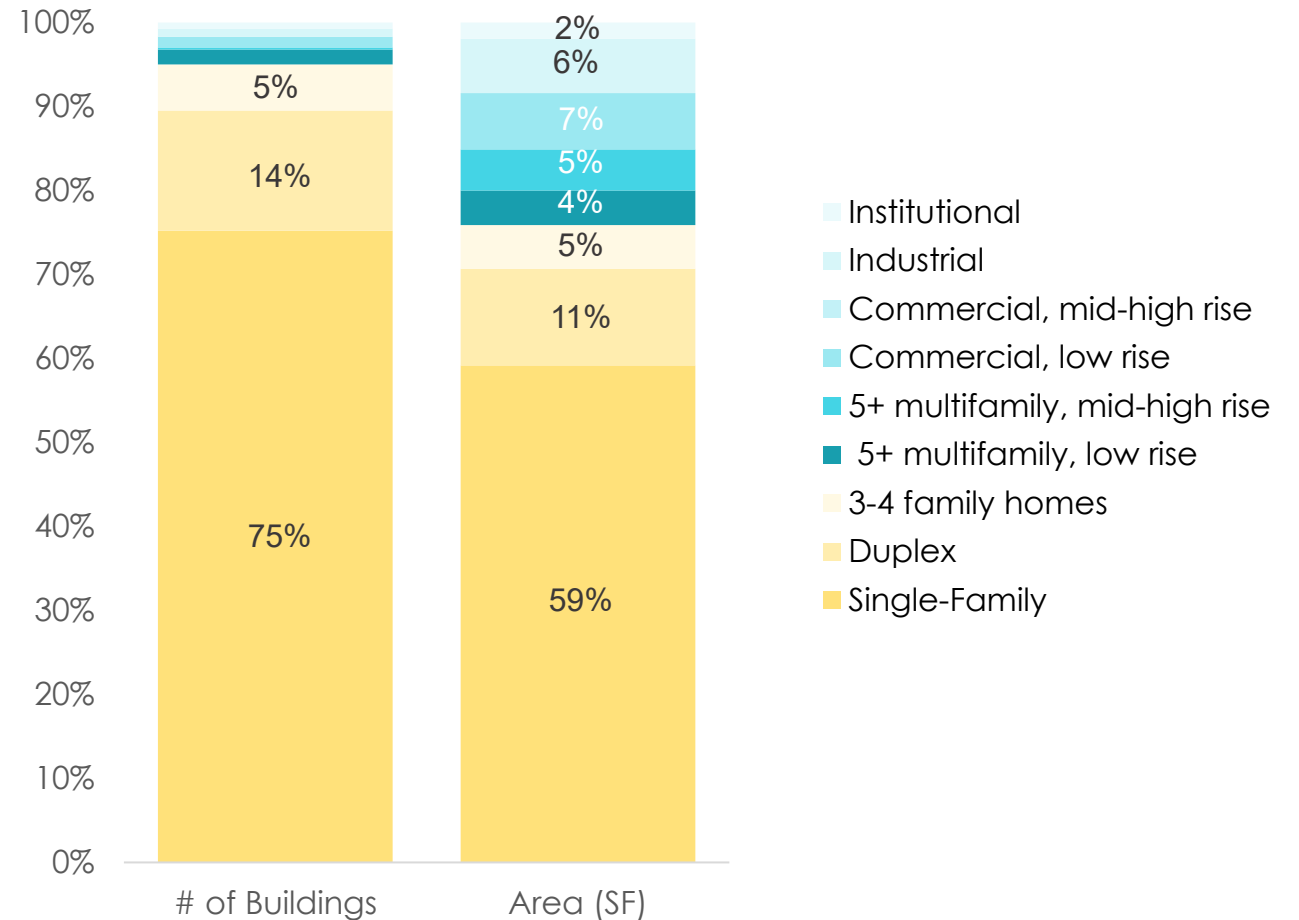
Wall Furnaces in Single Family Homes

Total utility costs: Homes with wall furnaces are estimated to have lower overall utility costs (likely due to home size)
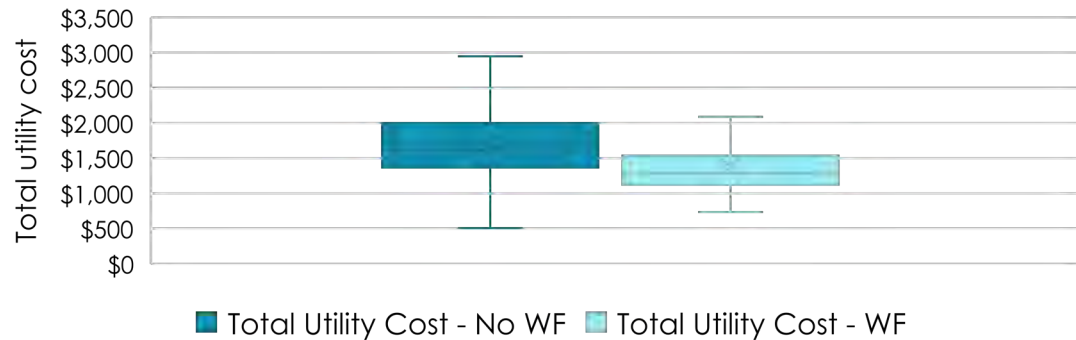
Wall furnaces and site EUI: Units with wall furnaces tend to have a higher EUI than units with other types of heating.
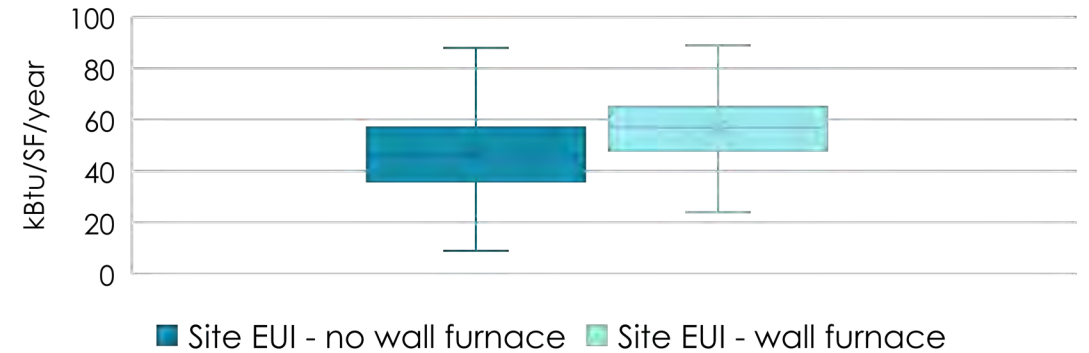
Wall furnaces and heating equipment efficiency: Most wall furnaces are recorded having efficiency of 70%, lower than other systems.
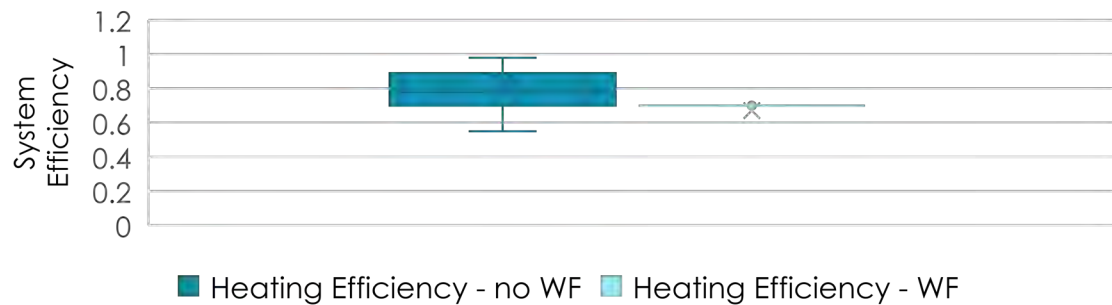
Natural gas use per square foot (SF): Wall furnaces are estimated to use more natural gas per SF than other heating systems

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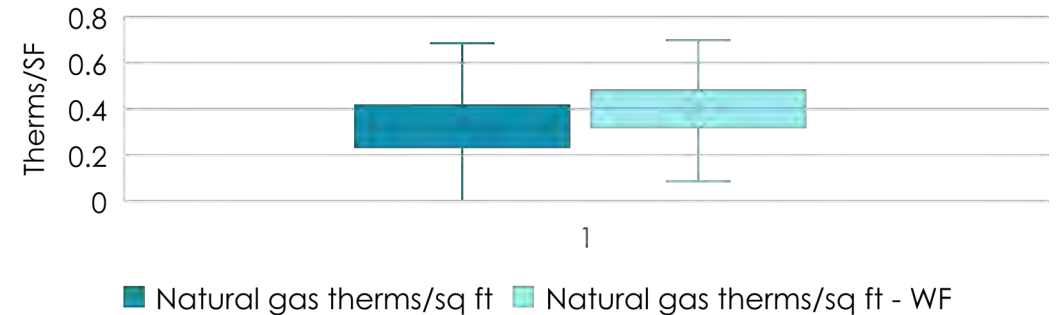
Key Findings from Analysis of Technical Indicators

▪ **The vast majority of buildings in Berkeley are residential buildings, and single family homes account for over 60% of buildings citywide.** This means that building electrification will primarily affect Berkeley residents, as opposed to owners of commercial or institutional buildings.

▪ **Berkeley has an older building stock, with the majority of its buildings constructed before World War II.** Older buildings that have not been substantially renovated may need additional upgrades to support building electrification, such as new electrical wiring or electrical panel upgrades.

▪ **Buildings in Berkeley tend to be on the smaller side, and over 90% of them are less than 5,000 square feet in floor area.** Electrification is often simpler and less expensive in smaller buildings as compared to larger buildings, although owners of smaller buildings may have more limited financial resources to invest in upgrades.

▪ **The vast majority of buildings with solar PV installed in Berkeley are single family homes.** Solar PV can lower the operational costs of electrified building systems, but the fact that solar PV is disproportionately found on single family homes is an equity challenge, since multifamily residents who are most in need of energy cost reductions will not benefit from these savings.

▪ **Wall furnaces are an inefficient fossil fuel-based heating technology that are common in Berkeley buildings.** These may be a good place to start for electrifying buildings in the city because they tend to be found in older buildings and electrifying these systems may be more cost-effective than other, more efficient gas heating systems.

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    - Social Indicators and Analysis
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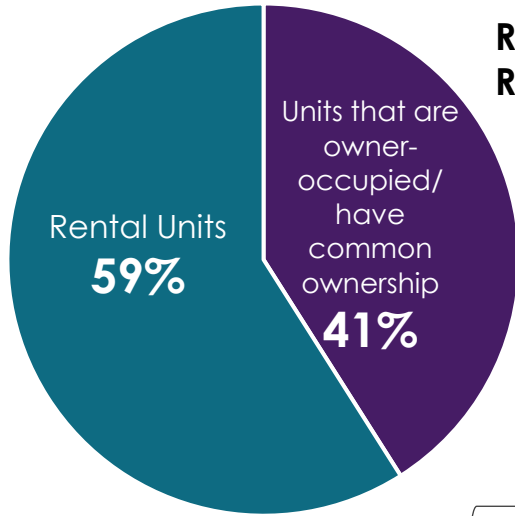
- Summary and Potential Next Steps

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Ownership and Decision-making Indicators

List of Ownership and Decision-making Indicators

- Ownership Type by Residential Housing Units

- Affordable Housing

- Consolidated Ownership & Management

Ownership Types – Breakdown by Total Residential Housing Units

Rental vs. Owner-occupied Residential Housing Units[1]

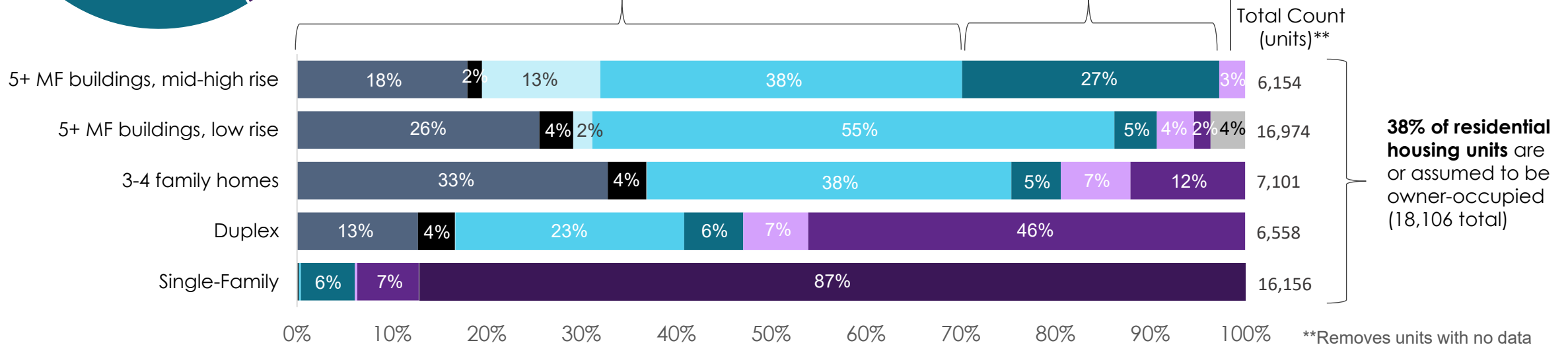Rental Units **59%**

Units that are owner-occupied/ have common ownership **41%**

3% of residential housing units are co-ops, condos, or other cooperative ownership (1,596 total)

Between 35-50% of all residential housing units[2] have some form of income qualification or rent control (~15,500-23,200 total)

Between 10-25% of all residential housing units[2] are market rate rentals (~4,800-12,600 total)

Legend

- Mixed (Rent Controlled)*
- Mixed (Non-rent controlled)*
- Rental - Income Qualified
- Rental - Rent-controlled
- Rental - Market Rate
- Co-ops and Condos
- Owner occupied
- Residential Institutional
- Assumed owner occupied

*Mixed indicates that the building has both owned and rental units.

Total Count (units)**

Building Type	Mixed (Rent Controlled)	Mixed (Non-rent controlled)	Rental - Income Qualified	Rental - Rent-controlled	Rental - Market Rate	Co-ops and Condos	Owner occupied	Residential Institutional	Assumed owner occupied	Total Count
5+ MF buildings, mid-high rise	18%	2%	13%	38%	27%	3%				6,154
5+ MF buildings, low rise	26%	4%	2%	55%	5%	4%	2%	4%		16,974
3-4 family homes	33%	4%		38%	5%	7%	12%			7,101
Duplex	13%	4%		23%	6%	7%	46%			6,558
Single-Family					6%	7%			87%	16,156

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

38% of residential housing units are or assumed to be owner-occupied (18,106 total)

**Removes units with no data

[1] The US Census Bureau's American Community Survey 5-year estimate for home ownership rate in 2017 is 43%.
[2] Because units are counted based on the ownership category of the building in which the units are located, mixed ownership units are not exact counts. Chart shows maximum income qualified and rent controlled units.
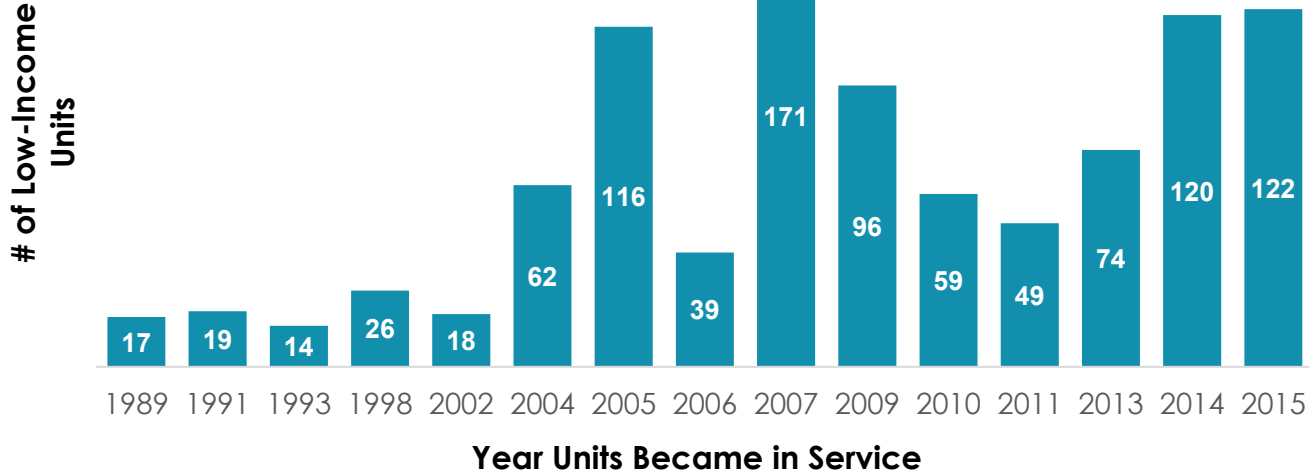
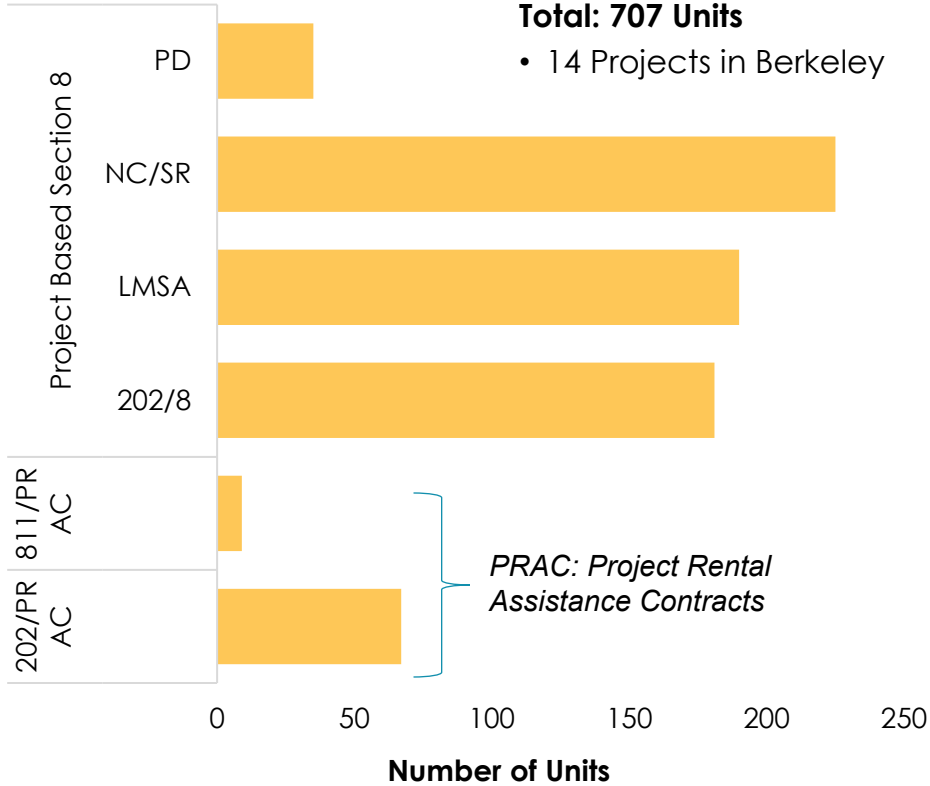## Subsidized Affordable Housing in Berkeley

- **Total Subsidized Housing Units in Berkeley:** 1,709
- **Total Rental Units in Berkeley:** 33,241

LIHTC* Units in Berkeley, by Year Built

Total: 1,002 Units
- 20 Projects in Berkeley (Up to 2015)
  - 11 Projects with 5-50 unit
  - 9 projects with 50+ Units
- Buildings have majority LI units

HUD-funded Units in Berkeley, by Project Type

Total: 707 Units
- 14 Projects in Berkeley

PRAC: Project Rental Assistance Contracts

Y-axis (left chart): # of Low-Income Units
X-axis (left chart): Year Units Became in Service

Year	Units
1989	17
1991	19
1993	14
1998	26
2002	18
2004	62
2005	116
2006	39
2007	171
2009	96
2010	59
2011	49
2013	74
2014	120
2015	122

Right chart categories: PD, NC/SR, LMSA, 202/8 (Project Based Section 8); 811/PR AC, 202/PR AC
X-axis: Number of Units

*Low-income Housing Tax Credits

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Ownership & Decision-making | Key Findings

Key Findings from Analysis of Ownership and Decision-making Indicators

- **Nearly 60% of housing units in Berkeley are rental units,** meaning that electrifying the majority of Berkeley's housing units will require dedicated programs and policies for rental properties.

- **The vast majority of single family homes in Berkeley are assumed to be owner-occupied, while the majority of housing units in duplexes and multifamily buildings are rentals.** Homeowners will directly benefit from electrification upgrades and may have the financial resources needed to make investments, although some low-income homeowners will not. Tenants in rental buildings also stand to benefit from these upgrades, however they have little control over their building owners' decisions.

- **At least one-third, and as much as half, of Berkeley's residential housing units require some form of income qualification or are subject to local rent control.** This means that a substantial portion of housing units may have difficulty raising capital to cover the costs of electrifying, although renters in these buildings will have some level of protection from rising rents.

- **There are over 1,700 subsidized affordable housing units in Berkeley, which is only 5% of the total rental housing stock in the city. The majority of housing units in Berkeley are under rent-control**, which provides some protections to renters, but not the same level of protection as the subsidized housing units.

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Social Indicators

List of Social Indicators

- Displacement risk

- Low Income

- Race

- Limited English

- Internet Access

- Emergency Room Visits for Asthma

- People with disabilities

- Age over 80

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Social Indicators
Low Income Distribution

Low Income is defined as 200% of the federal poverty line, which in Berkeley equates to*:

- $24,980 for an individual
- $51,500 for a family of four

Observations:

- Lower income households are concentrated in the Western half of Berkeley and just south of the UC Berkeley college campus.
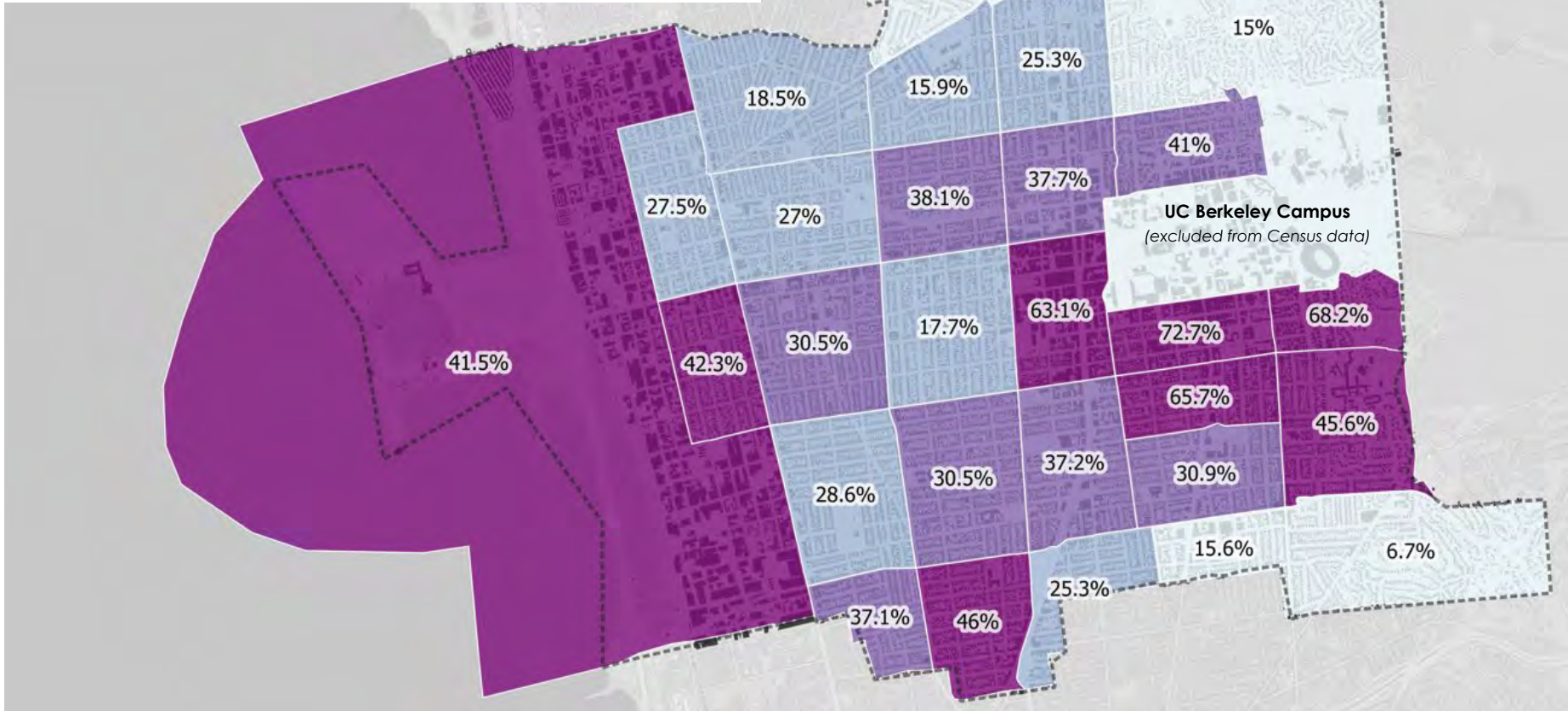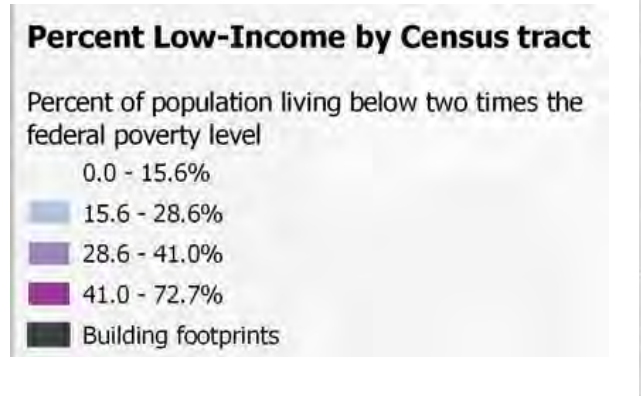
*Based on US Department of Health and Human Services, 2019 Poverty Guidelines

Percent Low-Income by Census tract

Percent of population living below two times the federal poverty level

- 0.0 - 15.6%
- 15.6 - 28.6%
- 28.6 - 41.0%
- 41.0 - 72.7%
- Building footprints

UC Berkeley Campus
(excluded from Census data)

7.9%
7.7%
11.6%
4.9%
9.6%
15%
25.3%
18.5%
15.9%
41%
27.5%
27%
38.1%
37.7%
30.5%
17.7%
63.1%
72.7%
68.2%
41.5%
42.3%
65.7%
45.6%
28.6%
30.5%
37.2%
30.9%
15.6%
6.7%
37.1%
46%
25.3%

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Social Indicators
Race Distribution
African Americans (not Hispanic or Latino)

Observations:

▪ African American households are concentrated in lower income areas in West and South Berkeley.

For Comparison: Low-income Distribution

Race by Census tract

Black or African American Alone (not Hispanic or Latino)

- 0.3 - 2.6%
- 2.6 - 3.7%
- 3.7 - 14.2%
- 14.2 - 35.7%
- Building footprints

Percent Low-Income by Census tract

Percent of population living below two times the federal poverty level

- 0.0 - 15.6%
- 15.6 - 28.6%
- 28.6 - 41.0%
- 41.0 - 72.7%
- Building footprints

UC Berkeley Campus
(excluded from Census data)

Source: US Census 2017 ACS 5-Yr Estimates
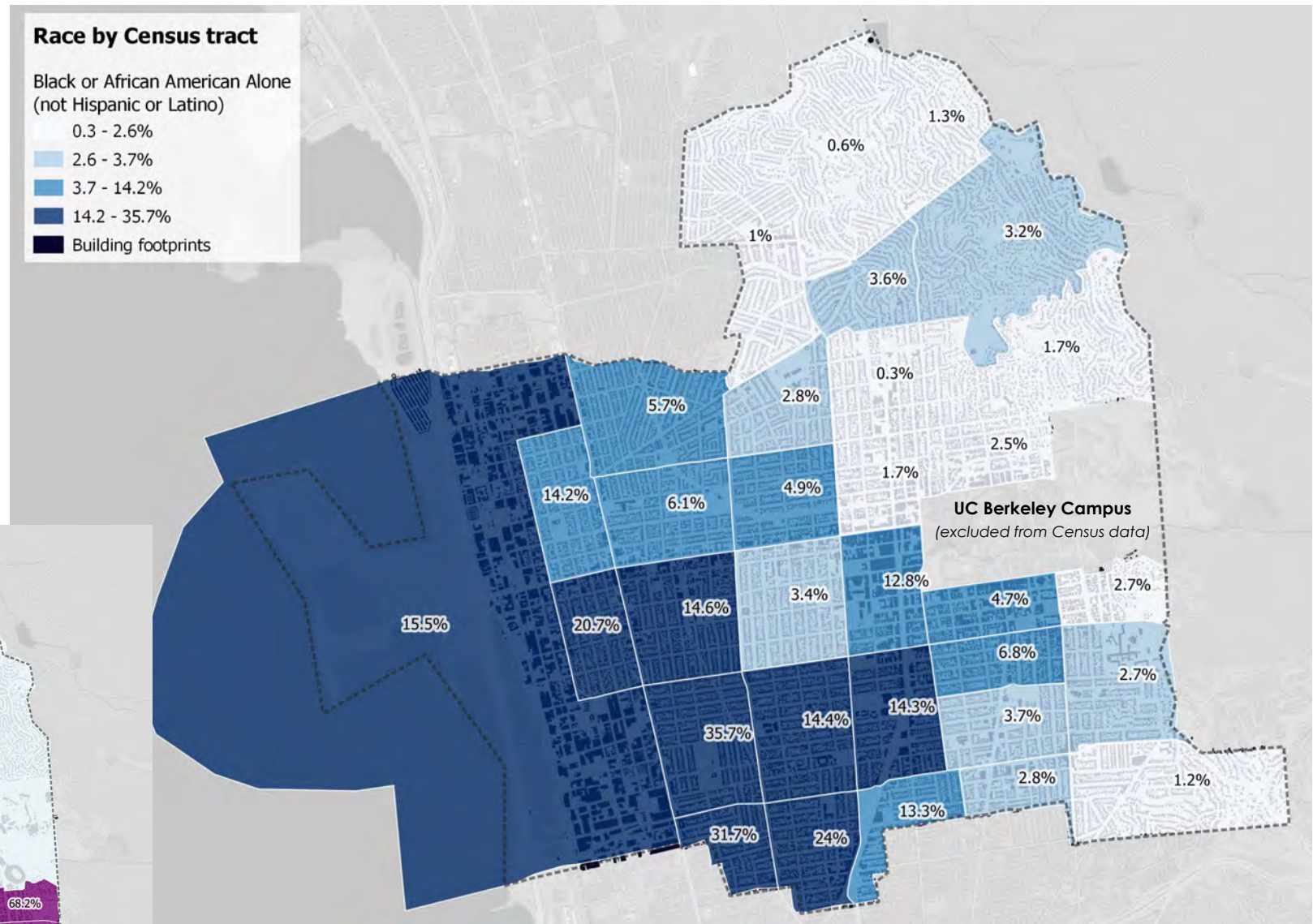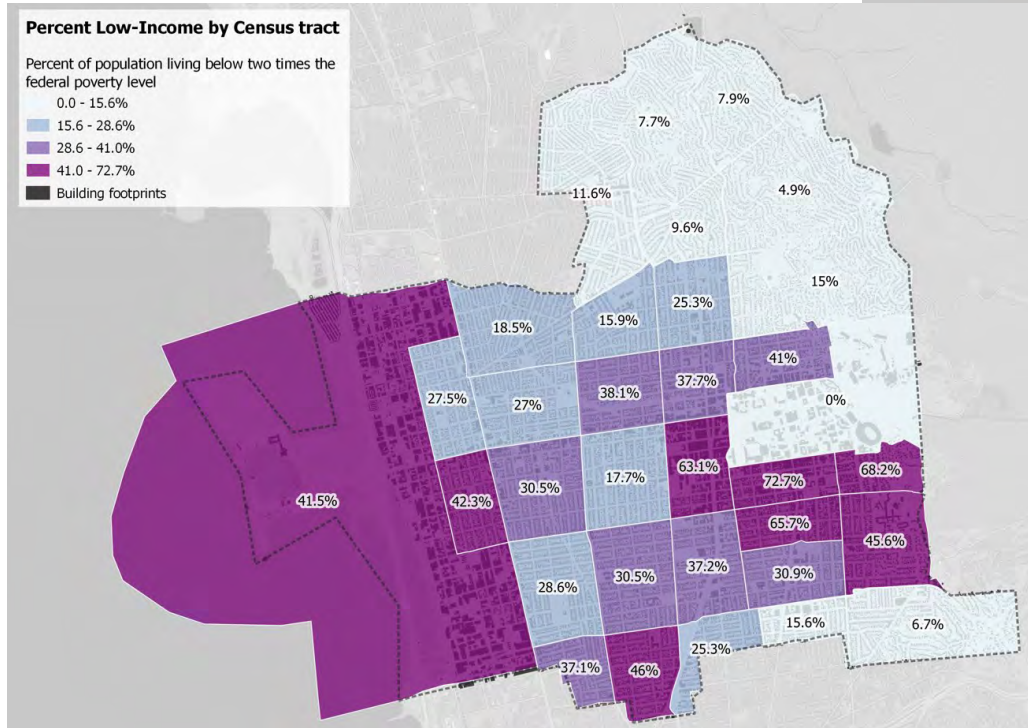
Social Indicators
Race Distribution
Asian Alone (not Hispanic or Latino)

Observations:

- Asian households are concentrated around the UC Berkeley college campus.

For Comparison: Low-income Distribution

Race by Census tract

Asian Alone
(not Hispanic or Latino)
- 4 - 10%
- 10 - 14%
- 14 - 20%
- 20 - 44%
- Building footprints

Percent Low-Income by Census tract

Percent of population living below two times the federal poverty level
- 0.0 - 15.6%
- 15.6 - 28.6%
- 28.6 - 41.0%
- 41.0 - 72.7%
- Building footprints

UC Berkeley Campus
(excluded from Census data)

Source: US Census 2017 ACS 5-Yr Estimates
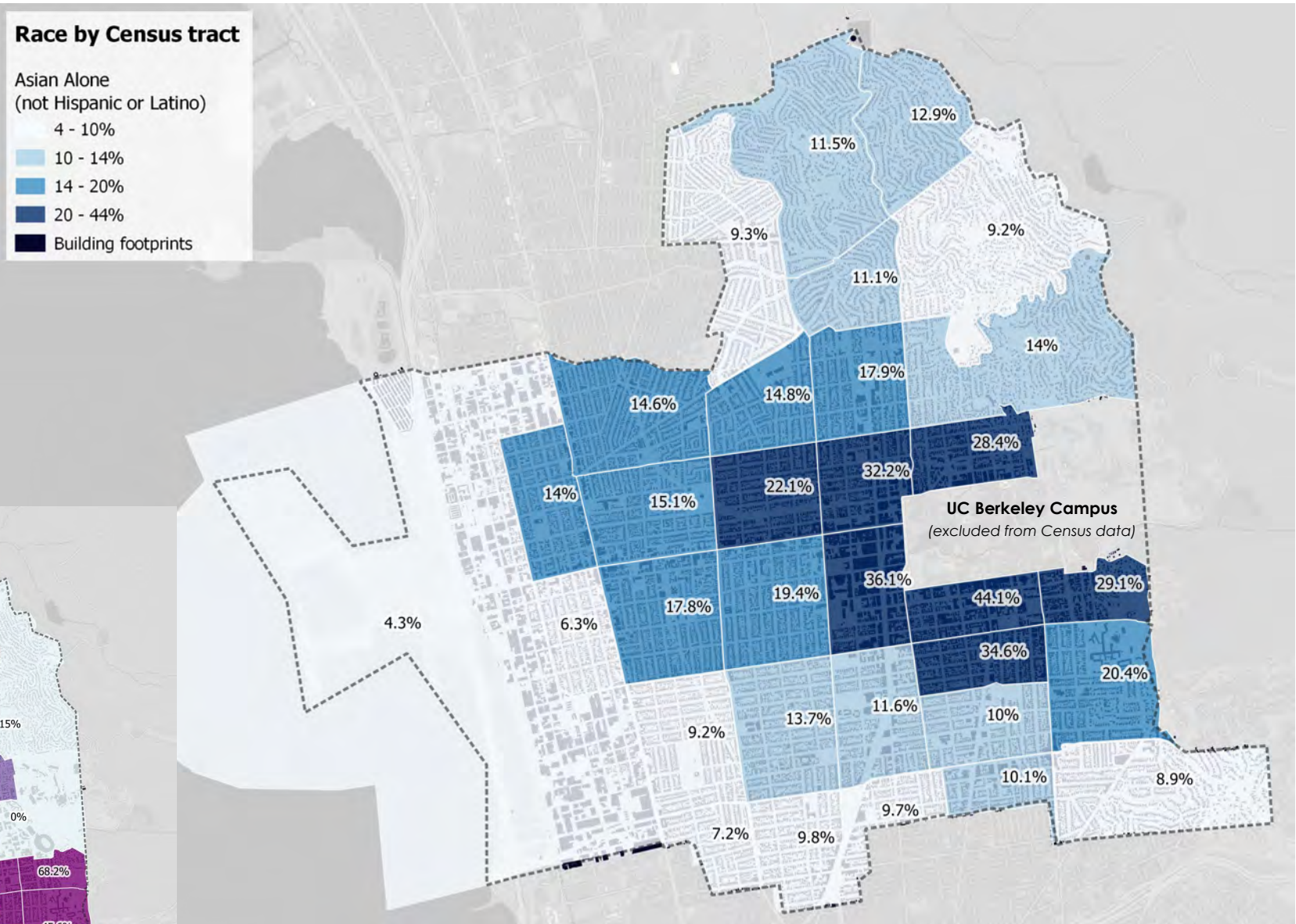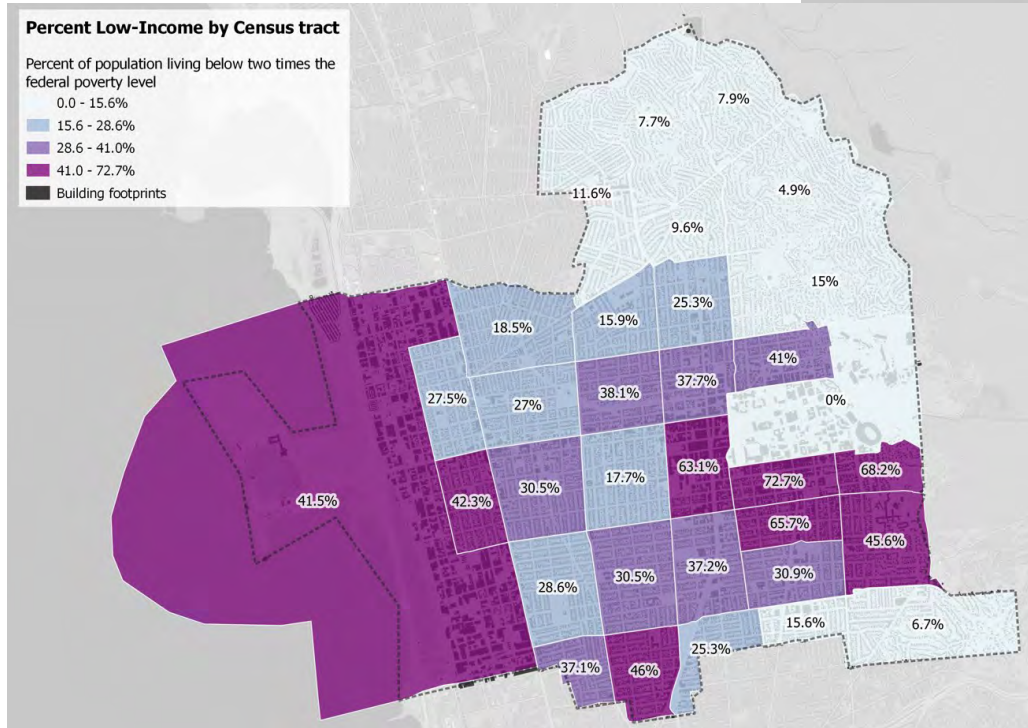
Social Indicators
Race Distribution
Hispanic or Latino Origin*

Observations:

- Hispanic and Latino households are more evenly distributed throughout Berkeley than other races, except in the Berkeley Hills.

For Comparison: Low-income Distribution

Race by Census tract

Hispanic or Latino
- 2.1 - 7.1%
- 7.1 - 9.3%
- 9.3 - 14.4%
- 14.4 - 31.5%
- Building footprints

UC Berkeley Campus
(excluded from Census data)

Percent Low-Income by Census tract

Percent of population living below two times the federal poverty level
- 0.0 - 15.6%
- 15.6 - 28.6%
- 28.6 - 41.0%
- 41.0 - 72.7%
- Building footprints
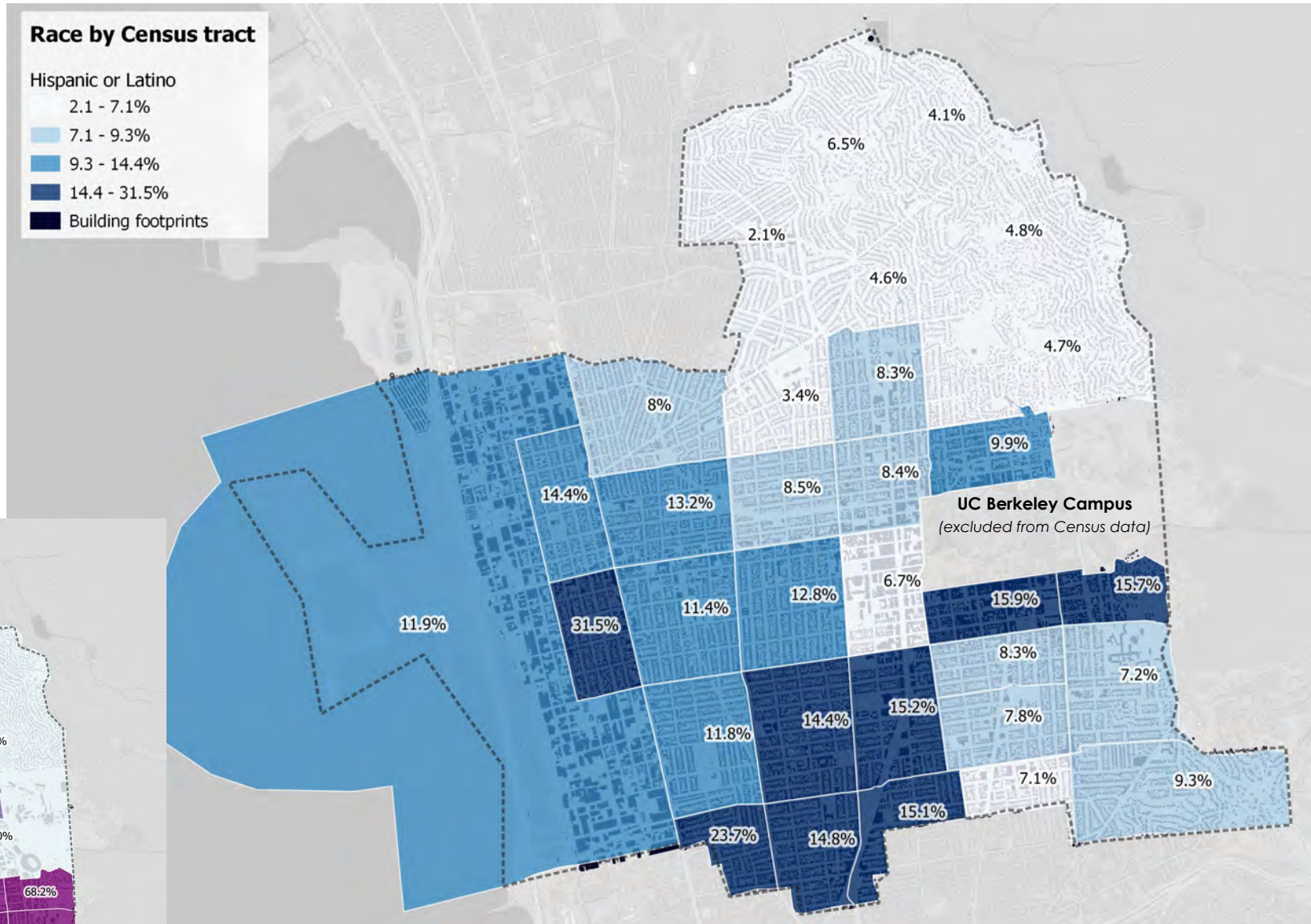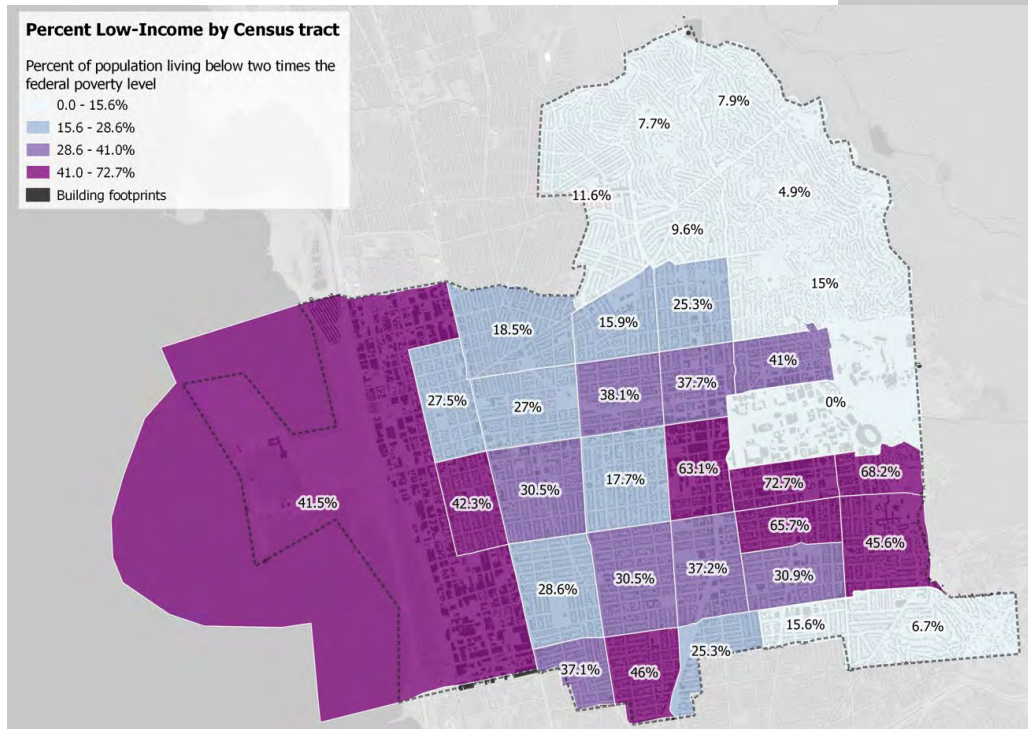
*"Hispanic or Latino Origin" is used here because it is the terminology used in the Census data.

Source: US Census 2017 ACS 5-Yr Estimates

Social Indicators
Displacement Risk

Observations:

- There is ongoing displacement in the Western half of Berkeley, which largely overlaps with Berkeley's African American population.

For Comparison: African American Population

UC Berkeley Gentrification and Displacement Typologies

- LI - At Risk of Gentrification and/or Displacement
- LI - Not Losing Low Income Households
- LI - Ongoing Gentrification and/or Displacement
- MHI - Advanced Gentrification
- MHI - Not Losing Low Income Households
- MHI - At Risk of Exclusion
- MHI - Ongoing Exclusion
- MHI - Advanced Exclusion
- College Town
- Data Unavailable or Unreliable

Map Source: Urban Displacement Project
Map Source: Urban Displacement Project

Low Income (LI) is defined as <80% of area median income (AMI) = < $60,500*

Medium-High Income (MHI) is defined as >80% of AMI = >$60,500

*Based on Census Bureau, American Community Survey 5-year estimate for 2017

Social Indicators

People who speak limited English

Observations:

- People who speak limited English tend to be located around the UC Berkeley college campus.

For Comparison: Low-income Distribution

Source: US Census 2017 ACS 5-Yr Estimates
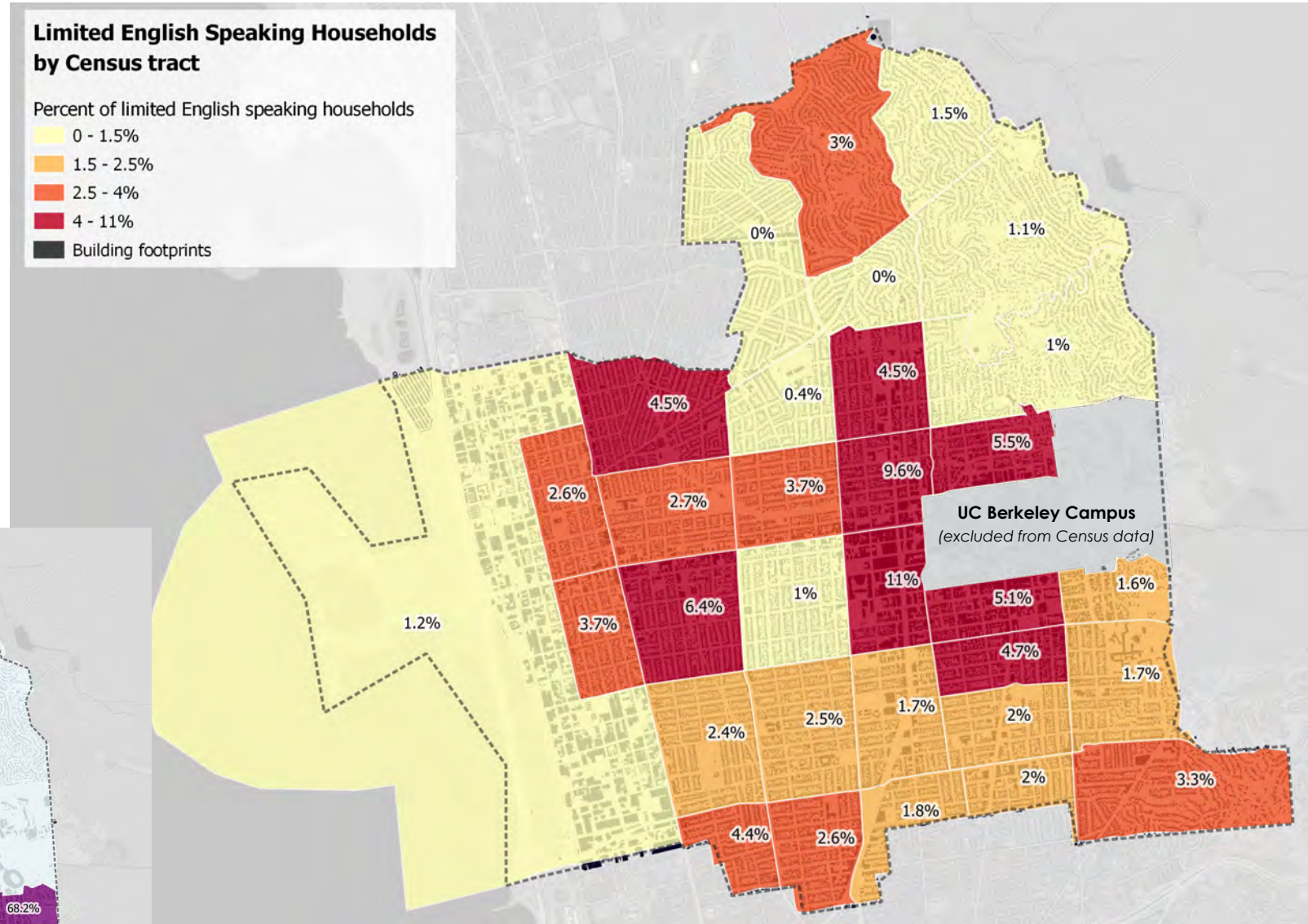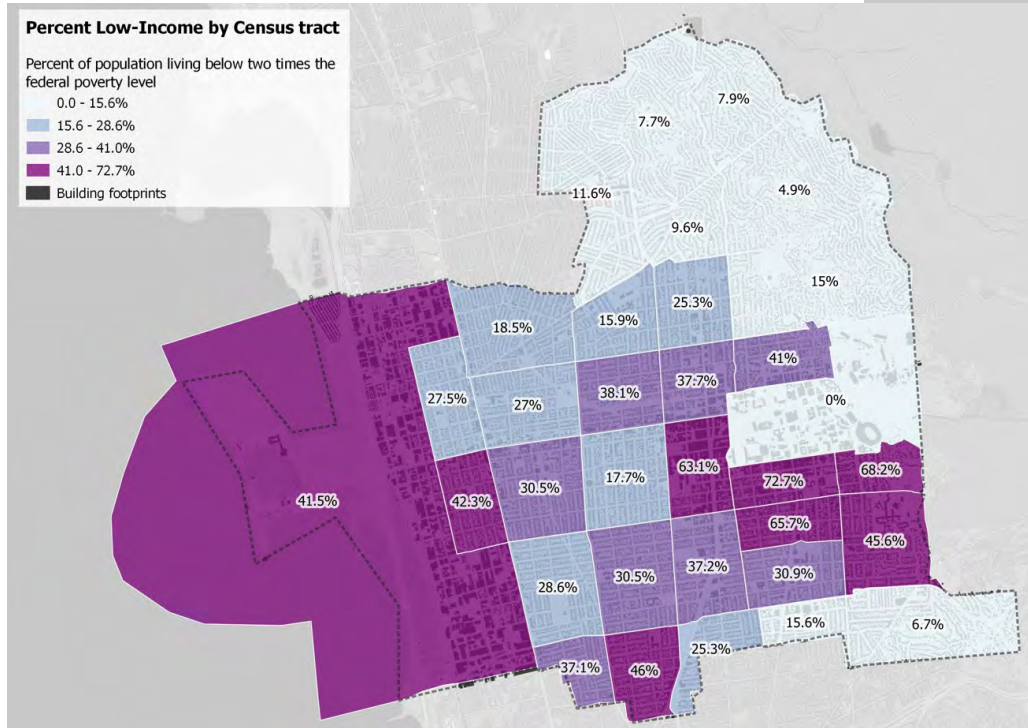
Social Indicators

People without access to the internet

Observations:

- People without access to the internet at home are concentrated in lower income areas.
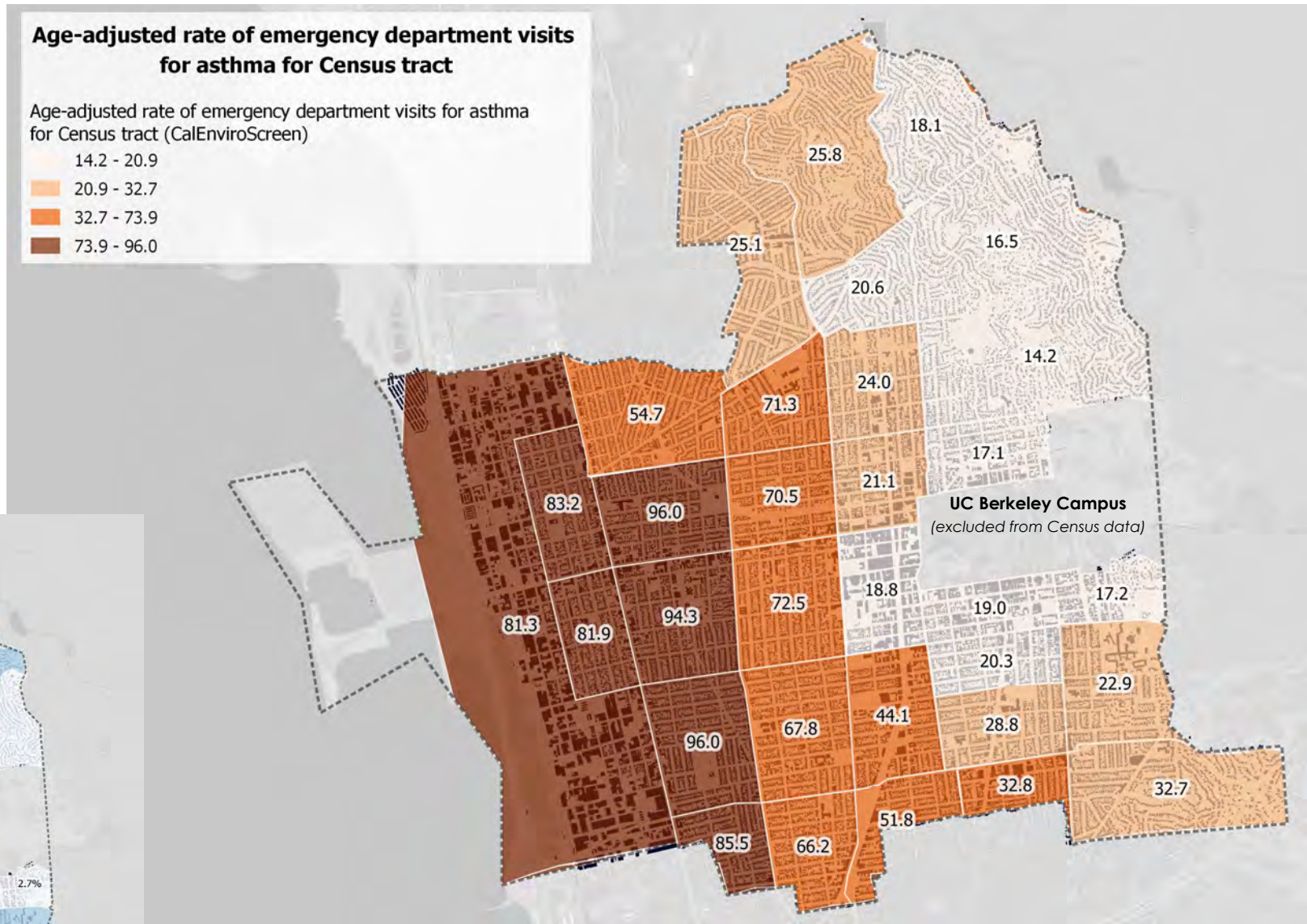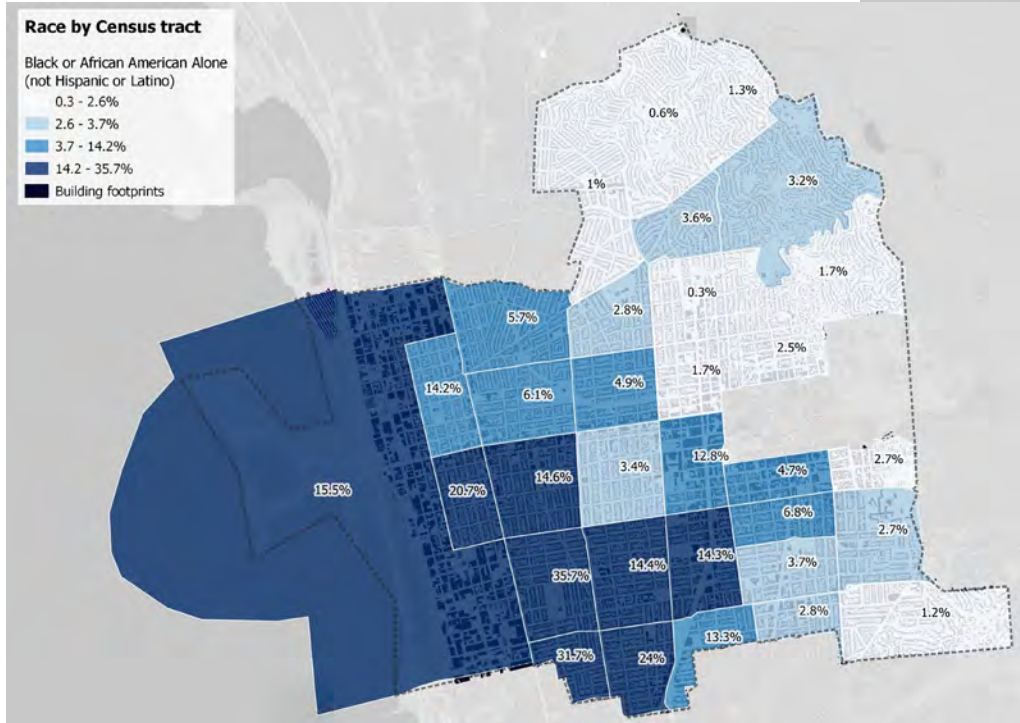
For Comparison: Low-income Distribution

Source: US Census 2017 ACS 5-Yr Estimates
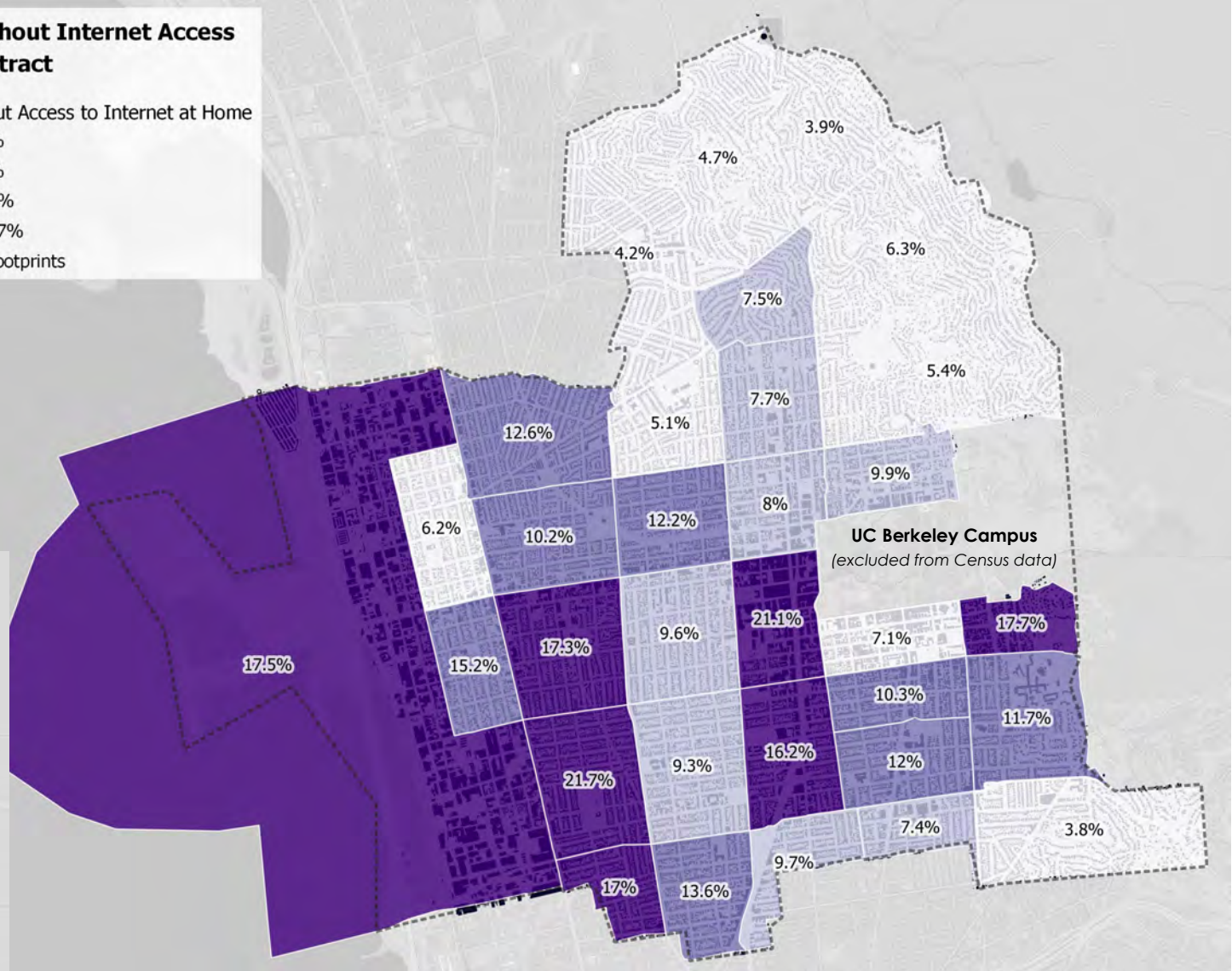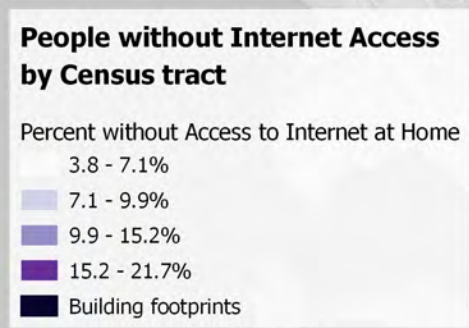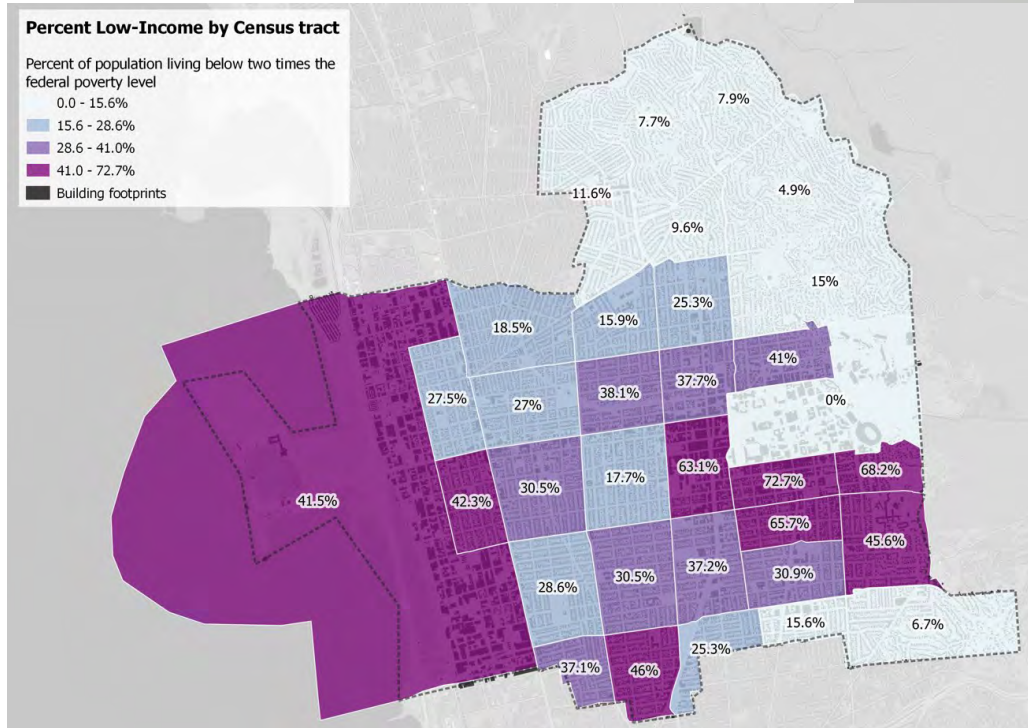
Social Indicators

Emergency Room Visits for Asthma

Observations:

- Rate of emergency room visits for asthma are highly concentrated in lower income areas and areas with a high African American population.

For Comparison: African American Population

Race by Census tract

Black or African American Alone (not Hispanic or Latino)
- 0.3 - 2.6%
- 2.6 - 3.7%
- 3.7 - 14.2%
- 14.2 - 35.7%
- Building footprints

Age-adjusted rate of emergency department visits for asthma for Census tract

Age-adjusted rate of emergency department visits for asthma for Census tract (CalEnviroScreen)
- 14.2 - 20.9
- 20.9 - 32.7
- 32.7 - 73.9
- 73.9 - 96.0

UC Berkeley Campus (excluded from Census data)

Social Indicators
People with Disabilities

Observations:

- People with disabilities are generally but not solely concentrated in lower income areas.
- There is one Census tract in South Berkeley with nearly double the rate of all others (21%).

For Comparison: Low-income Distribution

Source: US Census 2017 ACS 5-Yr Estimates
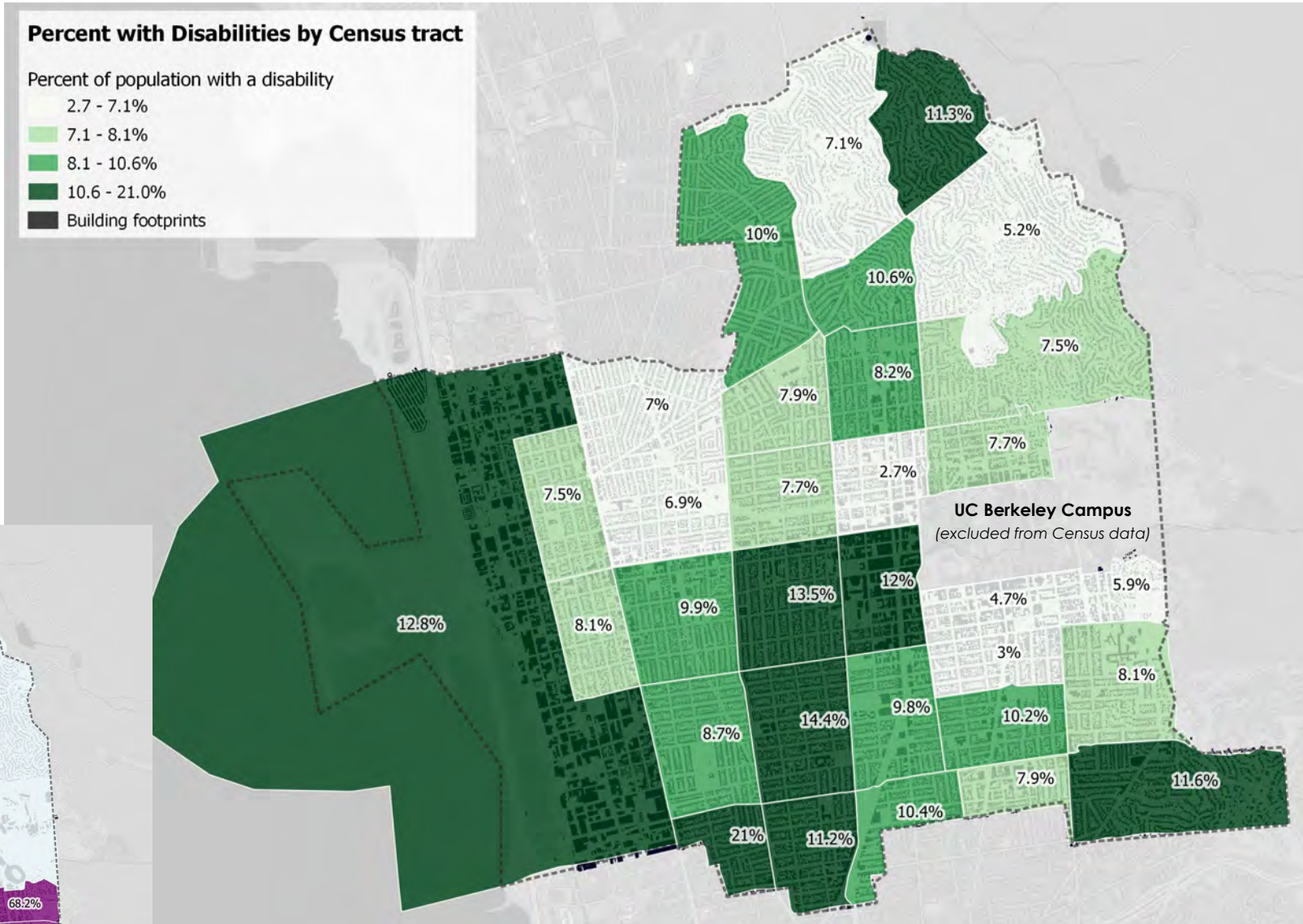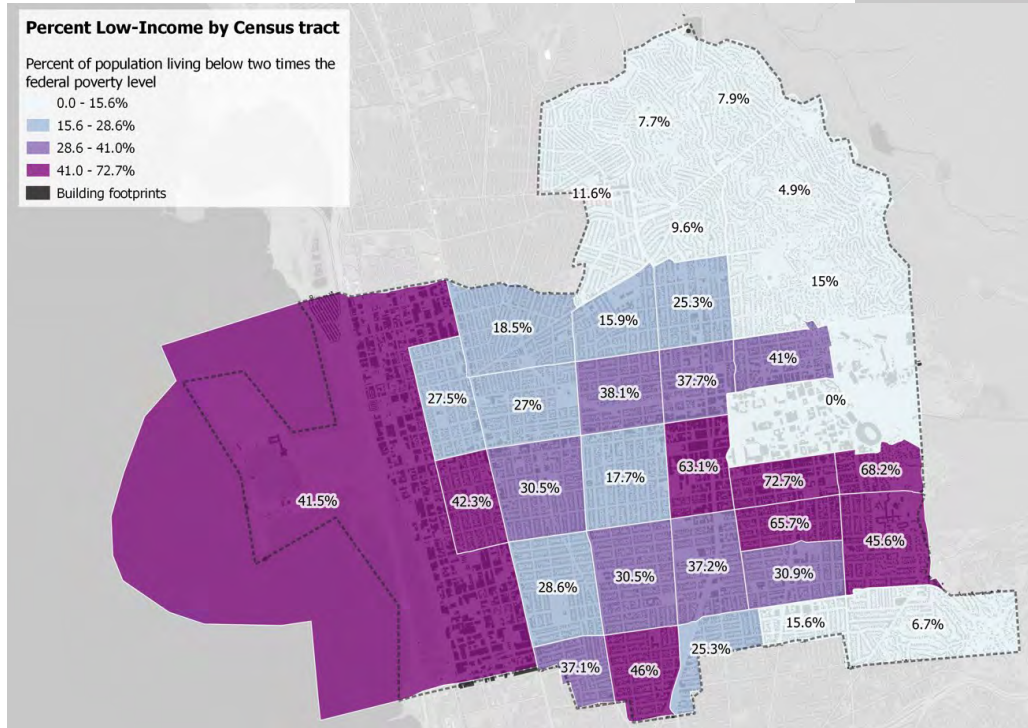
Social Indicators
People over the Age of 80

Observations:

- People over the age of 80 tend to be located in higher income areas of Berkeley.

For Comparison: Low-income Distribution

Source: US Census 2017 ACS 5-Yr Estimates
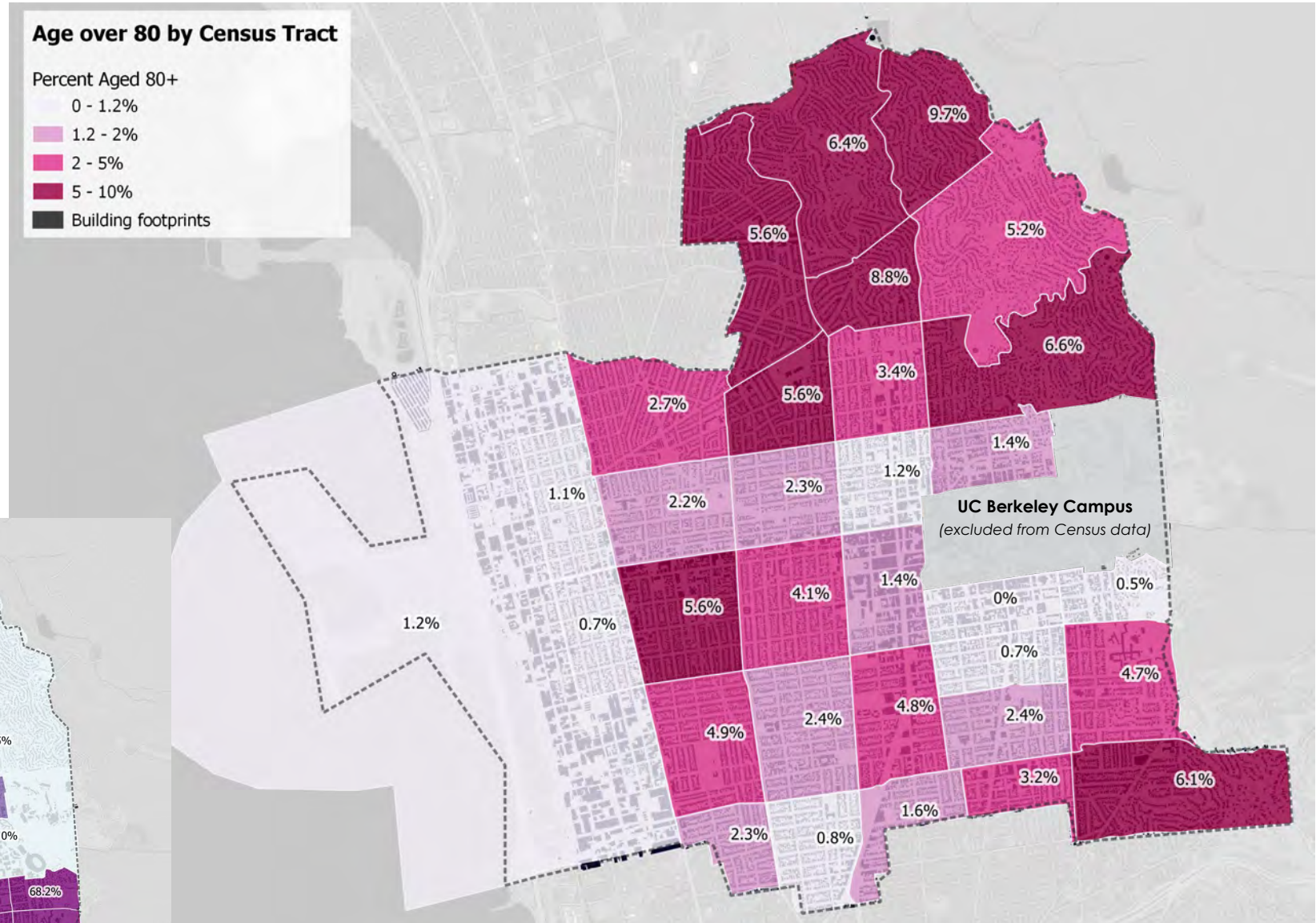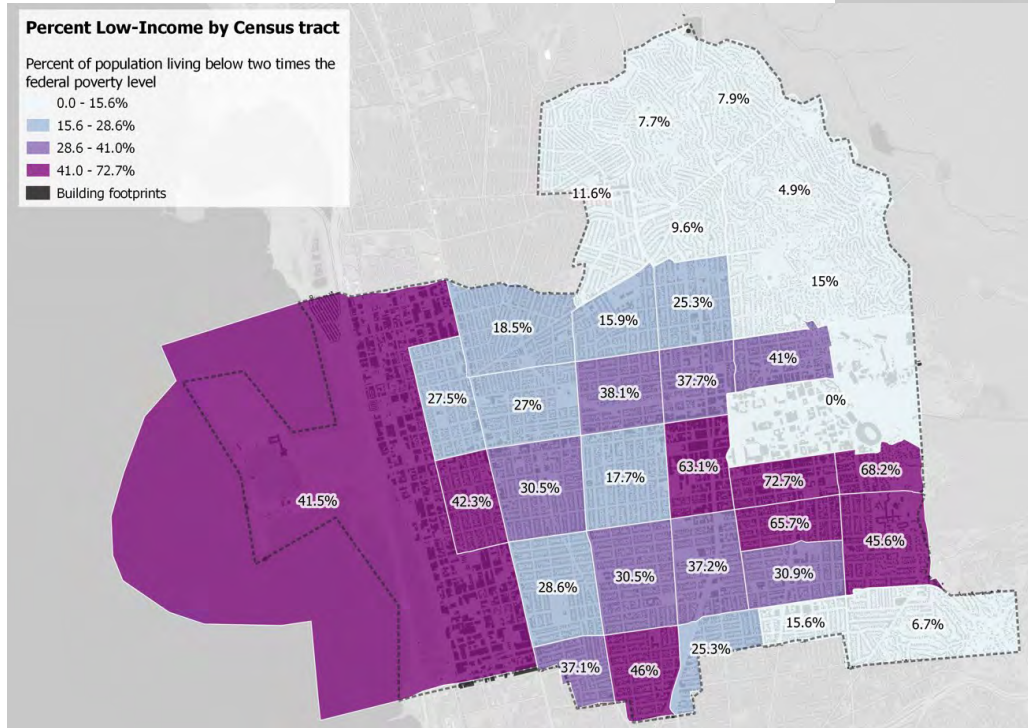
Social Indicators
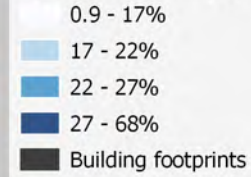## Families with Children
(Households with Children under 18)

Observations:

- Households with children are concentrated in middle income and lower income areas of the city.

For Comparison: Low-income Distribution
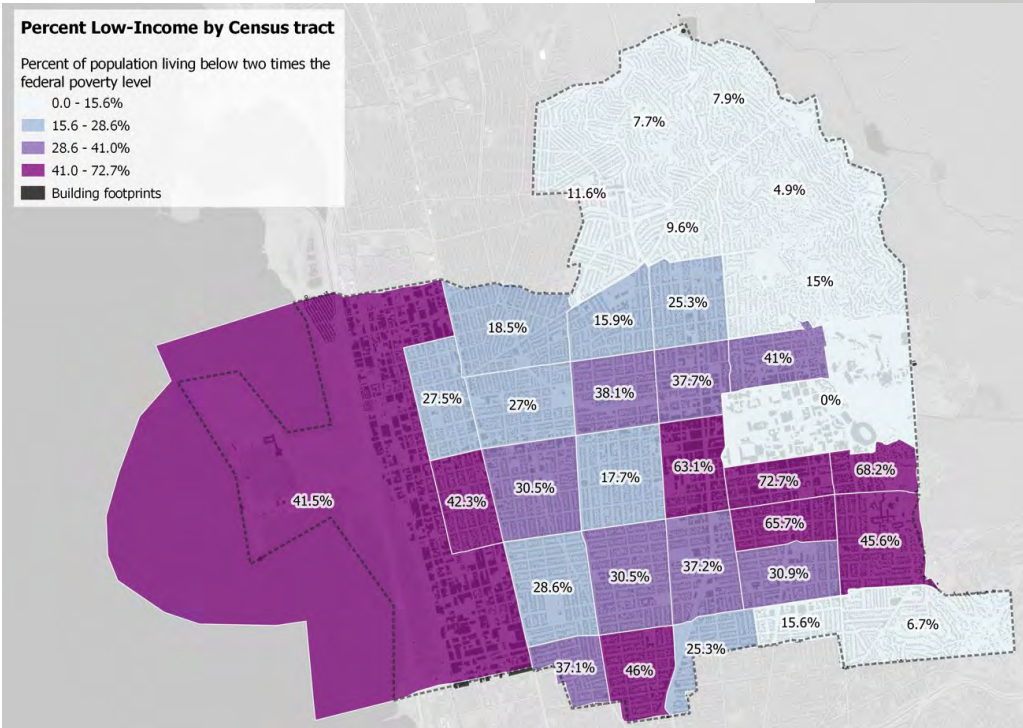
Source: US Census 2017 ACS 5-Yr Estimates
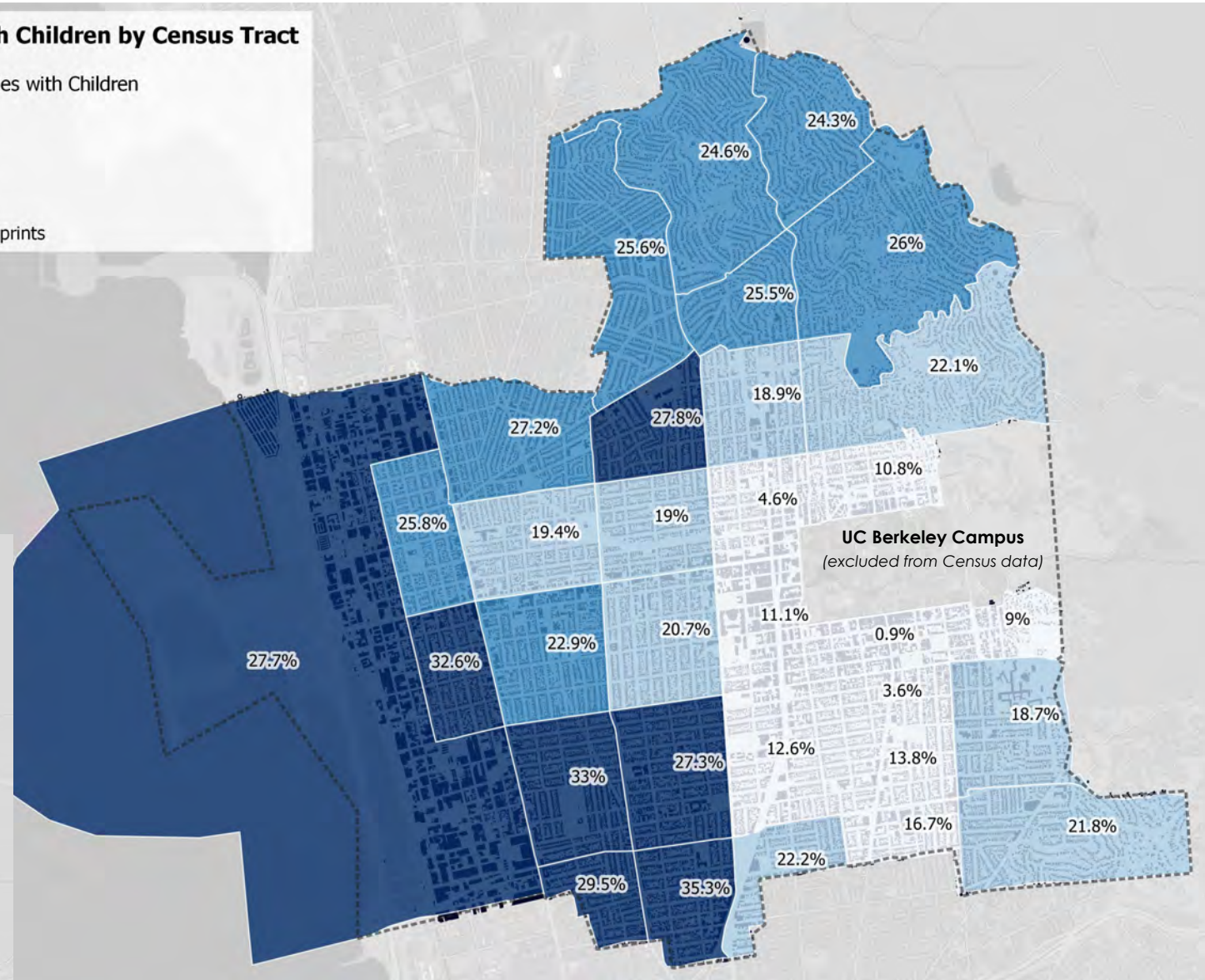
Social Indicators | Key Findings

Key Findings from Analysis of Social Indicators

- **The African American population in Berkeley faces disproportionate social inequities**. African Americans in Berkeley are highly concentrated in lower-income neighborhoods and are at a significant risk of displacement due to rising housing costs and gentrification. African Americans are also disproportionately living in areas with higher asthma rates and lower access to the internet. The needs of the African American population must be prioritized to ensure more equitable outcomes.

- **People living in neighborhoods in the western half of Berkeley are as much as five times more likely to have an asthma emergency than people living in more affluent parts of the city**. People living in these areas are also more likely to be lower-income people of color. Electrifying fossil fuel-based building systems can lower risks of asthma, however lower-income people are unlikely to be able to afford the equipment without financial assistance.

- **There are a substantial number of residents of Berkeley who lack access to the internet and who speak limited English.** Reaching these residents will require different types of outreach and communication that does not rely on online communication channels or conducted in English.

- **Berkeley has a fairly large population of residents with disabilities, who tend to be concentrated in lower-income areas of the city**. There is one census tract in Berkeley where one in five residents has a disability, and several others where 10% or more of the population has a disability. It will be important to be sensitive to the distinct needs of these communities.

- **Households with children also tend to be located in middle and lower-income areas of Berkeley**. Anecdotally, some young families who have been priced out of other areas are moving into historically African American and Hispanic neighborhoods, which may contribute to rising housing costs in those areas. Many of these neighborhoods also have high rates of asthma.

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- Summary and Potential Next Steps

Social Vulnerability & Environmental Risk Indicators

Environmental Risk Indicators

- Pollution Exposure

- Liquefaction Risk

- Landslide Risk

- Wildfire Risk
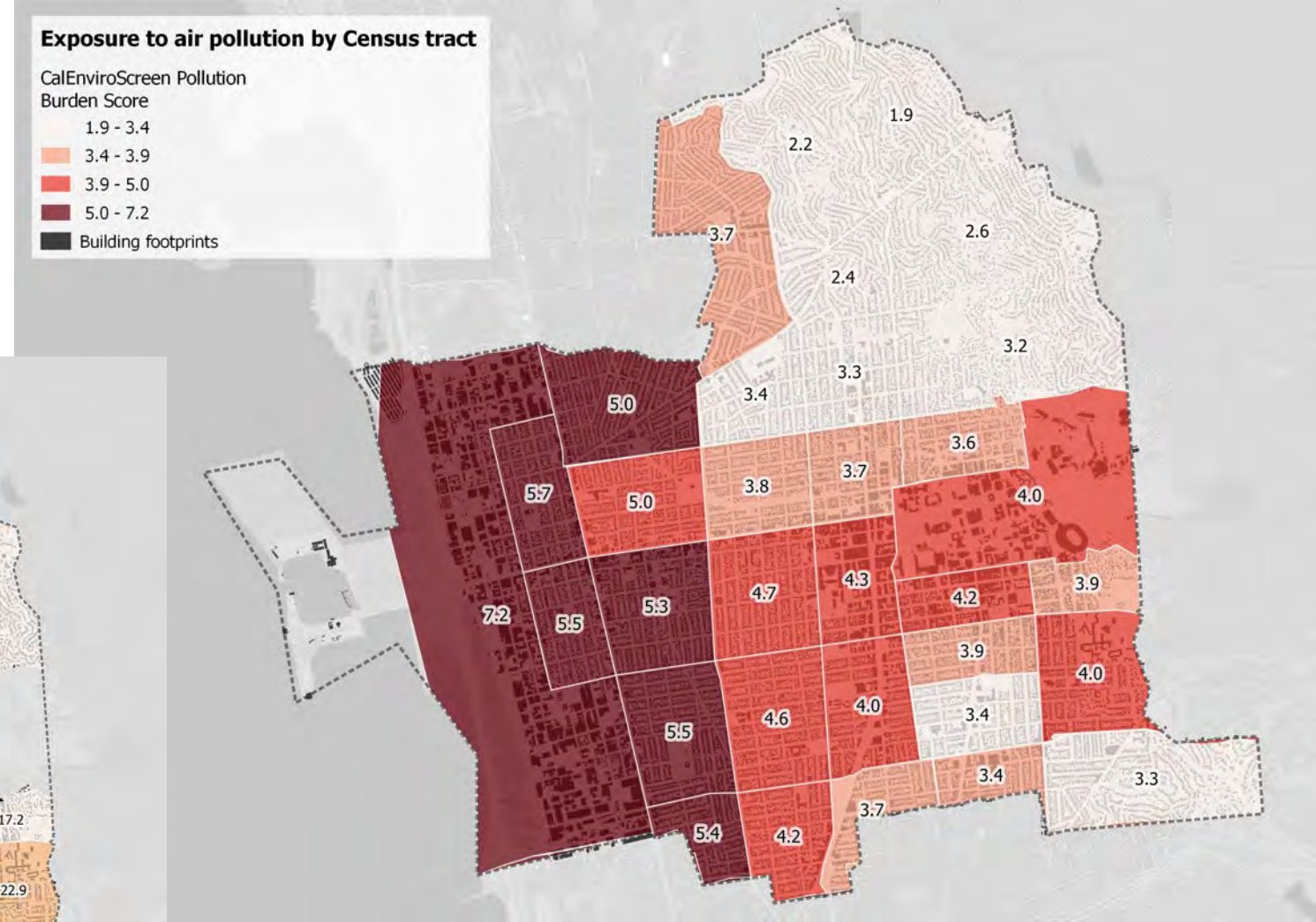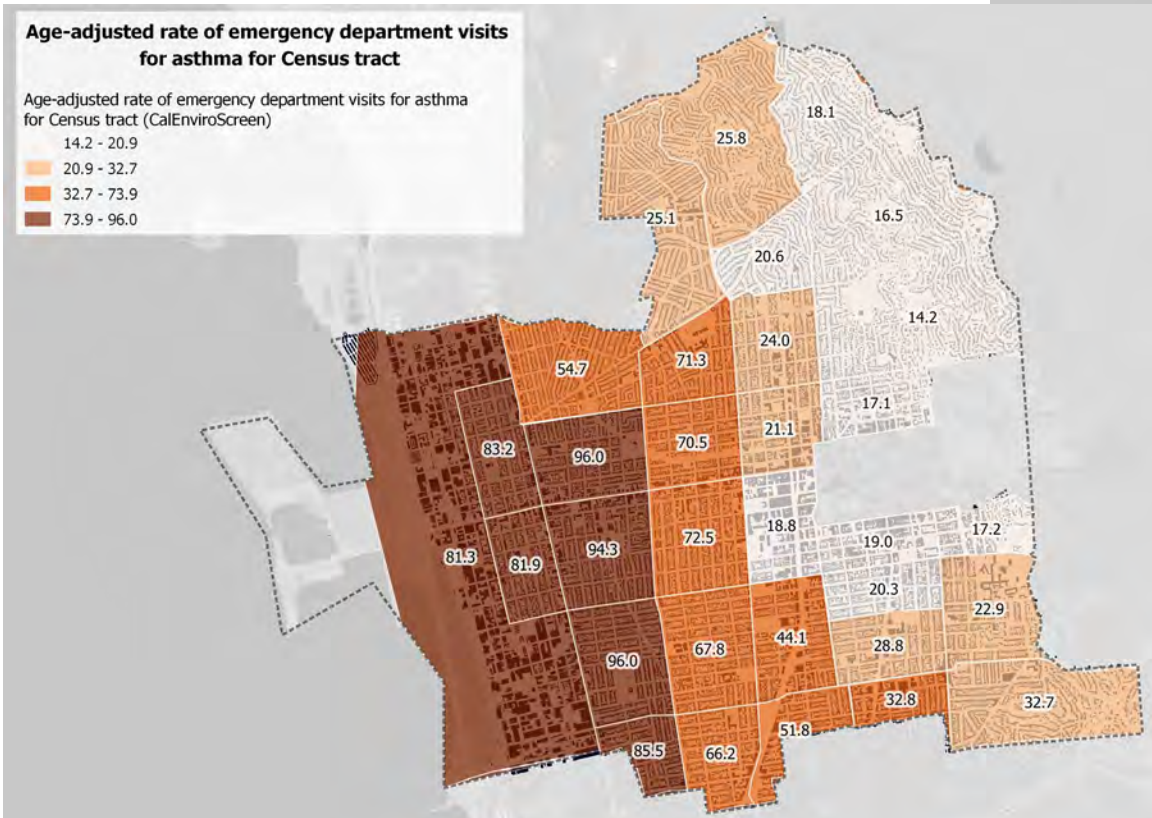
- Multiple Environmental Risks

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Environmental Risk Indicators

Air Pollution Exposure

Observations:

- Those in areas with high exposure to air pollution are also more likely to visit the emergency room for asthma.

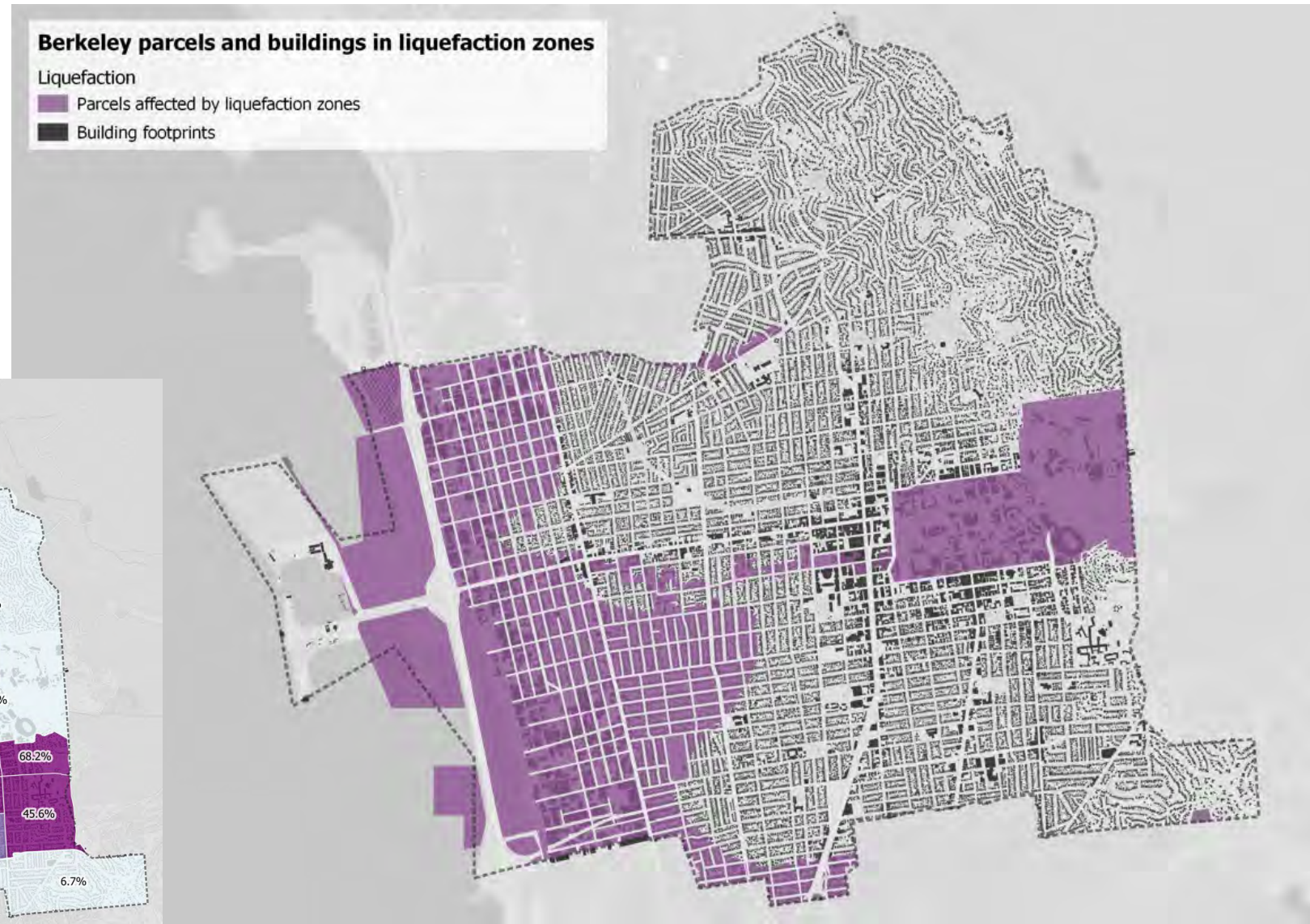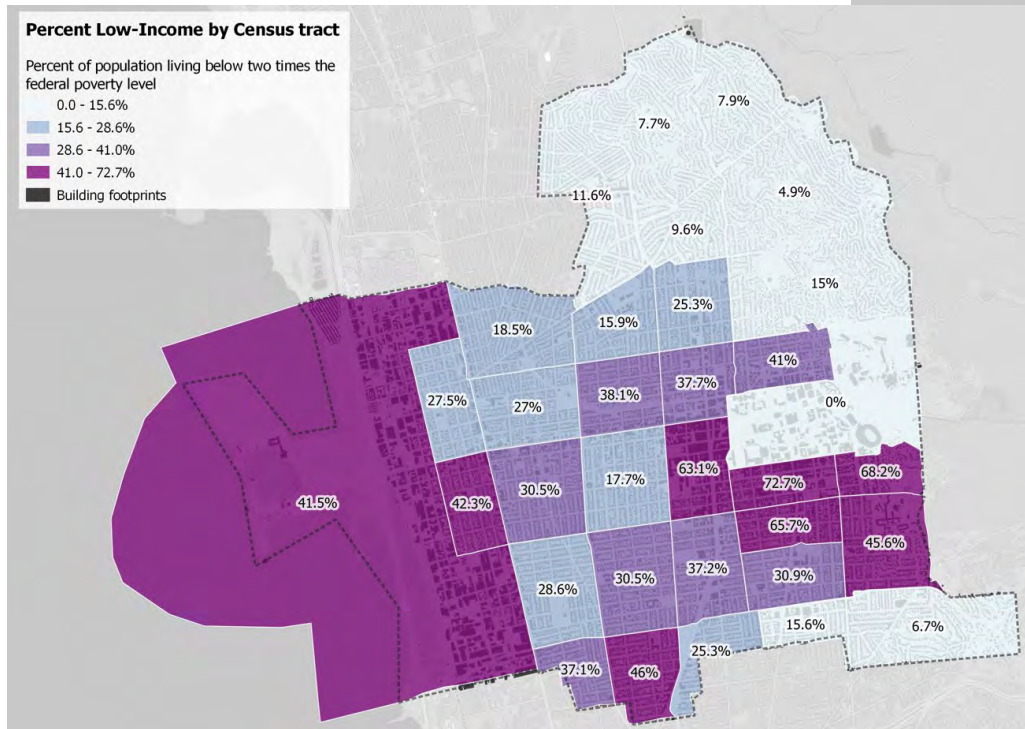**For Comparison: Emergency Room Visits for Asthma**

Source: CalEnviroScreen 2.0 Pollution Burden Score

Environmental Risk Indicators

Liquefaction Risk

Observations:

- Liquefaction risk is largely concentrated in lower income areas in Berkeley.
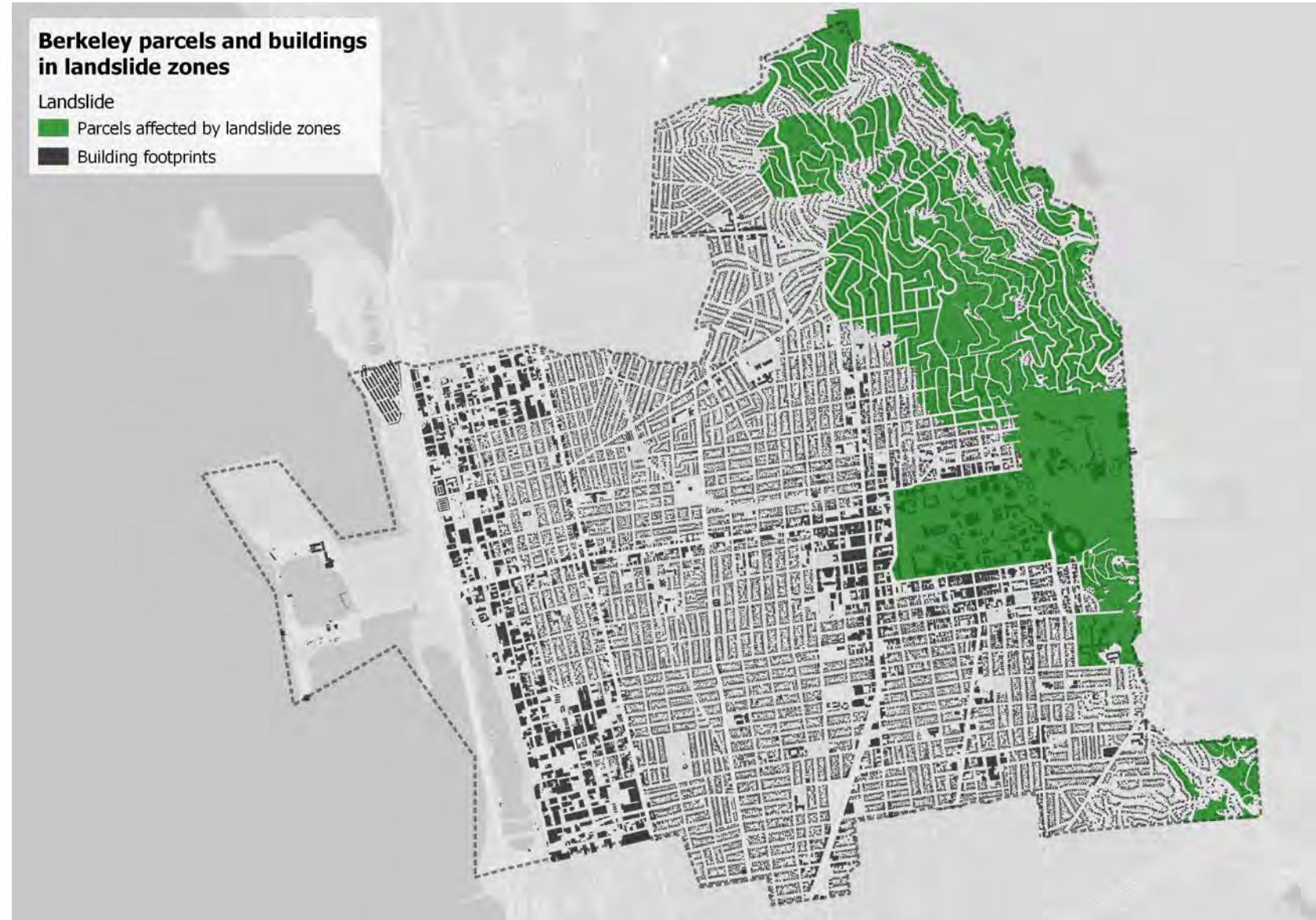

For Comparison: Low-income Distribution

Source: City of Berkeley Liquefaction Risk data

Environmental Risk Indicators

Landslide Risk

Observations:

- Landslide risk is centered in Eastern portion and higher income areas of Berkeley.

- UC Berkeley campus is also at risk of landslides.

Berkeley parcels and buildings in landslide zones

Landslide
- Parcels affected by landslide zones
- Building footprints

Source: City of Berkeley Landslide Risk data

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Environmental Risk Indicators

Wildfire Risk

Observations:

▪ Wildfire risk is centered in Eastern portion and higher income areas of Berkeley.

▪ UC Berkeley campus is also at risk of wildfires.

Berkeley parcels and buildings in wildfire risk zones

Fire hazard
- Very High
- Building footprints

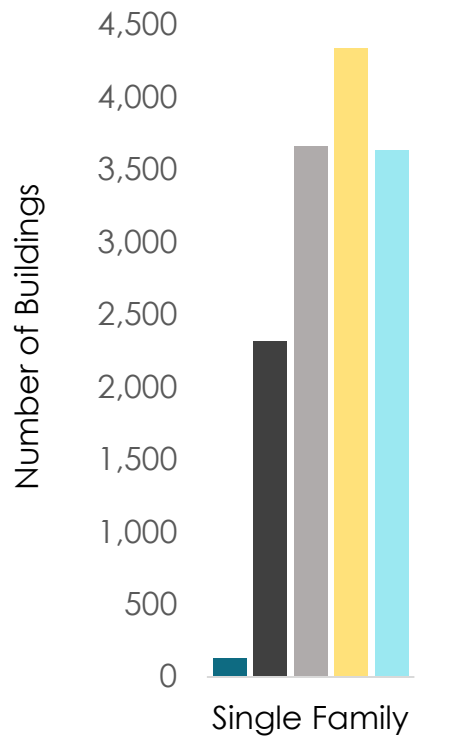Source: City of Berkeley Wildfire Risk data
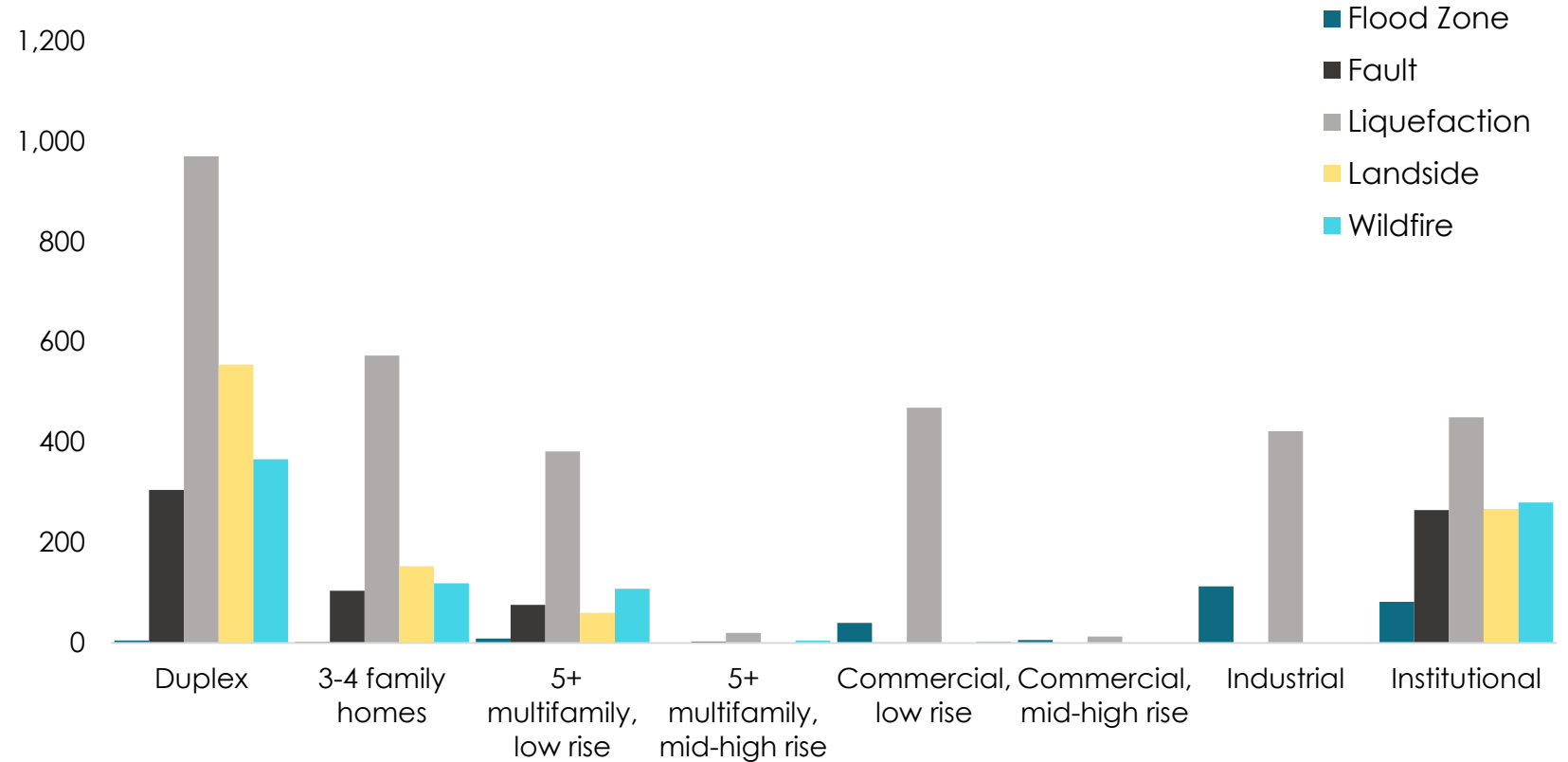
Environmental Risk Indicators

Multiple Hazards Exposure in Berkeley Buildings

Key Finding: 40% of buildings citywide (14,396 total) are susceptible to at least one environmental hazard.

Single Family Homes

All Other Building Typologies

Legend: Flood Zone, Fault, Liquefaction, Landside, Wildfire

Environmental Risk Indicators | Key Findings

Key Findings from Analysis of Environmental Risk Indicators

- **Areas with greater exposure to air pollution overlap significantly with areas where residents are at greater risk of having an asthma-related emergency.** Building electrification could help lower the amount of air pollution these residents are exposed to on a regular basis.

- **A significant number of buildings in Berkeley (40%) are at risk of at least one environmental hazard.** The greatest risks come from the threat of liquefaction or landslides-–environmental hazards that are also likely to become more frequent as a result of climate change and earthquakes.

- **Liquefaction risks primarily threaten lower-income neighborhoods in Berkeley, while landslide and wildfire hazards primarily threaten higher-income neighborhoods in the Berkeley Hills.** While it is important to protect all neighborhoods from environmental hazards, higher income residents are often better able to recover financially from an environmental disaster.

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- **Summary and Potential Next Steps**

Summary and Potential Building Groupings

Summary of Findings

▪ **Berkeley can use a combination of technical, ownership/decision-making, social, and environmental factors to help determine equitable building electrification strategies** that will best serve the needs of different building types and residents.

▪ **To ensure an equitable transition, it is critical to prioritize those who can benefit most and plan for any potential risks** to vulnerable communities. While early adopters can help spur the market for building electrification, focusing solely on this group runs the risk of leaving other communities behind and worsening current inequities.

▪ **To identify potential strategies for buildings, Berkeley can look at a combination of indicators and factors.** Potential groupings for buildings are included below, but these should be further discussed with Berkeley's priority communities and stakeholders.

Potential Building Groupings
(A starting point for future stakeholder discussions)

Priority Communities	High Opportunity Homes	Early Adopters
Potential Indicators: Low-income neighborhoods, African-American population, people with disabilities, properties with rent control, environmental risks, asthma rates.	**Potential Indicators:** Homes with wall heaters, solar PV, those installing an ADU, or in need of other environmental investments.	**Potential Indicators:** Homes with solar PV, in high-income neighborhoods, or owner-occupied homes.
Potential Interventions: Targeted programs and investments designed for residents with greatest needs to ensure they are met.	**Potential Interventions:** Targeted programs and investments designed for homes with greatest needs, cost-effective opportunities, or related upgrade needs.	**Potential Interventions:** Awareness campaigns or programs, with reduced incentives for this audience over time. Consider workforce development strategies for these programs.
Potential Next Steps: Convene community groups and stakeholders to discuss greatest community needs and hold program/policy design workshops with these stakeholders.	**Potential Next Steps:** Convene community groups and stakeholders to identify high opportunity homes and hold program/policy design workshops with these stakeholders.	**Potential Next Steps:** Partner with existing programs to reach early adopter audiences; assess local workforce/business development opportunities for priority communities.

Next Steps

Potential next steps for using this analysis in Berkeley could include:

- **Share and discuss the findings of this building and housing stock analysis with key local stakeholders and priority communities.** Data has limitations, and this analysis should not be relied on as the sole source of information about Berkeley's building and housing stock. Understanding the lived experiences of Berkeley's residents will be critical for validating the takeaways of this analysis and filling in data gaps.

- **Evaluate the full costs and benefits of building electrification,** including the full installation costs of equipment, the operational costs or cost-savings from building electrification, and non-financial benefits of building electrification technologies, such as improved air quality and reduced risks of asthma. A more holistic accounting of costs and benefits will help Berkeley make choices about how much to invest in funding and incentives and which types of buildings to prioritize for the greatest benefits.

- **Identify equitable approaches to building electrification that will improve outcomes for communities and residents that face clear social vulnerabilities and environmental risks.** Berkeley has an older building stock in need of upgrades. Residents also face major risks from rising housing costs, gentrification and displacement of its African American community, and inequitable pollution and environmental risk exposure, among other potential risks. Ideally, building electrification programs and policies will help support the goal of ensuring equitable outcomes for communities who have disproportionately suffered hardships and will mitigate risks of further harm to these communities.